DAHLIN

LAKEWOOD TOWN SQUARE DEVELOPMENT

4970 CLARK AVE., LAKEWOOD, CA 90712



PROJECT MANUAL

BID SET

10/02/26

DAHLIN | ARCHITECTURE | PLANNING | INTERIORS

1533-008

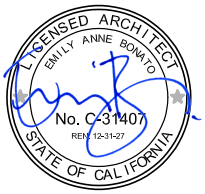
DOCUMENT 000107 - SEALS PAGE

Include on this Seals Page Document the seals of the design professionals of record required by statute to affix their seal to the documents. Where required, include a description of the Specification Sections prepared under the direction of each design professional.

1.1 DESIGN PROFESSIONALS OF RECORD

Architect:

Emily Bonato
DAHLIN
License #C31407, Exp. 12/31/27



Civil Engineer:

Robyn Katherman
David Evans and Associates
License #C98063., Exp 09/30/27



Landscape Architect:

Perry A. Cardoza
NUVIS Landscape Architecture
License #3943, Exp. 12/17/25



Structural Engineer:

Marya Nabhani
Labib Funk + Associates
License #S6248, Exp. 09/30/27



Mechanical & Plumbing Engineer

Andrew R. Gossman
Pocock Design Solutions, Inc.
License #M35839, 03/31/26



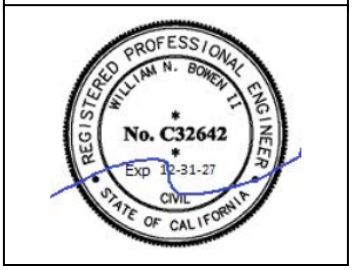
Electrical Engineer:

Stephen R. Zajicek
FBA Engineering
License #E10372, Exp 09/30/26



Pre-Engineered Canopy Engineer:

William N. Bowen
USA Shade
License #C32642, Exp 12/31/27



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SECTION 011000

SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Work covered by Contract Documents.
2. Contractor's use of site and premises.
3. Coordination with occupants.
4. Work restrictions.
5. Specification and Drawing conventions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 017300 "Execution" for coordination of Owner-installed products.

1.2 PROJECT INFORMATION

A. Project Identification: Lakewood Town Square.

1. Project Location: 4970 Clark Ave., Lakewood, CA 90712.

B. Owner: City of Lakewood.

1. Owner's Representative: Kevin Yamakawa, 562-866-9771.

C. Architect: DAHLIN Group, Inc..

1. Architect's Representative: Daniel Berghauser, 949-250-4680.

D. Landscape Architect: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:

1. Landscape Architect: Nuvis.

a. Landscape Architect Representative: Tom Munoz, 714-754-7311.

E. Project Manager: Ardurra.

1. Project Manager Representative: Mark Lewis, 949-677-0391.
2. Project Manager has been engaged for this Project to serve as an advisor to Owner and to provide assistance in administering the Contract for construction between Owner and Contractor, according to a separate contract between Owner and Construction Manager.

F. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.

1. See Section 013100 "Project Management and Coordination" for requirements for using web-based Project software.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

1. The Work of the Project is defined by the Contract Documents and consists of the construction as shown on the Contract Documents prepared by DAHLIN, which consist of developing a park that include seating areas, prefabricate shade canopies and stage canopy, lawn, restroom building (1,085 sf), trash enclosure, parking lot expansion, hardscape, planting, path and parking lot lights, associated site furnishings, and other Work indicated in the Contract Documents.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

C. Contractor's Responsibilities: The Work includes the following, as applicable:

1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
3. Receive, unload, handle, store, protect, and install Owner-furnished products.
4. Make building services connections for Owner-furnished products.
5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
6. Repair or replace Owner-furnished products damaged following receipt.

1.4 CONTRACTOR'S USE OF SITE AND PREMISES

A. Limits on Use of Site: Limit use of Project site to Work in areas indicated on drawings. Do not disturb portions of Project site beyond areas in which the Work is indicated.

B. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.5 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work to between 7 a.m. to 5 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.

1. Hours for Utility Shutdowns: Give Owner minimum 72 hour notice. Obtain Owner written permission.
2. Hours for noisy, vibration causing, odorous, and other occupant disruptive operations: Give Owner minimum 72 hour notice.

C. On-Site Work Day Restrictions: Do not perform work resulting in utility shutdowns or resulting in noisy activity on-site during work black-out days.

D. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:

1. Notify Architect Construction Manager Owner not less than two days in advance of proposed utility interruptions.
2. Obtain Owner's written permission before proceeding with utility interruptions.
3. Coordinate utility interruptions with adjacent properties that would otherwise impact these neighbors not less than seven days in advance of proposed utility interruptions.

E. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.

1. Notify Architect Construction Manager Owner not less than two days in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.

F. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Project site on Owner's property is not permitted.

1.6 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.

4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012300
ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other Work of the Contract.

C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Paver Replacement with Integral Color Concrete

1. Base Bid: Interlocking Pavers as indicated on LC-02 under “BASE BID OPTION” and as specified in Section ‘32 14 13 INTERLOCKING CONCRETE PAVEMENT ON AN AGGREGATE BASE’

2. Alternate: Integral Colored Concrete as indicated on LC-02 under “ALTERNATIVE OPTION” and as specified in Section ‘32 13 16 - CRAFTSMEN SPECIFICATION EXPOSED AGGREGATE FINISH’.

END OF SECTION 012300

SECTION 012500

SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of This Section Includes: Administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use form that is part of web-based Project management software or otherwise acceptable to Architect and Owner.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements

indicated. Indicate deviations, if any, from the Work specified.

d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES or applicable code.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Substitutions for Cause: Considered when:

a. Specified product is unavailable.
b. Specified product is not acceptable to authorities having jurisdiction.
c. Use of specified product would delay progress of the Work.
d. Contractor can provide significant cost or time savings.
e. Specified product does not comply with federal funding requirements.

2. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Requested substitution provides sustainable design characteristics that specified product provided for compliance with project requirements.
c. Substitution request is fully documented and properly submitted.
d. Requested substitution will not adversely affect Contractor's construction schedule.
e. Requested substitution has received necessary approvals from authorities having jurisdiction.
f. Requested substitution is compatible with other portions of the Work.
g. Requested substitution has been coordinated with other portions of the Work.
h. Requested substitution provides specified warranty.
i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience:

1. Architect will consider requests for substitution during Bidding. Once Bidding has completed, requests received after that time will be rejected by Architect.

a. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

1) Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign

and evaluation services, increased cost of other construction by Owner, and similar considerations.

2) Requested substitution does not require extensive revisions to the Contract Documents. The cost for any substitution requiring extensive revisions to the Contract Documents will be borne by the Contractor, at their sole expense.
3) Requested substitution is consistent with the Contract Documents and will produce indicated results.
4) Substitution request is fully documented and properly submitted.
5) Requested substitution will not adversely affect Contractor's construction schedule.
6) Requested substitution has received necessary approvals from authorities having jurisdiction.
7) Requested substitution is compatible with other portions of the Work.
8) Requested substitution has been coordinated with other portions of the Work.
9) Requested substitution provides specified warranty.
10) If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 012600

CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
2. Section 013100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.2 MINOR CHANGES IN THE WORK

A. Architect will issue through Construction Manager supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710.

1.3 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Construction Manager will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect or Construction Manager are not instructions either to stop work in progress or to execute the proposed change.
2. Within 15 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
c. Include costs of labor and supervision directly attributable to the change.
d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
e. Quotation Form: Use form agreeable to the Contractor, Architect, and

Owner .

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect and Construction Manager.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form agreeable to the Contractor, Architect, Construction Manager, and Owner.

1.4 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Change Proposal Request, Construction Manager will issue a Change Order for signatures of Owner and Contractor on AIA Document G701 or AIA Document G701CMa.

1.5 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Construction Manager may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900

PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:

1. Document 004373 "Proposed Schedule of Values Form" for requirements for furnishing proposed schedule of values with bid.
2. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
3. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.2 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.3 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
2. Submit the schedule of values to Architect through Construction Manager at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:

a. Project name and location.
b. Owner's name.
c. Owner's Project number.
d. Name of Architect.
e. Architect's Project number.

f. Contractor's name and address.
g. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703 or Owner accepted form.
3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:

    a. Related Specification Section or division.
    b. Description of the Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.
    f. Change Orders (numbers) that affect value.
    g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.

        1) Labor.
        2) Materials.
        3) Equipment.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

    a. Differentiate between items stored on-site and items stored off-site.

6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
7. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
8. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
9. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.4 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and Construction Manager and paid for by Owner.

B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 or Architect accepted form as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect or Construction Manager will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
5. Submit completed applications for payment with updated construction schedule.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

    a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. Transmittal: Submit signed and notarized original copies of each Application for Payment to Architect and Construction Manager by a method ensuring receipt . One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Products list (preliminary if not final).
5. Sustainable design action plans, including preliminary project materials cost data.
6. Schedule of unit prices.
7. Submittal schedule (preliminary if not final).
8. List of Contractor's staff assignments.
9. List of Contractor's principal consultants.
10. Copies of building permits.
11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
12. Initial progress report.
13. Report of preconstruction conference.
14. Certificates of insurance and insurance policies.
15. Performance and payment bonds.
16. Data needed to acquire Owner's insurance.

I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

    a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."

2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Certification of completion of final punch list items.

3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
4. Updated final statement, accounting for final changes to the Contract Sum.
5. AIA Document G706 or Architect accepted form.
6. AIA Document G706A or Architect accepted form.
7. AIA Document G707 or Architect accepted form.
8. Evidence that claims have been settled.
9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
10. Final liquidated damages settlement statement.
11. Proof that taxes, fees, and similar obligations are paid.
12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. RFIs.
4. Digital project management procedures.
5. Web-based Project management software package.
6. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.2 DEFINITIONS

A. BIM: Building Information Modeling.

B. RFI: Request for Information. Request from Owner, Construction Manager, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in

attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, in web-based Project software directory, and in prominent location in built facility. Keep list current at all times.

1.4 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and scheduled activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.5 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

    a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
    b. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    c. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
    d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
    e. Indicate required installation sequences.
    f. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Mechanical Rooms: Provide coordination drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
3. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
4. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
5. Mechanical and Plumbing Work: Show the following:

    a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    c. Fire-rated enclosures around ductwork.

6. Electrical Work: Show the following:

    a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
    b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
    c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.

d. Location of pull boxes and junction boxes, dimensioned from column center lines.

7. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
8. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

C. Coordination Drawing Process: Prepare coordination drawings in the following manner:

1. Schedule submittal and review of Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
4. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
5. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
6. Communications and Electronic Safety and Security Installer will indicate cable trays and cabling runs and equipment in purple color. Communications and Electronic Safety and Security Installer shall forward completed drawing files to Contractor.
7. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Architect to review and resolve conflicts on the coordination drawings.

D. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format:

a. Same digital data software program, version, and operating system as original Drawings.
b. DWG, Version Current, operating in Microsoft Windows operating system.

2. File Submittal Format: Submit or post coordination drawing files using PDF format.
3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.

a. Architect makes no representations as to the accuracy or completeness of

digital data files as they relate to Drawings.

b. Digital Data Software Program: Drawings are available in REVIT and AutoCAD compatible formats.

c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

1.6 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Date.
3. Name of Contractor.
4. RFI number, numbered sequentially.
5. RFI subject.
6. Specification Section number and title and related paragraphs, as appropriate.
7. Drawing number and detail references, as appropriate.
8. Field dimensions and conditions, as appropriate.
9. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
10. Contractor's signature.
11. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: AIA Document G716 Software-generated form with substantially the same content as indicated above, acceptable to Architect.

1. Attachments shall be electronic files in PDF format.

D. Action: Architect and Construction Manager will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect or Construction Manager after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

    a. Requests for approval of submittals.

b. Requests for approval of substitutions.
c. Requests for approval of Contractor's means and methods.
d. Requests for coordination information already indicated in the Contract Documents.
e. Requests for adjustments in the Contract Time or the Contract Sum.
f. Requests for interpretation of Architect's actions on submittals.
g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect or Construction Manager of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."

a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Construction Manager in writing within 5 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect and Construction Manager.
4. RFI number, including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's and Construction Manager's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

F. On receipt of Architect's and Construction Manager's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect and Construction Manager within three days if Contractor disagrees with response.

1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model and/ or CAD drawings will be provided by Architect for Contractor's use during construction.

1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
3. Digital Drawing Software Program: Contract Drawings are available in either REVIT or AutoCAD -Current versions for MS Windows based systems.
4. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of Agreement acceptable to Owner and Architect.

5. Architect’s project borders, sheet formatting, general notes, and details will not be provided for Contractor’s uses.
6. The following digital data files will be furnished for each appropriate discipline:

a. Floor plans.
b. Reflected ceiling plans.
c. Roof plans.
d. Exterior elevations.
e. Building sections.

B. Web-Based Project Management Software Package: Construction Manager to Provide, administer, and use web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.

1. Web-based Project management software includes, at a minimum, the following features:

a. Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
c. Document workflow planning, allowing customization of workflow between project entities.
d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
e. Track status of each Project communication in real time, and log time and date when responses are provided.
f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
g. Processing and tracking of payment applications.
h. Processing and tracking of contract modifications.
i. Creating and distributing meeting minutes.
j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
k. Management of construction progress photographs.
l. Mobile device compatibility, including smartphones and tablets.

C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with

links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.8 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of seven days prior to meeting.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner , Construction Manager, and Architect, within three days of the meeting.

B. Preconstruction Conference: Construction Manager will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner , Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

a. Responsibilities and personnel assignments.
b. Tentative construction schedule.
c. Critical work sequencing and long lead items.
d. Designation of key personnel and their duties.
e. Lines of communications.
f. Use of web-based Project software.
g. Procedures for processing field decisions and Change Orders.
h. Procedures for RFIs.
i. Procedures for testing and inspecting.
j. Procedures for processing Applications for Payment.
k. Distribution of the Contract Documents.
l. Submittal procedures.
m. Preparation of Record Documents.
n. Use of the premises .
o. Work restrictions.
p. Working hours.
q. Owner's occupancy requirements.

r. Responsibility for temporary facilities and controls.
s. Procedures for moisture and mold control.
t. Procedures for disruptions and shutdowns.
u. Construction waste management and recycling.
v. Parking availability.
w. Office, work, and storage areas.
x. Equipment deliveries and priorities.
y. First aid.
z. Security.
aa. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect , Construction Manager and Owner of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

a. Contract Documents.
b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Review of mockups.
i. Possible conflicts.
j. Compatibility requirements.
k. Time schedules.
l. Weather limitations.
m. Manufacturer's written instructions.
n. Warranty requirements.
o. Compatibility of materials.
p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.
t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Conduct progress meetings at weekly intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner , Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

        1) Review schedule for next period.

    b. Review present and future needs of each entity present, including the following:

        1) Interface requirements.
        2) Sequence of operations.
        3) Status of submittals.
        4) Deliveries.
        5) Off-site fabrication.
        6) Access.
        7) Site use.
        8) Temporary facilities and controls.
        9) Progress cleaning.
        10) Quality and work standards.
        11) Status of correction of deficient items.
        12) Field observations.
        13) Status of RFIs.
        14) Status of Proposal Requests.
        15) Pending changes.
        16) Status of Change Orders.
        17) Pending claims and disputes.

18) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

    a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Startup construction schedule.
2. Contractor's Construction Schedule.
3. Construction schedule updating reports.
4. Daily construction reports.
5. Material location reports.
6. Site condition reports.
7. Unusual event reports.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.
2. Section 014000 "Quality Requirements" for schedule of tests and inspections.

1.2 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Resource Loading: The allocation of labor and equipment necessary for completing an activity as scheduled.

1.3 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file.
2. PDF file.

B. Startup construction schedule.

1. Submittal of cost-loaded startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.

D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports to contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
2. Total Float Report: List of activities sorted in ascending order of total float.

E. Construction Schedule Updating Reports: Submit with Applications for Payment.

F. Daily Construction Reports: Submit at weekly intervals.

G. Site Condition Reports: Submit at time of discovery of differing conditions.

H. Unusual Event Reports: Submit at time of unusual event.

1.4 QUALITY ASSURANCE

A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including work stages interim milestones.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures .
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.5 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Computer Scheduling Software: Prepare schedules using current version of a program that is capable of managing construction schedules.

B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.

1. Contract completion date to not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Temporary Facilities: Indicate start and completion dates for the following as applicable:

a. Securing of approvals and permits required for performance of the Work.
b. Temporary facilities.
c. Construction of mock-ups, prototypes and samples.
d. Owner interfaces and furnishing of items.
e. Interfaces with Separate Contracts.
f. Regulatory agency approvals.
g. Punch list.

3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
5. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's and Construction Manager's administrative procedures necessary for certification of Substantial Completion.
7. Punch List and Final Completion: Include not more than days for completion of punch list items and Final Completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
2. Work Restrictions: Show the effect of the following items on the schedule:

    a. Uninterruptible services.
    b. Use-of-premises restrictions.
    c. Seasonal variations.
    d. Environmental control.

E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and the Contract Time.

F. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Final Completion percentage for each activity.

G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

H. Distribution: Distribute copies of approved schedule to Architect , Construction Manager, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.7 GANTT-CHART SCHEDULE REQUIREMENTS

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 14 days of date established for the Notice to Proceed.

1. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 5 percent increments within time bar.

1.8 CPM SCHEDULE REQUIREMENTS

A. Prepare network diagrams using AON (activity-on-node) format.

B. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule, so it can be accepted for use no later than 14 days after date established for the Notice to Proceed.

a. Failure to include any work item required for performance of this Contract must not excuse Contractor from completing all work within applicable completion dates.

2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for

reporting progress. Coordinate procedures with progress meeting and payment request dates.

4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.

C. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

    a. Preparation and processing of submittals.
    b. Mobilization and demobilization.
    c. Purchase of materials.
    d. Delivery.
    e. Fabrication.
    f. Utility interruptions.
    g. Installation.
    h. Work by Owner that may affect or be affected by Contractor's activities.
    i. Testing and inspection.
    j. Commissioning.
    k. Punch list and Final Completion.
    l. Activities occurring following Final Completion.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates to be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

    a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

D. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.

E. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Main events of activity.

4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the schedule of values).

F. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

G. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.

1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.

    a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
    b. Submit value summary printouts one week before each regularly scheduled progress meeting.

1.9 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Testing and inspection.
8. Accidents.
9. Meetings and significant decisions.
10. Unusual events.

11. Stoppages, delays, shortages, and losses.
12. Meter readings and similar recordings.
13. Emergency procedures.
14. Orders and requests of authorities having jurisdiction.
15. Change Orders received and implemented.
16. Construction Change Directives received and implemented.
17. Services connected and disconnected.
18. Equipment or system tests and startups.
19. Partial completions and occupancies.
20. Substantial Completions authorized.

B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

C. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

1. Submit unusual event reports directly to Owner within three day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

SECTION 013300

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
2. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
3. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
4. Section 014339 “Mockups” for Mockup requirements and submittals.
5. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's and Construction Manager's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's and Construction Manager's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and Construction Manager and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, mockups, and Contractor's construction schedule.
2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List

those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal Category: Action; informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Architect's and Construction Manager's final release or approval.
    g. Scheduled dates for purchasing.
    h. Scheduled date of fabrication.
    i. Scheduled dates for installation.
    j. Activity or event number.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Construction Manager.
5. Name of Contractor.
6. Name of firm or entity that prepared submittal.
7. Names of subcontractor, manufacturer, and supplier.
8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
9. Category and type of submittal.
10. Submittal purpose and description.
11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
12. Drawing number and detail references, as appropriate.
13. Indication of full or partial submittal, default is a full submittal.
14. Location(s) where product is to be installed, as appropriate.
15. Other necessary identification.
16. Remarks.
17. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and

limitations; include relevant additional information and revisions, other than those requested by Architect and Construction Manager on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

E. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.

a. Architect and Construction Manager reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect and/ or Construction Manager will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review

of each submittal.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

a. Manufacturer's catalog cuts.
b. Manufacturer's product specifications.
c. Standard color charts.
d. Statement of compliance with specified referenced standards.
e. Testing by recognized testing agency.
f. Application of testing agency labels and seals.
g. Notation of coordination requirements.
h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

a. Wiring diagrams that show factory-installed wiring.
b. Printed performance curves.
c. Operational range diagrams.
d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data .

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.
    f. Relationship and attachment to adjoining construction clearly indicated.
    g. Seal and signature of professional engineer if specified.

C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:

    a. Project name and submittal number.
    b. Generic description of Sample.
    c. Product name and name of manufacturer.
    d. Sample source.
    e. Number and title of applicable Specification Section.
    f. Specification paragraph number and generic name of each item.

3. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit three full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect , through Construction Manager,

will return submittal with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit three sets of Samples. Architect and Construction Manager will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.

        1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
        2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.

E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.

2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

1.7 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.8 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect and Construction Manager.

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp indication in web-based Project management software. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect and Construction Manager will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required , and return.

1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action , as follows:

a. No Exceptions Taken: No additional action is required and Contractor may progress forward and incorporate items into project work.
b. Exceptions as Noted: Contractor shall review and coordinate exceptions noted on submittal documents, make required corrections and may progress forward and incorporate items into project work. No Exceptions Taken: No additional action is required and Contractor may progress forward and incorporate items into project work.
c. Rejected: Item is rejected and may not be incorporated into project work.
d. Revise and Resubmit: Contractor shall review and coordinate exceptions

noted on submittal documents, make revisions to submittal documents and resubmit submittal documents to Architect. Contractor may not incorporate submitted items into project work.

e. Submit Specific Item: Contractor shall review and coordinate exceptions noted on submittal documents and must provide information noted by Architect. Remaining items may be incorporated into project work.

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Architect will return without review submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 014000

QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

E. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) in accordance with 29 CFR 1910.7, by a testing agency

accredited in accordance with NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."

H. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

I. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect or Construction Manager.

1.3 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.4 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are

minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

F. Reports: Prepare and submit certified written reports and documents as specified.

G. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.6 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-

control activities. Coordinate with Contractor's Construction Schedule.

B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
3. Owner-performed tests and inspections indicated in the Contract Documents .

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.7 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.

11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.8 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this

Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.

1. Requirements of authorities having jurisdiction supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.9 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor , and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services

required of Contractor by authorities having jurisdiction, whether specified or not.

2. Engage a qualified testing agency to perform quality-control services.

    a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 48 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Architect , Construction Manager, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect , Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency

sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspection equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.10 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner , and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect , Construction Manager, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect , through Construction Manager, with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.

2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and Construction Manager's and authorities' having jurisdiction reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014339

MOCKUPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Integrated exterior mockups.

B. Related Requirements:

1. Section 013300 “Submittal Procedures” for schedule review.
2. Section 014000 "Quality Requirements" for quality assurance requirements for aesthetic and workmanship mockups specified in other Sections.

1.2 DEFINITIONS

A. Integrated Exterior Mockups: Mockups of the exterior enclosure constructed on-site as freestanding temporary built elements or as part of permanent construction, consisting of multiple products, assemblies, and subassemblies.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site or location specified by Owner .

1. Meet with Owner, Construction Manager, Architect, testing and inspecting agency representative, and installers of major systems whose Work is included in integrated exterior mockups.
2. Review coordination of equipment and furnishings provided by the Owner for room mockups.
3. Review locations and extent of mockups.
4. Review testing procedures to be performed on mockups.
5. Review and finalize schedule for mockups, and verify availability of materials, personnel, equipment, and facilities needed to complete mockups and testing and maintain schedule for the Work.

1.4 ACTION SUBMITTALS

A. Shop Drawings: For integrated exterior mockups.

1. Include plans, elevations, sections, and attachment details.
2. Indicate manufacturer and model number of individual components, subassemblies, and assemblies.
3. Include site location drawing .
4. Revise and resubmit Shop Drawings to reflect approved modifications in details and component interfaces resulting from changes made during testing procedures.

1.5 MOCKUPS

A. Schedule: Provide schedule for mockup construction for review and approval by Construction Manager and Architect.

B. Build mockups to do the following:

1. Verify selections made under Sample submittals.
2. Demonstrate aesthetic effects.
3. Demonstrate the qualities of products and workmanship.
4. Demonstrate acceptable coordination between components and systems.
5. Perform preconstruction testing, such as window air-leakage and water-penetration-resistance testing.

C. Fabrication: Before fabricating or installing portions of the Work requiring mockups, build mockups for each form of construction and finish required. Use materials and installation methods as required for the Work.

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed in writing by Architect or Construction Manager.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

D. Notifications:

1. Notify Architect and Construction Manager seven days in advance of the dates when mockups will be constructed.
2. Notify Architect and Construction Manager 14 days in advance of the dates and times when mockups will be tested.
3. Allow seven days for initial review and each re-review of each mockup.

E. Approval: Obtain Architect's and Construction Manager's written approval of mockups before starting fabrication or construction of corresponding Work.

1. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 COORDINATION

A. Coordinate schedule for construction of mockups, so construction, testing, and review of mockups do not impact Project schedule.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design support structure for free-standing mockups.

B. Structural Performance:

1. Seismic Performance: Mockups and support structure to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

C. Mockup Testing Performance Requirements: Perform tests using design pressures and performance criteria indicated for assemblies and products that are specified in other Sections and incorporated into integrated exterior mockups.

2.2 INTEGRATED EXTERIOR MOCKUPS

A. Construct integrated exterior mockups in accordance with approved mockup Shop Drawings. Construct mockups to demonstrate constructability, coordination of trades, and sequencing of Work; and to ensure materials, components, subassemblies, assemblies, and interfaces integrate into a system complying with indicated performance and aesthetic requirements.

B. Build integrated exterior mockups using installers and construction methods that will be used in completed construction.

C. Use specified products that have been approved in writing by Architect. Coordinate installation of materials and products specified in individual Specification Sections that include Work included in integrated exterior mockups.

D. Provide and document modifications to construction details and interfaces between components and systems required to properly sequence the Work, or to pass performance testing requirements. Obtain Architect's Construction Manager's written approval for modifications.

E. Retain approved mockups constructed in place. Incorporate fully into the Work.

PART 3 - EXECUTION (Not Used)

END OF SECTION 014339

SECTION 015000

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

A. Installation, removal, and use charges for temporary facilities to be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Owner will pay sewer-service use charges for sewer usage by all entities for construction operations.

C. Water Service: Owner will pay water-service use charges for water used by all entities for construction operations.

D. Electric Power Service: Owner will pay electric-power-service use charges for electricity used by all entities for construction operations.

E. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

F. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

G. Sewer, Water, and Electric Power Service: Use charges are specified in Section 011200 "Multiple Contract Summary."

1.3 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

E. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
3. Indicate methods to be used to avoid trapping water in finished work.

F. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:

1. Locations of dust-control partitions at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air-filtration system discharge.
4. Waste-handling procedures.
5. Other dust-control measures.

G. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by Owner. Include the following:

1. Methods used to meet the goals and requirements of Owner.
2. Concrete cutting method(s) to be used.
3. Location of construction devices on the site.
4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with Owner.

1.4 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for

temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.5 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts **with 1-5/8-inch- OD top rails**

B. Wood Enclosure Fence: Plywood, **8 feet** high, framed with four 2-by-4-inch rails, with preservative-treated wood posts spaced not more than 8 feet apart.

C. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.

D. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats, minimum 36 by 60 inches.

2.2 TEMPORARY FACILITIES

A. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually

incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service:

1. Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities is not permitted.

E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

F. Electric Power Service:

1. Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
2. Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

    a. Install electric power service overhead unless otherwise indicated.
    b. Connect temporary service to Owner's existing power source, as directed by Owner.

G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

H. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.

3.4 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:

1. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Parking: Provide temporary offsite and/ or Use designated areas of Owner's existing parking areas for construction personnel.

C. Storage and Staging: Provide temporary offsite area and/ or Use designated areas of Project site for storage and staging needs.

D. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

    a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touch up signs, so they are legible at all times.

E. Waste Disposal Facilities:

1. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
2. Provide waste-collection containers in sizes adequate to handle waste from

construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Section 011000 "Summary."

C. Temporary Erosion and Sedimentation Control:

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Tree and Plant Protection:

1. Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

G. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

I. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.

J. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.6 MOISTURE AND MOLD CONTROL

A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

3.7 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 015723

TEMPORARY STORM WATER POLLUTION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Temporary stormwater pollution controls.

1.2 STORMWATER POLLUTION PREVENTION PLAN

A. The Stormwater Pollution Prevention Plan (SWPPP) is part of the Contract Documents and is bound into this Project Manual.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Construction Manager, and earthwork subcontractor.
2. Review requirements of the SWPPP, including permitting process, worker training, and inspection and maintenance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Stormwater Pollution Prevention Plan (SWPP): Within 15 days of date established for commencement of the Work, submit completed SWPPP.

B. EPA authorization under the EPA's "2017 Construction General Permit (CGP)."

C. Stormwater Pollution Prevention (SWPP) Training Log: For each individual performing Work under the SWPPP.

D. California Construction Stormwater General Permit – 2022, Order: WQ 2022-0057-DWQ

E. Inspection reports.

1.5 QUALITY ASSURANCE

A. Stormwater Pollution Prevention Plan (SWPPP) Coordinator: Experienced individual or firm with a record of successful water pollution control management coordination of projects with similar requirements.

1. SWPPP Coordinator shall complete and finalize the SWPPP form.
2. SWPPP Coordinator shall be responsible for inspections and maintaining of all requirements of the SWPPP.

B. Installers: Trained as indicated in the SWPPP.

PART 2 - PRODUCTS

2.1 TEMPORARY STORMWATER POLLUTION CONTROLS

A. Provide temporary stormwater pollution controls as required by the SWPPP.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with all best management practices, general requirements, performance requirements, reporting requirements, and all other requirements included in the SWPPP.

B. Locate stormwater pollution controls in accordance with the SWPPP.

C. Conduct construction as required to comply with the SWPPP and that minimize possible contamination or pollution or other undesirable effects.

1. Inspect, repair, and maintain SWPPP controls during construction.

a. Inspect all SWPPP controls not less than every seven days, and after each occurrence of a storm event, as outlined in the SWPPP.

D. Remove SWPPP controls at completion of construction and restore and stabilize areas disturbed during construction.

END OF SECTION 015723

SECTION 016000

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of This Section Includes: Administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section 011000 "Summary" for Contractor requirements related to Owner-furnished products.
2. Section 012500 "Substitution Procedures" for requests for substitutions.
3. Section 017700 "Closeout Procedures" for submitting warranties.

1.2 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products unless otherwise indicated.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluating Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of

additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:

1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
2. Data indicating compliance with the requirements specified in "Comparable Products" Article.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."

F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.3 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is inconspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:

a. Name of product and manufacturer.
b. Model and serial number.
c. Capacity.
d. Speed.

e. Ratings.

3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.4 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.6 PRODUCT WARRANTIES

A. Warranties specified in other Sections are to be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and

limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of Owner or endorsed by manufacturer to Owner.

B. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

    a. Submit additional documentation required by Architect through Construction Manager in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by Architect, whose determination is final.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

    a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."

2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies

with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."

3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.

   a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."

4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.

   a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
   b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.

5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.

   a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."

6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.

   a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
   b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.

7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.

C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for a comparable product. Architect will notify Contractor through Construction Manager of approval or rejection of proposed comparable product within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

1. Architect's Approval of Submittal: Marked with approval notation from Architect's action stamp and/ or Indication of approval in web-based Project management software. See Section 013300 "Submittal Procedures."
2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Two-Step Process: Approval by Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

D. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300

EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:

1. Construction layout.
2. Field engineering.
3. Installation.
4. Cutting and patching.
5. Coordination of Owner's portion of the Work.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.
9. Correction of the Work.

B. Related Requirements:

1. Section 011000 "Summary" for coordination of Owner-furnished products, and limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 PREINSTALLATION MEETINGS

A. Cutting and Patching Conference: Conduct conference at Project site.

1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect and Construction Manager of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:

a. Contractor's superintendent.
b. Trade supervisor responsible for cutting operations.

c. Trade supervisor(s) responsible for patching of each type of substrate.
d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.

2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Certified Surveys: Submit two copies signed by land surveyor.

C. Certificates: Submit certificate signed by professional engineer, certifying that location and elevation of improvements comply with requirements.

D. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.

a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

E. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.5 CLOSEOUT SUBMITTALS

A. Final Property Survey: Submit Three copies showing the Work performed and record survey data.

1.6 QUALITY ASSURANCE

A. Professional Engineer Qualifications: Refer to Section 014000 "Quality Requirements."

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, or when

encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:

    a. Primary operational systems and equipment.
    b. Plumbing piping systems.
    c. Mechanical systems piping and ducts.
    d. Control systems.
    e. Communication systems.
    f. Electrical wiring systems.
    g. Operating systems of special construction.

3. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect through Construction Manager in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect and Construction Manager promptly.

B. Engage a professional engineer experienced in laying out the Work, using the following accepted surveying practices:

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect and Construction Manager.

3.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect or Construction Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect and Construction Manager before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.5 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb, and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.6 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of Work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-

core drill.

4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, in accordance with regulations.

    a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces in accordance with written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017419

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

1.2 DEFINITIONS

A. CMU: Concrete masonry units.

B. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

C. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.

D. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.

E. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

F. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

G. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 7 30 days of date established for the Notice to Proceed. Plan must include the following:

1. Strategies to reduce the generation of waste during Project design and construction.
2. Waste diversion goals for Project, identifying the materials (both structural and nonstructural) targeted for recycling, reuse, or salvage and identifying the target diversion percentage per city and state requirements.
3. Where materials will be taken, including expected diversion rates for each material.

1.5 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use forms required by the Authority Having Jurisdiction or waste management company. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons.
4. Quantity of waste salvaged, both estimated and actual in tons.
5. Quantity of waste recycled, both estimated and actual in tons.
6. Total quantity of waste recovered (salvaged plus recycled) in tons.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. Qualification Statements: For waste management coordinator.

H. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed in accordance with EPA regulations.

Include name and address of technician and date refrigerant was recovered.

I. Refrigerant Recovery: Comply with requirements in Section 024116 "Structure Demolition" and Section 024119 "Selective Demolition" for refrigerant recovery submittals.

1.6 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements. Superintendent may serve as Waste Management Coordinator.

B. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

C. Waste Management Conference(s): Conduct conference(s) at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of each contractor and waste management coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation, and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.7 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan in accordance with requirements in this Section. Plan must include provisions for waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition site-clearing and construction waste generated by the Work. Use forms required by the Authority Having Jurisdiction or the waste management company. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use forms required by the Authority Having Jurisdiction or the waste management company. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.

2. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
3. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
4. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS

2.1 RECYCLING RECEIVERS AND PROCESSORS

A. Subject to compliance with requirements, available recycling receivers and processors include, but are not limited to, the following:

2.2 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total nonhazardous solid waste generated by the Work. Practice efficient waste management in use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials , including the following:

1. Demolition Waste:

    a. Asphalt paving.
    b. Concrete.
    c. Concrete reinforcing steel.
    d. Brick.
    e. CMU.
    f. Structural and miscellaneous steel.
    g. Rough hardware.
    h. Equipment.
    i. Plumbing fixtures.
    j. Piping.
    k. Valves.
    l. Sprinklers.
    m. Mechanical equipment.
    n. Electrical conduit.
    o. Copper wiring.
    p. Lighting fixtures.
    q. Lamps.
    r. Ballasts.
    s. Electrical devices.
    t. Switchgear and panelboards.
    u. Transformers.

2. Construction Waste:

a. Masonry and CMU.
b. Lumber.
c. Wood sheet materials.
d. Wood trim.
e. Metals.
f. Roofing.
g. Insulation.
h. Carpet and pad.
i. Gypsum board.
j. Piping.
k. Electrical conduit.
l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:

1) Paper.
2) Cardboard.
3) Boxes.
4) Plastic sheet and film.
5) Polystyrene packaging.
6) Wood crates.
7) Wood pallets.
8) Plastic pails.

m. Construction Office Waste: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following construction office waste materials:

1) Paper.
2) Aluminum cans.
3) Glass containers.

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials to accrue to Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials in accordance with recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to maximum extent practical in accordance with approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

    a. Inspect containers and bins for contamination, and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.3 RECYCLING DEMOLITION WASTE

A. Asphalt Paving Recycling: Break up and transport paving to asphalt-recycling facility.

B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

1. Pulverize concrete to maximum 1-1/2-inch size.

C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with

other metals.

1. Pulverize masonry to maximum 1-1/2-inch size.
2. Clean and stack undamaged, whole masonry units on wood pallets.

D. Wood Materials: Sort and stack members per size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

E. Metals: Separate metals by type.

1. Structural Steel: Stack members per size, type of member, and length.
2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

F. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.

G. Conduit: Reduce conduit to straight lengths and store by material and size.

H. Lamps: Separate lamps by type and store in accordance with requirements in 40 CFR 273.

3.4 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cutoffs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

    a. Comply with requirements in Section 329300 "Plants" for use of clean sawdust as organic mulch.

C. Gypsum Board: Stack large clean pieces on wood pallets or in containers and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

    a. Comply with requirements in Section 329300 "Plants" for use of clean ground gypsum board as inorganic soil amendment.

D. Paint: Seal containers and store by type.

3.5 DISPOSAL OF WASTE

A. Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Unless otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning:

1. Do not burn waste materials.

END OF SECTION 017419

SECTION 017700

CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final Completion procedures.
3. List of incomplete items.
4. Submittal of Project warranties.
5. Final cleaning.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
2. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
3. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
4. Section 017900 "Demonstration and Training" for requirements to train Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.2 DEFINITIONS

A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest-control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect and Construction Manager. Label with manufacturer's name and model number.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's Construction Manager's Owner's signature for receipt of submittals.

5. Submit testing, adjusting, and balancing records.
6. Submit sustainable design submittals not previously submitted.
7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.

5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list will state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.
5. Submit Final Completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Include the following information at the top of each page:

a. Project name.
b. Date.
c. Name of Architect and Construction Manager.
d. Name of Contractor.
e. Page number.

2. Submit list of incomplete items in the following format:

a. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit on digital media acceptable to Architect and by uploading to web-based project software site.

D. Warranties in Paper Form:

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

E. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

    a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
    b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
    d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    e. Remove snow and ice to provide safe access to building.
    f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    h. Clean flooring, removing debris, dirt, and staining; clean in accordance with manufacturer's instructions.
    i. Vacuum and mop concrete.
    j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean in accordance with manufacturer's instructions if visible soil or stains remain.
    k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
    l. Remove labels that are not permanent.

m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
o. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
p. Clean strainers.
q. Leave Project clean and ready for occupancy.

C. Construction Waste Disposal: Comply with waste-disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 CORRECTION OF THE WORK

A. Complete repair and restoration operations required by "Correction of the Work" Article in Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 017823

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Section 018626 "Electrical Performance Requirements" for requirements for Electrical Preventative Maintenance (EPM) Program binders that form part of the operation and maintenance data of this Section and include additional requirements for operation, maintenance, and emergency procedures, for electrical systems and equipment.

1.2 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.3 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:

1. Submit on digital media acceptable to Architect by uploading to web-based project software site by email to Architect. Enable reviewer comments on draft submittals.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.

1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.4 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.5 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual to contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.

7. Name and contact information for Architect.
8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
9. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation in accordance with ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.6 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.7 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.8 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of maintenance manuals.

1.9 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating

care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

SECTION 017839

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:

1. Section 017300 "Execution" for final property survey.
2. Section 017700 "Closeout Procedures" for general closeout procedures.
3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit copies of Record Drawings as follows:

a. Initial Submittal:

1) Submit PDF electronic files of scanned record prints and one set(s) of marked-up record file prints for the Architect's review.
2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:

1) Submit Record Digital Data Files and one set(s) of Record Digital Data File plots.
2) Plot each drawing file, whether or not changes and additional information were recorded.

B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

E. Reports: Submit written report weekly indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.3 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. Accurately record information in an acceptable drawing technique.
    c. Record data as soon as possible after obtaining it.
    d. Record and check the markup before enclosing concealed installations.
    e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Depths of foundations.
    d. Locations and depths of underground utilities.
    e. Revisions to routing of piping and conduits.
    f. Revisions to electrical circuitry.
    g. Actual equipment locations.
    h. Duct size and routing.
    i. Locations of concealed internal utilities.
    j. Changes made by Change Order or Construction Change Directive.
    k. Changes made following Architect's written orders.
    l. Details not on the original Contract Drawings.
    m. Field records for variable and concealed conditions.
    n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.

5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect and Construction Manager. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Annotated PDF electronic file with comment function enabled.
2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to Architect through Construction Manager for resolution.
4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.

    a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
    b. Architect will provide data file layer information. Record markups in separate layers.

C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

    a. Project name.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Architect and Construction Manager.
    e. Name of Contractor.

1.4 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record

Product Data.

3. Note related Change Orders , Record Product Data, and Record Drawings where applicable.

B. Format: Submit record specifications as annotated PDF electronic file.

1.5 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders , Record Specifications, and Record Drawings where applicable.

C. Format: Submit Record Product Data as annotated PDF electronic file.

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.6 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.7 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's and Construction Manager's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

SECTION 017900

DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Instruction in operation and maintenance of systems, subsystems, and equipment.
2. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Qualification Data: For facilitator.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.3 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:

a. Name of Project.
b. Name and address of videographer.
c. Name of Architect.
d. Name of Construction Manager.
e. Name of Contractor.
f. Date of video recording.

2. Transcript:

a. Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.

3. At completion of training, submit complete training manual(s) for Owner's use prepared in same PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
2. Review required content of instruction.
3. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.6 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training

modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

    a. System, subsystem, and equipment descriptions.
    b. Performance and design criteria if Contractor is delegated design responsibility.
    c. Operating standards.
    d. Regulatory requirements.
    e. Equipment function.
    f. Operating characteristics.
    g. Limiting conditions.
    h. Performance curves.

2. Documentation: Review the following items in detail:

    a. Emergency manuals.
    b. Systems and equipment operation manuals.
    c. Systems and equipment maintenance manuals.
    d. Product maintenance manuals.
    e. Project Record Documents.
    f. Identification systems.
    g. Warranties and bonds.
    h. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

    a. Instructions on meaning of warnings, trouble indications, and error messages.
    b. Instructions on stopping.
    c. Shutdown instructions for each type of emergency.
    d. Operating instructions for conditions outside of normal operating limits.
    e. Sequences for electric or electronic systems.
    f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

    a. Startup procedures.
    b. Equipment or system break-in procedures.
    c. Routine and normal operating instructions.
    d. Regulation and control procedures.
    e. Control sequences.
    f. Safety procedures.
    g. Instructions on stopping.

h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning.
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

1.7 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner and , through Construction Manager, with at least seven days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.9 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode with vibration reduction technology.

1. Submit video recordings on a thumb drive or by uploading to web-based Project software site.
2. File Hierarchy: Organize folder structure and file locations in accordance with Project Manual table of contents. Provide complete screen-based menu.
3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged in accordance with Project Manual table of contents:

a. Name of Contractor/Installer.
b. Business address.
c. Business phone number.
d. Point of contact.

e. Email address.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.

1. Film training session(s) in segments not to exceed 15 minutes.

a. Produce segments to present a single significant piece of equipment per segment.
b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.

D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.

1. Furnish additional portable lighting as required.

E. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

F. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017900

SECTION 024119

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes:

1. Demolition and removal of selected portions of exterior or interior of building or structure and site elements.
2. Removal and salvage of existing items for delivery to Owner and removal of existing items for reinstallation.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 017300 "Execution" for cutting and patching procedures.
3. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.
4. Section 330500 "Common Work Results for Utilities" for removal of site utility systems piping, equipment, and components.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner as indicated.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage; prepare for reuse; and reinstall where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.4 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review and finalize selective demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
4. Review areas where existing construction is to remain and requires protection.
5. Review and finalize protection requirements.
6. Review procedures for noise control and dust control.
7. Review storage, protection, and accounting for items to be removed for salvage or reinstallation.

1.6 INFORMATIONAL SUBMITTALS

A. Survey of Existing Conditions: Submit survey.

B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property , for environmental protection , for dust control and , for noise control. Indicate proposed locations and construction of barriers.

C. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Temporary interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 FIELD CONDITIONS

A. Owner will not occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before selective demolition, Owner will remove the following items:

a. Owner’s furnishings and miscellaneous equipment.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials:

1. It is not expected that hazardous materials will be encountered in the Work.

a. Hazardous materials will be removed by Owner before start of the Work.
b. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. On-site sale of removed items or materials is not permitted.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video , measured drawings. Comply with Section 013233 "Photographic Documentation."

1. Inventory and record the condition of items to be removed for salvage or reinstallation. Photograph or video conditions that might be misconstrued as damage caused by removal.
2. Photograph or video existing conditions of adjoining construction including finish surfaces, that might be misconstrued as damage caused by selective demolition operations or removal of items for salvage or reinstallation.

3.2 PREPARATION

A. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.3 UTILITY SERVICES AND BUILDING SYSTEMS

A. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utilities and building systems serving areas to be selectively demolished.

1. Arrange to shut off utilities with utility companies.
2. If disconnection of utilities and building systems will affect adjacent occupied parts of the building, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to those parts of the building.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
2. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
3. Maintain fire watch during and for at least 6 hours after flame-cutting operations.
4. Maintain adequate ventilation when using cutting torches.
5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by

authorities having jurisdiction.

2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete:

1. Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction. and recycle or dispose of them in accordance with Section 017419 "Construction Waste Management and Disposal."

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 03 10 00
CONCRETE FORMWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. Principal work in this Section:

1. Forms for cast-in-place concrete.

2. Shoring, bracing, accessories and form coating.

B. Work installed but furnished in other Sections:

1. Inserts, bolts, anchors and other items furnished by other trades for installation in formed concrete.

C. Related work:

1. Section 03 30 00 – Cast-in-place Concrete

1.2 SUBMITTALS

A. General: Submit in accordance with Section 01 33 00

B. Records: Keep an accurate record of the dates of all form removal and furnish copies to the Construction Manager.

C. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.

D. Include information on Material Tracking Worksheets.

1.3 QUALITY ASSURANCE

A. Lumber and plywood shall be grade-marked by a grading agency acceptable to the Building Department.

1.4 HANDLING

A. Procedure: In compliance with Section 01 60 00.

B. Storage: Store form facing materials above ground on framework or blocking. Protect from moisture and damage. Handle form facing materials to prevent damages which could be transferred to the concrete.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Forms for exposed concrete surfaces:

1. General: Plywood, metal, metal-framed/plywood-faced, or FRP which will provide continuous, flat, exposed concrete surface with the appropriate texture and appearance as specified on the architectural drawings. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on Drawings, where indicated.

2. Type:

a. For concrete surfaces to be sacked and rubbed: US Product Standard PS-1 'B-B (Concrete Form) Plyform", Class 1, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

b. Elsewhere where concrete will remain exposed, with or without a mechanical finish: Overlaid plywood complying with US Product Standard PS-1 'A-C or B-B High Density Overlaid Concrete Form,' Class 1, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

B. Forms for concealed concrete surfaces: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

C. Form ties and spreaders:

1. Provide cone or snap type ties designed to be completely removed from wall, or to break off and provide minimum 1-1/2 in. coverage over ends of the portion of snap tie remaining in the concrete.

2. Do not use wire ties, wood spreaders, or embedded types in which embedded portion is less than 1-1/2 in. from exterior face of concrete.

D. Chamfer strips: Extruded PVC, with 3/4 in. diagonal faces unless otherwise indicated, by The Burke Co., Greenstreak Plastic Products Co., or Sonneborn-Rexnord, Inc., or oiled softwood shapes with the same profile.

E. Form coatings: Commercial formulation form-coating compounds that will, not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

F. Prefabricated construction joint keyways: Key-Loc by Form-A-Key Products Div., or Keyed Kold Joint by The Burke Co., complete with all accessories.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate surfaces to receive concrete formwork and associated work and conditions under which work will be installed. Do not proceed until satisfactory conditions have been corrected in a manner complying with the Contract Documents and acceptable to the Installer. Starting of the work within a particular area will be construed as installer's acceptance of surface conditions.

3.2 FORM TYPES

A. General: Comply with the applicable provisions of ACI 347, Guide to Formwork for Concrete, and APA Design/Construction Guide, Concrete Forming.

1. The design and construction of forms and shoring is the Contractor's responsibility but shall comply with specified requirements.

2. Form contact surfaces shall be clean, free from dents, holes and other imperfections.

3. Establish and maintain benchmarks mines and controls necessary to achieve specified tolerances. Take an accurate; survey of the form location just prior to concrete pour.

B. Earth bank:

1. Except for exterior face of wall footings and grade beams which must be formed, earth banks may be used to form footings and grade beams if the soil is firm, neatly trimmed, and will retain concrete in the required size and shape.

2. The concrete coverage shall be increased as noted on the Drawings when concrete is cast against earth.

C. Wood forms:

1. Construct with plywood panels as large as practicable. Where because of their height walls or columns have a horizontal form joints, the horizontal joint shall be aligned throughout the same floor, or area, unless otherwise acceptable to the Construction Manager.

2. Concrete surfaces which will remain exposed in the Work:

a. Fill voids, fastener heads, and other imperfections in form contact surfaces with body putty sanded smooth.

b. Seal joints between plywood panels flush with compound specifically designed to seal forms, or other approved material to prevent concrete paste leakage.

c. Provide sharp, clean comers at form intersecting planes, without visible edges and offsets. Back joints with additional studs or girts.

d. Form recesses and projections with smooth finish materials, and install in forms with sealed joints to prevent displacement.

e. Drill holes accurately in forms to fit ties used. Prevent leakage of concrete around tie holes. Do not drive ties through undersized or improperly prepared holes.

3. Kerf backside of wood inserts used for forming keyways, regrets, recesses and similar treatments, to allow wood to swell without spalling concrete, and to assure easy removal.

D. Metal forms:

1. Fasten sections of forms tightly and interlock securely.

2. Provide precisely cut openings required by other trades.

3. Cut or drill forms for attaching sleeves or other items to be embedded in concrete.

E. Re-use of forms:

1. Form materials may be re-used if they produce finished surfaces equal to finished surfaces where new form materials are used.

2. Before re-use, thoroughly clean, recondition in every respect, suitable for their reuse purpose.

F. Tolerances: To obtain cast-in-place concrete not exceeding the tolerances specified in Section 03 30 00, except support form facing material to limit deflection to L/360 between supports for concrete.

3.3 FORM CONSTRUCTION

A. Construction:

1. Rigidly support and construct forms to the lines, surfaces and profiles necessary to produce concrete of the design indicated.

2. Construct forms to be removable without prying against concrete.

3. Make forms tight, without cracks or holes, to prevent leakage of mortar or loss of fine particles from concrete.

4. Cover or fill holes that are not used and cracks that have opened-up flush with adjacent surfaces.

B. Wales and studs: Of adequate size and spacing to prevent form failure and to obtain concrete within the tolerances specified.

C. All formwork shall be cambered as specified on drawings.

D. Ties and spreaders: Place ties symmetrically, equally spaced, in plumb and level rows; tie placement in exposed concrete is subject to the Construction Manager's approval. Do not permit wood, other than built-in treated bucks or nailing blocks, to remain permanently in the forms.

E. Form contact surfaces:

1. As specified above and as best suited to prevailing conditions; may be constructed of plywood, FRP, plastic, or steel.

2. Block plywood edges which do not occur at bearing points to eliminate joint offsets.

F. Special features:

1. Corners:

a. Form exposed corners between beams and columns to produce a square, smooth, solid joint without paste leakage.

b. Install chamfer strips in corners of all other forms, unless otherwise indicated. Miter chamfer strip at changes in direction.

c. Corners which will be concealed in the Work may be formed either square or chamfered.

2. Reglets, rebates, seats and pockets: Form as indicated or as necessary to receive or engage work of other trades.

3. Openings, chases and recesses:

a. Form as indicated or necessary to receive, pass and clear other work.

b. Verify sizes and locations with other trades before forming.

c. Closely cooperate in locating boxes, cans and sleeves furnished by other trades.

G. Form release agent: Thoroughly clean forms and coat with release agent prior to initial use (except when mill-oiled) and before each reuse.

1. Apply form coating in compliance with its manufacturer's printed instructions and coverage rates.

2. Coat steel forms with a non-staining, rust-preventative material. Rust-stained steel formwork is not acceptable.

3. Provide a coating of uniform thickness. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete against which fresh concrete will be placed.

4. Apply form coating before reinforcement is placed.

3.4 FORM REMOVAL

A. Remove forms only after concrete has developed sufficient strength to not be damaged by form removal operation, and to safely sustain its own weight and superimposed loads, as determined by testing field cured concrete cylinders and as scheduled below, but not sooner than specified in ACI 347.

1. Shoring and Reshoring:

a. Be solely responsible for the safety of all construction including the periods during and after the preparation and erection of formwork, placement of concrete, formwork removal, reshoring and removal of reshoring. No act of others shall relieve the Contractor of the sole responsibility for safety.

b. General: Formwork, shoring and reshoring shall relate to the structural systems on each floor. Shoring and reshoring must be aligned over and under beams and girders and spreader beams provided where necessary to transfer loads. Shoring for flat slab systems must be aligned over reshores with spreader beams where necessary to transfer loads to reshores.

c. General: Do not remove forms or shoring until members have acquired sufficient strength to support their weight and subsequent construction load without deflection exceeding L/480. Remove forms in a manner to maintain the strength and stability of the structure at all times. Determine time of removal per specified minimum removal times in the following table and lengthen as necessary by job conditions, weather, etc. No stripping allowed before concrete has cured sufficiently to prevent spalling, chipping, or other damage due to form removal.

Area	Time with Supplementing Control Cylinders	Time without Supplementing Control Cylinders	Min. percent of Specified 28 day Cylinder Strength
Beam and column side forms	1 day	2 days	35 percent
Wall forms	1 day	2 days	35 percent
Beam, girder and slab soffit forms	21 days	28 days	100 percent

B. Take care when removing forms that concrete surfaces are not marred or gouged, that comers are true, sharp and unbroken. Do not pry against concrete when removing forms.

C. Cut-off nails flush in concealed concrete surfaces. Cut back tie wires and nails in exposed concrete surfaces at least 1-1/2 in. Remove rod and cone ties and separators or similar devices and pull inward away from finished surfaces.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Principal work in this Section:

1. Reinforcing steel (rods and mesh) for cast-in-place concrete.
2. Accessories such as chairs and tie wires.

B. Related work in other Sections:

1. Section 03 30 00 - Cast-In-Place Concrete.
2. Section 04 22 20 – Concrete Masonry Units

1.2 SUBMITTALS

A. Procedure: In compliance with Division 1.

B. Shop drawings: Submit for reinforcement deviating from that shown on the Drawings.

1. Submit bar drawings and schedules with the corresponding placing diagrams. Drawings shall be complete for any specific area of Project when submitted.
2. Reinforcing shop fabrication and field placement drawings shall be submitted in an acceptable form, be checked and complete. Reuse of the Contract Documents is not permitted. Each submittal shall be provided at least five weeks in advance of reinforcing delivery to site.
3. Reinforcement shall be detailed based on construction joint locations that have been shown on shop drawings, as reviewed. Construction joints shall be indicated on reinforcing shop drawings. Submit proposed construction joints for review prior to submittal of reinforcing shop drawings.
4. The drawings shall be in such detail as to assure that there will be a minimum, if any, of difficulties in execution of the work in the field. Show layout of reinforcing by mark for each member on plan. For each member or collinear series of members, show side elevation of the member with top, bottom and tie reinforcing and spacing shown. Show cross section of each pertinent location. Show all bar lengths and dimensioned bar bending details for each bar type. The detailed bar listing shall be shown on a member-by- member basis indicating the number of bars of each type etc. Clearly show splicing and placing conditions at each splice area. Detail pilaster verticals with respect to beam, and anchor bolts. Placement diagrams shall clearly indicate locations of beam reinforcing passing through verticals and anchor bolts. Placement diagrams shall clearly show layering of beam reinforcement and slab reinforcement locations relative to beams. Walls

shall be shown in side elevations of each wall face indicating vertical, horizontal and beam reinforcing with sections showing placement.

5. The drawings shall consist of sections, plans and details clearly showing locations, sizes and spacing of all reinforcing steel, supporting bars and accessories. Include particular details at foundation-column intersections showing locations of vertical and horizontal reinforcing. Include detailed schedules and diagrams to indicate bends, sizes and lengths of all reinforcing steel items and clear cover for reinforcing.
6. Floor openings, wall openings, wall recesses and sleeves for all mechanical, plumbing and electrical work shall be coordinated with the respective trades and reinforcing shown on these drawings in accordance with the criteria indicated on the drawings.
7. After review, furnish all copies needed for fabrication and erection, and for the coordination and use of other trades.
8. Be fully responsible for furnishing and installing all materials called for or required by the Contract Documents even though these materials may have been omitted from the reviewed shop drawings or incorrectly indicated thereon.

C. Mill reports: Submit copies of mill reports and test data for reinforcing steel sampled and tested, prior to starting this work.

D. Proprietary splicing details.

E. Mill Certificates: Submit to Architect, three (3) copies of manufacturer's certificates of reinforcing steel mill tests.

F. Provide alignment templates at top of pilaster cage to maintain position of vertical bars such that the proper location of beam bars passing through the pilaster and anchor bolts is assured.

1.3 QUALITY ASSURANCE

A. Source quality control: Obtain mill reports for all types and sizes of reinforcing steel.

1. Mill reports shall contain the steel source, description, heat number, yield point, ultimate tensile strength, elongation percentage, bend test and chemical analysis.

    a. If the reports show that material is satisfactory, no tests will be required.
    b. For foreign steel, testing as specified below will be required by a testing laboratory acceptable to the Architect.
    c. For foreign steel, testing as specified below will be required by a testing laboratory acceptable to the Architect.
2. Ensure that the material delivered for use is that represented by the mill reports and obtain copies of mill reports, examine them, certify whether the material represented complies with Specifications requirements, and make distribution of reports as required. Report chemical composition of each heat, as determined by ladle analysis.
3. Where materials proposed for use cannot be identified, pay for an approved testing laboratory to make one series of tests (tensile and bend) from each 2.5 tons, or fraction thereof, of each size and kind of reinforcing steel. Include 2

samples, minimum, of sufficient length to allow tests to be made on the as-rolled bar.

1.4 HANDLING

A. Procedure: In compliance with Section 01 60 00.

B. Electrode storage: Comply with the combined recommendations of AWS and the electrode manufacturer for storage of electrodes. Do not use electrodes that have been wetted.

C. Delivery: Deliver reinforcement to the site bundled, tagged and marked; handle to prevent damage to material. Use metal tags indicating size, length and other markings shown on placement drawings. Maintain tags after bundles are broken.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reinforcing steel: Use ASTM A615, Grade 60 for gravity elements. Use ASTM A706, Grade 60 for primary reinforcing in moment frame columns, beams and shear wall boundary elements. ASTM A615 may be substituted for A706 if the actual yield strength based on mill tests does not exceed 78,000 psi and the ratio of actual tensile strength to the actual yield strength is not less than 1.25. For welding, conform to specified carbon equivalent or use bars conforming to ASTM A706.

B. Reinforcing mesh: ASTM A 185. Provide welded wire fabric in flat sheets, not rolls.

C. Welding electrodes for Reinforcing Bars: AWS A5.1 E80XX Series, low hydrogen, having a minimum yield point of 80,000 psi.

D. Tie wire: ASTM A 82, 16 gage (minimum) annealed steel wire.

E. Supports for reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire-bar-type supports complying with CRSI specifications.

1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs, or pre-cast concrete block chairs with embedded wire ties.
2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs that are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).
3. Over waterproof membranes and vapor barriers, use pre-cast concrete chairs to prevent puncturing of membrane.

2.2 FABRICATION

A. General: Except as modified by the Drawings and the Specifications, comply with Chapter 7 of CRSI Manual of Standard Practice for fabrication of reinforcing steel. Exposed Sealing Materials: All sealing materials exposed at entrance and storefront perimeter joints in contact with adjacent cladding materials: 2 component silicone, refer to Division 7 Section “Joint Sealants”.

B. Bending and forming:

1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs, or pre-cast concrete block chairs with embedded wire ties.
2. Heating reinforcement for bending is prohibited. Do not install bars with unscheduled kinks or bends.
3. Bars larger than #4 shall not be bent once cast in concrete or masonry.

C. Tolerances: Comply with ACI 117.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate surfaces to receive concrete reinforcement and associated work and conditions under which work will be installed. Do not proceed until satisfactory conditions have been corrected in a manner complying with the Contract Documents and acceptable to the Installer. Starting of the work within a particular area will be construed as Installer’s acceptance of surface conditions.

3.2 PLACING

A. Placement inspection: Place reinforcement under the continuous inspection of the Owner's Testing Agency.

B. Cleaning: Clean reinforcement of loose mill scale, excessive rust, oil, and other coating that might destroy or reduce its bond before placing it.

C. Placing: Comply with the listed reference standards as applicable.

1. ACI 315, Manual of Standard Practice for Detailing Reinforced Concrete Structures.
2. CRSI, Manual of Standard Practice.
3. AWS D1.4, Structural Welding Code - Reinforcing Steel.

D. Spacing of reinforcement: Space reinforcement to maintain the proper distance and clearance between parallel bars and between bars and forms.

3.3 WELDING

A. Welding: Comply with the requirements of AWS D1.4. Before welding, determine the weldability of reinforcing bars by laboratory chemical analysis of the steel. Only steel conforming to the chemical requirements specified in AWS D1.4 may be welded.

B. Welded splices: Use full penetration butt welds made by the electric-arc method unless indicated otherwise.

1. Use only welders who have passed the AWS standard qualification tests within the previous year.
2. Weld splices shall develop 125% of the specified yield strength of the reinforcing bars, or of the smaller bar in transition splices.
3. Clean bars of oil, grease, dirt and other foreign substances, and flame-dry before welding.
4. Prepare ends of bars in compliance with AWS D1.4. Preheat bars before welding.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Principal work in this Section:

1. Cast-in-place concrete.
2. Concrete floors, walls, curbs, and slabs on grade and over metal decking.

B. Work installed but furnished in other Sections:

1. Items to be embedded in concrete. Contractor shall prepare embed shop drawings for fabrication and placement for architect and engineer review prior to placement.

C. Related work in other Sections:

1. Section 03 10 00 – Concrete Formwork.
2. Section 03 20 00 – Concrete Reinforcement
3. Section 03 60 00 – Grout

1.2 SUBMITTALS

A. Procedure: In compliance with Division 1.

B. Data: Manufacturers' brochures and technical data for all manufactured products.

C. Certificates:

1. Cement certification.
2. Admixture certification: Include chloride ion content.
3. Batch plant tickets.

D. Concrete mix designs for approval: Certified concrete mix designs for initial and any subsequent changes in mix designs.

1.3 QUALITY ASSURANCE

A. Mock-up: Before beginning work, cast a sample panel of each type of finish at a location on the site agreed-upon with the Architect.

1. Protect panel until its removal is authorized by the Architect. Make such modifications as necessary to achieve a panel satisfactory to the Architect.

2. Approved panel shall serve as the standard for all remaining work. Remove panel only after completion and acceptance of work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portland cement: ASTM C 150, Type II low alkali, typical, Type V for all elements in contact with earth. Do not change source, brand or type of cement without Architect's written approval.

B. Fly ash: ASTM C 618, Type C or F. Do not change source, brand or type of fly ash without Architect's written approval.

C. Aggregates: Submit pit source and characteristics of each type aggregate to Architect prior to designing mixes.

1. Hardrock aggregates: ASTM C 33 graded so that coarse aggregate nominal size is not larger than 1/5 of the narrowest dimension between form faces; nor 3/4 of the minimum clear spacing between individual reinforcing bars or bundles of bars, whichever is less, but never greater than ¾ inch in any dimension for slabs 4 inches thick or less; 1-1/2 inches at all other locations.
2. Lightweight structural concrete: Mixed of Portland cement, sand, coarse lightweight aggregates, an air-entraining admixture and water. Testing laboratory shall design lightweight structural concrete in accordance with ACI 211.2 for 28-day compressive strengths required by Drawings or specified herein, with weight not exceeding 110 lbs. per cubic foot air dry. Trial batch strengths shall be as specified above. Lightweight structural concrete shall meet the drying shrinkage requirements specified.

D. Admixtures:

1. May be used only with the Architect and the Building Department approval.
2. Submit manufacturer's data for products proposed for use to the Architect in compliance with the requirements of Section 01 33 40.

E. Water: Fresh, clean, potable, and free of oil and other materials injurious to concrete.

F. Structural adhesive: ASTM C 881, 2-component material suitable for use on dry or damp surfaces. Provide material "Type", "Grade", and "Class" to suit project requirements.

1. Rezi-Weld 1000 by WR Meadows.
2. Thiopoxy by WR Grace.
3. Sikadur Hi-Mod by Sika Chemical Corp.
4. Patch and Bond Epoxy by The Burke Co.

G. Curing compound:

1. Liquid membrane-forming compound complying with ASTM C 309, Type I (1D), Class B, guaranteed not to affect the appearance of the concrete surfaces, and the bond, adhesion, or effectiveness of finishes and surface treatment specified herein to be applied to concrete.
2. Curing compound used on exposed concrete surfaces shall be non-discoloring, fast drying and shall be conclusively demonstrated not to darken or yellow with age.
3. Curing compound for use on concrete floors to receive adhered covering shall be specially formulated for such use and shall be certified by the manufacturer not to inhibit the bonding qualities of flooring adhesives.

~~H.~~ Dry-pack and grout: ~~One of the following with minimum of 5,000 psi compressive strength at 28 days:~~ See Section 03 60 00.

~~1. Masterflow 713 by Master Builders.~~
~~2. Five Star Grout by US Grout Corp.~~

I. Expansion joint materials:

1. Joint filler: Use in combination with plastic joint cap made by Greenstreak, Quaker Plastic Corp., WR Meadows, or equal.
   a. Homex Expansion Joint by Homasote Co., or equal non-bituminous product compatible with sealant specified in Section 07 92 00.
   b. Sealtight self-expanding cork by WR Meadows, or equal compatible with sealant specified in Section 07 92 00.

2. Joint sealant and back-up rod: As specified in Section 07 92 00.

J. Curing paper: Orange Label Sisalkraft by Fortifiber Corp., or equal.

K. Water stop: One of the following.

1. Waterstop-Rx by Cetco.
2. Waterstop-Plus by Intercontinental Chemical and Equipment, Inc. (Waterstop-Plus is extruded from a cartridge sealant.)
3. Bluestop by Vinyltex Corp.

2.2 SOURCE QUALITY CONTROL

A. Employ a testing laboratory, acceptable to the Owner and Architect, to test the materials for conformance with these Specifications before concrete mixes are established and when source is changed, unless recent test results of materials to be used on the Project, performed by an acceptable testing laboratory, are accepted by the Architect.

B. Testing coarse aggregates:

1. Test aggregates before and after concrete mix is established and whenever the character source of material is changed, but not less than one test for each 500 cubic yards.
2. Perform a sieve analysis to determine conformity with limits of gradation. Perform sampling and testing according to ASTM C 33, and as follows:
   a. Sampling of aggregates: ASTM D 75. Take samples of aggregates at source of supply, or if source of supply has been approved, from storage bunkers at ready-mixed concrete plant.
   b. Testing of aggregates shall include:
      1) Sieve analysis: ASTM C 136.
      2) Organic impurities: ASTM C 40. Fine aggregate shall develop a color not darker than the referenced standard color.
      3) Soundness: ASTM C 88. Loss after 5 cycles not over 8% for coarse aggregate, nor 10% for fine aggregate.
      4) Abrasion: ASTM C 131. Weight loss not over 10-1/2% after 100 revolutions, nor 42% after 500 revolutions.
      5) Deleterious materials: ASTM C 33.
      6) Materials passing No. 200 sieve: ASTM C 117, not over 1% for gravel, 1.5% for crushed aggregate per ASTM C 33.
      7) Reactive materials: ASTM C 289. Aggregates shall indicate no potential deleterious reactivity.
      8) Definitions: ASTM C 125.

3. Cement test:
   a. The cement mill laboratory will be acceptable as testing laboratory for this purpose when approved by the Building Department. Submit evidence to show that the cement mill laboratory is qualified to perform tests. The laboratory shall make tests for every 500 barrels or fraction thereof of cement used, in compliance with ASTM C 150.
   b. Make tensile strength test at 7 days. Tag the cement for identification at the location of sampling. A representative of the Testing Agency shall certify that materials being used are taken from the lots sampled and tested for this report.

2.3 CONCRETE MIXES

A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:

1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
2. Proportion lightweight structural concrete according to ACI 211.2 and ACI 301.

B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.

1. Requirements of Mix designer:
   a. List design mixes required, stating where each applies, and identified as follows:

1) "(3-57 AR Col)" which interpreted means 3000 psi, Size 57 agg., air-entrained retarder used for columns.

b. Design concrete mixes subject to controls specified under Paragraph, "Proportioning", including adjustments for seasonality.

c. Verify adequacy of design mix for compressive strength in accordance with ACI 301, Method 1 or Method 2 as hereinafter modified.

1) Method 1: Make and test compressive test cylinders in accordance with appropriate ASTM procedures to substantiate an average compressive strength as specified in Paragraph, "Proportioning".

2) Method 2: Appropriate field test data for concrete made with the same ingredients may be used. Thirty (30) or more consecutive strength test results of mixes with same materials and proportions used in similar construction and climatic conditions within past year shall be used to indicate performance in accordance with specification. Required average compressive strength shall be specified in Paragraph, "Proportioning".

d. Adjust mix designs that prove unsatisfactory in use, subject to Architects review. Concrete that does not consistently exhibit specified control characteristics shall be considered unsatisfactory. All work constructed with such concrete shall be removed and replace by Contractor.

2. Submit for Architects Review.

a. List of mixes.

b. Mix Proportions.

c. Proposed adjustments for seasonality.

d. Test results and/or mill certificates showing that mix proportions and materials comply with performance characteristics specified.

e. A concrete mix design submittal shall include the proposed mix components and quantities, material sources, aggregate gradations, manufacturer's data sheets for admixtures, etc. As well as actual strength and slump data for trial mix or historical data statistically summarized. Relative to semi-lightweight concrete also include splitting strength, modulus, shrinkage unit weight and other information as well as identify if the materials are vacuum saturated or not and the supplies description of their product. The mix sheet shall clearly indicate location of use, a pumped or place mix, and other conditions of proposed usage.

C. Proportioning:

1. Structural Concrete:

a. Water reducing (plasticizing) admixture required.

b. Trial Mix: Determine average compression strength by ACI 301, Method 1 with minimum of 15% greater than specified f'c or by Method 2 where average strength exceeds specified strength f'c by at least:

c. 400 psi if standard deviation is less than 300 psi.

d. 530 psi if standard deviation is 300 psi to 400 psi.

e. 690 psi if standard deviation is less that 400 psi to 500 psi.

f. 898 psi if standard deviation is less that 500 psi to 600 psi.

g. 1131 psi if standard deviation is less than 600 psi to 700 psi.

2. Minimum Cement Content: (94 pounds per bag)
   a. 3000 psi concrete: 5 bags per cubic yard. Maximum water 6.3 gallons per bag.
   b. 4000 psi concrete: 5 ¾ bags per cubic yard. Maximum water 5.5 gallons per bag.
   c. Pumped concrete: Increase minimum cement content as required to maintain equivalent water/cement ratios to those required for strengths of non-pumped concrete.
   d. Maximum Water/Cementitious material ratio is 0.50 unless noted otherwise in project plans.

3. Exterior Exposed Concrete:
   a. Air entrainment and water reducing admixtures as required. Do not add air entrainment agents to concrete to be abrasive blasted.
   b. Minimum Cement: 5 ½ bags per cubic yard.
   c. Maximum Water: 5 ½ gallons per bag.

4. Semi Lightweight Structural Concrete:
   a. Dry Weight: 110 pounds per cubic foot
   b. Splitting Tensile Strength: When tested in accordance with ASTM C496, minimum as follows for given compressive strength.
   c. Modulus of Elasticity: Minimum 2,400,000 pounds per square inch (secant modulus at 0.3 f'c).
   d. Cement Factor and Water-Cement Ratio: Base on degree of saturation and absorption characteristics of lightweight aggregates stockpiled for use.
   e. Shrinkage Compensated Cement: May be used to control drying shrinkage if acceptable to Architect.
   f. Natural Sand: ASTM C33 Substitute for lightweight fines.

5. Pumped Concrete:
   a. Aggregates:
      1) Maximum Size: One-third maximum opening in either pump or pipeline, whichever is smaller.
      2) Grading: As close as possible to middle of ASTM C33; for normal weight concrete and ASTM C330 for semi lightweight concrete grading range.
      3) Fine Aggregate Fineness Modulus (FM): 2.4 to 3.0 with 15 to 30 percent passing number 50 sieve and 5 to 10 percent passing number 100 sieve.
      4) Daily Variation in Fineness Modulus (FM): 0.20 from value used in selecting proportion.
      5) Lightweight Aggregate Moisture Content: At lease equal to 24-hour absorption percentage when tested in accordance with ASTM C127.
   b. Admixtures:
      1) Pumping Aids: As required to produce pumpable mix with sufficient strength.

2) Accelerators: Do not use with pumped concrete.

D. Concrete shrinkage test:

1. Before placing any concrete slabs or exposed concrete above grade, prepare a trial batch of the mix design, using the same aggregates, cement and admixtures (if any) proposed for use on the Project. Prepare at least 3 specimens for determining the "drying shrinkage" of each mix design including structural semi-lightweight concrete.
2. The "drying shrinkage" specimens shall be 4” x 4” x 11” prisms, made, cured, dried and measured as specified in ASTM C 157. Measure and report separately for 7, 14, 21 and 28 days of drying, after 7 days of moist curing. The effective gauge length of the specimens shall be 10”.
3. The average "drying shrinkage" of the test specimens after 28 days of drying shall not exceed 0.045%.

E. Submit reports showing results of sieve analysis, mix design and results of compression tests.

1. Make test specimens from not less than 3 batches of each design mix.
2. The trial batch strength for each mix shall exceed indicated f'c by 25% or a lesser amount based on standard deviations of strength test records according to ACI 318.
3. Do not start concrete production until mixes have been reviewed and are acceptable to the Architect.

F. Concrete mixing:

1. Mixing and delivery shall comply with ASTM C 94, these Specifications, and Building Code requirements.
2. The Owner's Testing Agency will perform check sieve analysis of the aggregates being used, check compliance with mix design and the cement being used against mix design; check that water has been removed from the drum before adding mix ingredients for the following load and shall witness the loading of mixing trucks. The Owner's Testing Agency will send a written report of each inspection to Architect indicating compliance with these Specifications.
3. In addition to the requirements of ASTM C 94 section 16.1, provide the following information on delivery tickets signed by an authorized representative of the batching plant with each mixer truck of concrete delivered to the site.
   a. Type and brand of cement.
   b. Cement content per cu. yd. of concrete.
   c. Maximum size of aggregate.
   d. Total water content expressed as water/cement ratio.
   e. Time batched.
4. Deliver batch tickets to Inspector at the site when concrete is delivered.
5. Maintain equipment in proper operating condition, with drums cleaned before charging each batch. Schedule rates of delivery in order to prevent delay of

placing the concrete after mixing, or holding dry-mixed materials too long in the mixer before the addition of water and admixtures.

6. Remove all materials, including water remaining in the ready-mix truck drum, completely before ingredients for the following loads are introduced in the drum.
7. Do not use concrete that has not been placed 30 minutes after leaving the mixer, or concrete that is not placed within 60 minutes after water is introduced into the mix.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate surfaces to receive cast in place concrete and associated work and conditions under which work will be installed. Do not proceed until satisfactory conditions have been corrected in a manner complying with the Contract Documents and acceptable to the Installer. Starting of the work within a particular area will be construed as Installer's acceptance of surface conditions.

3.2 GENERAL

A. Applicable provisions of the following American Concrete Institute publications govern the work of this Section.

1. ACI 301, Specifications for Structural Concrete for Buildings.
2. ACI 302, Guide for Concrete Floor and Slab Construction.
3. ACI 304, Guide for Measuring, Mixing, Transporting and Placing Concrete.
4. ACI 304.2, Placing Concrete by Pumping Methods.
5. ACI 305, Hot Weather Concreting.
6. ACI 306, Cold Weather Concreting.
7. ACI 308, Standard Practice for Curing Concrete.
8. ACI 117, Concrete Tolerances

3.3 PHASING

A. Allow sufficient time in the construction schedule for appropriate slab drying, in accordance with the finish manufacturer's recommendations, for slabs to receive a deferred finish that is moisture sensitive.

3.4 PREPARATION

A. Inspect excavations, subgrades and formwork, as applicable for each placing operation, for accuracy of lines, levels, elevations and dimensions.
B. Inspect placement of reinforcement and accessories for proper position, sizes, clearances, fastenings, laps and splices.

C. Moisten, do not saturate, earth subgrade and bearing surfaces. Do not place concrete on muddy subgrade.
D. Wet wood forms thoroughly when they are not treated with form release agent. Wet other materials sufficiently to reduce suction and maintain concrete workability.
E. Grade sand covering the vapor barrier to provide a layer of uniform thickness. Wet so that concrete is placed on damp sand.
F. Verify that steel decking joints are sealed and that there are no openings or voids that will permit concrete leakage.
G. Place items to be embedded in concrete, including but not limited to, conduits, sleeves, nailers, anchors and rough hardware, built into concrete as indicated or required.
    1. Do not embed piping and conduits unless approved by the Architect, and as indicated on the Drawings.
    2. Embed bolts, inserts and other items in the concrete. Secure accurately so that they are not displaced during concrete placing, compacting and finishing operations. Wire tie, nail or bolt embeds securely to forms.
    3. Set embedded bolts for materials and equipment attached to concrete to template, layouts and shop drawings. Verify size, length and location of electrical conduits with respect to equipment supports.
    4. Fill voids in sleeves, inserts and anchor slots temporarily with readily removable material to prevent entry of concrete in the voids.
    5. Install expansion joint fillers where indicated, and as required to isolate concrete slabs-on-grade from other building elements such as walls and equipment pads. Cover filler with plastic joint cap and leave in place until ready to receive sealant.
    6. Install the water stop in all construction joints below grade, and elsewhere as indicated.
        a. Place water stop in a continuous ribbon on the exterior face of the outermost dowel line. Keep a concrete cover of 2 inches, minimum.
        b. When using Waterstop-Rx, butt ends of water stop and nail to concrete to avoid displacement during concrete placing and consolidation.

H. Do not proceed with placement of concrete until all conditions are satisfactory.
I. Install vapor barrier where called for on the drawings under interior slabs on grade. Lap joints minimum 6 inches and seal. Do not disturb or damage vapor barrier while placing concrete. Repair damaged vapor barrier.

3.5 CONVEYING

A. Rapid handling: Transport concrete from the mixer to location of placing as rapidly as practical to avoid separation or loss of ingredients.
B. Transporting methods: Use pipes, cranes, carts, buggies or other approved means to deliver concrete to final locations. Do not use delivery systems (pipe, chutes, etc.) formed of aluminum for transporting concrete.
C. Free fall:
    1. As dictated by job conditions at each location, but not more than 4 ft. where concrete will be exposed in the work and 6 ft. at all other locations.
    2. Avoid large concentration of concrete in one location that would produce unacceptable deflection in supporting formwork or steel decking.

D. Concrete flow:
   1. Keep surface of concrete level during placing with a minimum of concrete allowed to flow from one position to another.
   2. Carry concrete up uniformly for the length of walls being placed to reduce lateral flow of concrete to 5 feet, maximum.

E. Runways: Construct substantial runways and scaffolding to avoid movement and vibration in the forms and reinforcing steel as a result of transporting and placing concrete.

3.6 PLACING

A. General: Comply with ACI 304. Do not place concrete in or under water.
B. Consolidation: Thoroughly consolidate concrete and work it around reinforcement and embedded items and into corners and angles of forms, by spading, rodding and tamping to exclude rock pockets, air bubbles and "honeycombs" and to obtain required density and strength.
C. Internal vibration:
   1. Use mechanical vibrators to consolidate each layer with that previously placed, to completely embed reinforcement and fixtures, and to bring fine materials to the faces and top surfaces to produce the proper finish.
   2. Assign at least one workman at each location where concrete is being placed to vibrate and consolidate the concrete in forms. Take care to avoid over-vibration causing separation of ingredients. Keep extra standby vibrator at the site.
   3. Do not use vibrator to move concrete.

D. Flow of concrete:
   1. Keep surface of concrete level during placing, with a minimum of concrete allowed to flow from one position to another.
   2. Place concrete in a continuous operation until each section or panel has been completed.

E. Record: Keep records showing location, date and time of placement and quantity of all concrete placed on the Project.
F. Floor slabs: Shape slabs to the levels, slopes and elevations indicated and accurately pitch or grade to drainage fittings and fixtures installed in them. Where indicated, depress slabs to receive other finishes.
G. Wall supported elements:
   1. Under normal weather conditions, wait at least 2 hours after depositing concrete in walls and columns before placing concrete in supported floors.
   2. Consider beams, girders, capitals and brackets as part of the floor systems.

H. Temperature: Do not place concrete when the temperatures of the materials in contact with the concrete, the concrete temperature, and the ambient temperature exceed the ranges recommended in ACI 305 and 306, or if it is likely to exceed these temperature before the concrete has taken its initial set, unless special precautions recommended by ACI 305 and 306 are provided.

I. Construction joints:
   1. Location: Locate joints to least impair the strength and appearance of the structure. Obtain the Architect's approval of all construction joint locations before casting concrete. In general construction joints shall be located as follows, unless otherwise indicated on the Drawings:
      a. In walls locate at the underside of floors or slabs, and at the top of footings or floor slabs.
      b. In slabs-on-grade locate joints where shown on the Drawings; offset not less than 5 feet, with a minimum of 2 offsets. Allow proper time lapse in placing of floor sections adjoining prior placings.
      c. In all cases make construction joints perpendicular to the main reinforcement. Continue reinforcement across joints, unless otherwise indicated.

   2. Provide keyways at least 1 ½ inches deep in construction joints in slabs, and between walls and footings etc. without exception; use prefabricated bulkheads for slabs.
   3. Keep exposed face of construction joints continuously moist from time of initial set until subsequent placing of concrete against them, but not to exceed the curing period. When not damp, wet (do not saturate) the contact surface of joints for a minimum of 24 hours before placing adjoining concrete.
      a. Before placing adjoining concrete, clean contact surfaces to remove all laitance, loosened particles of aggregate or damaged concrete, and expose sound, coarse aggregates solidly embedded in the matrix.
      b. To achieve the above, the contact surface may be washed with clean water under pressure (jet blast), may be sandblasted, or in areas which will be concealed from view when the building is completed an approved structural adhesive may be used on clean, structurally sound concrete. Remove wash water entirely from surface.
      c. If a contact surface becomes coated with foreign materials of any nature after being cleaned, clean again to suitable condition.

J. Tolerances: In compliance with ACI 117 with the following clarifications and as specified by the Architect for exposed concrete surfaces.
   1. Paragraph 4.5.4, Class A (1/8 in.) for offset in formwork.
   2. Paragraph 4.5.7, "Flat" 1/8 in. in 10 ft. for slabs.
   3. Unless more stringent requirements are specified for architecturally exposed surfaces provide concrete placement and finish as required to achieve tolerances as follows:
      a. Slab on grade: FF=35, FL=25, with minimum local values FF=20, FL=15
      b. Slab on metal deck: 1/8 in. in 10ft.

3.7 CURING

A. Formed concrete:
   1. Wet the tops and exposed portions of formed concrete and keep moist until forms are removed.

2. If forms are removed before 14 days after concrete is cast, coat concrete with curing compound as specified for flatwork below.

B. Concrete flatwork:
   1. After finishing, spray the specified curing compound uniformly in a minimum of 2 coats at 90 degrees to each other at 3 times the minimum coverage rates recommended by the manufacturer.
      a. Inspect treated surfaces daily for 14 days for evidence of drying.
      b. Re-wet the surfaces and apply a new application of curing compound, if premature drying occurs, as soon as can be done after finishing without marring the surfaces.

   2. All interior floors not scheduled to receive a deferred finish shall receive the sealer applied in compliance with its manufacturer's printed instructions. Remove sealer residue after curing period is completed.
   3. Concrete for the fountain and waterfall structure should be only water cured.

3.8 MISCELLANEOUS CONCRETE WORK

A. Provide all other concrete work indicated or required to complete the Work, even though not specifically specified, including the following.
B. Grouting and dry-packing: Comply with the grout manufacturer printed instructions and the following.
   1. Mix material with sufficient water so it flows under its own weight for grout, and to just moisten and bind the material together for dry-pack.
   2. Place dry-pack by forcing and rodding to fill all voids and provide complete bearing under plates. Place fluid grout from one side only and puddle to completely fill voids; do not remove dams or forms until grout attains initial set. Finish exposed surfaces smooth and damp cure at least 3 days.

C. Equipment bases and foundations:
   1. Provide machine, and equipment bases and foundations where indicated on Drawings.
   2. Set anchor bolts for machines and equipment to template at correct elevations, complying with diagrams or templates of the manufacturer furnishing the machines and equipment.

D. Pits, trenches, curbs, integrally-cast equipment pads and other miscellaneous concrete work: Construct to the profiles and dimensions indicated.
E. Waterproof membranes:
   1. Perform work over waterproof membranes to prevent damage to the membranes.
   2. Schedule this work to reduce to a practical minimum the period when the installed membrane is left without protection.
   3. Prior to placing concrete, inspect the membrane and repair damage that may have occurred.

3.9 PROTECTING/CLEANING

A. Take suitable precautions in compliance with applicable ACI requirements to secure satisfactory concrete in either hot or cold weather.
B. Restrict construction vehicular traffic on slabs-on-grade to prevent damage and staining.
C. Protect concrete to prevent damage and staining.
D. Protect work of other trades from damage by work of this Section with heavy kraft paper securely taped in place.
E. Upon completion, wash and clean exposed concrete and leave free of oil, paint, plaster and foreign substances, ready to receive applied finishes or to be left exposed.

3.11 DEFECTIVE CONCRETE

A. Concrete which does not meet the requirements of the Contract Documents will be deemed defective.
B. Remove defective concrete as directed by Architect and replace with concrete meeting the requirements of the Contract Documents, at no additional cost to the Owner.

3.12 FIELD QUALITY CONTROL

A. Concrete quality control: The following will be performed by the Owner's Testing Agency.
   1. Samples will be taken during progress of the work to determine slump, compression strength, aggregate sieve analysis, and grout-mix tests, with assistance furnished by the Contractor.
   2. 4 cylinders will be made for each day's pour or for each 100 cu. yds. or once for each 4,000 sq. ft. of surface area, whichever is less, for each type of concrete being cast.
   3. 1 cylinder will be tested at 7 days, and 2 cylinders at 28 days. The remaining cylinder will be kept in reserve in case tests are unsatisfactory.
   4. Samples will be made in compliance with ASTM C 172.
   5. Specimens will be made and laboratory cured in compliance with ASTM C 31.
   6. The 28-day values will be the criteria for acceptance of concrete regarding strength only.
      a. 7-day tests may be regarded as indicative of compliance or non-compliance with the 28-day strength requirements, and the Contractor should be guided accordingly in matter of adjusting proportions, if necessary, and notify the Architect.
      b. 7-day tests shall also be a guide to the Contractor regarding time for form removal.
   7. Slump tests will be made for each set of tests cylinders in compliance with ASTM C 143.

B. Tests evaluation:
   1. Concrete cylinder test will be evaluated in compliance with ACI 214 and 318.
   2. If 28-day test results indicate that concrete strength is not as specified, core concrete as directed by the Architect in compliance with ASTM C 42.

3. In the event that additional core tests do not show strength required, or as determined by load tests made in compliance with ACI 318, the defective concrete shall be removed and replaced, or shall be reinforced as directed by the Architect, at the Contractor's expense.
4. If core tests results fall below design strength specified, adjust the concrete mix or water content for future batches, at no additional cost to the Owner.

C. Concrete floors shall be tested for flatness & levelness per ACI 117 in the allotted time, by the contractor. Test results are to be sent to the architect & engineer. Floors are to be “Very Flat”, U.N.O.

END OF SECTION

SECTION 03 60 00
GROUT

PART 1 - GENERAL

1.1 SUMMARY

A. Principal work in this Section:

1. Grout under column base plates, and elsewhere as shown on the Drawings and required by job conditions.

B. Related work in other Sections:

1. Section 03 30 00 – Cast-in-Place Concrete
2. Section 05 12 00 – Structural Steel

1.2 SUBMITTALS

A. Procedure: In compliance with Division 1, General Conditions.

B. Data: Manufacturer's data sheets and independent test data for each type of grout proposed for use.

1.3 HANDLING

A. Procedure: In accordance with Division 1, General Conditions.

PART 2 - PRODUCTS

2.0 PRODUCTS

2.1 MANUFACTURERS

A. One of the following:

1. Euco NS Grout, The Euclid Company
2. Masterflow 928 Grout; Master Builders.
3. Five Star Grout; US Grout Corp.
4. Sonogrout, Sonneborn-Contech, Inc.

2.2 MATERIALS

A. Grouts:

1. Pre-packaged, non-metallic, non-gaseous, non-shrinking when tested in accordance with ASTM C 1107 Grade B or C at a fluid consistency (flow cone) of 20 to 30 seconds.
2. 30-minute old grout shall flow through flow cone after slight agitation, in temperatures of 40 to 90 deg. F.
3. Grout shall be bleed-free.

B. Grout strengths:

1. Where installed beneath base plates for steel columns: Minimum 28-day strength of 7,000 psi.
2. At non-structural locations: Minimum 28-day strength of 4,000 psi.

PART 3 - EXECUTION

3.3 PREPARATION

A. Concrete surfaces:

1. Clean concrete surfaces that will be in contact with grout of dust, construction debris, form oil, curing compound and other contaminants.
2. Roughen concrete surfaces by chipping or sandblasting to expose coarse aggregate.
3. Presoak concrete surfaces thoroughly for not less than 24 hours prior to grouting to reduce their suction.

B. Steel: Remove loose rust and scale, oil, dirt, and other contaminants.

C. Anchors, bolts and rough hardware:

1. Obtain setting templates from affected trades where the spacing and alignment of anchors, bolts, and similar items is critical.
2. Embed anchors, bolts, inserts and other items in grout as the work progresses.

3.4 GROUTING

A. General:

B. Grouting beneath base plates:

C. Railing posts, anchor bolts, frames, sills, and similar items:

D. Curing: Cure grout in compliance with its manufacturer's printed instructions to prevent rapid evaporation of water and shrinkage cracks.

END OF SECTION

SECTION 03 73 00

CONCRETE EPOXY ADHESIVE INJECTION

PART 1 - GENERAL

1.1 SCOPE

A. For Cracks up to ¼".

1. Requirements of the general conditions, supplementary general conditions and division 1 apply to work of this section.
2. Furnish all labor, materials, services equipment and appliance required to perform all work to complete the contract, including but not limited to, these major items:
3. Injection of concrete members with liquid epoxy adhesive in walls and architectural concrete members. Cracks that are at least .030 inches wide are to be epoxied.
4. All work shall conform to current standards for historical restoration.

B. RELATED WORK

1. Tests and inspections.
2. Repair of concrete and concrete finishes.

1.2 QUALITY ASSURANCE

A. Manufacturer qualifications: Provide epoxy injection system, which is the product of a manufacturer whose complete system has been approved by the architect. The manufacturer shall have a system that has been used for epoxy injection projects similar in nature for a minimum of fifteen (15) years. Pay all fees and obtain approval for material prior to commencing work.

B. Sub-contractor qualifications: The epoxy injection sub-contractor will have successfully performed previous installations similar in nature to the one involved in this contract. The epoxy injection sub-contractor shall have a minimum of the (5) years experience with epoxy injection work and shall be a trained and recommended applicator of the epoxy injection material manufacturer.

C. Qualifications of epoxy injection field superintendent: All work in the field shall be performed under the immediate control of a foreman or superintendent experienced in this type of work. This person shall exercise close check and rigid control of all operations as necessary for full compliance with all requirements.

D. Worker's qualifications: Contractors/Subcontractors workers in the epoxy injection process shall have completed a program of instruction in the methods of restoring concrete structures, utilizing the specific epoxy injection process indicated. The curriculum shall include theory in the nature and causes of cracking in concrete, methods of permanently repairing damaged concrete structures, he technical aspects of correct material selection and use, and the operation, maintenance and trouble shooting of equipment.

1.4 TESTING AND INSPECTION

A. Material Tests: Owner's testing laboratory will provide all material tests as required by architect and as specified herein. Owner will pay for any costs of testing.

B. Inspections: If necessary, owner will arrange and pay for the services of registered deputy building inspector for continuous inspections of all epoxy injection work. Inspector will be continuously present during the epoxy injection operations, and will make written reports to engineer, and certifications to architect as to compliance with building code requirements and contract drawings and specifications.

C. Field Quality Control:

1. Core Testing to verify penetration and strength. (Note: It is imperative that no rebar or tendons be cut. It may be necessary to use a pachometer to locate existing reinforcing).
2. Initial Cores: The contractors/subcontractor shall obtain one (1) 2" diameter initial core sample for each 100 lineal foot of crack repaired or as directed by the architect.
3. The cores shall be adequate in diameter to intersect the crack to the full depth of core and taken from locations as directed by the architect.

D. Methods of Testing Initial Cores

1. Penetration: Visual Examination
2. Bond Strength Compression Test: ASTM C 39

E. Test Requirements:

1. Penetration: A minimum of 90 percent of the crack shall be full of epoxy adhesive.
2. Bond Strength/Compression Test: concrete failure before adhesive failure, or 5,000 PSI with no failure either concrete or adhesive.

3. Evaluation and Acceptance of Tests: If the initial cores conform to the requirements of C.2 "Penetration" and "Bond Strength", epoxy adhesive injection work at the area represented by the cores shall be accepted.

4. If the initial cores do not conform to the requirements of C.2 “Penetration” above, the work shall not proceed further until the area represented by the cores is re-injected and retested for acceptance.
5. After rework of areas represented by failed initial cores is complete, the contractor shall obtain verifying cores, the number and location to be determined by the engineer. Verifying cores shall be tested in accordance with paragraph C.2 and C.3 for compliance.
6. If cores do not conform to the requirements for C.2 “Bond Strength” above, the work shall be re-injected.
7. After rework of areas represented by failed cores is complete, the contractor shall obtain verifying cores, the number and location to be determined by the engineer. Verifying cores shall be tested in accordance with paragraph C.2 and C.3 for compliance.

F. Payment for core testing:

1. Testing of initial core samples which have been taken by the contractor will be performed by the owner’s representative at the owner’s expense.
2. Additional cores, called verification cores, required as indicated in paragraph C.4 (rework) herein, will be tested by the owner at the contractor’s expense in accordance with the established fee schedule.

G. Pressure Test of Injection Equipment:

1. Method: The mixing head of the injection equipment shall be disconnected and tow adhesive component delivery lines shall be attached to the pressure check device. The pressure check device shall consist of two independent valved nozzles capable of controlling back pressure by opening or closing valve. There shall be a pressure gauge capable of sensing the pressure build up behind each valve. The valves in the pressure check device shall be closed and the equipment operated until the gauge pressure on each line reads 160. The pumps shall be stopped and the gauge pressure shall not drop below 150 PSI within 2 minutes.
2. Frequency of Pressure Test: The pressure test shall be run for each injection unit at the beginning of the shift and every four hours of use for all shifts the unit is used on the work of delaminations/crack repair.

H. Ratio Test of Injection Equipment:

1. Method: The mixing head of the injection equipment shall be disconnected and the two adhesive components shall be pumped simultaneously through the ratio checkdevice. The ratio check device shall consist of two independent valved nozzles capable of sensing the back pressure behind each valve. The discharge pressure shall be adjusted to 160 PSI for both components. Both adhesive components shall be simultaneously discharged into separate the calibrated containers. The amounts discharged into the calibrated containers during

the same time period shall be compared to determine that the volumes discharted deviate no more than 5% from the correct ratio as specified in the manufacturers product data sheet.

2. Proof of Ratio and Pressure Testing

I. At all Times during the course of the work the contractor shall keep complete an accurate record of the pressure and ratio tests specified above. These records shall be available to the architect. In addition, the architect/engineer, at any time without prior notification of the contractor, may request the contractor to conduct the tests specified above in the presence of the architect/engineer.

PART 2 - PRODUCTS

2.1 HIGH STRENGTH EPOXY RESIN ADHESIVE FOR INJECTION

A. Provide LARR reports for all products used for approval by architect/engineer.

B. Epoxy injection adhesive shall be Sikadur 53 as manufactured by Sika Corporation, tel (800) 933-7452, or ETI manufactured by Simpson Strong Tie, tel (562) 699-0543, or approved equal.

C. Surface Sealant: SikaTop 123 as manufactured by Sika Corporation, or ETR Epoxy Paste as manufactured by Simpson Strong Tie, or approved equal, and shall be sufficiently strong to resist injection pressures to prevent leakage during injection.

D. Provide other materials as required and recommended by manufacturers subject to approval by architect/engineer.

E. Equipment for injection type: The equipment used to meter and mix the two injection adhesive components, and inject the mixed adhesive into the crack shall be portable, positive displacement type pumps with interlock to provide ratio control of exact proportions of the two components at the nozzle. The pumps shall be electric or air powered and shall provide in line metering and mixing.

F. Discharge pressure: The injection equipment shall have automatic pressure control capable of discharging the mixed adhesive at any pre-set-set pressure up to + 1-5 PSI and shall be equipped with a manual pressure control override.

G. Ratio tolerance: The equipment shall have the capability of maintaining the volume ratio for the injection adhesive prescribed by the manufacturer of the adhesive within a tolerance of + 1-5% by volume at any discharge pressure up to 160 PSI.

H. Automatic Shut-Off Control: The injection equipment shall be equipped with sensors on both the component A and the component B reservoirs that will automatically stop the machine when either reservoir becomes dry.

PART 3 - EXECUTION OF WORK

3.1 PREPARATION

A. Surfaces adjacent to cracks or other areas of application shall be cleaned of loose paint, dir, loose concrete, dust, grease, oil, efflorescence or other foreign matter detrimental to bond of epoxy injection surface seal. Acids and corrosives shall not be permitted for cleaning.

B. Entry ports shall be provided along the crack at intervals to allow for maximum penetration of the epoxy adhesive. Spacing of the entry ports shall be approved by the architect.

C. Surface seal material shall be applied to the face of the crack or other areas of application between entry ports as needed. For through cracks a surface seal shall be applied to both faces.

D. Enough time for the surface seal material to gain adequate strength shall pass before proceeding with the injection.

3.2 EPOXY INJECTION

A. Injection of the epoxy adhesive shall begin at an entry port at one end of the crack or at the lowest port for a vertical crack. The injection shall continue until there is an appearance of epoxy adhesive at the next port adjacent to the entry port being pumped.

B. When epoxy adhesive travel is indicated by appearance at the next adjacent port, injection shall be discontinued on the entry port being pumped, and epoxy injection shall be transferred to next adjacent port where epoxy adhesive has appeared. At the contractor’s option, the injection can continue in the original port if epoxy is appearing at multiple ports adjacent to the port being pumped.

C. Epoxy adhesive injection shall continue until the cracks are completely filled.

D. If port to port travel of epoxy adhesive is not indicated, the work shall be immediately stopped and the architect notified.

3.3 FINISHING

A. When cracks are completely filed, epoxy adhesive shall be cured for sufficient time to allow removal of surface seal and ports without any draining or run-back of epoxy material from cracks.

B. Surface seal material and injection adhesive runs or spills shall be removed from concrete surfaces.

C. The surface area shall be finished flush with the adjacent concrete, showing no indications or protrusions caused by the placement of entry ports. Grind smooth as required.

D. After the work has been accepted by the owner engineer, cored holes shall be repaired using a two component bonding agent and suitable grout or patching mortar mix as acceptable to the engineer (Master Builders Construction grout or equal). The bonding agent shall be applied to the surfaces of the cored holes followed by application of the grout mix placed by hand trowel, thoroughly rodded and tamped in place, and finished to be similar in color, finish, and texture of existing concrete to the satisfaction of the owner, and ready for painting, material and procedure for filling testing core holes shall be submitted to and approved by the owner/engineer before proceeding with this work.

E. Surfaces shall be left in a “ready to paint” condition.

3.4 CLEAN UP

A. At conclusion of work remove all equipment, debris, and excess material and leave area broom clean.

END OF SECTION

SECTION 04 22 00

CONCRETE MASONRY UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes unit masonry assemblies consisting of the following:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry joint reinforcement.
5. Ties and anchors.
6. Embedded flashing.

B. Related Sections:

1. 03 20 00 Concrete Reinforcing
2. 03 30 00 Cast-in-Place Concrete
3. 05 12 00 Structural Steel

1.2 ACTION SUBMITTALS

A. Product Data: For each masonry unit, accessory, and other manufactured product indicated.

B. Shop Drawings: For masonry reinforcing bars; comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.

C. Samples: Showing the full range of colors and textures available for exposed masonry units.

1.3 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For each type of masonry unit, mortar, and grout required.

1.4 QUALITY ASSURANCE

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

C. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements in ACI 530.1/ASCE 6/TMS 602.

E. Hot-Weather Requirements: When ambient temperature exceeds 100 deg F, or 90 deg F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units.

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514 as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.

a. Products: Subject to compliance with requirements, provide one of the following:

1) ACM Chemistries, Inc.; RainBloc.
2) BASF Aktiengesellschaft; Rheopel Plus.
3) Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block.

C. Concrete Masonry Units: ASTM C 90.

1. Density Classification: Medium weight.
2. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
3. Type: I, moisture-controlled units.

D. Concrete Building Brick: ASTM C 55.
1. Density Classification: Medium weight.
2. Size (Actual Dimensions): 3-5/8 inches wide by 3-5/8 inches high by 7-5/8 inches long.

2.3 MASONRY LINTELS

A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from deep-cut U-shaped bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.4 REINFORCING

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M; ASTM A 616/A 616M, including Supplement 1; or ASTM A 617/A 617M, Grade 60.

~~B. Masonry Joint Reinforcement: ASTM A 951; mill galvanized, carbon-steel wire for interior walls and hot-dip galvanized, carbon-steel wire for exterior walls.~~

~~1. Wire Size for Side Rods: W1.7 or 0.148 inch diameter for 1/4 to 3/8 inch joints.~~
~~2. Wire Size for Cross Rods: W1.7 or 0.148 inch diameter for 1/4 to 3/8 inch joints.~~
~~3. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.~~
~~4. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.~~

~~C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.~~

2.5 TIES AND ANCHORS

A. Materials, General: As follows, unless otherwise indicated:

1. Galvanized Carbon-Steel Wire: ASTM A 82; with ASTM A 153, Class B-2 coating for exterior walls and Class 1 coating for interior walls.

2. Galvanized Steel Sheet: ASTM A 366/A 366M cold-rolled, carbon-steel sheet hot-dip galvanized after fabrication to comply with ASTM A 153, at exterior walls; and ASTM A 653/A 653M, G60, commercial-quality, steel sheet zinc coated by hot-dip process on continuous lines before fabrication at interior walls.

B. Bent Wire Ties: Rectangular units with closed ends and not less than 4 inches wide, made from 3/16 inch diameter, galvanized steel wire.

1. Where coursing between wythes does not align, use adjustable ties composed of 2 parts; 1 with pintles, the other with eyes.

C. Adjustable Anchors for Connecting to Steel Frame: Two-piece assemblies that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to wall.

1. Anchor Section: Crimped 1/4 inch diameter, galvanized steel wire anchor section for welding to steel.
2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.1875 inch diameter, galvanized steel wire.

D. Anchors for Connecting to Concrete: Provide two-piece assemblies that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch- thick, steel sheet, galvanized after fabrication.
2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.187-inch- diameter, hot-dip galvanized steel wire.

2.6 MISCELLANEOUS ANCHORS

A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.

B. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.034-inch, galvanized steel sheet.

C. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

2.7 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch thick.

2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.

3. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
4. Fabricate through-wall flashing with drip edge where indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.

B. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from high-density polyethylene incorporating chemical stabilizers that prevent UV degradation. Cell flashing pans have integral weep spouts that are designed to be built into mortar bed joints and weep collected moisture to the exterior of CMU walls and that extend into the cell to prevent clogging with mortar.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Mortar Net USA, Ltd.; Blok-Flash.

C. Solder and Sealants for Sheet Metal Flashings:

1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
2. Elastomeric Sealant: ASTM C 920, chemically curing silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; formulated from neoprene, urethane or PVC.

B. Preformed Control-Joint Gaskets: Designed to fit standard sash block and to maintain lateral stability in masonry wall. Made from styrene-butadiene-rubber compound complying with ASTM D 2000, Designation M2AA-805 cross-shaped premolded rubber spacers that form the vertical joint and serve as backer for sealants.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

2.9 MASONRY CLEANERS

A. Job-Mixed Detergent Solution: Solution of 1/2 cup dry measure tetrasodium polyphosphate and 1/2 cup dry measure laundry detergent dissolved in 1 gal. of water.

2.10 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.

B. Place 1/2 of water and sand in operating mixer. Then, add cement, lime, and admixture, and remainder of sand and water. After all ingredients are in the mixer, mix mechanically for not less than three minutes. Do not hand-mix ingredients.

C. Use admixtures as recommended by admixture manufacturer. Engage manufacturer or distributor supervision by a qualified field representative to ensure proper use of admixture.

D. Mortar for Unit Masonry: Comply with CBC Table(s) 2103.8(1), (2), or ASTM C 270 (cement-lime) for Type S mortar.

1. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
2. For masonry below grade, in contact with earth, and where indicated, use Type M.
3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for exterior veneer walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

E. Grout for Unit Masonry: Comply with CBC Table 2103.12, or ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 5 of ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.
    a. Use grout as fluid as possible for placing without segregation of constituent parts.

F. Retempering:

1. Mortar may be retempered with water as required to maintain high plasticity.
2. Retemper on mortar boards only, by adding water within a basin formed with the mortar and reworking the mortar into the water.
3. Mix mortar and grout uniformly. Use admixture according to manufacturer's written instructions.
4. Discard mortar and grout that are unused after 90 minutes from initial mixing time.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Use sound, dry, clean, full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges without spalling or other defects. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

C. Build chases and recesses to accommodate items specified in this and other Sections.

D. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

E. After walls are constructed, do not saturate with water for curing or other purposes, except that when atmosphere is dry, dampen surfaces with a very light fog spray for three days.

F. When moving a unit after it has been once set in place, remove the unit from the wall, clean of mortar and set in fresh mortar.

3.3 SHORES AND CENTERING

A. Temporary Formwork and Shores: Design and construct formwork and shores and centering to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Brace CMU walls adequately to withstand all forces they will be subjected to during construction. Walls, other than free-standing earth retaining walls, are not designed to be self-supporting for lateral loads until attached to floor and roof elements.

3.4 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/8 inch or minus 1/16 inch.
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Variation from Plumb:

1. For surfaces of columns, walls, and arrises, do not exceed 1/4 inche in 10 feet, 1/2 inch in 20 feet, nor 3/4 inch in 40 feet or more.
2. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/2 inch in 20 feet, or 3/4 inch in 40 feet or more.

C. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/8 inch in 10 feet, or 1/4 inch maximum; nor more than 1/16 inch within width of a single unit.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet.

D. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.

2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 1/8 inch or minus 1/16 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.
5. For conspicuous horizontal lines, such as exposed lintels, sills, parapets, and reveals, do not vary from level by more than 1/4 inch in 20 feet, nor 1/2 inch maximum.

3.5 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations. Do not use fragments of CMU.

B. Bond Pattern for Exposed Masonry: Lay exposed masonry in running bond pattern; do not use units with less than nominal 4 inch horizontal face dimensions at corners or jambs.

C. Built-in Work: As construction progresses, build in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.

D. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

E. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078446 "Fire-Resistive Joint Systems."

F. For bonding masonry to foundation, clean top of concrete foundation, remove laitance and expose aggregates before starting masonry construction.

G. Form corners with a standard masonry bond by overlapping CMU.

3.6 MORTAR BEDDING AND JOINTING

A. Lay hollow masonry units as follows:

1. With full mortar coverage on horizontal and vertical face shells.
2. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.

3. For starting course on foundations where cells are not grouted, spread out full mortar bed, including areas under cells.
    a. Keep areas where grout occurs free from mortar so that grout will contact the foundation.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than the joint thickness, unless otherwise indicated. Strike joints of masonry that will be concealed from view flush with the face of the CMU.

D. Rake out joints that are defective at the time of tooling, point and then tool.

E. Unless otherwise indicated, make joints 3/8 inch thick with full mortar coverage on face shells and on webs surrounding cells to be filled.

F. Do not wet CMU except that in very dry weather the contact surfaces of the CMU shall be moistened immediately before laying.

~~3.7 MASONRY JOINT REINFORCEMENT~~

~~A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.~~

~~1. Space reinforcement not more than 16 inches o.c.~~
~~2. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.~~

~~B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.~~

~~C. Provide continuity at wall intersections by using prefabricated T-shaped units.~~

~~D. Provide continuity at corners by using prefabricated L-shaped units.~~

~~E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.~~

~~F. When a foundation dowel does not line up with a vertical core, do not slope more than one horizontal in 6 vertical. Grout dowels into a core in vertical alignment, even though it is in an adjacent cell to the vertical wall reinforcement.~~

3.8 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 2 inches wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.
4. Provide flexible joint/gap for non-bearing units per drawings.

3.9 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows:
1. Install preformed control-joint gaskets designed to fit standard sash block.

3.10 LINTELS

A. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.11 FLASHING

A. General: Install embedded flashing in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At lintels, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.12 REINFORCED UNIT MASONRY INSTALLATION

A. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

3.13 GROUTING

A. Comply with CBC Section 2104 and Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602, and the following:
   1. Keep mortar droppings out of, or remove from the grout space before grouting. Fill all cells solid, unless otherwise indicated.
   2. Vertical cells to be filled shall have vertical alignment to maintain a continuous unobstructed cell area.
   3. Puddle grout and rod to encase steel and to ensure contact with masonry cells. Encase reinforcement in a minimum of 1/2 inch of grout between CMU and reinforcement.
   4. Vibrate grout after initial absorption of water by the CMU, but before plasticity is lost.
   5. Grout beams over opening in one continuous operation.
   6. Grout bolts and anchors inserted in the wall solidly so that there is a minimum of 1 inch of grout between bolt, the anchor, and the masonry unit.
   7. Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure.

3.14 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a Registered Deputy Inspector (RDI) to perform field quality-control inspection indicated below. Payment for these services will be made by Owner.

B. Whenever there is evidence that materials to be used in masonry construction do not conform to the Contract Document, the materials shall be tested for compliance before being used in the Work.

   1. Contractor shall pay for test to prove compliance with Contract Documents.

   2. Unless otherwise indicated, the following will be performed:

a. Provide masonry prism testing for masonry strength specified to be equal or greater than 2500 psi in accordance with CBC Section 2105.2.2.2 and 2105.3.
b. For masonry strength specified to be less than 2500 psi, testing shall be of unit strength method in accordance with CBC Section 2105.2.2.1.
c. Mortar and grout shall be tested in accordance with ASTM C 780 and ASTM C 1019 respectively.

3.15 CLEANING

A. Clean unit masonry by dry brushing to remove mortar fins and smears before tooling joints, as work progresses.

B. After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
2. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2 applicable to type of stain on exposed surfaces.

3.16 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

END OF SECTION

SECTION 04 22 23

ARCHITECTURAL CONCRETE MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Architectural concrete masonry exterior wall veneer facing.

B. Architectural concrete masonry exterior single wythe walls.

1.2 RELATED SECTIONS

A. Section 04 05 16.26 - Engineered Masonry Grouting.

B. Section 04 05 19.29 - Stone Anchors.

C. Section 05 20 00 - Metal Joists.

D. Section 05 50 00 - Metal Fabrications.

E. Section 07 62 00 - Sheet Metal Flashing and Trim.

F. Section 07 65 26 - Self-Adhering Sheet Flashing.

G. Section 07 90 00 - Joint Protection.

H. Section 09 96 23 – Anit-Graffiti Coating

1.3 REFERENCES

A. ASTM C 33 - Standard Specification for Concrete Aggregates.

B. ASTM C 90 - Standard Specification for Loadbearing Concrete Masonry Units.

C. ASTM C 140 - Standard Specification for sampling and testing Concrete Masonry Units.

D. ASTM C 150 - Standard Specification for Portland Cement.

E. ASTM C 595 – Standard Specification for Standard Hydraulic Cements

F. ASTM C 331 - Standard Specification for Lightweight Aggregates for Concrete Masonry Units.

G. ASTM C 1019 - Standard Test Method for Sampling and Testing Grout.

H. ASTM C 1093 - Standard Practice for Accreditation of Testing Agencies for Masonry.

I. ASTM C 1314 - Standard Test Method for Compressive Strength of Masonry Prisms.

J. ASTM C 1506 - Standard Test Method for Water Retention of Hydraulic Cement-Based Mortars and Plasters.

K. ASTM D 2287 - Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds

L. ASTM E 514 - Standard Test Method for Water Penetration and Leakage Through Masonry.

M. TMS 402 / 602-16 - Building Code Requirements and Specifications for Masonry Structures.

N. NCMA TEK Bulletin 3-3A - Reinforced Concrete Masonry Construction.

O. NCMA TEK Bulletin 8-2A - Removal of Stains from Concrete Masonry Walls.

P. NCMA TEK Bulletin 10-2B - Control Joints for Concrete Masonry Walls.

Q. NCMA TEK Bulletin 14-4A - Strength Design of Concrete Masonry.

R. NCMA TEK Bulletin 19-4A - Flashing Strategies for Concrete Masonry Walls.

S. NCMA TEK Bulletin 19-5A - Flashing Details for Concrete Masonry Walls.

1.4 DESIGN / PERFORMANCE REQUIREMENTS

A. Concrete Unit Masonry Construction: Comply with the following:
   1. TMS 602-16 - Building Code Requirements and Specifications for Masonry Structures.
   2. National Concrete Masonry Association (NCMA) TEK Bulletins.

1.5 SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

B. Product Data: Manufacturer's data sheets on each product to be used:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods including written plan for cold and hot weather construction and masonry cleaning procedures.

C. Selection Samples: Submit three full size units of each type/color of exposed architectural concrete masonry unit for review of color and texture to verify compliance with products specified. Provide the maximum color and texture variation range expected in the finished work. Production orders may be released after submittals are approved.

D. Manufacturer's Certificates and Test Reports: Certify products meet or exceed

specified requirements. Test reports should be within 12 months of bid date.

E. Mix Designs: For each type of grout. Include description of type and proportions of ingredients.
   1. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum ten years documented experience and a current member in good standing of the National Concrete Masonry Association.

B. Installer Qualifications: Company specializing in performing Work of this section with minimum five years documented experience with projects of similar scope and complexity.

C. Installer's Field Supervision: Maintain a full-time Supervisor/Foreman on job site during all phases of masonry work.

D. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

E. Source Limitations: Provide each type of masonry unit from a single manufacturing source to ensure uniform texture and color for continuous and visually related items.

F. Mock-Up: Prior to starting masonry work build sample wall panel(s) for Architect's inspection and acceptance. Build panel(s) on a firm foundation, in location acceptable to the Architect. Panel(s) shall be L-shaped, with long side a minimum of 5 foot 4 inches long by 4 foot 0 inches high and with one corner return at least 2 foot 0 inches long. Construct sample panel(s) full thickness, installing wall reinforcement, anchors, ties and other required accessories. Provide special features as directed for control joints, weeps, etc. Panel(s) shall show color range and texture of masonry units, bond, mortar joints and workmanship to be expected for the project.
   1. Build sample panels for:
      a. Each type of exposed unit masonry construction.
      b. Typical exterior wall.
      c. Typical interior wall.
      d. Typical exterior and interior walls.
   2. Clean one-half of each sample panel using approved masonry cleaning materials and methods to represent final cleaning. Remaining one-half to remain without final cleaning for comparison purposes.
   3. Retain sample panels during construction as a standard for judging completed masonry work. Do not alter, move, or destroy sample panels until work is completed or removal is authorized.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver architectural concrete masonry units to the job site on wood pallets with

manufacturer's recommended unit protective covers.

B. Inspect architectural concrete masonry units upon delivery to ensure color match with required materials and accepted samples.

C. Stack masonry units in a dry place off the ground on pallets or a prepared plank platform. Method of stacking is acceptable. Protect with non-staining waterproof tarpaulin coverings arranged to allow air circulation around and above masonry units.

D. Exercise care in the storage, handling and installation of masonry units. Do not build soiled or damaged masonry units into the work.

1.8 SEQUENCING

A. Ensure that locating templates and other information required from others for built-in installation of products of this section are furnished in time to prevent interruption of construction progress.

1.9 PROJECT CONDITIONS

A. Follow hot weather and cold weather requirements in the masonry code and specifications, TMS 402 and TMS 602.

B. Cold Weather Procedures:
   1. Preparation:
      a. If ice or snow has formed on the masonry bed, remove it by carefully applying heat not to exceed 120 degrees F until the surface is dry to the touch.
      b. Remove any block units or mortar that is frozen or damaged.
   2. Work in Progress:
      a. Air temperature 40 degrees F to 32 degrees F:
         1) Heat sand or mixing water to produce mortar temperatures that match air temperature.
      b. Air temperature 32 degrees F to 25 degrees F:
         1) Heat sand and mixing water to produce mortar temperatures between 40 degrees F and 120 degrees F.
         2) Maintain temperature of mortar on boards above freezing.
         3) Installation in colder air temperatures will require heat sources on the wall and the use of windbreaks or tents to create a controlled environment suitable for proper bonding and curing.
   3. Completed Work and Work Not in Progress:
      a. Mean daily air temperature of 40 degrees F to 32 degrees F: Protect masonry from rain and snow for 24 hours by covering with a weather-resistive membrane.
      b. Mean daily air temperature of 32 degrees F to 25 degrees F: Cover masonry with a weather-resistive membrane for 24 hours.
      c. Mean daily air temperature of 25 degrees F to 20 degrees F: Cover masonry with insulating blankets for 24 hours.

C. Hot Weather Procedures:
   1. When ambient temperature exceeds 90 degrees F and wind exceeds 8 miles per hour:
      a. Maintain temperature of mortar and grout between 70 degrees F and 120 degrees F.
      b. Limit the spread of the mortar bed to 4 feet and place units within 1 minute of spreading mortar.
      c. Control moisture evaporation in partially or newly completed walls by fog spraying with potable water, covering with opaque plastic or canvas or both.
   2. Protection of Work in Progress:
      a. Covering:
         1) Cover tops of walls with a strong waterproof membrane at the end of each day or work shutdown. Extend the waterproof membrane cover a minimum of 24 inches down the side of each wall.
         2) Hold cover securely in place.
      b. Load Application:
         1) Do not apply uniform floor or roof loading for at least 12 hours after completing columns and walls.
         2) Do not apply concentrated loads for at least 3 days after completing columns and walls.
      c. Staining:
         1) Prevent grout and mortar from staining the face of masonry.
         2) Remove grout and mortar that comes in contact with masonry units immediately.
         3) Protect sills, ledges and projections from mortar droppings.
         4) Protect base of wall from rain-splashed mud and mortar splatter.
         5) Turn scaffold boards on edge when work is not in progress to lessen splattering.

D. Coordination: Coordinate Work to ensure top of wall is covered and remains covered until properly block openings are protected with coping or finishing system indicated on the Drawings.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer:
   ORCO Block & Hardscape Stanton, CA, www.orco.com

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2 MATERIALS

A. Aggregate:
   1. ASTM C 33 normal weight aggregate.
   2. ASTM C 331 lightweight aggregate.

B. Cement: ASTM C 150 or ASTM C 595, Type required. Color, White/Grey as required for use with the color specified.

C. Water Repellent Admixture: Integral polymeric water repellent admixture for concrete masonry units used in masonry exposed to the exterior shall be:
   1. Master Builders: MasterPel Integral Water Repellent
      a. Water resistance: ASTM E 514

D. Color Pigments: Lightfast, alkali-resistant, weather-resistant natural or synthetic iron oxides manufactured specifically for use in concrete masonry units.

2.3 ARCHITECTURAL CONCRETE MASONRY UNITS

A. Hollow Load Bearing Units:
   1. Masonry units shall meet ASTM C 90:
   2. Provide unit type and size(s) indicated on the drawings. Size to be used include blocks to have Bond Beams, Lentil block, Double Open Units.
   3. Unit Color and Texture: Color and texture as indicated on drawings.
   4. Unit Weight: Medium weight
   5. All exterior exposed walls have a Mortar Wash to be applied and cover, using standard ORCO Type S Mortar.
   6. Unit Compressive Strength: Minimum net area compressive strength of 2,000 psi unless otherwise indicated.

B. Special shapes:
   1. Provide closures, jamb units, headers, lintels, bond beams and other special shapes as indicated.
   2. Provide standard manufactured sizes or cut full size units for fractional course height and lengths.

2.4 MASONRY ACCESSORIES:

A. Mortar shall be ORCO Blended Products Type S or MAC pre-blended mortar, unless otherwise indicated. Preblended mortars shall meet the property specification of ASTM C 270.
   1. Mortar color and type: MAC White
   2. Comply with manufacturer’s instructions for mixing and mortar preparation.

B. Provide water repellent admixture for exterior wall mortar.
   1. Water Repellent Mortar Admixture: Shall be MasterPel dry mortar admixture. Admixture shall be incorporated into pre-blended ORCO Blended Products Type S or Type M mortar.
   2. Comply with manufacturer's instructions for mixing and mortar preparation.

C. Masonry Anchorage and Reinforcement: Comply with applicable portions of TMS 602 Article 2.4, and/or Section 04 05 19.29 - Stone Anchors.

D. Fabricated Steel Lintels: Comply with Section 05 50 00 - Metal Fabrications.

E. Sheet Metal Flashing and Trim: Comply with Section 07 62 00 - Sheet Metal Flashing and Trim.

F. Flexible Flashing: Comply with Section 07 65 26 - Self-Adhering Sheet Flashing.

G. Foamed-in-place insulation materials and installation: Comply with Section 07 21 29 - Spray Foam Insulation.

H. Control Joints:
1. Vinyl: ASTM D 2287.

I. Weeps: Weeps are to be used in conjunction with flashing materials for proper functioning of the masonry wall drainage system. Specified weep material is:
1. Weep holes, weep tubes, plastic vents or cells in veneer wall systems such as from Hohmann & Barnard, or equivalent.

J. Masonry Cleaning Materials: Standard-strength proprietary masonry cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new concrete masonry without discoloring or damaging masonry surfaces. Provide cleaning product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units.

K. Masonry Sealing Materials: Provide cleaning material manufacturer's compatible masonry sealer coating for all single wythe concrete masonry exterior walls.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, structure and installation conditions. Do not proceed with architectural concrete masonry work until unsatisfactory conditions have been corrected.

B. Verify items provided by other Sections of work are properly sized and located.

C. Verify that items to be built in are in proper location, and ready for roughing into masonry work.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean substrate surfaces thoroughly prior to installation.

B. Establish lines, levels and coursing. Verify anchors and flashings are correctly located and installed.

C. Furnish temporary bracing as required during installation of masonry work. Maintain

in place until building structure provides permanent support.

D. Do not wet concrete masonry units except as per TMS 402/602

E. Prepare surfaces using the methods recommended by the manufacturer for achieving the

3.3 INSTALLATION

A. Layout walls in advance for accurate spacing of surface bond patterns, with uniform joint widths and to properly locate openings, movement type joints, returns and offsets. Whenever possible, avoid the use of less than half-size units at corners, jambs and other locations. Notify Design Professional when split masonry coursing at heads and sills of openings and cut concrete masonry coursing less than 4 inches in height not permitted.

B. Lay walls plumb and true to comply with specified tolerances. Provide square corners, except as otherwise indicated, with courses level, accurately spaced and coordinated with other work. Use double lines at multiple wythe walls.

C. Pattern bond: Lay exposed concrete unit masonry in running bond with vertical joint in each course centered on units in courses above and below. Bond and interlock each course of each wythe at corners. Do not use units with less than 4 inches of horizontal face dimensions at corners or jambs. Install special shape units where indicated.

D. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings, load bearing walls, all courses of piers, columns and pilasters and where adjacent to cells or cavities to be reinforced or filled with concrete or grout. Maintain 3/8-inch nominal joint widths, except as necessary at first course bed joints, and except for minor variations required to maintain bond alignment

E. Lay solid concrete masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints

F. Compress and cut joints flush for masonry walls that are below grade, concealed or covered by other materials.

G. Tool joints in all exposed masonry work to a concave joint when thumb print hard, unless plans indicate otherwise.

H. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners at jambs to fit stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

I. Step back unfinished work adjoining new work. Rack back 1/2 unit length in each course; do not tooth. Clean exposed surfaces of set masonry and remove loose masonry units and mortar before laying fresh masonry.

J. Provide interlocking masonry bond in each course at corners and intersecting walls, unless otherwise indicated on plans such as for stack bond.

K. Load-bearing walls: If carried up separately, provide rigid steel anchors spaced not more than 2 feet on center vertically. Embed ends in mortar filled cores. Build full height of story to underside of structure. Grout juncture with structure solid with grout.

L. Non load-bearing walls: Build full height of story to underside of structure, except as otherwise shown. Terminate full height non load-bearing walls one joint thickness below the structure to allow for deflection of the structural element without loading the wall. Provide an open joint for application of joint sealant.

M. As the work progresses, build in items specified under this and other Sections of the specifications. Fill in solidly with masonry around built-in items.
   1. Bed hollow metal frame anchors in mortar. Align anchors with joint coursing. Draw anchors tight and fill space between hollow metal frames and masonry solid with fine mortar grout.
   2. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath or other approved material, in the joint below and rod grout into core.
   3. Provide solid masonry bearing for all lintels, beams, joists, plates and load-bearing members.
      a. Provide solid masonry units or hollow units filled solid.
      b. Minimum one block course under steel angle lintels and steel joists not bearing on bond beams.
      c. Minimum two block courses under steel beams and steel beam lintels. Where beams and lintels are parallel with wall, extend solid bearing to walls, extend solid bearing 16 inches each side of centerline of beam.
   4. Take particular care to embed all conduits and pipes within concrete masonry without fracturing exposed shells and to fit units around switch, receptacle and other boxes set in walls. Where electric conduit, outlets, switch boxes and similar items occur, grind and cut units before building in services.
   5. Install anchors and reglets for flashing and related work built into masonry work.
   6. Install reinforcing steel and grout where indicated. Comply with Drawing details for reinforcing [steel size and spacing.

N. Adhered Veneer walls:
   1. TMS 402 and 603 and CBC; Unit sizes.
   2. Adhered veneer units not to exceed: 2 5/8 in. thickness; 36 in. any face dimension; 5 sq. ft. total face area; and 15 psf weight

   2. Wall area limitations. Height, width, and area of adhered veneer not limited except as required to control restrained differential movement stresses between veneer and backing.

   3. Backing. Shall provide a continuous, moisture-resistant surface to receive the adhered veneer. Backing permitted to be masonry, concrete, or metal lath and

portland cement plaster applied to masonry, concrete, steel framing, or wood framing.

4. Adhesion between adhered veneer units and backing shall have a shear strength of 50 psi minimum based on gross unit surface area when tested per ASTM C482, or shall be adhered in compliance with Article 3.3 C of TMS 602.

5. DSA-SS & DSA-SS/CC, OSHPD 1 & 4] Additional Requirements. General.

6. Anchored or adhered veneer shall not be used on overhead horizontal surfaces.

7. [DSA-SS & DSA-SS/CC, OSHPD 1 & 4]

8. Adhered veneer. Units exceeding 5/8 inch (16 mm) in thickness shall be applied as anchored veneer where used over exit ways or more than 20 feet (6096 mm) in height above adjacent ground elevation.

9. Bond strengths and tests. Veneer bond to backing in accordance with TMS 402 12.3.2.4. Minimum of two shear tests shall be performed for the adhered veneer between the units and the supporting element. At least one shear test shall be performed at each building for each 5,000 square feet (465 m2) of floor area or fraction thereof.

3. Masonry walls: Tie exterior masonry veneer wythe to masonry back-up with individual metal ties built into masonry back-up walls.
4. Concrete walls: Tie exterior masonry veneer wythe to concrete back-up with individual metal ties secured to dovetail anchor slots cast in concrete back-up.
5. Wood framed walls: Tie exterior masonry veneer wythe to back-up with individual metal ties nailed to wood stud wall framing.
6. Metal framed walls: Tie exterior masonry veneer wythe to back-up with individual metal ties screwed to metal wall framing.
7. Space ties 16 inches on center vertically and horizontally.
8. Place horizontal joint reinforcing in the masonry veneer as follows:
    a. For nominal 4” high concrete masonry veneer units, place the horizontal joint reinforcement at no greater than 12” vertical spacing.
    b. For nominal 8” high concrete masonry veneer units, place the horizontal joint reinforcement at no greater than 16” vertical spacing.

O. Anchor masonry to structural members where masonry abuts or faces such members to comply with the following:
1. Provide an open space not less than 1/2 inch width between masonry and structural member. Keep open space free of mortar or other rigid materials.
2. Anchor masonry to structural members with metal ties embedded in masonry joints and attached to the structure. Provide anchors with adjustable tie sections. Space anchors not more than 24 inches on center vertically and 36 inches on center horizontally.
3. Anchor veneers to concrete structural members with dovetail anchors.

P. Control Joints: Provide control joints for exterior masonry construction.
1. Provide sash blocks with premolded shear key. Rake out mortar, if any, and form continuous vertical joints in masonry construction to receive joint sealant

at the locations listed below.
2. Locate control joints as indicated on the Drawings.

Q. Bond Beams: Install bond beams where indicated. Comply with Drawings for reinforcing steel size and spacing. Fill bond beam masonry units solid with concrete fill or coarse mortar grout. Use smooth dowels to allow for horizontal movement at control joints unless otherwise indicated on the Drawings.

R. Lintels:
1. Install loose steel lintels furnished under Section 05 50 00 - Metal Fabrications Metal Fabrications where shown. Set lintels in full bed of mortar.
2. Provide minimum bearing at each jamb of 4 inches for openings for less than 6 feet and 8 inches for wider openings

S. Flashing and weeps: Install flashing as specified in Section 07 62 00 - Sheet Metal Flashing and Trim or Section -
1. Install concealed through wall masonry flashing at all cavity and veneer wall sills, masonry openings in exterior walls with masonry above head, over all horizontal steel members built into masonry and elsewhere as indicated. Comply with SMACNA "Architectural Sheet Metal Manual" Chapter 4 Flashing recommendations and with NCMA TEK Bulletins 19-4A and 19-5A details to ensure water resistant masonry construction.
2. Install weeps in head joints of final course of exterior masonry wythe above flashing. Space weeps maximum of 24 inches on center horizontally with exterior ends and located to avoid door openings. Install weeps at head joints with outside face of weep material held 1/8 inch from the finish face of masonry unit.
3. Install cavity fill on top of base flashing. Install a bed of mortar, conforming to the curve of the flashing, placed under the metal flashing.
4. Install vents in head joints of final top course exterior masonry veneer wythe. Install at head joints with outside face of vent material held 1/8 inch from the finish face of masonry unit. Space vents 24 inches on center horizontally.
5. Install compressible joint material at lintels and horizontal steel members. Build in joint fillers and seal with joint sealant specified in Section 07 90 00 - Joint Protection.

3.4 REINFORCED CONCRETE MASONRY

A. Fill scheduled wall and column masonry work. Fill all cores solid with concrete fill/coarse masonry grout as specified in Section 04 05 16.26 - Engineered Masonry Grouting.
1. Grouting: Comply with TMS 602 grout placement requirements. Consolidate grout at time of placement.
   a. Low-Lift Grouting: Place concrete fill/coarse masonry grout in maximum 5-foot vertical lifts.
   b. High-Lift Grouting (If Approved): Place concrete fill/coarse masonry grout in maximum 12 foot vertical lifts (Recommend the use of super plasticizer with hi-lift grout).
2. Recess top of grout fill minimum 1-1/2 inches below top of course to form a

key with following lift.

3. Where vertical reinforcing is required, install reinforcing before filling operation. Wet sticking of reinforcing is not permitted. Comply with Drawing details for reinforcing steel size and spacing.

B. Install bond beams where indicated. Install reinforcing before filling operation. Fill units solid with grout. Comply with drawing details for reinforcing steel size and spacing.

3.5 REPAIR AND POINTING

A. Clean and point exposed architectural concrete masonry at end of each working day. Remove and re-place masonry units that are loose, chipped, broken, stained, or otherwise damaged. Provide new units to match adjoining units and install in fresh mortar pointed to eliminate evidence of replacement.

B. During the tooling of joints, enlarge any voids or holes, except weeps and completely fill with mortar. Point up all joints at corners, openings and adjacent work to provide a neat, uniform appearance. Remove line pins and fill all line pin holes.

C. Wipe off excess mortar as the work progresses. Dry brush exposed masonry with bristle brushes at the end of each day's work. Remove mortar spatters and joint ridges.

3.6 QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Testing Prior to Construction: One set of tests.

C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

D. Concrete Masonry Unit Test: ASTM C 140 for compressive strength.

E. Mortar Test (Property Specification): For each mix provided, according to ASTM C 270,

F. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.7 CLEANING

A. Cut out defective mortar joints and holes in exposed masonry and re-point with mortar of matching color and texture. Commence cleaning of the masonry walls as soon as the mortar is thoroughly set and cured. After mortar has cured for a period

of 7 days (and no later than 14 days after completion of installation), the cleaning process can begin.

B. Demonstrate the cleaning procedure on the sample panel at the job site prior to commencing cleaning on the building. When the sample panel is cleaned to the approval of the Architect, and the walls are complete, clean the building with the approved cleaning method.

C. Protect adjacent and surrounding surfaces not intended to be cleaned from exposure to the cleaning chemical to prevent damage.

D. Prevent cleaning chemical from coming into contact with people, motor vehicles, landscaping and other building materials that could be harmed by such contact. Follow Masonry cleaner Manufacturers' recommendations for personal protection.

E. Clean the exposed masonry surfaces of stains, efflorescence, mortar, grout dropping and debris using methods that do not damage the masonry. Do not use high pressure cleaning or aggressive scrubbing after cleaner application.

F. The results of the cleaning process shall be inspected by the project Architect or authorized owner representative for acceptance after the walls have dried. For cleaning results to be accepted, the walls must comply with the standard set for the cleaning results on the sample panel, and the walls shall be free from mortar or efflorescence stains, and the color and texture of the finished walls shall not show damage, discoloration or staining from the cleaning process. If such damage or stains are present, then the walls must be cleaned and color corrected, as needed, to remove any such stains, discoloration or damage prior to the application of Coatings

G. After cleaning allow units to dry and when specified apply a sealer as provided in Section 3.8.

3.8 COATING:

A. After the results of the cleaning process have been fully accepted by the Architect, apply a colorless, non-staining, non-yellowing, breathable, penetrating water and graffiti repellent. Water and graffiti repellent shall be applied to exposed surfaces of the concrete masonry walls. Water-repellents must be capable of performing over hairline cracks and small voids less than 1/16". "Film Forming" Acrylic sealers will not be allowed. The water-repellent must not alter the color or texture of the wall after the material has fully cured. Repellent must be low VOC water or solvent based. Follow manufacturer's application recommendations.

3.9 PROTECTION

A. Protect installed products until completion of project.
   1. Protect top of wall until covered or capped to a waterproof condition by subsequent construction.
   2. Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Remove immediately any grout, mortar, and soil that

comes in contact with such masonry
3. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.
4. Protect sills, ledges, and projection from mortar splatter and dropping.
5. Protect surfaces of windows and door frames; as well as similar products with painted and integral finishes from mortar splatter and dropping

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 050300
HOT DIP GALVANIZING

PART 1 GENERAL

1.1 DESCRIPTION

A. Hot dip galvanize all permanently exposed structural steel including but not limited to structural steel, columns, beams and metal fabrications.

B. Related work in other Sections:

1. Section 05 12 00 – Structural Steel
2. Section 05 50 00 – Metal Fabrications
3. Section 05 30 00 – Steel Decking
4. Section 05 12 13 – Arch. Exposed Structural Steel Framing

1.2 QUALITY ASSURANCE

A. Comply with requirements of Section 01 40 00.

B. Coating applicator: Company specializing in hot dip galvanizing after fabrication and following the procedures of the Quality Assurance Manual of the American Galvanizers Association.

1.3 SUBMITTALS

A. Comply with requirements of Section 01 30 00.

B. Coating applicator's notarized Certificate of Compliance that the hot dip galvanized coating meets or exceeds the specified requirements of ASTM A 123 or A 153.

1.4 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01 61 00.

B. Load and store galvanized articles in accordance with accepted industry standards.

PART 2 PRODUCTS

2.1 STEEL MATERIALS

A. Material for galvanizing to be geometrically suitable for galvanizing as described in ASTM A 384 and A 385. Steel materials suitable for galvanizing include structural shapes, pipe, sheet, sheet, fabrications and assemblies.

B. Material shall be chemically suitable for galvanizing.

2.2 FABRICATION REQUIREMENTS

A. Fabricate structural steel in accordance with Class I, II, III guidelines as described in AGA's Recommended Details for Galvanized Structures.

B. Fabrication practices for products shall be in accordance with the applicable portions of ASTM A 143, A 384 and A 385, except as specified herein. Avoid fabrication techniques which could cause distortion or embrittlement of the steel.

C. The fabricator shall consult with the Architect and hot dip galvanizer regarding potential problems or potential handling problems during the galvanizing process, which may require modification of design before fabrication proceeds.

D. Remove all welding slag, splatter, anti-splatter compounds, and burrs prior to delivery to the galvanizer.

E. Provide holes and/or lifting lugs to facilitate handling during the galvanizing.

F. Avoid unsuitable marking paints. Consult with the galvanizer about removal of grease, oil pint and other deleterious material prior to fabrication.

G. Remove by blast cleaning or other methods, surface contaminants and coatings which would not be removable by the normal chemical cleaning process in the galvanizing operation.

H. Wherever possible, use slip joints to minimize field welding of material.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

A. Pre-clean steelwork in accordance with accepted methods to produce an acceptable surface for quality hot dip galvanizing.

3.2 COATING APPLICATION

A. Galvanize steel members, fabrications, and assemblies after fabrication by the hot dip process in accordance with ASTM A 123.

B. Galvanize bolts, nuts and washer and iron and steel hardware components in accordance with ASTM A 153.

C. Safeguard products against steel embrittlement in conformance with ASTM A 143.

D. Handle all articles to be galvanized in such a manner as to avoid any mechanical damage and to minimize distortion.

3.3 COATING REQUIREMENTS

A. Coating weight: Conform to paragraph 5.1 of ASTM A 123 or Table 1 of ASTM A 153 or requirements indicated in individual sections of this Project Manual, as appropriate. Special thickness requirements shall refer to ASTM A 123 3.1.7 and be specified to the minimum average mils of thickness.

B. Surface finish: Continuous, adherent, as smooth and evenly distributed as possible and free from any defect detrimental to the stated end use of the coated article.

C. Adhesion: Withstand normal handling consistent with the nature and thickness of the coating and normal use of the article.

3.4 TESTS

A. Inspection and testing of hot dip galvanized coatings shall be done under the guidelines provided in the AGA publication Inspection of Products Hot Dip Galvanized after Fabrication.

B. Include visual examination and tests in accordance with ASTM A 123 or A 153 as applicable to determine the thickness of the zinc coating on the metal surface.

3.5 REPAIR OF DAMAGE COATING

A. The maximum area to be repaired is defined in accordance with ASTM A 123 Section 4.6.

B. Repair areas damaged by welding, flame cutting or during handling, transport or erection, by one of the approved methods in accordance with ASTM A 780 whenever damage exceeds 3/16" in width. Minimum width thickness requirement for the repair are those described in ASTM A 123 Section 4.6.

END OF SECTION 050300

SECTION 05065

WELDED STUD CONNECTORS

PART 1 GENERAL

1.1 SUMMARY

A. Work included: Welded stud connectors.

B. Related work:

1. Structural steel.
2. Steel decking.
3. Cast-in-place concrete.

1.2 QUALITY ASSURANCE

A. Comply with requirements of Section 01400.

B. Reference standards: The applicable provisions of the following govern the work of this Section, except as noted.

1. ASTM A 108, Steel Bars, Carbon, Cold-Finished, Standard Quality.
2. AWS D1.1 Structural Welding Code, Steel.
3. ICBO Report No. 2614 or equivalent.

C. Welder's qualifications:

1. Currently certified and qualified in compliance with AWS D1.1.
2. Testing for recertification is Contractor's responsibility.

1.3 SUBMITTALS

A. Comply with requirements of Section 01400.

B. Product data: Manufacturer's technical product data, including detailed equipment and installation requirements.

C. Samples: Full size, when requested by Architect.

1.4 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 01600.

B. Protection: Protect materials from damage during shipping, handling and storage at the site.

C. Delivery: In unbroken sealed packages bearing manufacturer's name and label identifying the contents.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Studs: By Tru-Weld, Nelson Stud Welding Div. of Gregory Industries, and Stud Welding and Rebar Splicing Division of Erico Products, Inc. complying with the following:

1. Standard steel studs for welding by automatically timed stud-welding equipment, furnished complete with an arc shield (ferrule) of heat-resistant ceramic or equivalent for all studs, and, for studs 5/16 in. diameter or larger, a deoxidizing and arc stabilizing flux; not painted, galvanized, or cadmium-plated prior to welding and all finished by cold-heading, cold-rolling or machining.

2. Provide studs of uniform quality and condition, free of injurious laps, fins, seams, cracks, twists, bends not indicated, rust, rust pits, scale, oil and other injurious defects or substances.

3. Steel shall be Grade C-1015, C-1017 or C-1020, cold-drawn, conforming to ASTM A 108 and having minimum 60,000 psi tensile strength with 20% elongation in 2 in. and 50% area reduction.

B. Welding equipment: Automatically timed stud-welding equipment with a suitable power source, type and manufacture approved by the stud manufacturer.

PART 3 – EXECUTION

3.1 PREPARATION

A. Clean steel surfaces to receive studs of paint, scale, rust and other foreign substances by wire brushing, preening, prick-punching, grinding or other method required to produce clean, bare substrates.

3.2 STUD WELDING

A. General: Comply with stud manufacturer's printed instructions and the following:

B. Installation:
1. General:

a. Do not install studs on wet surfaces, nor studs showing defects, rusting, rust pits, scale, oil or other deleterious substances.

b. Install studs promptly after cleaning and preparation.

c. Break and remove arc shield after welding.

d. Free welded studs from defects or substances that interfere with intended functions.

2. Placing locations:

a. The longitudinal and lateral spacings for stud connectors with respect to each other and to edges of member flanges may vary 1” maximum from locations shown provided adjacent studs are not closer than 2-1/2” o.c.

b. Provide a minimum distance between edges of stud bases and flange edges equal to the stud diameter plus 1/8 in., but minimum 1-1/2” clearance where possible.

c. Location accuracy of other types of studs shall permit the assembly of attachments without alterations or reaming.

3. Stud lengths:

a. Stud lengths indicated are minimum net lengths after welding.

b. If reduction in length of a stud as it is welded is such that the length of the stud is more than 1/16” greater than specified by stud manufacturer, discontinue installation until cause is determined and eliminated and pre-production testing is satisfactorily repeated.

4. Defective fillets: Studs not showing a full 360 deg. weld fillet after welding may be repaired by adding a 3/16 in. fillet weld in lieu of the missing weld fillet in compliance with AWS D1.1 and using low-hydrogen electrodes.

3.3 REPLACING DEFECTIVE STUDS

A. Preparation for replacement studs and repairs: Repair steel surfaces as follows wherever a defective stud is removed.

1. Make the areas where a stud is removed flush and smooth.

2. Complete repairs before installing a replacement stud on a defective area.

B. Areas subject to tensile stress:

1. Make areas flush and smooth.

2. If base metal has been pulled-out by the stud removal, fill the pocket by shielded metal-arc welding conforming to AWS D1.1 using low-hydrogen electrodes, and grind the weld surfaces flush.

C. Areas subject to compression:

1. Where the stud failure is confined to shanks or fusion zones of the studs, a new stud may be installed adjacent to the defective area in lieu of repairing the defective area and installing a replacement stud, subject to approval.

2. If metal is pulled-out of the base metal, fill the pocket as specified above for tensile areas except that if defect depth is not more than the lesser of 1/8 in. or 7% of the base metal thickness, the defect may be faired by grinding in lieu of weld filling.

3.4 FIELD QUALITY CONTROL

A. Inspection:

1. Perform pre-production testing, stud installation and production testing under continuous inspection of the Owner's Testing Laboratory.

2. In addition to the standard reports, Testing Laboratory reports shall detail the location of defective studs with repair or replacement action taken, damage resulting from stud installation, and all defects and unusual occurrences.

B. Preproduction testing: Perform the following tests with each welding equipment power source at the start of each production period (time interval from start-up to any shut-down of any stud-welding equipment), at the start of any new welding procedure, and after any change in the welding procedure.

1. Stud shear connectors: After cooling, test the first 2 studs on a member by hammer bending to a 45 deg. angle. If a failure occurs in the weld zone of either stud, correct the procedure, and weld and bend test 2 more studs on the member. If either of the second 2 studs fail, continue all additional welding on separate materials until 2 consecutive studs are tested and found satisfactory before any more studs are welded to the member.

2. Studs other than shear connectors: Weld 2 studs to separate material in the same general position (such as flat, vertical, sloping or overhead) and of similar steel material and thickness as members to receive studs. After cooling, hammer bend the studs to a 30 deg. angle. If failure occurs in the weld zone of either stud, correct the procedure and successfully weld and test 2 successive studs before any studs are welded to members.

C. Production inspection and testing:

1. Inspection of stud shear connectors: After cooling, test at least one stud on each member by hammer bending to a 15 deg. angle; if a failure occurs either in the weld zone or stud shank, follow the method of correction as required herein for pre-production testing until successful installations are produced, and replaced defective studs. Test studs not showing a full 360 deg. fillet weld or that have been repaired by welding, all replacement studs, and any stud in which reduction in length is less than correct by hammer bending to a 15 deg. angle. For studs showing less than a 360 deg. weld fillet, bend stud in the direction opposite to the missing weld fillet. Remove and replace studs that crack either in the weld zone, base metal or shank under inspection and testing or under subsequent straightening.

2. Inspection of studs other than shear connectors: Test at least one stud in every one hundred studs by hammer bending to a 15 deg. angle or, if the stud is threaded, torque test with a calibrated torque wrench to an approved value for stud diameter and thread in an approved device. If the stud fails, correct the welding procedure as required herein for pre-production testing and bend or torque test 2 more in-place studs. If either of the 2 second studs fails, all studs represented by the tests shall be bent or torque tested, or shall be rejected and replaced. The extent of additional inspection and testing for critical structural connections shall be as designated by the Structural Engineer.

D. Straightening:

1. Leave in a bent condition those stud shear connectors and shear transfer devices that are bent less than 16 deg. and are free of failure provided no portion of the studs is within 1 in. of an exposed concrete surface.

2. Perform stud bending and straightening without heating and before completion of each day's stud welding.

3. Obtain inspection and approval of straightened studs before covering.

E. Load testing: Testing laboratory shall load test studs in the extent and by methods directed.

END OF SECTION

SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Includes:
   1. Structural steel as indicated on the Drawings, consisting and defined and enumerated in Section 2 - Definition of Structural Steel, of AISC Specifications and Code of Standard Practice.
   2. Shop priming structural steel concealed in the finished work and where not indicated or required to receive sprayed on fireproofing.
   3. Fabrication and finishing (hot dip galvanizing) of Architecturally Exposed Structural Steel is specified in Section 05 12 13.

B. Products furnished but not installed under this Section:
   1. Anchors for casting into concrete.
   2. Loose bearing plates to receive structural steel.

C. Related work includes:
   1. Grouting beneath base and bearing plates: Section 03 30 00.
   2. Special requirements for Architecturally Exposed Structural Steel: Section 05 12 13.
   3. ~~Cold-formed metal framing: Section 05 40 00.~~
   4. ~~Miscellaneous metal fabrications: Section 05 50 00.~~
   5. Metal stairs: Section 05 51 00.

D. Related work provided by Owner:
   1. Registered Deputy Inspector to inspect the fabrication, placement, welding, and high tensile bolting of structural steel in accordance with Building Code requirements.
   2. Testing Agency employed by the Owner shall provide all tests specified herein in accordance with Building Code requirements.

1.2 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following, except as otherwise indicated:
   1. AISC "Code of Standard Practice for Steel Buildings and Bridges.
      a. Paragraph 4.2.1 of the above Code is hereby modified by deletion of the following sentence: "This approval constitutes the Owner's acceptance of all responsibility for the design adequacy of any connections designed by the fabricator as part of his preparation of these shop drawings.
      b. Paragraph 4.2.2 delete in its entirety.
      c. Paragraph 7.9.3 of the above code is hereby modified by deletion of
         the following words: "The contract documents specify the sequence and schedule of placement of such elements."
   2. AISC "Specification for the Design, Fabrication, and Erection of Structural

Steel for Buildings "and including the Commentary" and Supplements thereto as issued.

a. Exterior structural steel exposed to public view including supports at canopies, shall comply with requirements of Section 10 "Architectural Exposed Structural Steel".

3. AWS D1.1 & D1.8 "Structural Welding Code."

4. ASTM-A6 "General Requirements for Delivery of Rolled Steel Plates, Shapes. Sheet Piling and Bars for Structural Use."

5. SSPC - Steel Structures Painting Manual, Volume 2, Systems and Specifications.

B. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with the AWS "Standard Qualification Procedure."

C. Source Quality Control: Materials and fabrication procedures are subject to inspection and test in mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

1. Promptly remove and replace materials or fabricated components which do not comply.

D. Structural General Notes shall apply to the work of this Section as though repeated verbatim herein.

1.3 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01 33 00.

B. Shop drawings:

1. Submit complete shop and erection diagrams required for the work of this Section.

2. Make erection diagrams as complete as possible before first submittal.

a. Should more than one submittal be required, later submittals shall clearly identify material added or revised subsequent to previous submittal.

b. Indicate all shop and erection details, including cuts, copes, connections, holes, threaded fasteners, and welds.

3. Identify welds, both shop and field, by AWS A2.4 Symbols for Welding and Non-Destructive Testing.

4. Coordinate shop drawings with the trades performing the work of Divisions 15 and 16. All holes and openings in beams for passage of ducts and pipes shall be shown on shop drawings and shall be made in the shop.

C. Review of shop drawings shall not relieve the Contractor from compliance with the requirements of the Structural Drawings and Specifications. The omission from shop drawings of any material shown of specified on the original Structural Drawings shall not relieve the Contractor of the responsibility for furnishing and installing such materials even though such shop drawings may have been returned with no exceptions observed.

D. Proof of compliance for materials: Submit mill test reports for all structural steel. Refer to paragraph 1.3.B.2.a for unidentified local stock steel.

E. Submit proposed sequence of field welding and obtain acceptance by Structural

Engineer before beginning work. Field weld sequence shall be planned to minimize residual stress due to weld shrinkage.

F. Manufacturer's data: Submit manufacturer's data on paint primer to be used on structural steel, including evidence that primer used beneath sprayed fireproofing is acceptable to the sprayed fireproofing materials manufacturer.

1.4 HANDLING

A. Comply with the requirements of Section 01 65 00.
B. Storage:
   1. Store steel members at the site above ground on platforms, skids or other approved supports.
   2. Protect steel from mechanical damage and corrosion.
   3. Comply with the combined recommendations of the AWS and the electrode manufacturer for their storage and care. Do not use electrodes that have been wetted.
   4. Store other materials in a weather tight and dry place, until ready for incorporation into this work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Rolled steel plates, shapes and bars: As indicated on the Structural General Notes.
B. Structural tubing: As indicated on the Structural General Notes.
C. Pipe columns: As indicated on the Structural General Notes.
D. Fastening materials:
   1. Bolts: ASTM A325 or A490, unless otherwise noted on the Drawings. High strength bolts shall be bearing type with threads excluded from the shear planes (I.E. A325-X) unless otherwise noted.
   2. Unfinished threaded fasteners, together with their nuts and washers: ASTM A307, Grade A, regular low carbon steel, hexagonal heads and nuts, where noted.
   3. Arc-welding electrodes: In accordance with Structural General Notes.
E. Anchor bolts: ASTM A307, non-headed type, or ASTM A449 as indicated on the Drawings.
F. Shop primer and field touch-up for concealed structural steel (non-fireproofed surfaces only): Series 10 Tnemec Primer, by Tnemec Co., or equal by Ameron.

2.2 FABRICATION

A. Workmanship equal to the best of standard practice in modern structural shops, and conforming to applicable provisions of the AISC Code of Standard Practice and Specifications.
B. All fabrication must be performed in shop of Building Department approved licensed fabricator. It is assumed that all fabrication will take place in one shop only. All additional inspection costs resulting form fabrication at more than one shop location will be back-charged to the Contractor.
C. Before being fabricated, or worked, wire-brush materials, clean of loose mill scale

and rust, and straighten by methods that will not injure the steel.

1. After punching or working a member, remove twists or bends before the parts are assembled.
2. Finished members shall be free from twists, bends, and open joints when erected.

D. Punch or drill holes; burned holes will be unacceptable.

E. Prior to fabrication, perform ultrasonic inspections on the areas of column flanges and girder flanges specified in paragraph 3.5,C,3.

F. After fabrication surfaces of structural steel except those indicated or required to be fireproofing (Architecturally exposed structural steel shall receive a hot-dip galvanized finish and shall remain unpainted in the finished work, see Section 05 12 13):

1. Shop Painting:

   a. Clean steel members, including their connections, in accordance with SSPC SP1, SP2, and SP3 as applicable, and the primer manufacturer's printed recommendations, and apply primer immediately thereafter to clean, dry surfaces, to a minimum dry film thickness recommended by primer manufacturer.

   b. Primer may be held 4" back from areas to be field welded where primer would interfere with good welding practices. Remove weld splatter from all welded joints, whether primed or not.

2. Shop Painting (NON-FIREPROOFED SURFACES ONLY):
   a Paint all structural steel with a shop coat of paint, except:
      1) Members encased in concrete.
      2) Contact surfaces of welded connections and areas within 2" of field welds except as noted.
      3) Surfaces receiving sprayed-on fireproofing.
      4) Surfaces receiving field welded steel studs.
   b Apply specified shop coat in accord with manufacturer's product data to provide a minimum dry film thickness recommended by paint manufacturer for each type of primer used. Apply shop coat of paint within four hours after cleaning and before rust-bloom occurs. Paint only in relative humidity below 85% and surface temperatures of 5 degrees Fahrenheit above dew point. Shop coat shall be applied using spray equipment on all structural steel exposed to public view.
   c. Apply lacquer to milled surfaces to dry film thickness of 0.5 mils.
3. Apply a heavy coat of bituminous paint to metal surfaces in contact with concrete or masonry. Do not apply on exposed surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify governing dimensions and conditions at the site before starting erection.

B. Verify the location and elevation of anchor bolts and concrete surfaces supporting steel to verify that they meet the following tolerances:

1. Elevation of concrete surfaces: Plus or minus 3/8".
2. Elevation top of anchor bolts: Plus 1", minus 3/8".
3. Out-of-position of anchor bolts: Plus or minus 1/8".
4. Anchor bolts shall be proof tested by Owner's testing agency at Architect's discretion

C. Make sure that conditions which would prevent proper and timely completion of this work are corrected before proceeding with erection.

D. Anchor bolts:
1. Furnish anchor bolts and connection material to be embedded in concrete and masonry when and as required to maintain job progress.
2. Provide the necessary drawings and templates for the setting of such anchor bolts and connection material.

3.2 ERECTION

A. Erect structural steel in accordance with the Contract Documents, reviewed shop drawings and AISC standards, except provide washers on all bolted connections regardless of the tightening method used.

B. Erection tolerances:
1. Establish leveling and plumbing measurements on the mean operating temperature of the structure, making allowances for the difference between temperature at time of erection and the mean temperature at which the structure will be when completed and in service.
2. Structural steel tolerances shall comply with Section 1.23.8.1 of AISC Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings, and AISC Code of Standard Practice for Steel Buildings and Bridges.

C. Field assembly:
1. Closely fit members and sections, and finish true to line and in precise position necessary to allow accurate erection and proper joining of parts in the field.
2. Drifting to enlarge unfair holes will not be allowed.
3. Do not heat members without prior approval.

D. Contact surfaces:
1. Component parts of built-up members shall be well pinned and rigidly maintained in close contact using clamps or temporary bolting during welding.
2. Compression joints depending upon contact bearing shall have bearing surfaces accurately milled perpendicular to their axis, or as detailed, and shall be free of mill scales, rust, paint, weld spatter and other foreign materials.

E. Gas cutting:
1. Use a cutting torch only where the metal being cut is not carrying stress during the operation, and provided stresses will not be transmitted through a flame-cut surface.
2. Make gas cuts smooth and regular in contour.
3. To determine the effective width of members so cut, deduct 1/8" from the width of the gas cut edges.

4. Make the radius or re-entrant gas cut fillets as large as practicable, but in no case less than 1".

F. Punching, drilling and reaming:
1. Material may be punched 1/16" larger than the nominal diameter of the bolt, wherever the thickness of the metal is equal to or less than the diameter of the bolt plus 1/8".
2. Where the metal is thicker than the diameter of the bolt plus 1/8", the holes shall be drilled or subpunched and reamed.
3. The die for sub-punched holes, and the drill for subdrilled holes, shall be 1/16" smaller than the nominal diameter of the bolt to be accommodated.
4. Finished holes shall be precisely located to insure passage of bolts through assembled materials without drifting.
5. Enlargement of holes necessary to receive bolts shall be done by reaming.
6. Poor matching of holes will be sufficient cause for rejection.

G. Bolting: High-strength steel bolts shall be used where indicated in accordance with the latest edition of specifications for Structural Joints Using ASTM A325 or A490 Bolts, as approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.
1. All high-strength bolting shall be installed under continuous inspection by a Owner's Deputy Inspector certified by the Building Department.

H. Erection: By professional riggers, carefully planned and laid out so that a minimum of cutting will be necessary.
1. Erect work plumb, square and true to line, and level, in precise positions as indicated.
2. Provide temporary bracing and guys where necessary to provide for loads and stresses to which the structure may be subjected, including those due to erection equipment and its operation, and until all welding and/or bolting is in completed and slabs and walls are in place for a period of 28 days minimum.

I. Temporary connections:
1. As erection progresses, bolt-up the work as necessary to maintain the steel in proper position while field bolting and welding is being done, and as necessary to take care of dead loads, wind, and erection stresses.
2. No field welding or high-strength bolting shall be done until structural steel has been properly aligned, plumbed and leveled.

J. Set column base plates in exact position, both as to alignment, level, and elevation, and support on steel wedges, or equivalent, until the grout has thoroughly set.
1. The center of each base shall be true to the column center within 1/16" and its elevation within 1/32" of theoretical lines.
2. Plates shall be exactly level on both axes.

3.3 WELDING

A. Welding and welded joints: Detail and execute welds in accordance with AWS requirements as modified by AISC standards, or as detailed and noted on the Drawings.

B. All welding shall be performed in accordance with the latest edition of "The

Structural Welding Code" of the American Welding Society: AWS D1.1.

C. Operators qualifications: Thoroughly trained and experienced in arc welding of structures, capable of making uniformly reliable butt and fillet welds in flat, vertical and overhead positions, and of producing neat, consistent work in actual operation.
   1. Operators shall be certified in accordance with AWS requirements, and certified by Building Department.
   2. If recertification is required, it shall be the Contractor's responsibility.

D. Ultrasonic and visual inspection of welded connections: Refer to Article 3.5 hereafter.

E. All structural welds (shop and field) shall be inspected by the Owner's Deputy Inspector certified by the Building Department unless specifically noted otherwise. Continuous inspection shall be provided for multiple pass welds.

F. Welding of reinforcing dowels to structural steel shall be by concrete reinforcement Contractor. See reinforcing notes for welding reinforcing steel.

G. Perform welding in sequence indicated on reviewed proposed sequence of field welding submittal.

H. Remove all welding splatter after completion of each weld.

I. See Structural General Notes for additional welding information and requirements.

3.4 GROUTING OF PLATES

A. Be responsible for maintaining bearing plates in proper location and at proper level while they are being grouted. Grouting is specified in Section 03 30 00.

3.5 FIELD QUALITY CONTROL

A. A testing agency employed by the Owner shall inspect all shop and field welding, and high-strength bolting.
   1. Testing agency shall furnish qualified inspectors.
   2. Tests and inspection shall comply with Code requirements, as amended by these Specifications and Building Department regulations.
   3. Testing agency will be required to certify in writing upon completion of this work that the welding and high-strength bolting have been performed in accordance with the requirements of the Contract Documents, and with applicable requirements of regulatory agencies having jurisdiction.

B. The testing agency shall test 10% of high strength bolts with a manual torque wrench to verify power wrench accuracy if the turn of the nut or calibrated wrench methods of tightening are used. If the direct tension indicator method of tightening is used, the testing agency shall observe the installation of bolts to determine that the approved procedure is properly used and shall determine that the correct indication of tension has been achieved in accordance with the washer manufacturer's instructions.

C. The testing agency shall provide ultrasonic inspection of full or partial penetration welds in accordance with AWS D1.1, and ASTM E114 and ASTM A435, modified to use continuous scanning, with the following limitations to the acceptance criteria of ASTM A435, any discontinuity indication of total loss over a width of one inch or greater measured across the width of the column flange, or less than one inch in width and greater than 6 inches in length, is unacceptable. Areas of

internal discontinuities exceeding the maximum permissible limits may be repaired subject to the approval of the Structural Engineer and the Building Department. Sketches of the defect repair will be required for such approvals.

1. The search pattern shall include the entire weld volume.
2. 100% inspection will be required for all shop and field full or partial penetration welds.
3. Prior to fabrication, the following areas of column flanges and girder flanges shall be subject to ultrasonic inspections:
    a. Within 6 inches either side of each groove welded girder flange-to-column connection.
    b. Within 3 inches either side of the welded web or web plate-to-column connection.
    c. Within 6 inches either side of splice point in columns.

D. The testing agency shall visually inspect all non-full or partial penetration welds and report on the results of the inspection.

E. The Contractor shall, at the completion of the work of this Section (refer also to Section 05300), furnish the Owner a survey of the structural steel frame, signed by a licensed surveyor, to verify compliance with the Drawings and Specifications as to dimensions, plumbness, elevations and tolerances.

3.6 TOUCH-UP

A. Clean abraded areas of shop primer and field welds to bright metal, and touch-up with same primer used for shop priming.

END OF SECTION

SECTION 05 12 13

ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

1.1 SUMMARY

A. Architecturally exposed structural-steel (AESS) framing.

1. Requirements in Section 05 12 00 "Structural Steel Framing" also apply to AESS.

1.2 DEFINITIONS

A. Category 1 AESS: Exposed structural steel that is within 96 inches (2400 mm) vertically and 36 inches (900 mm) horizontally of a walking surface.

B. Category 2 AESS: Exposed structural steel that is within 20 feet (6 m) vertically and horizontally of a walking surface.

C. Category 3 AESS: Exposed structural steel that is not defined as Category 1 or Category 2.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: City of LA-Certified Erector, Category.

B. Fabricator Qualifications: City of LA -Certified Plant, Category STD.

C. Mockups for AESS.

1.4 MATERIALS

A. Primer: **Zinc oxide**.

B. Etching cleaner for galvanized metal.

C. Primer for Galvanized Steel: **Water based**.

1.5 FABRICATION

A. Special care used in handling and fabricating AESS, and the following:

1. Exposed surfaces smooth, square, and free of surface blemishes.
2. Grind cut edges of **Category 1** and **2** AESS.
3. **Category 1** AESS exposed surfaces free of mill marks.

4. **Category 1 and Category 2** AESS exposed surfaces free of seams to maximum extent possible.
5. Blemishes filled, ground, or welded and ground before shop priming.
6. Piece marks hidden or removed after erection.
7. **Category 1** AESS fabricated to tolerances in AISC 303 for AESS.
8. **Category 2 and Category 3** AESS fabricated to tolerances in AISC 303 for steel that is not AESS.
9. Ends of **all** AESS hollow structural sections closed.
10. Curved Members: Distortion not visible from a distance of 20 feet (6 m).
11. Coping, Blocking, and Joint Gaps: Uniform gaps of 1/8 inch (3.2 mm) for **Category 1** AESS.

B. Weld Connections:

1. Continuous, sealed welds at angle to gusset-plate connections and similar locations where **Category 1 and 2** AESS is exposed to weather.
2. Continuous uniform welds for **Category 1** and **2** AESS.
3. Butt and groove welds ground flush for **Category 1 and Category 2** AESS.
4. Butt and groove welds made flush but not ground for **Category 3** AESS.
5. Backing bars and runoff tabs removed and steel ground smooth for **Category 1 and Category 2** AESS.
6. Exposed connections of **Category 1 and Category 2**AESS ground smooth where welded on far side.
7. Fillet welds for **Category 1 and Category 2** AESS made oversize and ground smooth.
8. Fillet welds for **Category 1 and Category 2** AESS made uniform with smooth face but not ground.

C. Cleaning Corrosion-Resisting Structural Steel: SSPC-SP 6/NACE No. 3.

D. Surface Preparation: **SSPC-SP 2**

E. Galvanizing: Hot dip.

1.6 ERECTION

A. **Category 1 and 2** AESS erected to tolerances in AISC 303 for AESS.

B. **Category 3** AESS erected to tolerances in AISC 303 for steel that is not AESS.

C. Connections welded per "Fabrication" Article and as follows:

1. Backing bars and runoff tabs removed and steel ground smooth for **Category 1 and Category 2** AESS.
2. Erection bolts removed in **Category 1 and Category 2** AESS and holes filled and ground smooth.
3. Weld access holes in **Category 1 and Category 2** AESS filled and ground smooth.

END OF SECTION

SECTION 05 30 00

METAL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Principal work in this Section:

1. Metal decking.
2. Accessories, filler pieces and metal closure pieces.

B. Related work in other Sections:

1. Section 05 12 00 – Structural Steel
2. Section 05 50 00 – Metal Fabrications
3. Section 05 03 00 – Hot Dip Galvanizing
4. Section 03 30 00 – Cast-in-place Concrete

1.2 SUBMITTALS

A. Procedure: In accordance with Division 1.

B. Dimensioned shop drawings showing section profiles, trim, detailed layout showing type and gage of steel decking, openings, sump pans (when applicable), supports, connections, welds and erection instructions. Identify welds by the AWS welding symbols. Indicate temporary shoring of decking where required.

C. Manufacturer's calculations and supporting data demonstrating that each metal deck proposed for use conforms to the Drawings, these Specifications and the Building Code.

D. Manufacturer's Installation instructions indicating specific installation sequence and special instructions.

1.3 QUALITY ASSURANCE

A. Welders' qualifications:

1. Welding shall be done only by welders currently certified for welding of light gage metal.
2. Qualification of welders and duration of qualification period in compliance with applicable requirements of AWS D1.3. Recertify and replace, with qualified

welders, welders producing unsatisfactory welds, even though they have passed qualification tests.

3. Testing for recertification is Contractor's responsibility.

B. Design criteria:

1. Fire rating: Be responsible for obtaining UL and Building Department approval of the decking, when used as a part of the assembly indicated on the Drawings in which fire resistive construction ratings are required.
2. Design: In compliance with the following reference standards.

a. SDI, Design Manual for Composite Decks, Form Decks and Roof Decks.
b. AISI, Specification for the Design of Cold-Formed Steel Structural Members, and AISC, Manual of Steel Construction.

C. Shoring: Unless noted otherwise on the Drawings, the decking doesn't require shoring, except that when the weight of the wet concrete fill is expected to exceed the deck manufacturer's published data for safe capacity and allowable deflection. The Contractor shall determine these locations and provide temporary shoring until concrete fill has attained its 28-day strength.

1.4 HANDLING

A. Procedure: In accordance with Section 01 60 00.

B. Labeling: Label each unit or bundle of metal decking, which is UL classified, to show manufacture, testing and Inspection.

C. Protection: Work showing dents, creases, burrs in cells, deformations, weathering or other defects affecting its use will not be accepted.

D. Storage: Store units off the ground with one end elevated to permit drainage. In wet or damp weather, cover with waterproof tarpaulins to avoid rusting.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel for decking and closure strips: ASTM A 653, with minimum yield strength of 33,000 psi, with a G 60 zinc coating.

B. Miscellaneous steel shapes: ASTM A 36.

C. Galvanizing repair paint: Tneme-Zinc 90-97 by Tnemec Co., Amercoat 68HS by Ameron Protective Coating Division, or MZ-4 by Valspar Corp.

D. Welding rods:

1. Complying with the printed recommendations of the metal deck manufacturer and AWS D1.1.
2. Submit the manufacturer's recommendations to the Architect prior to starting the installation.

2.2 FABRICATION

A. Decking:

1. Of the types and profiles indicated on the Drawings formed in lengths to span 3 or more supports, unless otherwise indicated, with flush, telescoping, or nested ends, end laps and nesting side laps.
2. Composite decking shall have either mechanically fixed shear devices such as embossments, holes or welded buttons, or inverted triangular shaped ribs.
3. Fabricate decking supporting waterproofing membrane, roofing and elastomeric coating with vent tabs protruding and staggered in the low flutes, 12 in. maximum o.c., or other joint deformation, to provide a minimum 1.5% openings (uniformly distributed) of the total deck area for relief of vapor pressure; do not use vent tabs to support mechanical equipment.

B. Form end closures, column flashing, access hole covers and cover plates of sheet metal.

C. Hangers for suspended ceilings:

1. Lip tabs or integral tabs. Nothing shall be hung from metal decking itself or from tabs punched directly in metal decking.
2. Provide slots or holes punched in decking for installation of pigtail wires.

D. Form roof sump pans from a single piece of galvanized sheet steel of same quality as deck units.

1. Thickness shall be a minimum of 14 gage before galvanizing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate surfaces to receive steel decking and associated work and conditions under which work will be installed. Do not proceed until satisfactory conditions have been corrected in a manner complying with the Contract Documents and acceptable to the Installer. Starting of the work within a particular area will be construed as installer’s acceptance of surface conditions.

3.2 INSPECTION

A. Verify conditions and measurements affecting the work of this Section at site. Make sure that detrimental conditions are corrected before proceeding with installation.

3.3 INSTALLATION

A. Install decking and accessories in compliance with their manufacturer's recommendations and the approved shop drawings.

B. Coordinate and cooperate with other trades in locating decking bundles to prevent overloading of structural framework.

C. Place decking on supporting steel framework and adjust to final position with ends accurately aligned and bearing on supporting steel supports not less than 2in. before fastening permanently.

D. Do not stretch or contract side lap interlocks. Place decking in straight alignment for entire length of run of cells and with close alignment between cells at ends of abutting deck units,

E. Cut and fit decking and accessories around other work projecting through or adjacent to the decking as shown on the Drawings. Provide neat, square and trim cuts.

F. Place roof sump pans over openings in steel deck and weld to top decking surface.

1. Space welds at 12” o.c. maximum with a minimum of one weld at each corner.
2. Cut opening in bottom of pan for roof drain accurately.

G. Do not use decking for storage or working platforms until permanently secured.

1. Coordinate protection and bracing of metal decking used as runway for transporting concrete.
2. Verify that decking manufacturer's directions for protection are followed.

3.4 FASTENING

A. Side joints: Fasten interlocking side closures as noted on the Drawings.

3.5 OPENINGS

A. Provide openings required for work of other trades and which are not indicated on Drawings only upon approval of the Architect as to size, location and reinforcement. The cost of such openings and reinforcement for same shall be home by the Contractor.

B. Provide additional steel reinforcement and closure pieces as required for strength, Continuity of decking and support of other work as shown.

C. Reinforce openings as Indicated on the Drawings.

D. Fabricate metal closure strips, for openings between decking and other construction, of sheet steel of same quality as deck units. Form to configuration required to provide tight-fitting closures at open ends of cells of flutes and sides of decking.

1. Adjusting plates: Provide in locations too narrow to accommodate full-size deck units and install as recommended by the deck manufacturer and approved on the shop drawings.
2. End closures: Provide metal cover plates or joint tape at joints between decking sheets to be filled with concrete to prevent concrete leakage.
3. Column flashing: Provide between floor decking and columns which penetrate the deck. Field cut flashing to fit, and tack weld to decking and columns.
4. Access hole covers: Provide to seal holes cut in decking to facilitate welding of decking to structural supports.

3.6 ATTACHMENTS

A. Coordinate location, spacing and type of connections required to attach wood nailers, suspended ceilings and similar items to decking.

B. Drill decking as shown and as required by approved shop drawings.

3.7 CLEANING AND TOUCHING-UP

A. Remove slag from welds, clean to bright metal and touch-up with zinc-rich paint; also clean and touch-up with zinc-rich paint raw edges of deck cut for openings.

B. Welds over which concrete fill will be placed need not be slagged and painted.

3.8 FIELD QUALITY CONTROL

A. The Testing Agency employed by the Owner will inspect, and test where applicable, all field welding.

1. Testing Agency will furnish qualified inspectors.
2. Tests and inspections shall comply with Code requirements, as amended by Building Department regulations.
3. Testing Agency will inspect welds visually when operators are making welds at commencement of this work and after this work is completed, for penetration of weld metal, fusion, and general ability of operator. Defective welds shall be corrected in compliance with applicable provisions of AWS D1.1.
4. Testing Agency will be required to confirm welder's qualifications and to certify in writing upon completion of this work that the welding has been performed in compliance with Drawings and Specification requirements, Including the use of AWS qualified procedures, the manufacturer's recommended use of automatic equipment, and the use of preheat, if required, and with all applicable requirements of regulatory agencies having jurisdiction.

B. The Testing Agency will report on the results of the inspection.

C. In addition to the survey required of the structural steel frame In Section 05120, the Contractor's surveyor shall also provide a survey of the steel decking, to verify dimensions, elevations and tolerances. Deck edge closure strips shall be within 1/4 in. of the theoretical location shown on the Drawings.

END OF SECTION

10/02/2026

SECTION 057000

DECORATIVE METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Decorative metal screen.

1.2 COORDINATION

A. Coordinate installation of anchorages for decorative metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including finishing materials.

B. Shop Drawings: Show fabrication and installation details for decorative metal.

1. Include plans, elevations, component details, and attachment details.
2. Indicate materials and profiles of each decorative metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.

C. Patterns, Models, or Plaster Castings: Made from proposed patterns for each design of custom casting required.

D. Samples for Initial Selection: For products involving selection of color, texture, or design including mechanical finishes.

E. Samples for Verification: For each type of exposed finish.

1. Sections of linear shapes.
2. Full-size Samples of castings and forgings.

a. For custom castings, submit finished Samples showing ability to reproduce detail , cast-metal color, and quality of finish. Samples may be of similar previous work.

3. Samples of welded joints showing quality of workmanship and color matching of materials.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator powder-coating applicator.

B. Welding certificates.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing decorative metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Installer Qualifications: Fabricator of products.

C. Powder-Coating Applicator Qualifications: A firm experienced in successfully applying powder coatings of type indicated and employing competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
4. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups for the following types of decorative metal:

a. One panel.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store decorative metal in a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

B. Deliver and store cast-metal products in wooden crates surrounded by enough packing material to ensure that products are not cracked or otherwise damaged.

C. Inspect materials upon delivery for damage. Repair damage to be indistinguishable from undamaged areas; if damage cannot be repaired to be indistinguishable from undamaged parts and finishes, replace damaged items.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal by field measurements before fabrication and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Correct defective work within a one year period after Date of Substantial Completion.

B. Warranty: Manufacturer's standard one year warranty against defects in materials, fabrication, finishes, and installation commencing on Date of Substantial Completion.

C. Warranty on FEVE and PVDF finishes: Manufacturer's standard ten year warranty on finish.

PART 2 - PRODUCTS

2.1 DECORATIVE METAL FABRICATORS

A. Fabricator: Subject to compliance with requirements, provide products by the following:

1. BOK Modern, Inc.; www.bokmodern.com; pattern B27..

2.2 METALS, GENERAL

A. Metal Surfaces, General: Use materials with smooth, flat surfaces unless otherwise indicated. Use materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

2.3 ALUMINUM

A. Fabricate products from alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.

B. Plate and Sheet: ASTM B209, Alloy 5005-H32.

2.4 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:

1. Aluminum Items: Aluminum fasteners.

B. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.

C. Provide concealed fasteners for interconnecting components and for attaching decorative metal items to other work unless exposed fasteners are unavoidable.

1. Provide square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.

2.5 FABRICATION, GENERAL

A. Assemble items in the shop to greatest extent possible to minimize field splicing and assembly.

1. Disassemble units only as necessary for shipping and handling limitations.
2. Clearly mark units for reassembly and coordinated installation.
3. Use connections that maintain structural value of joined pieces.

B. Make up wire-rope assemblies in the shop to field-measured dimensions with fittings machine swaged.

1. Minimize amount of turnbuckle take-up used for dimensional adjustment so maximum amount is available for tensioning wire ropes.
2. Tag wire-rope assemblies and fittings to identify installation locations and orientations for coordinated installation.

C. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

E. Form simple and compound curves in bars, pipe, tubing, and extruded shapes by bending members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces.

F. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

G. Mill joints to a tight, hairline fit. Cope or miter corner joints. Fabricate connections that will be exposed to weather in a manner to exclude water.

H. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.

I. Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Cut, reinforce, drill, and tap as needed to receive finish hardware, screws, and similar items unless otherwise indicated.

J. Comply with AWS for recommended practices in shop welding and brazing. Weld and braze behind finished surfaces without distorting or discoloring exposed side. Clean

exposed welded and brazed joints of flux, and dress exposed and contact surfaces.

K. Provide castings that are sound and free of warp, cracks, blowholes, or other defects that impair strength or appearance. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.7 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 50 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: RAL 6021.

C. Superior-Performance Organic Finish: Three -coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: RAL 6021.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative metal.

B. Verify that dimensions of supporting structure are within plus/minus 1/8 inch (3.175 mm) of dimensions indicated on shop drawings.

C. Verify that painting, roofing, masonry work, and other adjacent work that might damage grille, screen or divider finish have been completed prior to start of installation.

D. Verify that anchorage devices have been properly installed and located.

E. Do not install until after all adjacent painting, roofing and masonry have been completed.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

G. Notify Architect immediately of conditions that would prevent satisfactory installation.

H. Do not proceed with work until detrimental conditions have been corrected.

I. Furnish components to be installed in other work to installer of that other work, including but not limited to blocking, sleeves, inserts, anchor bolts, embedded plates, and supports for attachment of anchors.

3.2 INSTALLATION, GENERAL

A. Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.

B. Comply with Drawings and manufacturer's written instructions.

C. Perform cutting, drilling, and fitting required to install decorative metal. Set products accurately in location, alignment, and elevation, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.

D. Set grilles level, plumb, with uniform joints, and in alignment with adjacent work as indicated.

E. Use manufacturer's hardware for connections.

F. Attach securely in place using anchorage devices and fasteners as approved by Engineer of Record.

G. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.

H. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

I. Install concealed gaskets, joint fillers, insulation, and flashings as work progresses.

J. Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.

1. Retain protective coverings intact; remove coverings simultaneously from similarly finished items to preclude nonuniform oxidation and discoloration.

K. Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal arc welding and requirements for welding and for finishing welded connections in "Fabrication, General" Article. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

L. Weld connections that cannot be shop welded due to size limitations.

1. Weld in accordance with AWS D1.1/D1.1M.
2. Match shop welding and bolting.
3. Clean welds, bolted connections, and abraded areas.
4. Touch up shop primer and factory-applied finishes.
5. Repair galvanizing with galvanizing repair paint per ASTM A780/A780M.

M. Field Brazing: Comply with requirements for brazing and for finishing brazed connections in "Fabrication, General" Article. Braze connections that are not to be left as exposed joints but cannot be shop brazed because of shipping size limitations.

N. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.3 FIELD QUALITY CONTROL

A. Field Services: Provide the services of the manufacturer for field observation of installation.

3.4 TOLERANCES

A. Maximum Variation From True Position: 1/8 inch (3 mm).

B. Maximum Offset From True Alignment: 1/8 inch (3 mm).

3.5 CLEANING AND PROTECTION

A. Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents, or other substances that may damage the material or finish.

B. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces. Touch-up damaged finish coating using material provided by manufacturer to match original coating.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

D. Protect finishes of decorative metal from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering at time of Substantial Completion.

E. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the

shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057000

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Revise subparagraphs below to suit Project.
2. Framing with dimension lumber.
3. Framing with engineered wood products.
4. Wood blocking**,** cants, and nailers.
5. Wood furring and grounds.
6. Wood sleepers.
7. Plywood backing panels.
8. Hold-down Anchor Tension System
9. Rough Hardware and Fasteners

1.2 RELATED SECTIONS

A. 06 16 00 SHEATHING

B. 06 11 13 PREFABRICATED WOOD TRUSSES, JOISTS, AND BEAMS

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
3. Include data for I-Joist Framing members from manufacturer.
4. Include data for Hold-down Anchor Tension System

B. LEED SUBMITTALS

1. First option in "Certificates for (Credit MR 6) (Credit MR 7)" Subparagraph below applies
to LEED-CS; second applies to LEED-NC, LEED-CI, and LEED for Schools.
2. Certificates for Credit MR 6: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification

requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.

3. "Product Data for Credit IEQ 4.4" Subparagraph below applies to LEED-NC, LEED-CI, and LEED-CS.
4. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that product contains no urea formaldehyde.
5. Laboratory Test Reports for Credit IEQ 4: For composite-wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
4. Power-driven fasteners.
5. Powder-actuated fasteners.
6. Expansion anchors.
7. Metal framing anchors.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Certified Wood: Materials shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship" for the following:

1. Dimension lumber framing.
2. Laminated-veneer lumber.
3. Parallel-strand lumber.
4. Prefabricated wood I-joists.
5. Rim boards.
6. Miscellaneous lumber.

B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-

writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Provide dressed lumber, S4S, unless otherwise indicated.

C. Maximum Moisture Content of Lumber:

1. 19 percent unless otherwise indicated.
2. 15 percent for joists and beams for floors with 2 or more levels above.

D. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

E. Application: Treat items indicated on Drawings, and the following:

1. Framing for raised platforms.
2. Framing for stages.
3. Concealed blocking.
4. Framing for non-load-bearing exterior walls.
5. Roof construction.
6. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.

1. Application: Interior partitions not indicated as load-bearing.
2. Species:
   a. Western woods; WCLIB or WWPA; Douglas Fir-Larch

B. Load-Bearing Interior Partitions: No. 2 stud grade or better

1. Application: Framing walls as indicated on the drawings.
2. Species:
   a. Douglas fir-larch (north); NLGA.

C. Exposed Framing: Provide material hand-selected for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.

1. Application: Exposed exterior and interior framing indicated to receive a stained or natural finish.
2. Species and Grade: As indicated above for load-bearing construction of same type.

2.5 ENGINEERED WOOD PRODUCTS

A. Engineered Wood Products, General: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.

1. Extreme Fiber Stress in Bending, Edgewise: As indicated on drawings.
2. Modulus of Elasticity, Edgewise: As indicated on drawings.

C. Wood I-Joists: Prefabricated units, I-shaped in cross section, made with solid or structural composite lumber flanges and wood-based structural panel webs, let into and bonded to flanges. Provide units complying with material requirements of and with structural capacities established and monitored according to ASTM D 5055.

1. Web Material: Either oriented strand board or plywood, complying with DOC PS 1 or DOC PS 2, as specified by the manufacturer.
2. Structural Properties: Provide units with depths and design values not less than those indicated.
3. Provide units complying with APA PRI-400, factory marked with APA trademark indicating nominal joist depth, joist class, span ratings, mill identification, and compliance with APA standard.

D. Rim Boards: Product designed to be used as a load-bearing member and to brace wood I-joists at bearing ends, complying with research/evaluation report for I-joists.

1. Material: All-veneer product.
2. Thickness: 1-1/4 inches (32 mm).
3. Provide performance-rated product complying with APA PRR-401, rim board grade, factory marked with APA trademark indicating thickness, grade, and compliance with APA standard.

2.6 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber of any species.

C. For concealed boards, provide lumber with 19 percent maximum moisture content and the following species and grades:

1. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA. Douglas Fir-Larch

2.7 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged and fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch (13-mm) nominal thickness.

1. Plywood shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.8 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Power-Driven Fasteners: NES NER-272.

C. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

2.9 HOLD-DOWN TENSION ANCHOR SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide products indicated on the drawings or approved equal.

B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.

1. Use for interior locations unless otherwise indicated.

D. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.

1. Use for wood-preservative-treated lumber and where indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

D. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

E. Hold-down Tension Anchor System: Install framing anchors system to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

F. Do not splice structural members between supports unless otherwise indicated.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

3.2 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

SECTION 061053

MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Concealed blocking and nailers.

B. Principal Products:

1. Lumber for blocking and nailers.
2. Wood panels for blocking and back boards.
3. Wood treatments.

1.2 ACTION SUBMITTALS

A. Product Data: Rough carpentry materials.

1. Wood preservative treatment.
2. Fire retardant treatment.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:

1. Store lumber indoors, protected from elements.
2. Store lumber elevated above grade, protected from moisture.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lumber: DOC PS 20. Grading rules certified by ALSC Board of Review.

1. Maximum Moisture Content: 19 percent.

B. Plywood: DOC PS 1, Exterior A-C, fire retardant treated.

1. Thickness: See Drawings and 1/2 inch, minimum.

C. Fire Retardant by Pressure Process:

1. Exterior Type: ASTM D2898.
2. Interior Type A: ASTM D3201, 28 percent maximum moisture content at 92 percent relative humidity.
3. Surface Burning Characteristics per ASTM E84.

a. Flame Spread: 25.
b. Smoke Developed: 50.

4. Labeling: Testing agency classification.
5. Kiln dry after treatment.

a. Lumber: 19 percent maximum moisture content.
b. Plywood: 15 percent maximum moisture content.

6. Applications:

a. Concealed blocking.
b. Plywood utility backing panels.
c. Roof blocking.
d. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
e. Items shown on Drawings.

D. Wood Preservative, Pressure Treatment: AWPA U1 Category UC2 and Category UC3b.

1. Applications:

a. Roofing and Exterior Wall Assemblies: Wood cants, nailers, curbs, and blocking; Category UC2.
b. Concrete and Masonry Adjacent: Wood plates, sills, blocking, and furring; Category UC3b.
c. Items shown on Drawings.

2. Kiln dry after treatment.

a. Lumber: 19 percent maximum moisture content.
b. Plywood: 15 percent maximum moisture content.

2.2 INSTALLATION ACCESSORIES

A. Fasteners and Anchors: ASTM A153/A153M hot-dip galvanized. or Type 304 stainless steel.

1. General: Follow requirements for wood member size and type.

a. Preservative Treated Wood: Type 304 stainless steel.
b. Other Applications: ASTM A153/A153M hot-dip galvanized.

2. Nails, Brads, and Staples: ASTM F1667.
3. Power-Driven Fasteners: NES NER-272.
4. Wood Screws: ASME B18.6.1.
5. Screws for Fastening to Metal Framing:

a. Cold-Formed Metal Framing: ASTM C954.
b. Other Metal Framing: ASTM C1002.

6. Anchors:

    a. Toggle bolt type for anchorage to hollow masonry.
    b. Expansion shield and lag bolt type for anchorage to solid masonry or concrete.
    c. Bolt or ballistic fastener for anchorages to steel.

B. Separation Layer: Butyl Rubber flashing sheet membrane.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set members level and plumb, in correct positions.

B. Place horizontal members crown side up.

C. Construct curb members of solid wood sections.

D. Space framing per Drawings or 16 inches on center.

E. Curb roof openings except where prefabricated curbs are used. Form corners by alternating lapping side members.

F. Coordinate curb installation with installation of decking and support of deck openings, roofing vapor retarder, and parapet construction.

G. Fasten plywood backing panels to substrate with fire retardant classification marking exposed to view; coordinate locations with equipment requiring backing panels.

H. Install continuous flexible flashing separator as follows:

1. Wood Preservative Treated Lumber: Between wood and metal decking.
2. Without Preservative Treatment: Between wood and concrete or masonry.

I. Follow AWPA M4 for site applied preservative treatment to cut surfaces of SBX preservative treated lumber.

3.2 PROTECTION

A. Protection: Protect SBX treated wood from weather. Apply EPA-registered borate treatment when inorganic boron treated wood becomes wet. Apply borate solution by spraying. Follow EPA-registered label requirements.

END OF SECTION 061053

SECTION 06 16 00
SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.
3. Subflooring.
4. Underlayment.
5. Sheathing joint and penetration treatment.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements.

B. LEED Submittals:

1. Certificates for Credit MR 6: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
3. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that product contains no urea formaldehyde.
4. Laboratory Test Reports for Credit IEQ 4: For adhesives and composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For following products, from ICC-ES:

1. Preservative-treated plywood.
2. Fire-retardant-treated plywood.
3. Foam-plastic sheathing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

2.2 WOOD PANEL PRODUCTS

A. Emissions: Products shall meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Certified Wood: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":

1. Plywood.
2. Oriented strand board.
3. Particleboard underlayment.
4. Hardboard underlayment.

C. Plywood: DOC PS unless otherwise indicated.

D. Oriented Strand Board: DOC PS 2.

2.3 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction, Use Category UC3b for exterior construction.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according ASTM D 5516 and design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high-temperature fire-retardant treatment is indicated, span ratings for temperatures up to 170 deg F (76 deg C) shall be not less than span ratings specified.

C. Kiln-dry material after treatment to a maximum moisture content of 19 percent.

D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

E. Application: Treat plywood indicated on Drawings.

2.5 WALL SHEATHING

A. Plywood Wall Sheathing: Exposure 1, Structural I sheathing.

B. Oriented-Strand-Board Wall Sheathing: Exposure 1, Structural I sheathing.

C. Paper-Surfaced Gypsum Wall Sheathing: ASTM C 1396/C 1396M, gypsum sheathing; with water-resistant-treated core and with water-repellent paper bonded to core's face, back, and long edges.

1. Type and Thickness: **Type X, 5/8 inch (15.9 mm)**] thick (see arch'l details).

D. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.

1. Type and Thickness: **Type X, 5/8 inch (15.9 mm)**] thick(see arch'l details).

E. Cellulose Fiber-Reinforced Gypsum Sheathing: ASTM C 1278/C 1278M, gypsum sheathing.

1. Type and Thickness: **Type X, 5/8 inch (15.9 mm)**] thick (see arch'l details).

F. Cementitious Backer Units: ASTM C 1325, Type A.

1. Thickness: **As indicated** (see arch'l details).

G. Extruded-Polystyrene-Foam Wall Sheathing: ASTM C 578, Type IV, with tongue-and-groove or shiplap long edges.

1. Thickness: **As indicated** (see arch'l details)..

H. Foil-Faced, Polyisocyanurate-Foam Wall Sheathing: ASTM C 1289, Type I or Type II, Class 2, rigid, cellular, polyisocyanurate thermal insulation. Foam-plastic core and facings shall have a flame-spread index of 25 or less when tested individually.

1. Thickness: **As indicated** (see arch'l details).

2.6 ROOF SHEATHING

A. Plywood Roof Sheathing: Exposure 1, Structural I sheathing.

B. Oriented-Strand-Board Roof Sheathing: Exposure 1, Structural I sheathing.

2.7 SUBFLOORING AND UNDERLAYMENT

A. Plywood Subflooring: DOC PS 1, Exposure 1, Structural I single-floor panels or sheathing.

2.8 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

2.9 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Division 07 Section "Joint Sealants."

B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

C. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

2.10 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 and ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."

D. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Combination Subfloor-Underlayment:

    a. Glue and nail to wood framing.
    b. Screw to cold-formed metal framing.
    c. Space panels 1/8 inch (3 mm) apart at edges and ends.

2. Subflooring:

    a. Glue and nail to wood framing.
    b. Screw to cold-formed metal framing.
    c. Space panels 1/8 inch (3 mm) apart at edges and ends.

3. Wall and Roof Sheathing:

    a. Nail or staple to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
    b. Space panels 1/8 inch (3 mm) apart at edges and ends.

4. Underlayment:

    a. Nail or staple to subflooring.
    b. Space panels 1/32 inch (0.8 mm) apart at edges and ends.
    c. Fill and sand edge joints of underlayment receiving resilient flooring immediately before installing flooring.

3.3 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to wood framing with screws.
2. Install boards with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
3. Install boards with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.

3.4 CEMENTITIOUS BACKER UNIT INSTALLATION

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.5 FOAM-PLASTIC SHEATHING INSTALLATION

A. Comply with manufacturer's written instructions.

B. Foam-Plastic Wall Sheathing: Install vapor-relief strips or equivalent for permitting escape of moisture vapor that otherwise would be trapped in stud cavity behind sheathing.

C. Apply sheathing tape to joints between foam-plastic sheathing panels and at items penetrating sheathing. Apply at upstanding flashing to overlap both flashing and sheathing.

3.6 PARTICLEBOARD UNDERLAYMENT INSTALLATION

A. Comply with CPA's recommendations for type of subfloor indicated. Fill and sand gouges, gaps, and chipped edges. Sand uneven joints flush.

1. Fastening Method: Glue and nail underlayment to subflooring.

3.7 HARDBOARD UNDERLAYMENT INSTALLATION

A. Comply with CPA's recommendations and hardboard manufacturer's written instructions for preparing and applying hardboard underlayment.

1. Fastening Method: Nail or staple underlayment to subflooring.

END OF SECTION 061600

SECTION 061713

LAMINATED VENEER LUMBER (LVL)

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Microlam Lumber.

B. Related work:

1. Division 6 for rough carpentry.

1.2 SYSTEM DESCRIPTION

A. Design requirements: Specified products shall be designed and manufactured to the standards set forth in the National Evaluation Service, Inc. (NES) Report No. NER-481, ICBO Evaluation Service Report No. ER-4979 or the Canadian Construction Materials Centre (CCMC) Report No. 12627-R.

1.3 SUBMITTALS

A. Data: Submit manufacturer's product data, specifications, typical installation details and other data for lumber, adhesives, fabrication process, preservative treatment and accessories as necessary to demonstrate compliance with the specified requirements.

B. Shop drawings:

1. Submit large scale, dimensioned drawings showing profiles, materials, member sizes, dimensions and hardware.
2. Show connections to adjacent construction. Furnish isometric drawings for conditions too difficult to illustrate in 2 dimensions.
3. Coordinate the shop drawings with the work of other trades that are part of, or will be incorporated into, the work of this section. Indicate work to be performed by other trades, including adjacent and abutting materials to which this work is to be secured.

C. LEED

1.4 QUALITY ASSURANCE

A. Uniformity: Obtain all structural composite lumber products used for the Project from the same manufacturer.

B. Manufacturer's qualifications:

1. Firm with minimum of 5 years experience in the production of specified products.
2. Obtain lumber only from a manufacturer who will send a qualified technical representative to the Project site before covering the work of this section to review installation.

C. Installer's qualifications: Firm and individuals with a minimum of 5 consecutive years experience in the installation of specified products on projects similar in material, design, complexity and extent to this Project, and whose work has resulted in applications with a record of successful in-service performance.

D. Certifications: Factory-mark all lumber delivered to the Project site with stamp indicating product type and grade, ICC Evaluation, manufacturer's name, plant number and the independent inspection agency's logo.

1.5 HANDLING

A. Delivery: Deliver materials to project site in original protective wrappings, clearly labeled with manufacturer's identification labels intact and legible, indicating manufacturer's name, brand, type, source of product, date of manufacture, and grade.

B. Storage: Store engineered wood products as shipped, in original wrappers, flat and off the ground on support blocks as recommended by the manufacturer, protected from sun and water.

1. Repair damaged or torn wrap with manufacturer's recommended repair tape.
2. Store away from direct sunlight, combustible materials and sources of heat.
3. Do not subject materials to abnormal heat, extreme dryness, humid conditions or sudden changes in temperature.

C. Handling:

1. Handle products to avoid damage.
2. To minimize checking, seal ends of lumber after trimming or cutting and before storing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of design is for "Microllam" laminated veneer lumber by Trus Joist / Weyerhauser, or equal.

2.2 MATERIALS

A. LVL lumber by one of the following:

1. Microllam LVL by Weyerhaeuser Company (basis of design). [ES-ESR-1387]
2. Versa-Lam by Boise Cascade Corp.[ESR-1040]
3. LP Solidstart LVL by Louisiana-Pacific Corp. [ESR-2403]
4. Pacific Woodtech LVL by Pacific Woodtech Corporation. [ESR-2909]
5. Redlam by Redbuilt. [ESR-2993]

B. Accessories:

1. Builder's rough hardware: As specified in Section 06 1000.

2. Metal framing accessories:
   a. Basis of design is for galvanized or cadmium-plated steel joist hangers, framing anchors, fasteners and other such connection devices shall be of standard manufacture, of the types indicated, by Simpson Co. Other acceptable manufacturers include the following:
      1) Harlen Metal Products, Inc.
      2) USP Structural Connectors.
      3) Or equal.
   b. Nails used with the framing accessories shall be those furnished by the manufacturer with the framing accessories.

C. End sealer: Manufacturer's standard transparent, colorless wood sealer, effective in retarding transmission of moisture at cross-grain cuts.

2.3 FABRICATION

A. Shop-fabricate lumber to the dimensions and profiles indicated, or required, in continuous lengths with all veneer grains oriented parallel to the member length, and in accordance with the reference standards.
   1. Each member shall be identified by a stamp indicating the product type and grade, ICC-ES evaluation report number, manufacturer’s name, plant number, date of fabrication, and the independent inspection agency’s logo.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine adjacent construction and supports.

B. Correct conditions detrimental to the proper and timely completion of this work before proceeding with installation.

3.2 INSTALLATION

A. General: Install in accordance with the Contract Drawings, the lumber manufacturer’s recommendations, the requirements of the authorities having jurisdiction and the following.
   1. Erect plumb, true, securely anchored, accurately aligned, with all required fastenings, accessories, etc.
   2. Align framing members to receive finished surfaces so the difference in plane between adjacent members is 1/8-inch or less at any point.
   3. Accurately cut and solidly fit to provide strong, rigid joints with full bearing for members. Shimming is not be permitted.
   4. Cut or notch sloping members as required in order to provide uniform bearing surfaces.

B. Connections: Comply with CBC requirements as follows:
   1. Lateral nail holding, bolts perpendicular to glue lines: Use CBC holding requirements for Douglas Fir.

2. Nailing: Requirements are based on 3/4-inch by 3-1/2-inches members.
   a. Parallel to glue lines: 4-inch O.C. minimum for 10d common nails; 3-inch O.C. minimum for 8d nails.
   b. Perpendicular to glue lines: In accordance with CBC requirements.
3. Bolts: Use malleable iron washers under bolt heads and nuts, tighten securely, ensure bolt threads do not bear on wood.
4. Lag screws: Use malleable washers under heads. Screw, do not drive, lag screws.

C. Cutting: Cut members as shown on the Drawings for passage of pipes, conduits, etc.
   1. Obtain Architect's permission prior to performing cutting not specifically shown.
   2. Unless otherwise detailed, or required by the authorities having jurisdiction, reinforce locations where cutting is performed with 1/8-inch by 3-inch by 18-inch galvanized steel straps punched for 10d nails at 6-inch o.c.

3.3 FIELD QUALITY CONTROL

A. Temporary construction loads that cause member deflections or stresses beyond design limits are not permitted.

B. Manufacturer shall conduct periodic on-site inspections of installation operations to verify the lumber manufacturer's recommended procedures are being followed.

END OF SECTION 061713

SECTION 066400

PLASTIC PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Laminated plastic wall paneling in janitor closets.

B. Principal Products:

1. Factory laminated plastic sheet panels.
2. Accessories.

C. Related Requirements.

1. Section 061053 Miscellaneous Rough Carpentry for wood furring.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Coordinate plastic paneling with the following:

a. Sections 061053 and 092116 for blocking and nailers.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
2. Initial selection color charts.

B. Shop Drawings:

1. Show panel layout, trim, measurements, corners, terminations, and other installation details.

C. Samples:

1. Panel Material: Manufacturer standard size for each color and texture.
2. Trims: Manufacturer standard size for each color and profile.
3. Assembly Samples: Corner detail with floor intersection, 8 inches in each direction, minimum.

1.4 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports: Manufacturer test results showing:

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1. Verification of flame and smoke resistance per UL testing.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For plastic wall panels and accessories.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Testing Agencies: Acceptable to the authority having jurisdiction.

B. Certifications: From Contractor for specified performance, sizes, and tolerances.

C. Field Samples: Install plastic paneling, 48 by 48 inches minimum size. Include panel joint and top trim in sample.

1.7 FIELD CONDITIONS

A. Ambient Conditions: Perform Work within following limitations:

1. Building enclosed and environmental systems maintaining design conditions for Owner occupancy.

PART 2 - PRODUCTS

2.1 FACTORY LAMINATED PLASTIC SHEET PANELS

A. Source Limitations:

1. Provide panels and trim from single manufacturer.

B. Factory Laminated Glass-Fiber-Reinforced-Plastic Paneling, WC-04: ASTM D5319 or ASTM D3841, gelcoat finished panels laminated to gypsum board.

1. Manufacturers and Products: See Finish Schedule on Drawings.
2. Panel Construction:

a. Gypsum Board: ASTM C1396, Type X, 5/8 inch.

2.2 ACCESSORY MATERIALS

A. Trims: Panel manufacturer standard material and profiles.

1. Panel joint trims.
2. Inside and outside corners.
3. Termination Trims: J molding.
4. Colors: Architect selected.

B. Adhesives: Panel manufacturer recommended product, complying with VOC limitations.

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C. Fasteners: Manufacturer recommended. Finish exposed fasteners to match panels.

D. Sealant: Mildew resistant silicone. See Section 079200.

E. Substrate Filler: Manufacturer recommended.

F. Substrate Primer: See Section 099000.

2.3 PERFORMANCE

A. Wall Panel Materials: USDA approved for incidental food contact.

B. Surface Burning: ASTM E84 Class A.

1. Flame Spread Index: 25, maximum.
2. Smoke Developed Index: 450, maximum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Verify substrates are ready to receive Work.

B. Preinstallation Testing: Test moisture content of substrate does not exceed the following:

1. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Masonry: 12 percent.
4. Wood: 15 percent.
5. Portland Cement Plaster: 12 percent.
6. Gypsum Board: 12 percent.

C. Gypsum Board: Verify that finishing compound is dried and sanded smooth.

3.2 PREPARATION

A. Removal: Remove wall coverings, loose or soluble paint, and other materials that would interfere with adhesive bond.

B. Fill cracks and smooth irregularities with filler, sand smooth. Vacuum clean surfaces.

C. Surface Appurtenances: Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings before preparing surfaces or finishing.

D. Conditioning:

1. Condition product prior to installation.

3.3 INSTALLATION

A. Install panels with full bond to substrate.

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B. Install trims.

C. Joints:

1. Vertical joints only.
2. Set joints 12 inches minimum from corners and terminations.
3. Fill joints with manufacturer recommended sealant product prior to installation of panels.

D. Remove excessive adhesive during installation.

E. Apply sealant to all trims, joints, and terminations per Section 079200.

3.4 CLEANING

A. Cleaning: Remove excess adhesive, dust, dirt, and other contaminants.

1. Clean panels with manufacturer recommended cleaner.

B. Reinstall wall plates and accessories removed before Work of this section.

END OF SECTION 066400

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SECTION 072100

THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Thermal insulation for building enclosure.

B. Principal Products:

1. Foam board insulation.
2. Fibrous board insulation.
3. Blanket insulation.
4. Loose fill insulation.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting one week, minimum, before starting Work of this Section.

1.4 ACTION SUBMITTALS

A. Product Data.

1.5 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports: Manufacturer test results showing:

1. Thermal performance.
2. Surface burning characteristics.
3. Combustibility.
4. Density.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:

1. Store insulation in dry location, protected from elements.
2. Handle insulation to prevent soiling and damage.
3. Foam Board: Protect combustible insulation against ignition.

PART 2 - PRODUCTS

2.1 FOAM BOARD INSULATION

A. Extruded Polystyrene Board: ASTM C578.

1. Manufacturers and Products:

a. Kingspan GreenGuard.
b. DuPont STYROFOAM.
c. Owens Corning FOAMULAR NGX.

2. Type IV, 25 psi, square edges.
3. Surface Burning Characteristics: ASTM E84.

a. Flame Spread Index: 25, maximum.
b. Smoke Developed Index: 450, maximum.

B. Extruded Polystyrene Drainage Board: ASTM C578.

1. Manufacturers and Products:

a. DuPont STYROFOAM PERIMATE.
b. Kingspan GreenGuard XPS Drainage Channel Board.

2. Type VI, 40 psi.
3. Edges: Shiplap or channel.
4. Outer Face: Fabricated with drainage channels.

C. Foil-Faced Polyisocyanurate Board: ASTM C1289, Type I, Class 1.

1. Manufacturers and Products:

a. Atlas Roofing Corporation EnergyShield Pro.
b. Carlisle Coatings & Waterproofing Inc R2+ SHEATHE.
c. DuPont THERMAX Insulation.
d. Hunter Panels Xci Foil.
e. Johns Manville AP Foil.
f. Rmax, Inc. ECOMAXci.

D. Glass-Fiber-Mat Faced Polyisocyanurate Board: ASTM C1289, Type II.

1. Manufacturers and Products:

a. Atlas Roofing Corporation EnergyShield CGF Pro.
b. Carlisle Coatings & Waterproofing Inc R2+ Matte.
c. Hunter Panels Xci CG.
d. Rmax, Inc Durasheath.

2. Class 1, Grade 2, 20 psi.

2.2 BLANKET INSULATION

A. Unfaced Mineral-Fiber Blankets: ASTM C665, Type I.

1. Manufacturers and Products:

a. Johns Manville TempControl Mineral Wool or MinWool Sound Attenuation Fire Batt.
b. Owens Corning Thermafiber Fire & Sound Guard Plus.
c. Rockwool COMFORTBATT.

2. Surface Burning Characteristics: ASTM E84.

a. Flame Spread Index: 25, maximum.
b. Smoke Developed Index: 50, maximum.

3. Combustion: Passes ASTM E136.
4. Postconsumer Plus One-Half Preconsumer Recycled Content: Five percent, minimum, or per AHJ.

B. Building Insulation Blankets: Thin, flexible, high-R insulation.

1. Manufacturers and Products:

a. BASF SLENTEX.

2. Thickness: 10 mm.
3. Thermal Resistance: R-9 per inch, minimum.

2.3 INSULATION ATTACHMENT

A. Insulation Adhesives: Products compatible with insulation and substrates, capable of securing insulation to substrate without damaging insulation or substrates.

B. Mechanical Fasteners: Insulation manufacturer recommended screws with integrated insulation-retaining washers for attachment through sheathing to metal framing.

C. Spindle-Type Adhered Anchors for Temporary Support During Installation: Galvanized steel plate with galvanized or copper-coated steel spindle.

1. Manufacturers and Products:

a. AGM Industries.
b. Gemco.
c. Gripnail.
d. Midwest Fasteners.
e. TRUFAST Walls.

2. Spindle Length: Suited to insulation depth.

D. Insulation-Retaining Washers: Galvanized steel self-locking washers.

1. Washer Size: Recommended by anchor manufacturer.

E. Insulation Standoffs: Galvanized steel spacer fit over spindle providing 3 inches space between insulation and substrate.

F. Anchor Adhesive: Type recommended by anchor manufacturer for substrate.

G. Wire Mesh: 20 gauge galvanized wire hex netting with 2 inch openings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates and remove projections and appurtenances that may damage insulation or inhibit adhesion.

3.2 INSTALLATION - GENERAL

A. Extend insulation to cover entire area shown to be insulated.

B. Insulate tightly around obstructions and penetrations.

C. Fill voids with compressed fibrous insulation.

D. Foam Board Insulation: Protect from extended sunlight exposure beyond manufacturers stated limits.

3.3 INSTALLATION OF CAVITY WALL INSULATION

A. Foam Board Insulation: Adhere insulation boards firmly against substrate. Butt units tightly.

B. Mineral-Wool Board Insulation: Mount insulation boards on fasteners. Butt units tightly.

1. Install washers to hold boards firmly against substrate.

3.4 INSTALLATION OF FRAMED WALL INSULATION

A. Blanket Insulation: Fill cavities between framing members with insulation. Snugly fit insulation.

1. Recessed Lighting Fixtures: Maintain 3-inch clearance between insulation and fixtures not rated for insulation contact.
2. Eave Ventilation: Install eave ventilation troughs between roof framing members at vented eaves.
3. Metal-Framed Wall Cavities over 96 Inches High:

a. Unfaced Blankets: Apply insulation fasteners to stud faces before installing insulation.

4. Wood-Framed Construction: ASTM C1320.

a. Rafter and Joist Installation: Support insulation 24 inches on center, maximum and within 12 inches of each blanket end.
b. Unfaced Blankets: Provide wire mesh, stapled or nailed to wood framing.

B. Loose-Fill Insulation: ASTM C1015. Fill cavity spaces to uniform density.

3.5 PROTECTION

A. Protect insulation from damage due to weather, ultraviolet radiation, physical abuse, and other causes. Provide temporary coverings or enclosures until permanent construction is completed.

END OF SECTION 072100

SECTION 072700

WEATHER BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Weather barriers in building enclosure assemblies.

B. Principal Products:

1. Vapor permeable fluid applied membrane weather barrier.
2. Transition sealers.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Coordinate weather barrier installation with roofing, wall openings, and waterproofing installation.

B. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting one week, minimum, before starting Work of this Section.
2. Additional Attendees:

a. Weather barrier substrate installers.
b. Installers of items penetrating weather barriers.
c. Adjacent roofing and waterproofing installers.
d. Installers of storefront, window, and doors.
e. Installers of cladding systems installed over weather barriers.
f. Testing agency.

3. Additional Agenda Items:

a. Substrate preparation.
b. Transition detailing.
c. Weather barrier protection and repair.
d. Weather barrier testing and inspection.

C. Sequencing Procedures:

1. Complete weather barrier installation after roofing.
2. Ultraviolet exposure. Do not expose weather barrier materials to sunlight longer than manufacturer recommends.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Weather barrier membrane.
2. Primers.
3. Preformed silicone seals.

B. Shop Drawings:

1. Locations and extent of weather barriers.
2. Termination conditions.
3. Gap and expansion joint bridging.
4. Interface with other assemblies and materials.
5. Outside and inside corners.
6. Penetration sealing.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates: Certify weather barrier membrane chemical and adhesive compatibility with adjacent and contacted materials.

B. Test and Evaluation Reports: Manufacturer test results showing:

C. Source Quality Control Submittals: Shop test and inspection reports.

D. Field Quality Control Submittals: Field test reports.

E. Qualification Statements: Installer.

1.5 CLOSEOUT SUBMITTALS

A. Warranty Documentation: For weather barrier.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Installers:

a. Weather Barrier Subcontractor: ABAA Accredited.
b. Individual Installers: Certified by Building Performance Quality Institute for the ABAA in accordance with its Site Quality Assurance Program.

2. Testing Agencies:

a. Whole Building Testing Agencies: Firm employing individual certified by ABAA per ISO 17024.

B. Preconstruction Mockup Testing: Test wall mockups. Complete testing 30 days, minimum, before scheduled field installation.

1. Air Leakage Testing: ASTM E1186 and ASTM E786 at 1.57 lb/sf ft.
2. Adhesion Testing: ASTM D4541.
3. Water Penetration Testing: ASTM E1105.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:

1. Store materials in their original undamaged packages in a clean, dry, protected location and within manufacturer recommended temperature range required.

1.8 FIELD CONDITIONS

A. Ambient Conditions: Perform Work within following limitations.

1. Ambient and Surface Temperature: Within manufacturer acceptable range.
2. Precipitation and Fog: None occurring.

1.9 WARRANTY

A. Installer Warranty:

1. Weather Barrier Assembly: Warrant against installation failure.

a. Failure includes product disintegration, loss of airtight seal, loss of watertight seal, and adhesion failure.
b. Warranty Period: Ten years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

A. Source Limitations: Obtain accessory products from same manufacturer as primary weather barrier.

2.2 VAPOR PERMEABLE FLUID APPLIED MEMBRANE WEATHER BARRIER

A. Weather Barrier: Synthetic polymer, fluid applied membrane.

1. Manufacturers and Products:

a. Carlisle Coatings & Waterproofing Fire Resist Barritech VP.
b. GCP Applied Technologies Perm-A-Barrier Liquid VPL.
c. Henry Company Air-Block 17MR.
d. Tremco ExoAIR 230.
e. W.R. Meadows AIR-SHIELD LMP.

2. VOC Content: 100 g/L, maximum.

B. Weather Barrier-1: Synthetic polymer fluid applied membrane.

1. Manufacturers and Products-1:

a. AVM Industries Aussie Shield 300-PLM.
b. Parex USA Weathertech WeatherSealVP AB LT.
c. Pecora Corporation XL-Perm.
d. PROSOCO R-Guard.
e. Sika Sikagard AWB 660.
f. W.R. Meadows AIR-SHIELD TMP.
g. Or approved equal.

2. VOC Content-1: 100 g/L, maximum.

2.3 VAPOR PERMEABLE SHEET MEMBRANE WEATHER BARRIER

A. Weather Barrier: Self-adhering membrane.

1. Manufacturers and Products:

a. 3M Air Barrier 3015VP.
b. Dorken Systems DELTA-VENT SA or S.
c. GCP Applied Technologies PERM-A-BARRIER VPS 30.
d. Henry Company Blueskin VP160.
e. VaproShield RevealShield SA or WrapShield SA.
f. W.R. Meadows AIR-SHEILD SMP.

2. Puncture Resistance: 40 lbf, minimum, per ASTM E154.

2.4 TRANSITION SEALERS

A. Preformed Silicone Seals: Low-modulus silicone extrusions.

1. Manufacturers and Products:

a. Dow Chemical DOWSIL Silicone Transition Strip.
b. GE Sealants US11000 UltraSpan.
c. Pecora Corp Sil-Span.
d. PROSOCO R-Guard SureSpan EX.
e. Tremco Spectrem Simple Seal.

2. ASTM C1518, Movement Class 200, Tear Class PT.
3. Color: Architect selected.
4. Adhesive: Preformed silicone seal manufacturer approved medium or low-modulus silicone sealant.

2.5 PERFORMANCE

A. Environmental Performance: Continuous weather resistive assembly acting in conjunction with adjacent materials to resist air and water leakage into the building and to function as a drainage plane for incidental moisture.

1. Air Infiltration:

a. Material: ASTM E2178, 0.004 cfm/sf at 1.57 lb/sq ft pressure differential,

maximum.
b. Assembly: ASTM E2357, 0.04 cfm/sf at 1.57 lb/sq ft.

2. Vapor Permeance: ASTM E96 Desiccant Method, 10 perms, minimum.

B. Fire Resistance:

1. NFPA 285: Tested as a component of a passing assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify surfaces are sound, dry, even, and free of contaminants.

B. Masonry: Verify joints are flush and completely filled and excess mortar is removed from veneer ties.

C. Sheathing: Verify corners, and edges are securely fastened, with fasteners set flush.

3.2 PREPARATION

A. Protection of In-Place Conditions: Mask and cover adjacent surfaces to protect from overspray.

B. Surface Preparation: Clean and prepare substrates.

1. Ensure that penetrating Work is in place and complete.
2. Remove loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants.
3. Fill cracks, joints, and gaps with weather barrier manufacturer recommended products.

C. Gypsum Sheathing:

1. Fill overdriven fastener holes.
2. Seal exposed cut edges.

D. Priming: Prime substrate.

3.3 INSTALLATION - GENERAL

A. Coordinate the installation of weather barrier membrane with other building elements.

1. Connect weather barrier to roofing and below grade waterproofing systems.
2. Connect and seal weather barrier material to exterior door, louver, and storefront systems.

B. Fluid Applied Weather Barrier Installation: Apply weather barrier system using manufacturer recommended minimum thickness and coats to provide building envelope continuity.

C. Sheet Membrane Weather Barrier Installation: Fasten sheet membrane to substrate; ensure continuous weather barrier configured to direct moisture to exterior.

D. Substrate Gaps and Joints: Bridge with manufacturer recommended transition membrane.

1. Seal around penetrations with termination mastic or sealant.
2. End of Day Procedure: Seal top edge of membrane with termination mastic.

3.4 FIELD QUALITY CONTROL

A. Inspections:

1. Correct and complete substrate preparation and priming.
2. Weather barrier continuity.
3. Weather barrier support against substrate.
4. Site conditions maintained within manufacturer limits.
5. UV Exposure below manufacturer limits.
6. Proper weather barrier installation.
7. Adjacent material compatibility.
8. Transitions at changes in direction and structural support at gaps have been provided.
9. Connections between assemblies completed correctly.
10. All penetrations have been sealed.

B. ABAA Installer Audits: Cooperate with ABAA testing agency. Allow access to Work areas and staging. Notify ABAA in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Do not cover Work of this Section until testing and inspection is accepted. Arrange and pay for site audits by ABAA to verify conformance with the material manufacturer instructions, the site Quality Assurance Program used by ABAA, and this section of the project specification.

C. Non Conforming Work: Make corrections or replace, and retest.

3.5 CLEANING

A. Cleaning: Clean spillage from adjacent construction.

3.6 PROTECTION

A. Protection: Protect weather barrier materials from damage until material is covered by permanent construction.

1. Install cladding materials before exceeding material UV exposure limit.

END OF SECTION 072700

SECTION 074113

METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Standing seam metal roof system.

B. Principal Products:

1. Manufactured metal roof panel system.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Coordinate installation of roofing system with air barrier and roof to wall connections.

B. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting one week, minimum, before starting Work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Roofing system components and finishes.
2. Underlayment.
3. Initial selection color charts.

B. Shop Drawings: Show material profile, seam spacing and details, fastening methods, flashings, terminations, and installation details.

1. Provisions for thermal expansion and contraction.
2. Fascia trim.
3. Hanging gutters and downspouts.
4. Snow guards.

C. Samples: Metal and finish, 8 by 10 inches, minimum.

1.4 INFORMATIONAL SUBMITTALS

A. Field Quality Control Submittals: Field inspection reports.

B. Manufacturer Reports: Field inspection reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal finish.

B. Manufacturer warranty documentation.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Installers: Specializing in sheet metal roof fabrication and installation, approved or trained by manufacturer.

B. Mockup: Construct mockup of sheet metal roofing of approximately 100 square feet; include associated attachments, flashings, joints and junctions, control or expansion joints, terminating items, and eave protection.

1. Locate mockup where acceptable to Architect.
2. Take minimum 8 megapixel photographs of installation stages to record concealed conditions. Make photographs available to Architect and Owner upon request.
3. Incorporate accepted mockup as part of Work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage. Provide waterproof coverings to prevent uneven weathering.

B. Prevent contact with discoloring or staining materials.

1.8 PROJECT CONDITIONS

A. Do not install underlayment at ambient or surface temperatures less than 40 degrees F.

B. Do not install panels on wet or frozen substrates.

1.9 WARRANTY

A. Roofing System: Warrant system against damage under design wind conditions and water leakage through roof system.

1. Make repairs to roofing system required due to defects in materials or workmanship resulting in water leakage into or through roofing system.
2. Include labor and materials necessary to make required repairs.
3. Not limited to specific dollar amount.
4. Warranty Period: 20 years.

B. Finish Warranty: Repair deteriorated finishes or replace components.

1. Deterioration includes the following:

a. Color Fading: More than 5 Hunter units per ASTM D2244.
b. Chalking: More than No. 8 rating per ASTM D4214.
c. Paint cracking, peeling or checking.

2. Warranty Period: Ten years.

PART 2 - PRODUCTS

2.1 MANUFACTURED METAL ROOF PANEL SYSTEM

A. Metal Roofing, RF-01: Architectural standing seam panel roofing system with snap-on seam covers.

1. Manufacturers:

a. AEP Span, as basis of design.
b. ATAS International, Inc. PC System.
c. Berridge Manufacturing Co.
d. Centria Architectural Systems.

2. Seam Height: Nominal 1-1/2 inch.
3. Seam Spacing: Nominal 16 inches.
4. Steel Panel System: ASTM E1514; galvanized steel, 0.028 inch thick minimum.
5. Panel Surface: Smooth.
6. Finish: PVDF coating system.

a. Color: See Drawings.

B. Panel Clips: Hot-dip galvanized steel designed to fit between two adjacent panels and secure both panels.

C. Panel Fasteners: Hot-dip galvanized steel.

D. Panel End Closures: Sponge neoprene, cut to fit panel configuration.

E. Sealant: Manufacturer recommended type.

2.2 MATERIALS

A. Coil Coated Galvanized Steel Sheet: ASTM A755/A755M; structural steel sheet, G90 zinc coating.

2.3 PERFORMANCE

A. Structural Design Criteria: See Structural Drawings.

B. Structural Loads: See Drawings and Applicable code compliant.

C. Withstand live loads stated on Structural Drawings without damage.

1. Deflection Limit: For wind loads, 1/180 of span, maximum.

D. Resist loads from design wind speed stated on Structural Drawings without damage, including uplift.

E. Wind Uplift Rating: UL 508 class UL-90.

F. Environmental Performance:

1. Air leakage: ASTM E1670, 0.06 cfm/sq ft, maximum, measured at reference differential pressure across assembly of 1.57 lb/sq ft.
2. Water Leakage: ASTM E1646, no water at 6.24 psf test pressure difference.
3. Expansion and Contraction: Withstand 120 degree F ambient and 180 degree F surface thermal cycling without failure.

2.4 INSTALLATION ACCESSORIES

A. Waterproof Underlayment: High temperature resistant, self-adhesive modified bitumen sheets recommended by manufacturer for use under metal roofing.

1. Manufacturers and Products:

a. Carlisle WIP 300HT.
b. GCP Applied Technologies Grace Ice and Water Shield HT.
c. Henry Company Blueskin PE200 HT.
d. Owens Corning WeatherLock Specialty Tile & Metal.
e. Polyglass Polystick P.

2.5 FABRICATION

A. Fabrication Standard: SMACNA Architectural Sheet Metal Manual.

B. Form pieces in longest practical lengths.

C. Hem exposed edges on underside 1/2 inch; miter and seam corners.

D. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

E. Fabricate flashing and termination trim from same material as roof panels.

F. Fabricate gutters from roof panel material per SMACNA recommendations.

G. Provide escutcheons for pipe and conduit penetrations.

2.6 STEEL FINISHES

A. Liquid Fluoropolymer Steel Sheet Coil Coatings: Three coat system, 70 percent PVDF resin by weight, minimum.

1. Pencil Hardness, ASTM D3363: HB - H.
2. Salt Spray Resistance, ASTM G85: 1,000 hours.
3. Humidity Resistance, ASTM D2247: 1,000 hours.
4. Dry Film Thickness: ASTM D1400: 0.25 mil primer coat 1.0 mil pearlescent color

coat.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect roof deck to verify deck is clean and smooth, free of depressions, waves, or projections, and properly sloped for drainage.

B. Verify deck is dry.

C. Verify joints in wood deck are solidly supported and fastened.

D. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set.

E. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

A. Fill knot holes and surface cracks with latex filler or cover with aluminum sheet to provide continuous support for underlayment.

B. Broom clean deck surfaces.

3.3 INSTALLATION OF SELF-ADHESIVE UNDERLAYMENT

A. Apply primer if recommended by manufacturer.

B. Starting at low edge, apply one ply of underlayment horizontally over substrate and parallel to roof edge.

C. Weather lap each strip 6 inches minimum over previous strip.

D. Lap ends 6 inches minimum.

E. Press laps with roller for flat, full contact seams.

F. Apply second layer of full-width material centered on valleys and ridges.

G. Press to full bond with substrate without voids, wrinkles, bridging, or fishmouths. Seal ends and edges.

H. Extend minimum 6 inches up adjacent vertical surfaces.

3.4 INSTALLATION OF SYNTHETIC UNDERLAYMENT

A. Apply synthetic underlayment over areas not covered by waterproof underlayment.

B. Lap over waterproof underlayment minimum 4 inches in direction of water flow. Lap adjacent sheets minimum 2 inches.

C. Lay sheets in straight rows parallel to roof edge, and without wrinkles or fishmouths.

D. Secure underlayment to deck as recommended for use with metal roofing.

E. Repair tears and punctures.

3.5 INSTALLATION OF METAL PANELS

A. Install panels aligned and plumb.

B. Fasten panels to support with concealed fasteners.

C. Where panels cannot be installed in single lengths, align horizontal lap seams with alternating lengths between adjacent panels.

D. Install trim to maintain visual continuity of system in flat surfaces free of buckling or oilcanning.

E. Apply trim and flashing with screws for secure, weatherproof performance.

1. Where fasteners have to be exposed on trim or flashings, use fasteners with heads finished to match panels and with neoprene washers.

F. Install joint sealers and gaskets to prevent water penetration.

G. Flash penetrations through roofing with metal trim to match panels:

1. Lap flashings over roof panels 12 inches minimum on all sides and seal with double bead of sealant.
2. Install metal draw band and sealant at top of pipe penetrations.
3. Install water diverters at uphill side of square and rectangular penetrations.

H. Installation Tolerances:

1. Variation from Location: Plus or minus 1/4 inch.
2. Variation from Plane: 1/4 inch in 10 feet.
3. Misalignment of Horizontal Lap Seams: 1/4 inch.

3.6 INSTALLATION OF RAIN DRAINAGE COMPONENTS

A. Hanging Gutters:

1. Join sections with lapped and sealed joints.
2. Attach gutters to eaves with gutter anchors space maximum 36 inches o/c.
3. Install watertight end closures.
4. Provide stainless steel beehive strainers in each outlet.

B. Downspouts:

1. Join sections with telescoping joints.
2. Attach downspouts with brackets that hold downspout 1 inch from wall; locate brackets with equal spacing that does not exceed 5 feet.

3.7 PROTECTION

A. Do not permit traffic over unprotected roof surface.

END OF SECTION 074113

SECTION 074616

ALUMINUM SIDING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Aluminum plank soffits.
2. Exterior aluminum trellis beams.

B. Principal Products:

1. Extruded aluminum plank soffits.
2. Extruded aluminum beams.
3. Extruded aluminum cladding.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Coordinate siding installation with air barriers, flashing, and other adjoining Work.

B. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting one week, minimum, before starting Work of this Section.
2. Additional Attendees: Installers; Subcontractors installing air and weather barriers, flashing, sealants, and adjoining Work.

1.3 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings:

1. Show siding layout.
2. Detail and locate methods of attachment, support clips, provisions for movement, flashing, trim, edge and field conditions, interface with adjacent materials, locations of cutouts or special shapes, and existing construction..

C. Samples:

1. Each aluminum siding type, size, and finish, 12 inch long sections.
2. Demonstrate color, pattern, and joints.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Materials:

1. Aluminum Siding: 10 percent of installed materials, but not less than two boxes of panels and trims each.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Installers: Manufacturer approved.

B. Mockups: Construct 5 foot by 5 foot minimum size. Demonstrate product interfaces, intersections, and terminations.

1. Mockups Location: Field.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:

1. Store products elevated above ground, within manufacturer's temperature and environmental limits, away from moisture, and protected from traffic and construction activities. Minimize on-site storage before installation.

1.7 FIELD CONDITIONS

A. Ambient Conditions: Perform Work within following limitations:

1. Temperature and Humidity: Within manufacturer published limits.
2. Precipitation: None occurring and none predicted within 24 hours.

B. Existing Conditions: Verify field measurements before fabrication. Show field measurements on Shop Drawings.

1.8 WARRANTY

A. Manufacturer Warranty:

1. Aluminum Siding: Warrant against product, installation, and total system failure.

a. Warranty Period: 50 years.

B. Finish Warranty: Repair deteriorated finishes or replace components.

1. Deterioration includes the following:

a. Color Fading: More than 5 Hunter units per ASTM D2244.
b. Chalking: More than No. 8 rating per ASTM D4214.
c. Paint cracking, peeling or checking.

2. Warranty Period: 15 years.

PART 2 - PRODUCTS

2.1 ALUMINUM PLANK SIDING SYSTEM

A. Aluminum Trellis Beam, ALM-02: Extruded aluminum beam.

1. Manufacturers and Products:

a. Longboard Link & Lock, as basis of design.lINK & lOCK
b. Alumination Architectural Products EcoFlex.
c. Knotwood Architectural Systems Cladding Panels.
d. Maibec ALU6F.

2. Beam Size: 8 inches by 15/8".
3. Surface: Smooth.
4. Sheen: Matte
5. Finish: Woodgrain powder coat.

a. Wood Appearance Architect selected color.

2.2 ALUMINUM PLANK SOFFIT SYSTEM

A. Aluminum Plank Soffits, HPL-03: Extruded aluminum planks.

1. Manufacturers and Products:

a. Longboard Tongue & Groove System, 6" V-Groove Plank, as basis of design."
b. Alumination Architectural Products EcoFlex.
c. Maibec ALU6F.
d. Knotwood Architectural Systems Cladding Panels.

2. Plank Size: 6 inch.
3. Surface: Smooth.
4. Sheen: Matte
5. Finish: Woodgrain powder coat.

a. Wood Appearance Architect selected color.

2.3 ALUMINUM CLADDING

A. Aluminum Cladding, ALM-03: Extruded aluminum

1. Manufacturers and Products:

a. Longboard Tongue & Groove, 4" V-Groove Plank, as basis of design.
b. Alumination Architectural Products EcoFlex.
c. Knotwood Architectural Systems Cladding Panels.
d. Maibec ALU6F.

2. Plank Size: 4 inch.
3. Surface: Smooth.

4. Sheen: Matte.
5. Finish: Woodgrain powder coat.

    a. Wood Appearance Architect selected color.

2.4 INSTALLATION COMPONENTS

A. Support Girt System: Thermally broken, sizes as shown on Shop Drawings.

1. Manufacturers and Products:

    a. Cascadia Windows & Doors Cascadia Clip.
    b. Cladiator SLOTTED-Z.
    c. SMARTci GREENGirt Clip.
    d. SFS Intec NVELOPE NV1.

2. Depth: See Drawings.
3. Fasteners: Corrosion resistant screws for anchorage to substrate.

B. Support Girt System-1: ASTM C645 Cold-formed steel framing, CP 90 coating; sizes and shapes shown on Shop Drawings.

1. Shape: Z-furring.
2. Fasteners-1: Corrosion-resistant screws for anchorage to substrate.

C. Fasteners: Manufacturer standard corrosion-resistant, nonstaining, nonbleeding fasteners compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.

D. Accessories: Manufacturer standard components as required for complete installation.

1. Starter channels.
2. J-tracks.
3. Outside and outside corners.
4. Finish caps, and end trims.

E. Flashing and Trim: Same metal and finish as wall panels.

2.5 PERFORMANCE

A. Fire Performance:

1. Surface Burning: 25, maximum per ASTM E84.
2. Smoke Developed Index: 450, maximum per ASTM E84.
3. Fire Rated Wall Assemblies: Testing agency listed assembly requirements.
4. Exterior Wall Testing: Wall assembly tested per NFPA 285.

B. Environmental Performance:

1. Expansion and Contraction: Withstand 120 degree F ambient and 180 degree F surface thermal cycling without failure.

2.6 MATERIALS

A. Aluminum Extrusions: ASTM B221, manufacturer recommended alloy and temper.

B. Aluminum Sheet: ASTM B209, manufacturer recommended alloy and temper.

C. Assembly Sealants: Silicone.

1. VOC Content: 250 g/L maximum.

D. Separation Coating: Bituminous paint; SSPC-Paint 12.

E. Concrete Anchors: Group 1 stainless steel expansion anchors.

2.7 FINISHES

A. Powder Coating: One coat fluoropolymer finish; AAMA 2604.

1. Manufacturers and Products:

a. IFS Coatings IFS 400SD.

2. Color: See Drawings.
3. Pattern: See Drawings.

B. Powder Coating-1: One coat fluoropolymer finish; AAMA 2605.

1. Manufacturers and Products-1:

a. IFS Coatings IFS 500FP.
b. Akzo Nobel Interpon.

2. Color-1: See Drawings.
3. Pattern-1: See Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Verify substrate installation and air barrier application is complete and tested per Section 072700.
2. Verify framing members are ready to receive aluminum siding.
3. Verify penetrating items are ready for cladding system installation.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Support Girt System: Install in orientation, sizes, and locations shown on shop drawings. Coordinate with continuous insulation.

C. Separation Coating: Provide isolation material as required per manufacturer.

3.3 INSTALLATION OF ALUMINUM PLANK SYSTEM

A. Install starter strips, inside and outside corners, edgings, soffit, drip, cap, sill and window/door opening flashings.

1. Install flashing with end dams. Lap joints minimum 6 inches and seal watertight. Secure flashing with non-penetrating anchorages.

B. Install outside corners, fillers and closure strips.

C. Install planks. Arrange joints in linear pattern.

D. Maintain joints true to line, tight fitting, and hairline.

E. Attach components in a manner not restricting thermal movement.

3.4 CLEANING

A. Remove protective material from factory finished aluminum surfaces.

B. Clean exposed surfaces. Remove excess sealants.

3.5 PROTECTION

A. Protect siding from contaminating substances and damage.

END OF SECTION 074616

SECTION 07 46 36
SOLID PHENOLIC PLANK SIDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Provide labor, materials, products, equipment, and services to complete the solid phenolic plank siding work specified herein. This includes, but is not necessarily limited, to:

1. Fabricated exterior rear-ventilated solid phenolic plank siding systems.
2. Water-resistive barriers.
3. Auxiliary materials required for complete installation.

B. Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole and may be directly applicable to this Section.

1. Related requirements provided below are for convenience purposes only.
   a. Section 07 21 00, Thermal Insulation: for provision of insulation.
   b. Section 07 27 00, Air Barriers: for provision of air barriers.
   c. Section 07 61 00, Sheet Metal Flashing and Trims: for provision of miscellaneous flashings and accessories.
   d. Section 07 92 00, Joint Sealants: for provision of joint sealants.

1.2 REFERENCE

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.

B. All reference amendments adopted prior to the Bid Closing date of this Project shall be applicable to this Project.

C. All materials, installation and workmanship shall comply with all applicable requirements and standards.

D. American Architectural Manufacturers Association

1. AAMA 501.2-15: Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems

E. American Society for Testing and Materials (ASTM)

1. ASTM A653 / A653M-20: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

2. ASTM B317/B317M-07(2015): Standard Specification for Aluminum-Alloy Extruded Bar, Rod, Tube, Pipe, Structural Profiles, and Profiles for Electrical Purposes (Bus Conductor)

3. ASTM C645-18: Standard Specification for Nonstructural Steel Framing Members

4. ASTM E2556/E2556M-10(2016) Standard Specification for Vapor Permeable Flexible Sheet Water-Resistive Barriers Intended for Mechanical Attachment

F. British European Standards

1. BS EN 438-2: 2016: High-pressure decorative laminates (HPL). Sheets based on thermosetting resins (usually called laminates) - Determination of properties

2. BS EN 438-6: 2016: High-pressure decorative laminates (HPL). Sheets based on thermosetting resins (usually called laminates)

G. International Organization for Standardization

1. ISO 178:2019: Plastics — Determination of flexural properties

2. ISO 9001:2015, Quality management systems

3. ISO 14001:2015, Environmental management systems

4. ISO 14025:2006, Environmental labels and declarations — Type III environmental declarations — Principles and procedures

H. US Green Building Council (USGBC)

1. LEED Version 4.0, LEED (Leadership in Energy and Environmental Design): LEED BD+C: Core and Shell Development

I. American Society for Testing Materials

1. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials

2. ASTM E330 Standard Test Method for Structural Performance of Exterior Curtain walls

J. California Department of Public Health (CDPH)

1. CDPH Standard Method v1.2–2017: Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2

K. California Department of Housing and Community Development

1. Wildland-Urban Interface (WUI) For Exterior Sidings and Sheathings

1.3 DEFINITIONS

A. Drained / back-ventilated rainscreen cladding (D/BV): Rainscreen system that deflects and drains off the majority of rainwater using the outermost surface of the wall. Joints are intended to withstand the kinetic action of wind-driven rain wind. However, no attempt is made to minimize leakage using pressure equalization or other methods.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct conference at Project site.

1. Meet with Owner, Architect, solid phenolic plank siding Subcontractor, solid phenolic plank siding manufacturer's representative, structural-support Subcontractor, and Subcontractors whose work interfaces with or impacts Solid Phenolic Plank Siding, such as doors, windows, and louvres Subcontractors.
2. Review and finalize construction schedule, as well as establish staffing, material, equipment, and facilities requirements to proceed with the work of this Section and avoid delays.
3. Review procedures necessary for solid phenolic plank siding installation, including manufacturer's written instructions.
4. Verify condition of sub-framing and supports, including alignment and connection to structural elements, and confirm that such framing meets manufacturer's acceptance criteria.
5. Conduct a review of flashing, penetrations, openings, and other special details that may impact solid phenolic plank siding installation.
6. Review regulations and requirements pertaining to insurance, certificates, as well as requirements for testing and inspections.
7. Confirm requirements for temporary protection of solid phenolic plank siding assemblies during and after installation.
8. Review and establish procedures for repairing siding planks that have been damaged during or after installation.
9. Maintain records of proceedings, including remedial measures and action items. Provide copy of meeting records to each participant.

B. Coordination: Coordinate work of this Section with Subcontractors providing rain drainage work, flashings, trims, sealants, and other adjacent components to ensure final installation is secure and free from air or water leakage beyond limits indicated in Contract Documents.

1.5 ACTION SUBMITTALS

A. Make Submittals in accordance with provisions indicated in Section 01 33 00, Submittal Procedures.

B. Product Data: Submit product literature and data sheets for solid phenolic siding planks indicating product features, performance criteria, physical dimensions, finishes and limitations.

C. Sustainable Design Submittals:

1. Building Product Disclosure and Optimization: To promote the use of environmentally and health-conscious construction materials, manufacturer must provide publicly available information as follows:

   a. Environmental Product Declarations (EPD): Submit Product-specific Type III EPD conforming to ISO 14025

   b. Health Product Declarations (HPDs): Submit documentation demonstrating chemical inventory of materials to at least 0.1% (1000ppm) and conforming to: Health Product Declaration Open Standard v2.2

2. Sourcing of Raw Materials: Submit Forest Stewardship Council (FSC) chain-of-custody certifications demonstrating that products are manufactured from certified wood sources that comply with forest certification standards.

3. Low-Emitting Materials:

   a. Submit certifications indicating compliance with general emissions evaluation per CDPH Standard Method v1.2 as specified in this Section.

   b. Submit composite wood evaluation and certifications for no-added formaldehyde (NAF) or ultra-low emitting formaldehyde (ULEF) composite-wood products per California Air Resources Board (CARB) composite wood products Airborne Toxic

   c. Control Measure (ATCM)

D. Shop Drawings: Show the following:

1. Solid phenolic plank siding manufacturing and installation details, including edge conditions, joints, profiles, corners, anchorages, attachment assembly, trims, flashings, closures, and accessories.

E. Delegated-Design Submittals: Submit Shop Drawings and submittals for solid phenolic siding that have been signed and sealed by a Professional Engineer licensed in the jurisdiction of the Project, and who is responsible for their preparation.

F. Samples: Submit samples minimum 305 mm (12 inches) in length by actual plank width for each exposed finish required. Include fasteners, closures, and other solid phenolic plank siding accessories.

1.6 INFORMATIONAL SUBMITTALS

A. Sample Warranties: Submit sample warranties for extended warranties indicated in this Section for Architect's review.

B. Test and Evaluation Reports: Submit copies of test and evaluation reports prepared by independent testing agencies acceptable to authorities having jurisdiction attesting to the conformity of solid phenolic plank siding with fire performance requirements stipulated in this Section.

C. Code Evaluation Reports: Submit ICC-ES or UES report validating conformity with appropriate chapters and clauses of the International Building Code.

D. Certificates:

1. Submit proof of manufacturer's ISO 9001 registration and compliance.

2. Submit proof of manufacturer's ISO 14001 registration and compliance.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: Submit solid phenolic plank siding maintenance data for inclusion in building's operation and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide Products from a manufacturer with minimum 10 years of experience and capable of providing solid phenolic plank siding systems that meet or exceed performance requirements indicated in this Section.

1. Manufacturer must be an ISO 9001 and ISO 14001 registered company.

B. Installer Qualifications: Provide competent installers who are trained and approved by manufacturer and have a minimum of five years' experience in the application of the Products, systems, and assemblies indicated in this Section.

C. Mock-ups: Construct mock-ups at Project site to validate decisions made through submittals, to show aesthetic qualities, and to establish benchmarks for quality of fabrication and installation.

1. Construct mockup of typical solid phenolic plank siding assembly including corner, soffits, supports, attachments, and accessories as indicated on Drawings

2. Mock-up at time of Substantial Performance of the Work: May be incorporated in the completed Work if intact and undamaged.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Conform to manufacturer’s written instructions for delivery, storage, and handling.

B. Deliver solid phenolic plank siding and accessories undamaged and undeformed. Provide protection to solid phenolic plank siding during transportation and handling.

C. Unload, store, and erect solid phenolic plank siding such way that are not bent, warped, twisted, or suffer other damage.

D. Store solid phenolic plank siding horizontally on platforms or pallets, covered with appropriate weathertight and ventilated covering. Provide protective polyethylene sheet between pallet and the first planks, as well as on top of stack.

E. Provide steel or nylon straps to secure planks to pallets to prevent them from moving. Protect edges and corners.

F. Store solid phenolic plank siding in a dry location with positive slope for water drainage. Do not store solid phenolic plank siding in contact with other materials that may discolor, dent, or otherwise affect them.

1.10 FIELD CONDITIONS

A. Weather Conditions: Begin installation only when current and anticipated weather conditions allow for proper assembly of solid phenolic plank siding in accordance with manufacturers' written instructions and warranty requirements.

1.11 WARRANTY

A. Extended Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty certificate, in which manufacturer undertakes to repair or replace components of solid phenolic plank siding systems that exhibit material defects within warranty period. Defects include, but are not limited to, spontaneous splitting, splintering, rot, or delamination caused by material or manufacturing flaws.

B. Manufacturer's warranty is in addition to, and does not supersede, any other rights that Owner may have under Contract Documents.

C. Warranty Period: Ten years from date of completion of solid phenolic plank siding installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design: Materials specified in this Section are based on “EasyMEG F1” Closed Joint Vertical as manufactured by ABET USA INC N48W37031 E. Wisconsin Ave PO Box 88 Oconomowoc, WI 53066 ;Tel: 1-800-223-2238; web: https://abetlaminati.com Locally represented by: Pacific Architectural Concepts- www.PAC-SoCal.com 310-600-7705

B. Substitution Limitations: No further substitutions are acceptable.

2.2 REGULATORY REQUIREMENTS

A. System Fire Propagation Characteristics: Solid phenolic wall panel system must be tested to and pass the requirements of NFPA 285.

1. Flaming on, or in wall assembly: not more than 2.75 m above opening.

2. Maximum heat flux during flame exposure on wall assembly: not more than 14.5 kW/m2 when measured at 3.5 m above opening.

B. Surface Burning Characteristics: in accordance with ASTM E84 with the following results:

1. Flame Spread Index (FSI): 10 or less.

2. Smoke Developed Index (SDI): 70 or less.

2.3 DESIGN/PERFORMANCE REQUIREMENTS

A. Engineering Design: Employ the services of a Professional Engineer licensed to practice in the jurisdiction of the Project, and carrying professional liability insurance, to design and certify solid phenolic siding assemblies, including their attachment to the building’s framing systems.

A. Structural Performance: Provide solid phenolic panel systems capable of withstanding the effects of the live and dead loads in accordance with requirements of ASTM E330:

1. Wind Loads: As indicated on Drawings, but not more than 62 psf (2.96 kPa) allowable transverse load.

2. Deflection Limits: no greater than 1/180 of the span.

B. Design system as a drained / back-ventilated rainscreen cladding. Provide minimum 25 mm (1 inch) air space behind siding unless otherwise indicated.

C. Design drainage system to allow free flow of water from wall's interior to the exterior. Provide flashings and accessories to prevent moisture from entering the wall or to divert it to the exterior. Ensure drained water does not discolor architectural finishes, pool in puddles, or create icicles.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

2.4 SUSTAINABILITY CHARACTERISTICS

A. General Emissions Evaluation: solid phenolic plank siding must be tested and proven to be compliant using the applicable exposure scenario per CDPH Standard Method v1.2–2017.

B. Composite Wood Evaluation: Composite wood, as defined by CARB ATCM, must demonstrate low formaldehyde emissions consistent with certification requirements for ULEF or NAF resins.

C. Wood components used in phenolic plank siding assembly must be FSC-certified.

2.5 SOLID PHENOLIC PLANK SIDING SYSTEM (HPL-01 & 02):

A. Provide exterior-grade compact solid phenolic siding planks conforming to BS EN 438-6 and NEMA LD3 (Grade CGS) consisting of a core layer fabricated from sheets of kraft paper impregnated with phenolic resins, and with the following minimum characteristics:

1. Accelerated Weathering Test: to ASTM G155; minimum 4,500 hours exposure with no cracking, checking, crazing or other factors that may affect performance after exposure.

2. Freeze-thaw testing: To ICC-ES AC92; Pass 10 freeze-thaw cycles cycling between 120 deg F to -20 deg F (49 deg C to -29 deg C)

3. Bond Strength: to ICC-ES AC92 ASTM C297; average tensile stress of minimum 10 psi (69 kPa) for all specimens.

4. Flexural Strength: to ICC-ES A92 and ASTM D1037. Average flexural strengths of freeze-thaw and wet specimens must minimum 60% of the average strength of dry-control specimens to pass.

5. Salt Spray Resistance: to ICC-ES A92 and ASTM B117; no deleterious effects such as cracking, checking, crazing, erosion, delamination, or any other distress that might affect performance as an exterior wall covering after 300 hours of exposure to salt solution.

6. Water Resistance: to ICC-ES AC92 and ASTM D2247; no deleterious effects such
as cracking, checking, crazing, erosion, delamination, or any other distress that might affect performance as an exterior wall covering after 14 days of exposure to water.

7. Fastener Pull-Through: to ICC-ES AC92 and ASTM D1037; average load of not less than 1442 lbs. (6.4 kN).

B. Plank Nominal Thickness: 8 mm (5/16 inch)

C. Attachment system: Manufacturer’s standard attachment system suitable for EasyMEG Closed Joint Horizontal or Vertical siding configurations.

D. Plank Dimensions: As indicated on Drawings.

E. Finish: Manufacturer’s standard UV-resistant single sided decorative. Consultant to select from Abet Laminati’s Standard collection in a SEI (satin) finish produced with FSC papers

F. Colors and patterns: Allow Architect to select colors and patterns from the following collections Abet Laminati’s EasyMEG collection.

2.6 AUXILIARY MATERIALS

A. Substructure: manufacturer’s standard clip system fabricated from aluminum extrusions as specified below and capable of providing joint aesthetic indicated in this Section.

1. Aluminum extrusions: Aluminum alloy to 6063-T5 or 6063-T6 J-channels and hat-channels conforming to ASTM B317 or ASTM B221 attached to existing building structure and designed to support cladding panels.

2. Material visible after assembly of siding planks: finished to be inconspicuous in final installation. Paint as required to be concealed behind open joints.

3. Basis-of-Design Products: EasyMEG By Abet Laminati Closed Joint Attachment system. EZMR EasyMEG Rail and EZMC clips for vertical and horizontal attachment.

B. Bird and Insect Screening: Aluminum mesh with minimum wire diameter of 0.012 inch (0.30 mm), painted as necessary to be concealed behind siding open joints. Screening must provide at least 50% open area.

C. Accessories: as required for full weather-tight siding system. Include starter strips, edge trims, flashings, closures, corner caps and similar components. Unless otherwise indicated, ensure accessories are fabricated from aluminum to match solid phenolic plank siding finishes.

D. Fasteners for Siding Planks: Stainless steel self-tapping screws or other fasteners suitable for withstanding design loads and stresses.

E. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal framing members to substrates.

F. Water Resistive Barrier (WRB): to ASTM E2556/E2556M, UV-Resistant, 3-layer tear-resistant spun-bonded polypropylene (PP) fabric. Product must be designed for application with open-joint cladding systems.

1. Acceptable Products:

a. “DELTA®FASSADE S” by Dörken Systems, Inc.

b. “Tyvek Commercial Wrap” or “Tyvek Commercial Wrap D” by Dupont

c. “WeatherMate” or “WeatherMate Plus” by Dow Chemical Company

d. “RevealShield” by VaproShield

e. “GreenGuard C500 Building Wrap”, “GreenGuard C2000 Building Wrap”, “GreenGuard Classic Wrap” (a.k.a. Lowes Housewrap), or “GreenGuard RainDrop 3d” by Pactiv Building Products

f. “R-Guard Spray Wrap” or “R-Guard MVP” by Prosoco.

G. Air Barrier/Vapor Retarder: As specified in Section 07 27 00, Weather Barriers.

H. Insulation: As specified in Section 07 21 00, Thermal Insulation.

2.7 FABRICATION

A. EasyMEG Plank siding must be provided in the US by The Manufacturer “Abet USA Inc”. No other fabricators are permitted.

B. Planks must be Made in the USA by Abet USA Inc

C. Planks to be provided free of defects and ready to install in the specified size.

D. Plank lines, breaks, and angles must be straight and true, with no warping or buckled surfaces.

E. Cut, sand and round edges to a smooth finish for any field cut Planks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, locations, and existing conditions to ensure compliance with required installation tolerances, solid phenolic plank siding supports, and other factors that might impact performance of the work.

B. Ensure framing, girts, angles, channels, studs, and other support components and attachments are installed within alignment tolerances specified by solid phenolic plank siding manufacturer.

C. Where applicable, verify that air-barriers, vapor-retarders, and water-resistive barriers have been properly installed over sheathing or backing substrate to prevent air infiltration or water penetration.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Commencement of work implies acceptance of in-place conditions.

3.2 PREPARATION

A. Install manufacturers supplied sub-framing, furring and other miscellaneous support members and anchorages according to solid phenolic plank siding manufacturer's written recommendations. Space sub-framing channels at interval indicated on reviewed Shop Drawings.

B. Install water resistive barrier behind solid phenolic siding planks in accordance with water resistive barrier manufacturer’s instructions.

3.3 SOLID PHENOLIC PLANK SIDING INSTALLATION

A. Install solid phenolic plank siding in accordance with the manufacturer's written instructions, in the orientations, sizes, and locations indicated on Drawings. Unless otherwise indicated in manufacturer’s installation instructions or on reviewed Shop Drawings, install siding planks perpendicular to supports.

B. Securely fasten solid phenolic plank siding and other components to structure, while allowing for thermal and structural movements.

C. Install accessories with positive attachment to building and with weathertight mounting. Coordinate installation with flashings and other components.

3.4 ERECTION TOLERANCES

A. Installation Tolerances: align solid phenolic siding planks within installed tolerance of 2 mm per m (0.08 inch per 3.3 feet) between fixing points, non-accumulative, on level, plumb, and location lines as indicated.

3.5 FIELD QUALITY CONTROL

A. Engage fabricator of products supplied under this Section to conduct a review of procedures including handling, installation, application, protection, and cleaning of products and provide written reports to Architect. Provide field services, which include product use recommendations and periodic site visits to ensure that products are installed according to the manufacturer's instructions.

1. Schedule site visits to review Work at the following stages:

    a. After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.
    b. Twice during progress of Work at 25% and 60% complete.
    c. Upon completion of Work, after cleaning is carried out.

2. Obtain reports promptly after field reviews are completed and submit to Architect.

B. Inspection and Testing Agency: Owner may engage a qualified independent testing agency to perform field tests and inspections.

1. Water-Spray Testing: After installation, test sample area as directed on-site by Architect for water penetration in accordance with AAMA 501.2.

2. Where tests and inspections reveal defective work, provide corrective measures promptly.

3. Additional tests and inspections, if required, will be performed at Contractor's expense to determine compliance of replaced or additional work with specified requirements.

3.6 CLEANING AND PROTECTION

A. Remove temporary protective covers and strippable films before installing solid phenolic plank siding. Where films are provided on both sides of siding planks, ensure both films are removed at the same time to avoid siding warpage.

B. Clean completed surfaces of solid phenolic plank siding according to manufacturer's instructions.

C. Following installation of solid phenolic plank siding, clean obstructions, dirt, and sealants from weep holes and drainage channels.

D. Replace broken or damaged solid phenolic plank siding that cannot be repaired successfully using finish touchup or equivalent minor repair operations.

END OF SECTION

SECTION 074646

FIBER-CEMENT SIDING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Fiber cement trim.

B. Principal Products:

1. Fiber-cement trim.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Coordinate siding installation with air barriers, flashing, and other adjoining Work.

B. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting one week, minimum, before starting Work of this Section.
2. Additional Attendees: Installers; Subcontractors installing air and weather barriers, flashing, sealants, and adjoining Work.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Materials, component profiles, fastening methods, jointing details, sizes, surface texture, finishes, and accessories.
2. Initial selection color charts.

B. Shop Drawings: Detail the following:

1. Fabrication and installation layouts.
2. Edge conditions at openings and corners.
3. Penetrations.
4. Flashing, trim and anchorage.

C. Samples:

1. Trim: 12 inch long by actual width.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Product Certificates: For type of fiber-cement siding and soffit.

B. Test and Evaluation Reports: Manufacturer and independent testing agency test results for fiber-cement siding.

C. Delegated Design Submittals:

1. Design for installation system, support girt system, and anchorage to substrate.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: Product and accessories, include in maintenance manual.

1.6 QUALITY ASSURANCE

A. Mockups: Construct fiber-cement wall panel installation10 foot by 10 foot. Demonstrate installation methods, product interfaces, intersections, and terminations.

1. Mockup Location: Field.

B. Qualifications:

1. Installers: All products listed in this section are to be installed by a single installer trained by manufacturer or representative.
2. Licensed Professionals: Licensed in California.

1.7 WARRANTY

A. Manufacturer Warranty:

1. Fiber-Cement: Warrant against product and installation failure.

a. Failure includes structural failure and deterioration of materials.
b. Warranty Period: Ten years.
c. Dollar Limit: None.

PART 2 - PRODUCTS

2.1 FIBER-CEMENT PANEL SIDING -

A. Fiber-Cement Trim: ASTM C1186, Grade II minimum, Type A.

1. Manufacturers and Products:

a. Nichiha Fiber-Cement NichiPanel VintageSmooth
b. JamesHardie Trim or Artisan Trim
c. Swisspearl Group Patina NXT.

2. Trim Sizes: See Drawings.
3. Thickness: 5/8 inch.
4. Texture: Smooth and Wood grain.
5. Finish: Factory baked on paint.

a. Color: See Drawings.

2.2 INSTALLATION COMPONENTS

A. Support Girt System: ASTM C645 Cold-formed steel framing, AISI S240 CP 90 coating, sizes and shapes shown on Drawings.

1. Shape: Hat channels.
2. Fasteners: Corrosion-resistant screws.

B. Starter Bars, Panel Clips, and Corner Clips: Panel manufacturer recommended products.

C. Fasteners: Type recommended by siding manufacturer; hot dip galvanized steel, heads colored to match fiber-cement finish.

D. Flashing: See Section 076200.

E. Sealant: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

F. Touch-Up Paint: Panel manufacturer recommended product, matching panel color.

2.3 PERFORMANCE

A. Delegated Design:

1. Delegate fiber-cement attachment design to installer licensed Structural Engineer.
2. Structural Design Criteria: See Structural Drawings.
3. Allowable Deflection: 1/240, maximum.

B. Fire Performance:

1. Surface Burning: 25, maximum per ASTM E84.
2. Smoke Developed Index: 50, maximum per ASTM E84.
3. Fire Rated Walls: Testing agency listed assembly requirements.
4. Exterior Wall Testing: Exterior wall assembly tested per NFPA 285.

C. Environmental Performance:

1. Expansion and Contraction: Withstand 120 degree F ambient and 180 degree F surface thermal cycling without failure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Verify substrate installation and air barrier application is complete and tested per Section 072700.
2. Verify framing members are ready to receive fiber-cement siding systems.

3. Verify penetrations are complete and securely fastened.

3.2 PREPARATION

A. Installation Direct to Sheathing:

1. Mark stud locations with chalk lines.
2. Install preservative treated wood furring behind fiber-cement products.

3.3 INSTALLATION - TRIM

A. Install trim plumb, level, and accurately aligned.

B. Apply sealant to joints between siding and trim and between trim pieces.

C. Face screw trim to sheathing.

D. Corners: Miter joints.

E. Paint field-cut edges to match factory finish.

3.4 CLEANING

A. Protect installed products. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION 074646

SECTION 075000

MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Fully adhered TPO membrane roofing system at roof gutter.

B. Principal Products:

1. TPO roofing.
2. Substrate boards.
3. Vapor retarders.
4. Roof insulation.
5. Cover boards.
6. Walkways.

1.2 REFERENCES

A. Definitions:

1. Roofing Terminology: See ASTM D1079 and the NRCA Roofing and Waterproofing Manual glossary.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Coordinate installation of roofing system with air barrier and roof to wall connections.

B. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting one week, minimum, before starting Work of this Section.
2. Additional Attendees:

a. Testing agency representative.
b. Substate installer.
c. Weather barrier installer.

3. Additional Agenda Items:

a. Preparation procedures.
b. Installation procedures.
c. Coordination and scheduling required with related Work.
d. Protection of construction and site.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Roofing membrane and accessory products.
2. Substrate board.
3. Vapor retarders.
4. Roof insulation and cover board.
5. Roof walkway material.
6. Initial selection color charts.

B. Shop Drawings: Include plans, elevations, sections, details, intersections with adjacent assemblies, terminations, and attachments, including:

1. Base flashings.
2. Membrane terminations.
3. Flat and tapered insulation, including cants and slopes.

C. Samples:

1. Membrane Sheet: 6 by 6 inch sample of each type and color.
2. Flexible walkway materials.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Statements:

1. Installer: Manufacturer authorization.

a. All products listed in this section are to be installed by a single installer with a minimum of five years demonstrated experience in installing products of the same type and scope as specified.

B. Certificates: Manufacturer affidavit that Project design and conditions have been reviewed and that the installation will be fully warrantable if correctly installed. This submittal may be in the form of a photocopy of manufacturer authorization to Installer to proceed with installation.

C. ICC-ES test and evaluation reports for roofing system components.

D. Product Test Reports for roofing system components, performed or witnessed by a qualified testing agency.

E. Source Quality Control Submittals: Shop test and inspection reports.

F. Manufacturer Reports: Field quality control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Roof system maintenance requirements.

B. Warranty Documentation: For complete roof system.

C. Project Plaque: Provide permanent sign or framed document with the following information attached to wall near primary access to main roof.

1. Roofing installer name, address, and telephone number.
2. Roofing system manufacturer name, address, and telephone number.
3. Starting date of warranty and length of warranty period.

1.7 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers: UL listed and FM Global approved for roofing system.
2. Installer: Licensed, authorized, or approved by roofing manufacturer to install manufacturer roofing system and provide full specified warranty.
3. Testing Agencies: A qualified firm that is approved, authorized, certified, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements: Store roofing system components protected from the elements, precipitation and standing water, freeze/thaw cycling, and protected from sunlight, if required.

1.9 FIELD CONDITIONS

A. Ambient Conditions: Perform Work within limitations recommended by manufacturer.

1.10 WARRANTY

A. Manufacturer Warranty: Warrant roofing system against failure.

1. Total System Warranty: Include primary roof membrane and substrate boards, vapor retarder, cover boards, flashings, and metal edge assemblies, and other components of roofing system.

a. Warranty Period: 20 years.
b. Dollar Limit: None.

PART 2 - PRODUCTS

2.1 COMPONENT MATERIALS

A. General: Provide components of roofing system recommended by manufacturer for a complete system.

1. Component Materials: Compatible with each other and adjacent materials.

B. Adhesive: Manufacturer standard water based bonding adhesive.

C. Flexible Flashing: Same material as roofing membrane, manufacturer recommended thickness.

D. Lap Joint Sealant: Manufacturer standard, color to match membrane.

E. Butyl Mastic: Manufacturer standard water stop mastic.

F. Termination Bars: Manufacturer standard stainless steel or aluminum, pre-drilled for included anchors.

G. Battens: Manufacturer standard, pre punched, steel sheet, with aluminum-zinc alloy or zinc coating.

H. Fasteners: Compliant with FM Global 4470 for corrosion resistance, including metal or plastic washers, and acceptable to roof system manufacturer.

I. Flashing Accessories: Prefabricated or field fabricated boots, corners, cones, pipe seals, and other shapes required for complete roof system installation, compatible with primary roof membrane.

1. Colors: Match roofing membrane color.

J. Accessories: Miscellaneous reinforcing, sealants, and other items recommended by manufacturer for complete roof system installation.

2.2 SUBSTRATE BOARDS

A. Substrate Board: ASTM C1177, gypsum core, glass-mat facing, water-resistant.

1. Manufacturers and Products:

a. Georgia-Pacific Corporation Dens Deck Prime with Eonic Technology.
b. National Gypsum Company Gold Bond Dexcell Glass Mat Roof Board.
c. USG Corporation Securock Gypsum-Fiber Roof Board.

2. Thickness: 5/8 inch, Type X.

B. Fasteners: FM Global 4470 compliant for corrosion resistance, including metal or plastic washers.

2.3 VAPOR RETARDER

A. Self-Adhering Sheet Vapor Retarder: ASTM D1970, polyethylene film with rubber asphalt adhesive, slip resistant surface, and paper backing.

1. Thickness: Minimum 30 mils.
2. Permeance: 0.1 perm, maximum.
3. Manufacturer may recommend priming with manufacturer standard primer.

B. Self-Adhering Sheet Vapor Retarder-1: Polyethylene film with butyl rubber adhesive, slip resistant surface, and paper backing.

1. Thickness: Minimum 30 mils.
2. Permeance: 0.1 perm, maximum.

2.4 ROOF INSULATION

A. General: Roof insulation, preformed boards, manufactured or approved by roof membrane manufacturer, manufacturer standard sizes, thicknesses as shown on Drawings.

B. Composite Molded Polystyrene Board Insulation: ASTM C578.

1. Density: Type IX, 1.8-lb/cu. ft. minimum density.
2. Factory-Applied Facer:

    a. Cellulosic fiber insulation, ASTM C208, Type II, Grade 2, asphalt coated, thickness 1/2 inch.
    b. Oriented strand board, DOC PS 2, Exposure 1, thickness 7/16 inch.

C. Tapered Insulation: Factory formed, tapered insulation boards, 1/4 inch per foot slope or as shown on Drawings.

D. Special Shapes: Provide preformed insulation shapes to form crickets, saddles, tapers, and other shapes to facilitate drainage.

E. Adhesive: Recommended by insulation manufacturer for adhering insulation layers together and insulation to substrate.

1. Adhesive Types: Asphaltic, asbestos free, cold applied or Single- or multi-component urethane low-rise, apply in bead or full-spread as recommended by manufacturer.

2.5 COVER BOARDS

A. Water Resistant Gypsum Board: ASTM C1177 or ASTM C1278, 1/4 inch thick, factory primed.

1. Manufacturers and Products:

    a. Georgia-Pacific Corporation DensDeck Prime with Eonic Technology.
    b. National Gypsum Company DEXcell FA Glass Mat Roof Board.
    c. USG Corporation Securock Gypsum-Fiber Roof Board.

2.6 SUSTAINABILITY CHARACTERISTICS

A. Roof Membranes:

1. Solar Reflectance Index: ASTM E1980; 78 minimum, based on testing of identical products by a qualified testing agency.
2. Energy Star Listing: Roofing system listed on the DOE ENERGY STAR Roof Products Qualified Product List for low slope roof products.
3. Energy Performance: ANSI/CRRC S100, roofing system minimum solar reflectance of not less than 0.70 and minimum emissivity of 0.75.

2.7 PERFORMANCE

A. Accelerated Weathering: ASTM G152, ASTM G154 or ASTM G155; withstand 2,000 hours of testing.

B. Impact Resistance: ASTM D3746 or ASTM D4272.

C. Compatibility: Roof system materials are to be compatible within themselves and with all adjacent material as installed.

D. Roof System Design: Certified by testing to FM 4474, UL 580 or UL 1897 to resist uplift pressures as shown on Structural Drawings.

E. FM Approvals Listing: Roofing system and components follow requirements of FM Global 4450 or FM Global 4470, and must be listed in FM Approvals RoofNav for Class 1 noncombustible construction. Materials are to retain FM Approvals markings.

F. Fire/Windstorm Classification: Class 1A-75.

G. Exterior Fire Test Exposure: ASTM E108 or UL 790 testing by a qualified testing agency, Class A, products marked as compliant by testing agency.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine and verify conditions for compliance with roof system manufacturer recommendations:

1. Substrate.
2. Roof openings and penetrations.
3. Curbs, nailers, and cants.

3.2 PREPARATION

A. Clean and prepare substrate per manufacturer written instructions.

B. Protect roof drainage and other equipment and surfaces from roofing materials.

C. Acoustical Deck Insulation: Install insulation strips in roof deck ribs per deck manufacturer instructions.

3.3 ROOFING INSTALLATION - GENERAL

A. Complete terminations, flashings, roofing installation, and temporary measures by end of each workday and during rain events.

B. Tie in to Existing Roof Systems: Use only compatible materials, maintaining weathertight condition and existing warranties.

3.4 INSTALLATION - SUBSTRATE BOARD

A. Install substrate boards with long sides perpendicular to roof slopes in straight lines, stagger end joints. Install with tight butt joints.

1. Fasten substrate board to top flanges of steel deck.
2. Fasten substrate board to steel deck flanges per FM Global RoofNav and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.

3.5 INSTALLATION - VAPOR RETARDER

A. Self Adhering Sheet Vapor Retarder: Prime substrate. Install self adhering sheet vapor retarder in place; lap side seams minimum 3-1/2 inches and ends minimum 6 inches. Seal laps by rolling.

B. Install vapor retarder to provide complete seal against air movement at penetrations and terminations.

3.6 INSTALLATION - INSULATION

A. Do not allow insulation to be exposed to precipitation or left exposed at the end of the workday.

B. Install tapered insulation under area of roofing to conform to slopes shown on Drawings.

C. Install insulation to required thickness. Install in layers with joints staggered from previous layer 6 inches in each direction, minimum.

D. Install insulation with long sides in straight rows with end joints staggered between rows, butt joints at edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.

1. Fit insulation by trimming, within 1/4 inch of nailers, obstructions, and penetrations.
2. Trim and fit insulation at roof drains.

E. Adhered Insulation: Install each layer of insulation adhered to substrate as follows:

1. Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly press insulation in place.
2. Set each layer of insulation in a uniform, full spread of insulation adhesive, firmly press insulation in place.
3. Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. Allow primer to dry.
4. Set each layer of insulation in a full coverage mopped layer of hot roofing asphalt, applied within plus or minus 25 deg F of manufacturer recommended temperature.

3.7 INSTALLATION - COVER BOARD

A. Install cover boards over insulation with long sides in straight lines and end joints staggered between rows. Offset joints from insulation layer below a minimum of 6 inches in each direction. Loosely butt cover boards together and fasten to roof deck.

1. Fasten cover boards per FM Global RoofNav for specified Windstorm Resistance Classification.
2. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.

3.8 INSTALLATION - ADHERED ROOFING MEMBRANE

A. Unroll roofing membrane and allow to relax before installing.

B. Start installation of roofing in presence of roofing system manufacturer technical personnel.

C. Align roofing to an accurate layout, maintaining side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply to substrate and underside of roofing as recommended by manufacturer. Do not apply adhesive at splice areas of roofing.

E. Hot Roofing Asphalt: Apply a solid mopping of hot roofing asphalt to substrate at temperature and rate required by manufacturer, and install fabric backed roofing. Do not apply adhesive at splice areas of roofing.

F. Mechanically fasten adhered roofing securely at terminations, penetrations, perimeters and other areas shown.

G. Apply roofing with uphill side laps overlapping lower layers with slope of roof deck where possible.

H. Repair tears, voids, lapped seams, or defects in roofing that do not follow requirements.

I. Spread sealant or mastic bed over deck drain flanges at roof drains, and securely seal membrane roofing in place with clamping ring.

3.9 MEMBRANE SEAMING

A. Heat Welded Seam Installation: Heat weld seams using methods and equipment recommended by membrane manufacturer.

B. Leave seams uncovered until they are inspected by manufacturer technical representative.

3.10 INSTALLATION - BASE FLASHING

A. Adhere flashings and flashing accessories to substrates.

B. Apply adhesive to substrate and underside of sheet flashing, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field formed inside and outside corners per roofing manufacturer recommendations.

D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets per manufacturer requirements. Seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate using termination bars.

3.11 FIELD QUALITY CONTROL

A. Field Tests and Inspections: Engage inspectors to perform tests and inspections and prepare reports. Allow inspectors access to Work areas.

1. Failed Test Retest Cost: Contractor responsibility.
2. Do not begin construction until inspectors have verified compliance of materials.
3. Do not use materials that fail tests and inspections.

B. Inspections: Continuous during application.

1. Substrate conditions.
2. Substrate preparation.
3. Vapor barrier application, if required.
4. Membrane application.
5. Flashings.
6. Protection components.
7. Penetrations and drainage components.
8. Furnish reports to Architect.

C. Flood Testing: ASTM D5957; flood test each contained roofing area for leaks before pacing overlying construction. Employ temporary containment components and assemblies, plug or dam drains, and flood with potable water.

1. Flood to an average depth of 2-1/2 inches minimum depth 1 inch maximum depth 4 inches.

    a. Maintain 2 inches of clearance to top of base flashing.

2. Flood each area for 24 hours.
3. After completing flood testing, repair leaks, then repeat flood tests.

    a. Continue to repair defects until roofing and flashings are watertight.

D. Final Roof Inspection: Arrange for roofing system manufacturer or testing agency to inspect completed roofing installation.

E. Repair or remove and replace roofing system components that fail tests or do not

follow requirements.

3.12 PROTECTING AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period.

B. Sweep roof surface; remove loose fasteners, rocks, and other items that might damage membrane.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075000

SECTION 076200

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Counterflashing at membrane roof systems.
2. Counterflashing at roof utility penetrations.
3. Roof drainage system flashing and components.
4. Flashing at exterior wall systems.

B. Principal Products:

1. Sheet metal flashing and counterflashing.
2. Roof drainage components.
3. Rainscreen flashing components.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting one week, minimum, before starting Work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Initial selection color charts.

B. Shop Drawings.

1. Show fabrication and profiles for each item.
2. Show base metals, thicknesses, and finishes.
3. Include attachment and connection details.
4. Include details for corners, changes in plane, expansion joints, and terminations.
5. Show locations of expansion joints.
6. Copings and Roof Edge Fascia Trim: Include NRCA tested design information.

C. Samples:

1. Gutters, Copings, and Roof Edge Fascia Trim: 12 inch lengths in required finish.
2. Coil-Coated Trim: 12 inch long sections in required finish.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Certify copings and roof edge fasciae trim are ANSI/SPRI/FM 4435 ES-1 tested and FM approved.
2. Certify low-slope roof gutters are ANSI/SPRI GT-1 tested.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: Sheet metal flashing, trim, and accessories.

B. Warranty Documentation: Coil-coated sheet metal finish.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Fabricators: Listed by UL, FM, or other agency acceptable to authority having jurisdiction to fabricate copings and roof edge fascia per NRCA tested designs to meet ANSI/SPRI/FM 4435 ES-1 securement requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:

1. Store sheet metal elevated above grade, protected from precipitation and stormwater runoff.
2. Handle fabrications to prevent twisting, bending, and abrasion.
3. Prevent contact with materials causing discoloration or staining.

1.8 WARRANTY

A. Include roof edges, coping, and gutters in warranty for roofing system specified in Section 075000.

B. Finish Warranty: Repair deteriorated finishes or replace components.

1. Deterioration includes the following:

a. Color Fading: More than 5 Hunter units per ASTM D2244.
b. Chalking: More than No. 8 rating per ASTM D4214.
c. Paint cracking, peeling or checking.

2. Warranty Period: Ten years.

C. Installer Warranty:

1. Sheet Metal Fabrications: Warrant against installation failure.

a. Failure includes damage by wind under stated design speed or thermal movement.
b. Warranty Period: Two years.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

A. Performance Requirements:

1. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim are not to rattle, leak, or loosen, and are to remain watertight.
2. Self-Adhering Flexible Flashing Performance: Self-adhering flexible flashing shall meet minimum performance requirements when tested according to AAMA 711.

B. Design Wind Load Criteria: See Structural Drawings.

C. Environmental Performance:

1. Expansion and Contraction: Withstand thermal cycling over 120 degrees F ambient and 180 degrees F on material surfaces.

2.2 MATERIALS

A. Galvanized Steel Sheet: ASTM A653; structural steel sheet, G90 zinc coating.

1. Finish: Two coat fluoropolymer.
2. Color: Architect selected; standard.

B. Stainless Steel Sheet: ASTM A240; Type 304, dead soft fully annealed.

1. Surface: Smooth.
2. Finish: 2B.

2.3 ACCESSORIES

A. Fasteners for Metals Other Than Aluminum: Same material and finish as item being fastened, with soft neoprene washers where exposed.

B. Solder: ASTM B32; type suitable for application and material being soldered.

C. Synthetic Underlayment: Manufactured roof underlayment sheets meeting ICC-ES AC188 acceptance criteria. Supply recommended fasteners.

1. Manufacturers and products:

a. GCP Applied Technologies TRI-FLEX XT.
b. Owens Corning Duck Defense High Performance Roof Underlayment.
c. Tamko Building Products Synthetic Guard Plus.

D. Waterproof Underlayment: Self adhesive sheets manufactured to withstand high temperature below metal components; minimum 30 mils thick. Supply recommended

primer.

1. Manufacturers and Products:

    a. Carlisle Coatings & Waterproofing Inc CCW WIP 300HT.
    b. GCP Applied Technologies Vycor Self-Adhered Flashing.
    c. Henry Company Blueskin PE200 HT.
    d. Owens Corning WeatherLock Specialty Tile & Metal.
    e. Polyguard Products, Inc. Deck-Guard HT Roofing & Watershield Underlayment.

E. Slip Sheet: Rosin-sized building paper.

F. Concealed Sealant: Butyl, ASTM C1311.

1. Manufacturers and Products:

    a. Pecora Corporation BA-98.
    b. Tremco Butyl Sealant.

G. Exposed Sealant: See Section 079200.

H. Separation Coating: Bituminous paint; SSPC-Paint 12.

I. Plastic Cement: ASTM D4586, Type I.

J. Surface-Applied Reglets: Extruded aluminum with bottom edge drip and top edge sealant recess. Supply with stainless steel screws with neoprene washers and anchorage devices appropriate to substrate.

2.4 FABRICATION

A. Fabrication Reference Standards:

1. SMACNA Architectural Sheet Metal Manual.
2. NRCA Roofing Manual.

B. Form section shapes shown on Drawings, accurate in size, square, and free from distortion or defects.

C. Fabricate cleats of same material as sheet metal, interlocking with sheet.

D. Hem exposed edges on underside 1/2 inch; miter and seam corners.

E. Moving Joints: Sealed lapped, bayonet-type, or interlocking hooked seams.

F. Non Moving Joints: Sealed watertight.

G. Fabricate corners, changes in plane, and terminations in shop with minimum 18 inch legs.

H. Counterflashing:

1. Material:

    a. Galvanized Steel; 0.022 inch base metal thickness.
    b. Stainless Steel: 0.019 inch thickness.

2. Fabricate to extend minimum 4 inches over protected construction, with hemmed bottom drip edge.
3. Shop fabricate interior and exterior corners.

I. Gutters:

1. Material:

    a. Galvanized Steel; 0.022 inch base metal thickness.
    b. Stainless Steel: 0.019 inch thickness.

2. Profile: See Drawings.
3. Expansion Joints: Maximum 50 feet on center.
4. Outlets: Beehive strainers of stainless steel wire.

J. Conductor Heads: Fabricate with joints sealed watertight.

1. Material:

    a. Galvanized Steel; 0.022 inch base metal thickness.
    b. Stainless Steel: 0.019 inch thickness.

K. Roof Edge Fascia Trim: Fabricate per NRCA details for tested designs.

1. Material:

    a. Galvanized Steel; 0.022 inch base metal thickness.
    b. Stainless Steel: 0.019 inch minimum thickness.

2. Length: 8 to 12 feet long units.
3. Joints: Overlap 4 inches.
4. Scuppers: Fabricate fascia with scuppers that extend 4 inches beyond fascia and have drip edge.

L. Copings: Fabricate per NRCA details for tested designs.

1. Material:

    a. Galvanized Steel; 0.022 inch base metal thickness.
    b. Stainless Steel: 0.019 inch minimum thickness.

2. Length: 8 to 12 feet long units.
3. Joints: Butt joints with 12 inch concealed backing plate.

M. Steep Slope Roofing Fabrications:

1. Material:

a. Galvanized Steel; 0.022 inch base metal thickness.
b. Stainless Steel: 0.019 inch thickness.

2. Eave and Rake Flashing: Extend 2 inches onto roof sheathing and 1/4 inch below sheathing.
3. Valley Flashing: 24 inch minimum sheet width.

2.5 METALLIC-COATED STEEL FINISHES

A. Liquid Fluoropolymer Steel Sheet Coil Coatings: Two coat system, 70 percent PVDF resin by weight, minimum.

1. Pencil Hardness, ASTM D3363, HB - H.
2. Salt Spray Resistance, ASTM G85, 1,000 hours.
3. Humidity Resistance, ASTM D2247, 1,000 hours.
4. Dry Film Thickness: ASTM D1400, Paint system manufacturer recommended.

B. Silicone Polyester Coatings: Manufacturer standard process, epoxy primer and silicone polyester topcoat.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that roof openings, penetrations, and curbs through roof are solidly set, reglets in place, and nailing strips located.

B. Verify that roofing base flashings are in place, sealed, and secure.

3.2 PREPARATION

A. Paint concealed uncoated metal surfaces with 15 mil minimum thickness separation coating.

3.3 INSTALLATION

A. Installation Reference Standards:

1. SMACNA Architectural Sheet Metal Manual.
2. NRCA Roofing Manual.

B. Install flashing with concealed fasteners.

C. Secure fabrications with concealed fasteners where possible.

D. Apply plastic cement between metal and bituminous materials.

E. Separate dissimilar metals with separation coating or non absorptive gaskets.

F. Underlayment:

1. Synthetic: Install and adhered according to manufacturers instructions.

2. Self-Adhered: Prime surfaces and install according to manufacturers instructions.

G. Slip Sheet: Apply on top of underlayment prior to installing sheet metal flashing work.

H. Counterflashing: Install counterflashing in contact with base flashing.

1. Anchor counterflashing in reglets with wedges and apply sealant to joint per Section 079200.
2. Drill counterflashing installed with surface mounted reglets so that anchorage fasteners go through the sheet metal. Apply sealant to back side of top edge and fasten reglet to wall construction. Apply sealant to top edge per Section 079200.
3. Lap ends of counterflashing minimum 6 inches.

I. Secure gutters in place and install strainers in outlets.

J. Edge Fascia Trim: Coordinate installation with roofing system to provide watertight protection for wall.

1. Install trim in straight lines with accurately aligned profiles.
2. Apply sealant to both edges of backing plates at joints.
3. Install anchorage base and cleats with screws.
4. Install fascia with continuous cleat.
5. Install covers with full engagement of anchorage cleats and uniform joint width.

K. Copings: Coordinate installation with roofing system to provide watertight protection for wall.

1. Install copings in straight lines with accurately aligned profiles.
2. Apply sealant to both edges of backing plates at joints.
3. Install anchorage base and cleats with screws.
4. Install outer edge with continuous cleat.
5. Install covers with full engagement of anchorage cleats and uniform joint width.

3.4 CLEANING

A. Remove soiling, stains, and hand prints.

B. Uncoated Galvanized Steel Sheet: Remove substances that would impair paint bond.

END OF SECTION 076200

SECTION 077100

ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Roof specialties.

B. Principal Products:

1. Manufactured roof edge systems.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Coordinate work results of this Section with roofing and wall air and water barrier membrane for continuity of protection against water and air infiltration.

B. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting in conjunction with roofing preinstallation meeting.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Manufactured coping system; include factory-fabricated termination and transition shapes.
2. Manufactured edge securement trim for low slope roofing; include factory fabricated termination and transition shapes.
3. Initial selection color charts.

B. Shop Drawings: Show profiles and dimensions, joining methods, accessory item locations, anchorage and flashing details, and adjacent construction interfaces.

C. Samples: Specified metal and finish.

1. Coping Covers: 12 inches long, minimum.
2. Edge Securement Trim: 12 inches long, minimum.

1.4 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports: Manufacturer test results showing wind uplift resistance as tested per ANSI/SPRI/FM 4435 ES-1.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Warranty documentation.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Section 075000 roofing system installer.

B. Mockups: Provide components for exterior wall mockup assemblies.

1. Approved mockups establish work results standard.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Prevent deformation, abrasion, and other damage during handling and installation.

B. Remove strippable finish protection film when recommended by manufacturer.

1.8 FIELD CONDITIONS

A. Existing Conditions: Verify field measurements before fabrication. Show field measurements on Shop Drawings.

1.9 WARRANTY

A. Include roof specialties in roof system warranty specified in Section 075000.

B. Manufacturer Warranty: Warrant against product and installation failure.

1. Failure includes products blowing off, deforming, leaking, or causing membrane roofing failure when exposed to specified wind conditions.
2. Warranty Period: 20 years.

C. Finish Warranty: Repair deteriorated finishes or replace components.

1. Deterioration includes the following:

a. Color Fading: More than 5 Hunter units per ASTM D2244.
b. Chalking: More than No. 8 rating per ASTM D4214.
c. Paint cracking, peeling or checking.

2. Warranty Period: Ten years.

PART 2 - PRODUCTS

2.1 MANUFACTURED ROOF EDGE SYSTEMS

A. Roof Edge Requirements: Engineered systems tested per ANSI/SPRI/FM 4435 ES-1 for roofing membrane securement.

B. Manufactured Coping System: Snap-on cover with concealed gasketed splice plates that accommodate thermal movement and drain water out of system.

1. Manufacturers:

    a. ATAS International.
    b. Carlisle Drexel Metals.
    c. Hickman Edge Systems.
    d. Metal-Era.

2. Configuration: Full width of wall and Cantilever system extending over wall cladding.
3. Cover Material: Aluminum, Galvanized steel, and Stainless steel sheet, smooth finish.
4. Cover Thickness: 0.063 inch.
5. Cover Finish: PVDF coil coating, Clear anodized, and Color anodized.
6. Cover Profile: See Drawings.
7. Cover Face: Drip edge.
8. Cover Dimensions: See Drawings.
9. Securement: Continuous cleats.
10. Anchorage Fasteners: Stainless steel screws.
11. Accessories: Factory fabricated units for terminations and changes in direction or plane.

C. Manufactured Roof Edge Trim: Snap-on cover with concealed gasketed splice plates that accommodate thermal movement and drain water out of system; no exposed fasteners.

1. Manufacturers:

    a. ATAS International.
    b. Carlisle Drexel Metals.
    c. Hickman Edge Systems.
    d. Metal-Era.

2. Profile: Drip edge.
3. Cover Material: Aluminum, Galvanized steel, and Stainless steel sheet, smooth finish.
4. Cover Thickness: 0.063 inch.
5. Cover Finish: PVDF coil coating, Clear anodized, and Color anodized.
6. Cover Dimensions: See Drawings.
7. Securement: Continuous cleats.
8. Anchorage Fasteners: Stainless steel screws.
9. Accessories: Factory fabricated units for terminations and changes in direction or plane.

D. Metal Perimeter Blocking System: Galvanized steel deck anchorage blocking with prepunched holes and associated fasteners.

1. Manufacturers and Products:

a. Hickman Edge Systems LLC EdgeBox-RI.

2.2 PERFORMANCE

A. Structural Loads: See Structural Drawings and Applicable code compliant.

B. Environmental Performance:

1. Expansion and Contraction: Accommodate 180 degree F surface and 120 degree F ambient temperature differential without failure.

2.3 STAINLESS STEEL FINISHES

A. Stainless Steel: 2B.

2.4 ALUMINUM FINISHES

A. Color Coating: Two coat fluoropolymer finish with minimum 70 percent PVDF resin by weight in color; AAMA 2605.

1. Color: Architect selected.

B. Anodizing: AAMA 611 Class I or AAMA 612 with electrodeposition organic seal.

1. Color: Clear or Architect selected.

2.5 GALVANIZED STEEL FINISHES

A. Coil Coating, Non-Metallic: Two coat fluoropolymer finish with minimum 70 percent PVDF resin.

1. Color: Architect selected.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify wood blocking for support and anchorage is positioned correctly, securely fastened, level, and in plane.

B. Verify installation surfaces are clean, dry, and free of foreign matter.

C. Verify wall air barrier membrane extends under roof membrane flashing on the anchorage blocking.

D. Verify roof membrane flashing extends over anchorage blocking and is securely fastened to the blocking.

3.2 INSTALLATION

A. Install roof specialties to provide weatherproof performance and prevent water intrusion into building enclosure elements or interior.

B. Copings:

1. Install copings in straight lines with accurately aligned profiles.
2. Install anchorage base and cleats with screws.
3. Install splice plates with continuous gaskets that prevent lateral movement of water to void below cover.
4. Install covers with full anchorage cleat engagement and uniform joint width.

C. Edge Securement Trim:

1. Install trim in straight lines with accurately aligned profiles.
2. Install anchorage base and cleats with screws.
3. Install splice plates with continuous gaskets that prevent lateral movement of water to void below cover.
4. Install covers with full anchorage cleat engagement and uniform joint width.

3.3 PROTECTION

A. Protect roof specialties from foot traffic and damage.

3.4 CLEANING

A. Remove soiling and stains from installed components.

END OF SECTION 077100

SECTION 077200

ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Roof accessories.

B. Principal Products:

1. Pipe penetration boxes.
2. Accessories.

C. Related Requirements.

1. Section 07 50 00: Roofing system.
2. Section 07 71 00: Roofing specialties.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Coordinate roof accessories with roofing installation.

B. Preinstallation Meeting Attendees and Procedures:

1. Require roof accessory installer to attend roofing system preinstallation meeting.

1.3 ACTION SUBMITTALS

A. Product Data: Each roof accessory type and size.

1. Mounting type, materials, and hardware.
2. Initial selection color charts.

B. Shop Drawings: Plans, elevations, and attachment details.

1.4 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports: Manufacturer test results showing:

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

B. Warranty Documentation: For pipe penetration boxes.

PART 2 - PRODUCTS

2.1 PIPE PENETRATION BOXES

A. Pipe Penetration Boxes: Insulated waterproofing aluminum housings with pipe penetrations.

1. Manufacturers and Products:

a. Roof Penetration Housings Roof VAULT.
b. Or approved equal.

2. Construction Aluminum welded body with powder coating.
3. Penetration Configuration: As required for watertight installation with multiple penetrations.

2.2 PERFORMANCE

A. Structural Loads: See Drawings and Applicable code compliant.

B. Environmental Performance:

1. Expansion and Contraction: Withstand 120 degree F ambient and 180 degree F surface thermal cycling without failure.

2.3 INSTALLATION MATERIALS

A. Protective Coating: Bituminous, ASTM D1187 Type 1 or II.

B. Anchorage Fasteners: Stainless steel screws.

2.4 FABRICATION

A. Where deck slope exceeds 1:48, fabricate tapered curbs to provide level lid.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that deck surfaces and roof openings are ready to receive Work of this Section.

3.2 PREPARATION

A. Apply protective coating on aluminum surfaces contacting cementitious materials, wood, and dissimilar metals.

3.3 INSTALLATION

A. Set curbs in full contact with roof deck.

B. Anchor roof accessories to resist specified loads.

C. Anchor pipe penetration boxes rigidly and securely. Install with flanges fully supported on structural deck.

D. Touch up damaged factory-applied finishes.

3.4 CLEANING

A. Cleaning: Remove soiling and stains.

END OF SECTION 077200

SECTION 079200

JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Exterior and interior sealants.

B. Principal Products:

1. Exterior exposed nontraffic sealants.
2. Exterior pedestrian traffic sealants.
3. Exterior concealed sealants.
4. Interior sealants and caulking.
5. Installation Accessories.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting minimum one week before starting Work of this Section for exterior building sealants.
2. Additional Attendees:

a. Installers of exterior building sealants.
b. Air barrier installer.
c. Roofing installer.

1.3 ACTION SUBMITTALS

A. Submittal Procedures:

1. Provide submittals for all sealants, exterior and interior, in a single group, regardless of how many subcontractors will install sealants. Multiple submittals for sealants are not acceptable.

B. Product Data:

1. Each sealant type.
2. Expanding tape seals.
3. Initial selection color charts and Samples.

C. Joint Sealant Schedule:

1. Joint types.
2. Joint locations.
3. Sealant types and proprietary products.

4. Joint sealant colors.

D. Samples:

1. Cured sealant custom color ribbons; 12 inches minimum length.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Provide written verification and list of products for Work under subsequent work packages that the same proprietary sealants will be used that were used for previous work packages.

B. Test and Evaluation Reports: Independent testing agency testing results.

1. Compatibility and adhesion test reports.
2. Staining potential test reports.

C. Field Quality Control Submittals: Field test and inspection reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data.

B. Warranty Documentation: Sealants.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Installers: Authorized representative who is trained and approved by manufacturer.
2. Testing Agencies: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

B. Preconstruction Testing: Complete testing 30 days minimum before scheduled field installation or as recommended by manufacturer.

1. Adhesion: Field Test exterior wall sealants for adhesion to metal, masonry, and concrete per ASTM C794 and manufacturer published requirements to determine need for primer and substrate preparation.
2. Staining: Laboratory Test exterior wall and interior tile sealants for staining of metal and substrates per ASTM C1248.

C. Mockups: Install sealants in mockup assemblies required in other Sections. Demonstrate product interfaces, intersections, and terminations.

1. Adhesion: Test sealant joints in mockup per ASTM C1193, Method A in Appendix X1.1 or ASTM C1521, Method A. At joints between different materials, test each joint surface separately.
2. Approved mockups establish work results standard.

1.7 FIELD CONDITIONS

A. Ambient Conditions: Perform work within following limitations.

1. Temperature: Perform work within sealant manufacturer published temperature limits.
2. Precipitation: None occurring and none predicted within 24 hours.

1.8 WARRANTY

A. Manufacturer Warranty:

1. Exterior Sealants: Warrant joint sealants will provide a watertight weather seal for the Warranty duration.

a. Failure includes loss of elastomeric properties and required performance attributes.
b. For porous substrates, failure also includes discoloration of substrates.
c. Warranty Period, Urethanes: Five years.
d. Warranty Period, Silicones: 20 years.
e. Warranty Period, Class 25 Acid-Curing Silicones: Ten years.
f. Warranty Period, Hybrid Urethane and STP Sealants: 20 years.

PART 2 - PRODUCTS

2.1 SEALANTS - GENERAL

A. Source Control: Provide one proprietary product for each type of sealant required, regardless of what Subcontractor installs the sealant.

1. Installers of joint sealants under subsequent work packages must use the same proprietary sealants used in the first work package that includes joint sealants.

B. Select proprietary sealants for compatibility with other construction products that the sealants will contact.

C. Multiple colors may be required for exposed sealants to coordinate with substrate colors.

2.2 EXTERIOR EXPOSED NONTRAFFIC SEALANTS

A. Class 25 Silicone Sealant: Single component, nonsag, acid curing; ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers and Products:

a. Dow DOWSIL 999-A.
b. Pecora Corporation 860.

2. Colors: Architect selected.

B. Class 50 Silicone Sealant: Single component, nonsag, neutral curing; ASTM C920,

Type S, Grade NS, Class 50, Use NT.

1. Manufacturers and Products:

    a. Dow DOWSIL 795.
    b. GE Construction Sealants SCS2000 SilPruf.
    c. Pecora Corporation PCS.
    d. Sika Sikasil WS-295 FPS.
    e. Tremco Spectrem 2.

2. Colors: Architect selected.

C. Class 50 Silicone Nonstaining Sealant: Single component, nonsag, neutral curing; ASTM C920, Type S, Grade NS, Class 50, Use NT; classed as nonstaining when tested per ASTM C1248.

1. Manufacturers and Products:

    a. Dow DOWSIL 756 SMS.
    b. GE Construction Sealants SCS9000 SilPruf NB.
    c. Pecora Corporation 864NST.
    d. Tremco Spectrem 3.

2. Colors: Architect selected.

D. Class 100/50 Silicone Sealant: Single component, nonsag, neutral curing; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

1. Manufacturers and Products:

    a. Dow DOWSIL 790.
    b. GE Construction Sealants SCS2700 SilPruf. LM.
    c. Pecora Corporation 864NST.
    d. Sika Sikasil WS-290 FPS.
    e. Tremco Spectrem 1.

2. Colors: Architect selected.

E. Class 100/50 Silicone Nonstaining Sealant: Single component, nonsag, neutral curing; ASTM C920, Type S, Grade NS, Class 100/50, Use NT; classed as nonstaining when tested per ASTM C1248.

1. Manufacturers and Products:

    a. Dow DOWSIL 790.
    b. GE Construction Sealants s SCS2700 SilPruf. LM.
    c. Pecora Corporation 890FTS.
    d. Sika Sikasil WS-290 FPS.
    e. Tremco Spectrem 1.

2. Colors: Architect selected.

F. One-Part Class 25 Urethane Sealant: ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers and Products:

a. Tremco Vulkem 116.
b. Sika SikaflexCR 195.

2. Colors: Architect selected.

G. One-Part Class 100/50 Urethane Sealant: ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

1. Manufacturers and Products:

a. Sika Sikaflex-15.
b. Tremco Dymonic 100.

2. Colors: Architect selected.

H. Multi-Part Class 25 Urethane Sealant: ASTM C920, Type M, Grade NS, Class 25, Uses NT and T.

1. Products:

a. Pecora Corporation Dynatred.
b. Sika Sikaflex 2c NS EZ Mix.
c. Tremco THC 901.

2. Colors: Architect selected.

I. Multi-Part Class 50 Urethane Sealant: ASTM C920, Type M, Grade NS, Class 50, Use NT, G, M, A, and O.

1. Manufacturers and Products:

a. Pecora Corporation DynaTrol II.
b. Sika 2CNS Plus.

2. Color: Architect selected.

J. Silane-Modified Polymer Sealant: ASTM C920, Type S, Grade NS, Class 50, Use NT, G, M, A and O.

1. Products of this type include STPE silyl-terminated polyether, STPU silyl-terminated polyurethane, polyurea, and other silane-modified polymer formulations.
2. Manufacturers and Products:

a. Pecora Corporation DynaTrol 1-XL Hybrid.
b. Sika Sikaflex HY 150.
c. Soudal Soudaseal 50LM.

3. Color: Architect selected.

2.3 EXTERIOR PEDESTRIAN TRAFFIC SEALANTS

A. Pourable Silicone Sealant: ASTM C920, Type S, Grade P, Class 100/50, Uses T, M, A, O.

1. Manufacturers and Products:

a. Dow DOWSIL 890 SL.
b. Pecora Corporation 300SL.
c. Tremco Spectrem 900SL.

2. Color: Architect selected.

B. Pourable Urethane Sealant: ASTM C920, Type S, Grade P, Class 25, Uses T.

1. Manufacturers and Products:

a. Sika Sikaflex SL 1.

2. Colors: Architect selected.

C. Pourable Urethane Sealant-1: ASTM C920, Type M, Grade P, Class 25, Use T.

1. Manufacturers and Products:

a. Sika Sikaflex 2c SL.

2. Colors: Architect selected.

D. Pourable Urethane Sealant-2: ASTM C920, Type M, Grade P, Class 50, Use T.

1. Manufacturers and Products:

a. Pecora Corporation DynaTrol II-SL.

2. Colors: Architect selected.

E. Pourable Urethane Sealant-3: ASTM C920, Type M, Grade P, Class 100/50, Use T.

1. Manufacturers and Products:

a. Tremco Vulkem 445SSL.

2. Colors: Architect selected.

F. Pourable Silane-Modified Polymer Sealant: ASTM C920, Type S, Grade P, Class 25, Use T, M, A, O.

1. Manufacturers and Products:

a. Pecora Corporation Urexpan NR-201.

2. Colors: Architect selected.

2.4 EXTERIOR CONCEALED SEALANTS

A. Butyl Sealant: ASTM C1311.

1. Manufacturers and Products:

a. Pecora Corporation BC-158.
b. Tremco Butyl Sealant.
c. C.R. Laurence 888.

B. Class 25 Concealed Silicone Sealant: Single component, nonsag, acid curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers and Products:

a. Dow DOWSIL 999-A.
b. Pecora Corporation 860.

C. Silicone Air Barrier Sealant: Single component, nonsag, neutral curing; ASTM C920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers and Products:

a. Dow DOWSIL 758 Silicone Weather Barrier Sealant.
b. Pecora Corporation AVB Silicone Sealant.

D. Paintable Caulking: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

1. Applications:

a. Exterior assembly joints in painted fiber-cement siding and trim.

2.5 EXTERIOR PREFORMED JOINT SEALS

A. Silicone Extrusion Seals: Cured low-modulus silicone extrusion transition membrane and liquid-applied sealant for exterior wall openings.

1. Manufacturers and Products:

a. Dow DOWSIL Silicone Transition System with DOWSIL 758 silicone adhesive.
b. Pecora Corporation Sil-Span with 864NST silicone adhesive.
c. Sika Silbridge-300 with Sikasil WS-295.
d. Tremco Proglaze ETA with Spectrem 1 Silicone Sealant.

2. Joint Widths: See Drawings.

B. Expanding Tape Seals: Precompressed, self expanding secondary seal behind liquid sealants, wax free.

1. Manufacturers and Products:

a. Emseal Joint Systems Backerseal.

2. Tape Size: Manufacturer recommended for Project applications.

C. Expanding Tape Seals with Color Facing: Silicone-coated, compressed, adhesively attached, primary seal joint filler.

1. Manufacturers and Products:

a. Emseal Joint Systems Seismic Colorseal.

2. Joint Size: Manufacturer recommended for Project applications.
3. Installation Sealant: Silicone sealant in same color as facing.
4. Color: Architect selected.

2.6 INTERIOR SEALANTS AND CAULKING

A. Interior Color Sealant: Silane-modified polymer sealant or urethane; ASTM C920, Type S, Grade NS, Class 50, Uses T and NT.

1. Manufacturers and Products:

a. Pecora Corporation DynaTrol I XL Hybrid.
b. Sika Sikaflex HY 150.

2. Colors: Architect selected.

B. Sanitary Sealant: Mildew-resistant silicone; ASTM C920, Type S, Grade NS, Class 25 or greater, Use NT.

1. Manufacturers and Products:

a. Dow DOWSIL 786 SILICONE SEALANT.
b. Pecora Corporation; 898 NST.
c. Tremco Incorporated Tremsil 200 Sanitary.

2. Colors: Architect selected.
3. Applications:

a. Joints around plumbing fixtures and fittings.
b. Perimeters of lavatory counters.

C. Urethane Security Sealant: ASTM C920, Type M, Grade NS, Class 12-1/2, Use NT.

1. Manufacturers and Products:

a. Pecora Corporation DynaFlex.

b. Sika Sikaflex-11 FC.

2. Colors: Architect selected.

D. Silane-Modified Polymer Security Sealant: ASTM C920, Grade NS, Class 12-1/2, Use T1, M, G, A and O.

1. Manufacturers and Products:

a. Pecora Corporation DynaFlex SC.

E. Epoxy Security Sealant: ASTM C881, Type I and III, Grade 3, Class B and C.

1. Manufacturers and Products:

a. Pecora Corporation DynaPoxy EP-1200.

F. Paintable Caulking: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

1. Manufacturers and Products:

a. Pecora Corporation AC20.
b. Sika MasterSeal NP 520.
c. Tremco Tremflex 834.

2. Applications:

a. Interior joints noted as caulking.
b. Joints, crevices, and irregularities wider than hairline joints in or between dissimilar materials and painted surfaces.
c. Perimeters of door frames, frames and trim for glazing, and frames or trim for other wall and ceiling openings at painted surfaces.
d. Ceiling joints between structural precast concrete floor planks.

2.7 IMMERSIBLE JOINT SEALANTS

A. Class 25 Urethane or Polysulfide: Single component; ASTM C920 Type S, Grade NS, Class 25, Use NT and I.

1. Manufacturers and Products:

a. Pecora Corporation Synthacalk GC2.
b. Sika Sikaflex NP 1.

2. Colors: Architect selected.

B. Class 35 Urethane: Multiple component; ASTM C920 Type M, Grade NS, Class 35, Use NT and I.

1. Manufacturers and Products:

a. Sika Sikaflex N P2.

2. Colors: Architect selected.

2.8 INSTALLATION ACCESSORIES

A. Primer: As required by sealant manufacturer.

B. Backer Rod: ASTM C1330, Type C, closed-cell or Type O, open-cell, manufacturer recommended types.

C. Bond Breaker Tape: Self-adhesive plastic tape to prevent sealant from adhering to back of joint.

D. Cleaners: Manufacturer recommended types.

E. Masking: Non-staining, self-adhesive.

2.9 MIXES

A. Multicomponent Sealants: Mix components immediately before use.

B. Field-Tinted Products: Mix colorant with base to uniform consistency and custom color.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean joint surfaces for optimum adhesion. Remove dirt, moisture, and incompatible substances.

B. Roughen vitreous and glazed joint surfaces as recommended by sealant manufacturer.

C. Remove laitance and form release agents from concrete.

D. Existing Joints: Cut out and remove existing joint sealants down to original substrate. Small amounts of elastomeric sealants left in surface irregularities of concrete and masonry may be left in place subject to Architect approval, provided that they are securely bonded to surface, are compatible with new sealant, and are tested to demonstrate that suitable adhesion with new sealant can be achieved. Where these conditions cannot be met, remove existing sealants completely.

E. Prime joint surfaces where recommended by sealant manufacturer. Protect adjacent surfaces from misapplication or spillage of primer.

F. Mask surfaces adjacent to joints to receive elastomeric sealants. Remove masking after tooling.

3.2 INSTALLATION

A. Installation Reference Standard: Follow ASTM C1193.

B. General Installation Requirements:

1. Exterior Joint Sealants: Provide continuous, weatherproof seals to prevent infiltration of air and water through the joints.
2. Interior Joint Sealants: Provide continuous seals to prevent air infiltration through the joints in which they are installed. Install sanitary sealant to prevent water infiltration.
3. Appearance: Apply sealants with smooth surfaces free of gaps, voids, bubbles, lumps, crevices, runs, drips, striations, and other irregularities.

C. Set joint filler units at uniform depths in joints to support sealants and maintain proper sealant cross section shape and depth recommended by manufacturer for each application.

D. Set joint filler for sealant neck dimension 1/3 of joint width, maximum, or as recommended by manufacturer for application.

E. Install joint fillers under compression and friction fit. Do not install filler units that have absorbed water.

1. Do not leave voids or gaps between ends of joint filler units.
2. Do not stretch, twist, puncture, or tear joint fillers.
3. Remove joint fillers that have absorbed moisture or which have ruptured gas cells and install suitable new fillers before sealant application.

F. Install bond breaker tape where joint filler is not used to prevent adhesion to back of joint.

G. Deposit sealants in uniform, continuous ribbons without gaps or air pockets.

H. Tool sealants to ensure full adhesion. Form smooth, slightly concave surface.

I. Cure joint sealants.

3.3 FIELD QUALITY CONTROL

A. Field Tests and Inspections: Engage inspectors to perform tests and inspections and prepare reports. Allow inspectors access to work areas.

1. Failed Test Retest Cost: Contractor responsibility.
2. Do not use materials that fail tests and inspections.

B. Adhesion Testing: ASTM C1521, Method A.

1. Perform three tests.
2. Report Content:

a. Presence of voids and discontinuities.
b. Sealant dimensions and seal shape.
c. Failures in adhesion and cohesion.

C. Non Conforming Work: Remove sealants that do not pass tests, reapply sealant, and

retest.

3.4 CLEANING

A. Clean spills, misapplications, and material migrations immediately as they occur.

B. Clean marred surfaces by whatever means are necessary to eliminate evidence of spillage.

END OF SECTION 079200

SECTION 081113

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Standard and custom hollow metal doors and frames.
2. Louvers installed in hollow metal doors.

B. Related Sections:

1. Division 01 Section "General Conditions".
2. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
3. Division 08 Section "Door Hardware".
4. Division 08 Section "Access Control Hardware".
5. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
9. SDI-113 Standard Practice for Determining the Steady-State Thermal Transmittance of Steel Door & Frame Assemblies.

10. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
11. ASTM C1199 - Standard Test Method for Measuring the Steady-State Thermal Transmittance of Fenestration Systems Using Hot Box Methods
12. ASTM E1423 - Practice for Determining Steady State Thermal Transmittance of Fenestration Systems.
13. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
14. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
15. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
16. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
17. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
18. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
19. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.

B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.

C. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of anchorages, joints, field splices, and connections.
6. Details of accessories.
7. Details of moldings, removable stops, and glazing.
8. Details of conduit and preparations for power, signal, and control systems.

D. Samples for Verification:

1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.

B. Quality Standard: In addition to requirements specified, furnish SDI-Certified

manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".

C. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:

1. CECO Door Products (C).
2. Curries Company (CU).
3. Stiles Custom Metal, Inc.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60(Z180) or A60 (Z180) metallic coating.

C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60(Z180) or A60 (Z180) metallic coating.

2.3 HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.

B. Exterior Doors: Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard vertical steel-stiffener core. Minimum 22 gauge steel-stiffeners at 6 inches on-center construction attached by spot welds spaced not more than 5" on centers. Spaces between stiffeners filled with fiberglass insulation (minimum density 0.8#/cubic ft.).
3. Level/Model: Level 4 and Physical Performance Level A (Maximum Duty), Minimum 14 gauge (0.067 inch - 1.7-mm) thick steel, Model 2.
4. Vertical Edges: Vertical edges to have the face sheets joined by a continuous weld extending the full height of the door. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches.
5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.

7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard vertical steel-stiffener core. Minimum 22 gauge steel-stiffeners at 6 inches on-center construction attached by spot welds spaced not more than 5" on centers. Spaces between stiffeners filled with fiberglass insulation (minimum density 0.8#/cubic ft.).
3. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053-inch - 1.3-mm) thick steel, Model 2.
4. Vertical Edges: Vertical edges to have the face sheets joined by a continuous weld extending the full height of the door. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches.
5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

D. Manufacturers Basis of Design:

1. Curries Company (CU) - Steel-Stiffened - 747 Series.

2.4 HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Frames: Minimum 14 gauge (0.067-inch -1.7 mm) thick steel sheet.
3. Manufacturers Basis of Design:

a. Curries Company (CU) - M Series.

C. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Frames: Minimum 14 gauge (0.067-inch -1.7 mm) thick steel sheet.
3. Manufacturers Basis of Design:

a. Curries Company (CU) - M Series.

D. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

E. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. Jamb Anchors: All anchors welded to frame.

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.

B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inchesSTART_SIEND_SI thick.

C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.6 LOUVERS

A. Metal Louvers: Anemostat PLSL Series.

1. Blade Type: Vision proof inverted V or inverted Y.
2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

B. Louvers for Fire Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire protection rating of 1-1/2 hours and less.

1. Manufacturers: Subject to compliance with requirements, provide louvers to meet rating indicated.

a. **<Insert manufacturer's name>**

2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

2.7 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.8 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

    a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.

8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches on-center and as follows:

        1) Two anchors per jamb up to 60 inches high.
        2) Three anchors per jamb from 60 to 90 inches high.
        3) Four anchors per jamb from 90 to 120 inches high.
        4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inchesSTART_SIEND_SI or fraction thereof above 120 inches high.

    b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Three anchors per jamb up to 60 inches high.
        2) Four anchors per jamb from 60 to 90 inches high.
        3) Five anchors per jamb from 90 to 96 inches high.
        4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inchesSTART_SIEND_SI or fraction thereof above 96 incheshigh.
        5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.

10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
11. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.

E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.9 STEEL FINISHES

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure

maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.

C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

E. Verify tolerances against manufacturers installations instructions for tornado and hurricane storm shelter openings.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.

1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

3.5 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

END OF SECTION 081113

SECTION 087100

DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C - Positive Pressure Fire Tests of Door Assemblies.

3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. Content: Include the following information:

    a. Type, style, function, size, label, hand, and finish of each door hardware item.
    b. Manufacturer of each item.
    c. Fastenings and other pertinent information.
    d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    e. Explanation of abbreviations, symbols, and codes contained in schedule.
    f. Mounting locations for door hardware.
    g. Door and frame sizes and materials.
    h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
b. Complete (risers, point-to-point) access control system block wiring diagrams.
c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

1.5 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical

and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

F. California Building Code: Provide hardware that complies with CBC Section 11B.

1. All openings as a part of an accessible route shall comply with CBC Section 11B-404.
2. The clear opening width for a door shall be 32” minimum. For a swinging door it shall be measured between the face of the door and the stop, with the door open 90 degrees. There shall be no projections into it below 34” and 4” maximum projections into it between 34” and 80” above the finish floor or ground. Door closers and stops shall be permitted to be 78” minimum above the finish floor or ground. CBC Section 11B-404.2.3.
3. Operable hardware on accessible doors shall comply with CBC Section 11B-309.4 and shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. Operable parts of such hardware shall be 34” minimum and 44” maximum above finish floor or ground. Where sliding doors are in the fully open position, operating hardware shall be exposed and usable from both sides.
4. Hardware (including panic hardware) shall not be provided with “nightlatch” function for any accessible doors or gates unless the following conditions are met:

    a. Such hardware has a ‘dogging’ feature and is dogged during the time the facility is open.
    b. All ‘dogging’ operation is performed only by employees as their job function (non-public use).

5. The force for pushing or pulling open a door shall be in accordance with CBC Section 11B-404.2.9.

    a. Interior hinged doors, sliding or folding doors, and exterior hinged doors: 5 pounds (22.2 N) maximum. Required fire doors: the minimum opening force allowable by the DSA authority, not to exceed 15 pounds (66.7N). These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position.
    b. The force required for activating any operable parts, such as lever hardware, or disengaging other devices shall be 5 pounds (22.2N) maximum to comply with CBC Section 11B-309.4.

c. The 5 pound (22.2 N) maximum force shall be validated for the size of the door used. The Building Materials Listing of the California State Fire Marshal shall indicate that the door hardware meets the 5 pound (22.2 N) force and shall also list the largest door that can be used.

6. Door closing speed shall comply with CBC Section 11B-404.2.8. Closers shall be adjusted so that the required time to move a door from an open position of 90 degrees to a position of 12 degrees from the latch is 5 seconds minimum. Spring hinges shall be adjusted so that the required time to move a door from an open position of 70 degrees to the closed position is 1.5 seconds minimum.
7. Floor stops shall not be located in the path of travel and 4” maximum from walls.
8. Thresholds shall comply with CBC Section 11B-404.2.5.

G. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.

H. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

I. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

J. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.8 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hardware shall not have any visible manufacturer names on exposed materials, except cylinders, when the door is in a closed position.

2.2 BUTT HINGES

A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

    a. Two Hinges: For doors with heights up to 60 inches.
    b. Three Hinges: For doors with heights 61 to 90 inches.
    c. Four Hinges: For doors with heights 91 to 120 inches.
    d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

    a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
    b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

    a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
    b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

    a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.

5. Manufacturers:

    a. McKinney (MK) - TA/T4A Series, 5-knuckle.

2.3 POWER TRANSFER DEVICES

A. Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to

12) to accommodate the electrified functions specified in the Door Hardware Sets with a 1-year warranty. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

    a. McKinney (MK) - QC (# wires) Option.

B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

    a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
    b. McKinney (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

    a. McKinney (MK) - QC-C Series.

2.4 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
5. Manufacturers:

    a. Rockwood (RO).

B. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Pulls shall be provided with a 10” clearance from the finished floor on the push side to accommodate wheelchair accessibility.
5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
6. Manufacturers:

    a. Rockwood (RO).

2.5 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.
2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
4. Tubular deadlocks and other auxiliary locks.
5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
6. Keyway: Manufacturer’s Standard.

C. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. New System: Key locks to a new key system as directed by the Owner.

D. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).

E. Construction Keying: Provide construction master keyed cylinders.

F. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.6 MORTISE LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Manufacturers:

a. Sargent Manufacturing (SA) - 8200 Series.

2.7 DEADLOCKS AND LATCHES

A. Mortise Deadlocks, Small Case: ANSI/BHMA A156.36, Grade 1, small case mortise type deadlocks constructed of heavy gauge wrought corrosion resistant steel. Steel or stainless steel bolts with a 1" throw and hardened steel roller pins. Deadlocks to be products of the same source manufacturer and keyway as other specified locksets.

1. Manufacturers:

a. Sargent Manufacturing (SA) - 4870 Series.

2.8 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.9 SURFACE DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Heavy duty surface mounted door closers shall have a 30-year warranty.

2. Manufacturers:

a. Norton Rixson (NO) - 7500 Series.
b. Sargent Manufacturing (SA) - 351 Series.

C. Door Closers, Surface Mounted (Unitrol): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted closers with door stop mechanism to absorb dead stop shock on arm and top hinge. Hold-open arms to have a spring loaded mechanism in addition to shock absorber assembly. Arms to be provided with rigid steel main arm and secondary arm lengths proportional to the door width.

1. Manufacturers:

a. Norton Rixson (NO) - Unitrol Series.

D. Door Closers, Surface Mounted (Cam Action): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, high efficiency door closers with

complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be of the cam and roller design, one piece cast aluminum silicon alloy body with adjustable backcheck and independently controlled valves for closing sweep and latch speed.

1. Manufacturers:

    a. Norton Rixson (NO) - 2800ST Series.
    b. Sargent Manufacturing (SA) - 422 Series.

2.10 ARCHITECTURAL TRIM AND ACCESSORIES

A. Door Protective Trim:

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:

    a. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:

    a. Rockwood (RO).

2.11 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

a. Rockwood (RO).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

a. Norton Rixson (RF).
b. Rockwood (RO).
c. Sargent Manufacturing (SA).

2.12 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. Pemko (PE).

2.13 ELECTRONIC ACCESSORIES

A. Switching Power Supplies: Provide the least number of power supplies at the appropriate amperage level sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.

1. Power supplies shall meet all functions and features as specified herein.

a. UL listed dual voltage 12 or 24 VDC field selectable continuous output.
b. Tolerates brownout or overvoltage input ± 15% of nominal voltage.
c. Thermal shutdown protection with auto restart.
d. Circuit breaker protection against overcurrent and reverse battery faults.
e. Integrated battery charging circuit to prevent overvoltage on locking devices.
f. Available with a single relay fire trigger or individually triggered relayed outputs.
g. Monitoring options as specified.

2. Manufacturers:

a. Securitron (SU) - AQD Series.

2.14 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.15 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.

E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.
2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

B. Manufacturer's Abbreviations:

1. MK - McKinney
2. RO - Rockwood
3. SA - SARGENT
4. OT - Other
5. RF - Rixson
6. NO - Norton
7. ZE - Zero International
8. PE - Pemko
9. SU - Securitron

Hardware Sets

Set: 1.0

Doors: 101a

3	Hinge (heavy weight)	T4A3386 NRP	US32D	MK
1	Keyed Privacy Lock	LB 36 8225 LNL	US26D	SA
1	Cylinder	Match Facility Standard		OT
1	Surface Closer	2800ST	689	NO
1	Kick Plate	K1062 10" High CSK BEV TORX	US32D	RO
1	Wall Stop	402	US26D	RO
1	Brush Sweep	18061CNB	Al	PE
1	Threshold	Per Detail & Field Conditions x FHSL	Al	PE
3	Silencer	608		RO

Set: 2.0

Doors: 102a, 103a

3	Hinge (heavy weight)	T4A3386 NRP	US32D	MK
1	Classroom Deadlock	36 4877	US26D	SA
1	Cylinder	Match Facility Standard		OT
1	Push Pull Set	110x73C/73CL CFC x CFTT***	US32D	RO
1	Surface Closer	2800ST	689	NO

1	Kick Plate	K1062 10" High CSK BEV TORX	US32D	RO	
1	Wall Stop	402	US26D	RO	
1	Brush Sweep	18061CNB	Al	PE	
1	Threshold	Per Detail & Field Conditions x FHSL	Al	PE	
3	Silencer	608		RO	

Notes: ***Order push/pull with pull mounted offset to bottom of pull plate, to allow extra room for cylinder/thumbturn.

Set: 3.0

Doors: 104a

2	Hinge (heavy weight)	T4A3386	US32D	MK	
1	Electric Hinge (heavy weight)	T4A3386-QCxx	US32D	MK	⚡
1	Fail Secure Lock	RX 36 8271 LNL	US26D	SA	⚡
1	Cylinder	Match Facility Standard		OT	
1	Door Closer	7500	689	NO	
1	Kick Plate	K1062 10" High CSK BEV TORX	US32D	RO	
1	Wall Stop	402	US26D	RO	
1	Gasketing	294AV		PE	
1	Brush Sweep	18061CNB	Al	PE	
1	Threshold	Per Detail & Field Conditions x FHSL	Al	PE	
1	Frame Harness	QC-C__x (length as required)		MK	⚡
1	Door Harness	QC-C__x (length as required)		MK	⚡
1	Power Supply	AQDx-8C8R2 (size as reqd)		SU	⚡
1	Card Reader	By Security Contractor			

Notes: Presenting authorized credential to reader on wall momentarily releases outside lever allowing door to be opened.
REX switch in inside lever signals access control system of authorized egress.
Free egress at all times via inside lever.
During loss of power, door remains locked.

Set: 4.0

Doors: 105a

2	Hinge (heavy weight)	T4A3786 NRP	US26D	MK	
1	Electric Hinge	T4A3786 QCxx	US26D	MK	⚡

1	Fail Secure Lock	RX 36 8271 LNL	US26D	SA	
1	Cylinder	Match Facility Standard		OT	
1	Surface Closer	UNI7500	689	NO	
1	Kick Plate	K1062 10" High CSK BEV TORX	US32D	RO	
3	Silencer	608		RO	
1	Frame Harness	QC-C__x (length as required)		MK	
1	Door Harness	QC-C__x (length as required)		MK	
1	Power Supply	AQDx-8C8R2 (size as reqd)		SU	
1	Card Reader	By Security Contractor			

Notes: Presenting authorized credential to reader on wall momentarily releases outside lever allowing door to be opened.
REX switch in inside lever signals access control system of authorized egress.
Free egress at all times via inside lever.
During loss of power, door remains locked.

Set: 5.0

Doors: 106a, 106b

5	Hinge (heavy weight)	T4A3386 NRP	US32D	MK	
1	Electric Hinge (heavy weight)	T4A3386-QCxx	US32D	MK	
2	Flush Bolt	555	US26D	RO	
1	Dust Proof Strike	570	US26D	RO	
1	Fail Secure Lock	RX 36 8271 LNL	US26D	SA	
1	Cylinder	Match Facility Standard		OT	
2	Conc Overhead Hold Open, HD	1ADJ-x26	630	RF	
2	Kick Plate	K1062 10" High CSK BEV TORX	US32D	RO	
1	Astragal	43SP		ZE	
1	Rain Guard	346C		PE	
1	Gasketing	294AV		PE	
2	Sweep	315CN	Al	PE	
1	Threshold	Per Detail & Field Conditions x FHSL	Al	PE	
1	Frame Harness	QC-C__x (length as required)		MK	
1	Door Harness	QC-C__x (length as required)		MK	
1	Power Supply	AQDx-8C8R2 (size as reqd)		SU	
1	Card Reader	By Security Contractor			

Notes: Presenting authorized credential to reader on wall momentarily releases outside lever allowing door to be opened.

REX switch in inside lever signals access control system of authorized egress.
Free egress at all times via inside lever.
During loss of power, door remains locked.

Set: 6.0

Doors: 107b

1	All Hardware	By Gate Supplier	OT

END OF SECTION 087100

SECTION 088300

MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Custom size wall mounted mirrors.

B. Principal Products:

1. Mirrors.
2. Accessories.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Mirror glass.
2. Installation accessories.

B. Shop Drawings:

1. Each custom mirror type and size.
2. Mirror wall panels; show joint locations.

C. Samples:

1. Mirrors: 6 inches square.

a. Demonstrate edge treatment.

2. Mirror Clips: Full size.
3. Mirror Trim: 6 inch lengths.

1.3 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports: Manufacturer test results showing:

1. Indicate compatibility and adhesion of backing and installation materials.

B. Qualification Statements: Installer.

1.4 FIELD CONDITIONS

A. Ambient Conditions: Perform Work within following limitations.

1. Building enclosed and environmental systems maintaining design conditions for

Owner occupancy.
2. Installation Temperature: 50 degrees F, minimum.

1.5 WARRANTY

A. Manufacturer Warranty:

1. Warrant against delamination.
2. Warranty Period: Five years.

PART 2 - PRODUCTS

2.1 MIRRORS

A. Tempered Safety Mirrors: ASTM C1048, Kind FT and ASTM C1036 Class 1-Clear, Quality- Q1; with copper and silver coating, and organic overcoating.

1. Edges: See Drawings.
2. Thickness: 6 mm.
3. Tint Color: See Drawings.

2.2 INSTALLATION MATERIALS

A. Setting Blocks: Silicone; 80 to 90 Shore A durometer hardness.

B. Spacer Shims: Silicone; 50 to 60 Shore A durometer hardness, self adhesive on one face.

C. Mirror Clips: Anodized aluminum with anchorage screws.

1. Manufacturers:

a. C.R. Laurence.

D. Top and Bottom Channels: Extruded aluminum J-profile channels, supplied with stainless steel screws.

1. Finish: Clear anodized and Stainless steel.

2.3 PERFORMANCE

A. Safety Mirrors: 16 CFR 1201, Category II.

1. Locations shown on Drawings, door mounted mirrors, and mirrors with bottom edges 36 inches or less above floor.

2.4 FABRICATION

A. Fabricate mirrors to size before delivery to site.

B. Fabricate mirrors for 1/8 inch clearance to adjacent construction.

C. Seal edges to prevent chemical or atmospheric penetration of reflective coating.

D. Seal edges of mirrors after edge treatment to prevent chemical or atmospheric penetration of glass coating.

E. Tempered Safety Mirrors: Fabricate with horizontal roller wave.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that wall surfaces are in plane so mirrors can be installed without distortion.

3.2 PREPARATION

A. Adhesive Installation: Clean surfaces, remove adhesion inhibiting substances.

3.3 INSTALLATION

A. Follow NGA GANA Glazing Manual for mirror installation methods.

B. Install mirrors plumb and level, and free of optical distortion.

C. Install mirrors with 1/8 inch edge clearance and 1/8 inch, minimum space behind mirror.

D. Frameless Mechanical Installation:

1. Screw attach top and bottom channels to wall framing.
2. Install setting blocks in thin bead of silicone sealant.
3. Set mirrors without direct metal contact.
4. Install mirror clips at mirror edges not secured by channels.

3.4 CLEANING

A. Remove labels, wash and polish mirror surfaces and metal supports.

END OF SECTION 088300

SECTION 089119

FIXED LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Prefinished extruded aluminum wall louvers.

B. Principal Products:

1. Fixed blade louvers.
2. Louver screens.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Coordinate louver installation with mechanical ductwork and wall flashing.

B. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting one week, minimum, before starting Work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Performance and Product Data, including AMCA Certified Ratings Seals.
2. Initial selection color charts.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other Work.

1. Show mullion profiles and locations.

C. Samples: Finished metal, 6 by 6 inches in size.

1.4 INFORMATIONAL SUBMITTALS

A. Delegated Design Submittals: Stamped shop drawings and design calculations.

1. Fixed louvers.

B. Test and Evaluation Reports: Manufacturer test results showing:

1. Airflow performance.

C. Source Quality Control Submittals: Shop test and inspection reports.

D. Field Quality Control Submittals: Field inspection reports.

E. Manufacturer Reports: Field instruction, test, and inspection reports.

F. Qualification Statements: Manufacturer or fabricator.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fixed louvers.

B. Warranty Documentation: For louvers and finishes.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Welding: Provide copies of welder certificates as informational submittals if requested by Architect.

a. Steel: AWS D1.1, Structural Welding Code - Steel.
b. Aluminum: AWS D1.2, Structural Welding Code - Aluminum.
c. Stainless Steel: AWS D1.6, Structural Welding Code - Stainless Steel.

2. Installers: Manufacturer approved.
3. Licensed Professional: Engineer experienced in designing louvers, licensed in California.

B. Certifications: From Contractor for specified performance, sizes, clearances, and tolerances.

1.7 FIELD CONDITIONS

A. Existing Conditions: Verify field measurements before fabrication. Show field measurements on Shop Drawings.

1.8 WARRANTY

A. Finish Warranty: Repair deteriorated finishes or replace components.

1. Deterioration includes the following:

a. Color Fading: More than 5 Hunter units per ASTM D2244.
b. Chalking: More than No. 8 rating per ASTM D4214.
c. Paint cracking, peeling or checking.

2. Warranty Period: Ten years.

PART 2 - PRODUCTS

2.1 FIXED BLADE LOUVERS

A. Aluminum Louvers, LV-1, LV-2, and LV-3: Horizontal, drainable, extruded aluminum frames and blades.

1. Certifications:
2. Louver Depth: See Drawings.
3. Frame and Blade Nominal Thickness: 0.060 inch for blades and 0.080 inch for frames, minimum.
4. Mullion Type: Exposed.
5. Louver Performance Ratings:

    a. Free Area: 18 by 18 inch louver, minimum.
    b. Point of Beginning Water Penetration: 800 fpm, minimum.
    c. Air Performance: 0.10 inch wg static pressure drop at 700 fpm free area intake velocity, maximum.

6. Finish: Color coating and Color anodized.

    a. Color: Architect selected.

2.2 LOUVER SCREENS

A. General: Provide screens.

1. Screen Location: Interior face of louver.
2. Screening Type: Insect screening.
3. Screen Frame: Same material and finish as louver, corners mitered.

B. Insect Screens: 18 x 16 aluminum or stainless steel mesh.

C. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

2.3 PERFORMANCE

A. Delegated Design:

1. Delegate fixed louver design to fabricator licensed Structural Engineer.
2. Structural Design Criteria: See Structural Drawings.
3. Structural Loads: See Drawings.
4. Allowable Deflection: 1/180, maximum.
5. Seismic Movement: ASCE/SEI 7.

    a. Criteria: See Drawings.

B. Environmental Performance:

1. Expansion and Contraction: Withstand 120 degree F ambient and 180 degree F surface thermal cycling without failure.

2.4 MATERIALS

A. Aluminum Extrusions: ASTM B221, manufacturer standard alloy and temper.

B. Aluminum Sheet: ASTM B209, manufacturer standard alloy and temper.

C. Steel Sheet: ASTM A653, G90 zinc coating, mill phosphatized.

D. Stainless Steel Sheet: ASTM A666, Type 316.

E. Separation Coating: Bituminous paint; SSPC Paint 12.

F. Fasteners: Stainless steel, types and sizes suitable for installation conditions.

1. Where exposed or semi exposed, use countersunk flathead screws finished to match adjacent surface.

G. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

2.5 FABRICATION

A. Factory Assembly:

1. Assemble louvers in largest units practical for shipping and handling.
2. Fabricate to fit in openings of sizes shown on approved Shop Drawings, with allowances for fabrication tolerances and perimeter joints.

B. Include supports, anchorages, and accessories required for complete assembly.

C. Recessed Louvers: Provide subsills made of same material as louvers and extended sills.

D. Sill Pans: Aluminum sheet finished to match louvers; configure for drainage per ASTM E2112.

2.6 ALUMINUM FINISHES

A. Powder Coating: Fluoropolymer finish with minimum 70 percent PVDF resin by weight in color coat; AAMA 2605.

1. Color and Gloss: Architect selected.

B. Interior or Concealed Surfaces Option: Interior and Concealed surfaces may receive powder or acrylic coating that matches exterior color.

2.7 STEEL FINISHES

A. Liquid Fluoropolymer Steel Sheet Coil Coatings: Two coat system; minimum 70 percent PVDF resin by weight.

1. Pencil Hardness, ASTM D3363; HB-H.
2. Salt Spray Resistance, ASTM G85; 1,000 hours.

3. Humidity Resistance, ASTM D2247; 1,000 hours.
4. Dry Film Thickness: ASTM D1400; 0.25 mil primer coat and 1.0 mil color coat.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify prepared openings and flashings are ready to receive Work and opening dimensions are as shown on Shop Drawings.

3.2 INSTALLATION

A. Install louvers level, plumb, and parallel to wall.

B. Install sill pan flashing and align louver assembly to drain moisture to exterior.

C. Secure louvers in opening framing with exposed fasteners.

D. Install insect screens and frames.

E. Install backer rod and perimeter sealant per Section 079200.

3.3 CLEANING

A. Remove protective finish coverings.

B. Clean surfaces and components.

END OF SECTION 089119

SECTION 092116

GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Gypsum board faced assemblies at partitions and ceilings.

B. Principal Products:

1. Suspension systems.
2. Gypsum board.
3. Tile backing panels.
4. Backing.
5. Firestopping components.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Coordinate concealed framing for supports and anchorage of other work.

B. Preinstallation Meeting:

1. Conduct meeting one week, minimum, before starting Work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data.

B. Samples:

1. Trim Accessories: 12 inch lengths of trim other than edge beads and control joints.
2. Textured Finishes: Apply to gypsum board, 4 by 6 inches minimum.

1.4 INFORMATIONAL SUBMITTALS

A. ICC-ES Evaluation Reports:

1. Embossed high strength steel studs.
2. Firestop tracks.
3. EQ coatings.

B. Delegated Design Submittals:

1. Nonstructural metal framing, for deflection limits under horizontal loading.

Indicate the following for each partition type and height:

a. Stud size.
b. Stud thickness.
c. Spacing.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements: ASTM C840.

B. Protect cold-formed framing per AISI S202.

PART 2 - PRODUCTS

2.1 FRAMING - GENERAL

A. Framing Members and Components, General: AISI S220.

1. Protective Coating: ASTM A653/A653M, G40 hot dip galvanized. EQ coatings following AISI S220 that have ICC-ES Evaluation Reports are acceptable.

2.2 PARTITION FRAMING

A. Standard Studs and Tracks: AISI S220.

1. Depth: See Drawings.
2. Base Steel Thickness: See Drawings.

B. Factory Cutout Steel Framing:

1. Manufacturers and Products:

a. Marino\WARE StudRite.

2. Overall Depth: See Drawings.
3. Base Steel Thickness: See Drawings.

C. Steel Shelf Base Track:

1. Manufacturers and Products:

a. Telling Industries VersaDry Track.

2. Depth: Coordinate with stud depth.
3. Protective Coating: ASTM A653, G40.
4. Fire Rating: ASTM E119, same as partition.

D. Deflection Top Track: Not required with adjustable-height deflection studs. Provide the following:

1. Single Slotted Track: Steel top track with 2-1/2 inch deep slotted flanges; studs fastened through slots.

2. Base Steel Thickness: Match studs.

E. Hat-Shaped Furring Channels:

1. Minimum Base Steel Thickness: See Drawings.
2. Depth: See Drawings.

F. Z-Furring:

1. Minimum Base Steel Thickness: See Drawings.
2. Depth: See Drawings.

G. Bridging: Cold rolled steel channels, 54 mil base steel thickness, with minimum 1/2 inch wide flanges.

1. Depth: See Drawings.

2.3 GYPSUM BOARD

A. Fire Resistant Gypsum Board: ASTM C1396, paper faced.

1. Core: 5/8 inch, Type X; locations shown on Drawings.

B. Ceiling Board: ASTM C1396.

1. Thickness: 1/2 inch Type C.

C. Moisture and Mold Resistant Gypsum Board: ASTM C1396.

1. Manufacturers and Products:

a. CertainTeed M2Tech Mold Resistant.
b. Georgia-Pacific Gypsum ToughRock Mold-Guard.
c. National Gypsum Gold Bond XP.
d. Pabco Gypsum Mold Curb Plus.
e. USG Corp Sheetrock MoldTough.

2. Core: 5/8 inch Type X.
3. Mold Resistance: 10 per ASTM D3273.

2.4 TILE BACKING PANELS

A. Glass-Mat, Water Resistant Gypsum Backing Board: ASTM C1178.

1. Manufacturers and Products:

a. CertainTeed Corp. GlasRoc Tile Backer.
b. Georgia Pacific DensShield Tile Backer.
c. National Gypsum Company eXP Fire-Shield Tile Backer.
d. Pabco Gypsum Pabco Glass Interior.
e. USG Durock Brand Glass-Mat Tile Backerboard.

2. Core: 5/8 inch, Type X.
3. Mold Resistance: 10 per ASTM D3273.

2.5 BACKING

A. Manufactured, Preformed Sheet Steel Backing: 6 inch wide, 68 mil steel, formed to fit stud spacing.

1. Manufacturers and Products:

a. ClarkDietrich FastBack Backing System.
b. Metal-Lite Flush-Mount Metal Stud Backing.

B. Flat Strap Backing Plates: Steel sheet screwed to studs.

1. Width: 6 inches minimum or as needed for secure anchorage of wall mounted items.
2. Base Steel Thickness: 63 mils minimum where supporting the following items.

a. Handrails, grab bars, and other items that support live loads.
b. Fireplace mantles.
c. Curtains and drapery track.
d. Headboards.
e. Wall supported counter tops and cabinets.
f. Ladders.
g. Electrical panels.
h. Electrically operated fixtures, furnishings, or equipment.
i. Large lighting fixtures.
j. Wall mounted televisions and monitor screens.
k. Mirrors.
l. Large artwork.

3. Base Steel Thickness-1: 33 mils minimum where supporting the following items.

a. Wood trim.
b. Toilet and bath accessories, other than grab bars.
c. Small lighting fixtures.
d. Anchorage for base cabinets.
e. Small artwork.

2.6 PERFORMANCE

A. Delegated Design:

1. Delegate stud framing to manufacturer licensed Structural Engineer.

B. Structural Design Criteria:

1. Horizontal Partition Load: 10 psf.
2. Vertical Ceiling Load: Supported material dead load.
3. Partition Horizontal Deflection Limits:

a. Tile or Stone Finished Partitions: 1/360 of wall height.
b. Other Partitions: 1/240 of wall height.

4. Ceiling Vertical Deflection Limits: 1/360 of span.

C. Fire Resistance: Assemblies tested per ASTM E119.

1. Fire Ratings: See Drawings.

D. Acoustic Performance:

1. STC: Tested per ASTM E90, classified per ASTM E413.

2.7 INSTALLATION COMPONENTS

A. Framing Installation:

1. Anchors: Framing manufacturer recommended types for substrates.
2. Fasteners: ASTM C1002; Type S; length to suit application.
3. Tie Wire: ASTM A641, zinc coated, 0.062 inch diameter, minimum.
4. Acoustic Gaskets: Closed cell foam self-adhesive strips allowing fastener penetration without foam displacement, 1/8 inch thick minimum, widths to match stud sizes.
5. Exterior Wall Isolation Strips:

a. Asphalt Saturated Organic Felt: ASTM D226, Type I, #15 asphalt felt, nonperforated.
b. Foam Gaskets: Adhesive backed, close-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, stud-appropriate width.

B. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum coated steel sheet, rolled zinc, or plastic.
2. Shapes: Cornerbead, bullnose bead, U-bead, or LC-bead.

C. PVC Trim: ASTM C1047 and ASTM D3678.

1. Manufacturers:

a. ClarkDietrich.
b. Plastic Components, Inc.
c. Trim-Tex Inc.

2. Shapes: Cornerbead, bullnose bead, U-bead, and LC-bead.

D. Aluminum Trim: Extruded units.

1. Manufacturers:

a. Fry Reglet Corp.
b. Gordon, Inc.

c. Or approved equal.

2. Finish: Clear anodized.
3. Profiles: See Drawings.

E. Sound Attenuation Blankets: ASTM C665, Type I, unfaced semi rigid mineral wool or fiberglass, thickness shown on Drawings, sized for friction fit.

1. Manufacturers and Products:

a. CertainTeed Corporation Fiber Glass Building Insulation.
b. Johns Manville Unfaced Fiber Glass Batts.
c. Knauf Insulation EcoBatt Insulation.
d. Owens Corning PINK Next Gen Fiberglas Insulation.

2. Fire Rated Partitions: Insulation type required by fire resistance designs referenced on Drawings.
3. Surface Burning Characteristics: ASTM E84.

a. Flame Spread: 25 maximum.
b. Smoke Developed: 50 maximum.

4. Thickness:

a. Walls: 3 1/2 inches.
b. Ceilings: 6 1/4 inches.

F. Acoustic Sealant: ASTM C834; nonsag, paintable, nonstaining, butyl free, latex sealant.

1. Manufacturers and Products:

a. Accumetric LLC BOSS 824 Acoustical Sound Sealant.
b. GE Construction Sealants RCS20.
c. Grabber Construction Products Acoustical Sealant GSC.
d. Hilti, Inc. CS-S SA Light.
e. Pecora Corporation AIS-919.
f. Specified Technologies, Inc. Smoke N Sound Acoustical Sealant.
g. USG Corporation SHEETROCK Acoustical Sealant.

2. Fire Rated Partitions: Acoustical sealant type required or permitted by fire resistance designs shown on Drawings.

G. Electrical Box Pads: Moldable non curing one component, intumescent, fire rated material for through penetration fire stop systems and sound attenuation systems; self adhering; 1/8 inch thick, minimum.

1. Manufacturers and Products:

a. Kinetics Noise Control Fire-Rated Isobacker.
b. Specified Technologies, Inc. SpecSeal Firestop Putty Pads.

H. Thermal Insulation: Section 072100.

I. Gypsum Board Fasteners:

1. Steel Framing 33 mils Thick and Less: ASTM C1002, Type S, self-piercing tapping screws.
2. Steel Framing Greater than 33 mils Thick: ASTM C954, self-drilling tapping screws.

J. Tile Backer Board Fasteners: Board manufacturer standard, corrosion resistant steel.

K. Laminating Adhesive: Recommended type for directly adhering gypsum panels to continuous substrate.

L. Joint Materials:

1. Interior Gypsum Board: ASTM C475/C475M; products compatible with substrate and other coatings applied to surface.

a. Skim Coat For Final Coat of Level 5 Finish: Spray applied high build coating.

2. Tile Backer Board: Product recommended by backer unit manufacturer.

2.8 TEXTURE FINISHES

A. Primer: Texture finish manufacturer standard product.

B. Texture Finish: Ready mixed, aggregate filled product for roller application.

1. Finish Texture: Architect selected.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify rough-in utilities are in proper locations.

B. Examine panels for moisture and mold; discard damaged panels.

3.2 PREPARATION

A. Remove sprayed fireproofing to the extent required to install gypsum assemblies. Patch damaged fireproofing.

3.3 INSTALLATION - GENERAL

A. Framing Standard: ASTM C754 and ASTM C840.

1. Portland Cement Plaster Assemblies: Follow ASTM C1063 for additional framing installation.

3.4 INSTALLATION - PARTITION FRAMING

A. Framing to Structure: Extend partition framing to underside of structure. Attach ceiling track to structure.

B. Framing to Ceiling: Extend framing to ceiling. Attach ceiling track to ceiling framing.

C. Framing Without Gypsum Board on Both Faces: Brace stud framing system rigid; attach bridging to prevent stud rotation.

D. Orient stud flanges the same direction within wall assembly.

E. Stud Spacing:

1. Single Layer Applications: See Drawings.
2. Multiple Layer Applications: See Drawings.
3. Tile Backer Applications: See Drawings.

F. Install backing where supporting wall mounted fixtures, furniture, equipment, or other construction.

G. Fire Resistance Rated Partitions: Tested assembly requirements.

H. Firestop Track: Tested assembly requirements.

I. Deflection Accommodation: Where framing extends to overhead structure, install deflection top track systems to prevent axial loading of finished assemblies.

J. Framed Openings: Follow ASTM C754 for framing above door heads.

1. Install two studs at each jamb.
2. Headers: Install track on top of header for installation of cripple studs.

K. Direct Furring:

1. Anchor furring channels spaced See Drawings to substrate.

a. Exterior Walls: Install isolation strip between furring and exterior walls.

L. Z-Furring:

1. Apply insulation per Section 072100. Hold insulation in place with Z-furring members spaced at 24 inch centers, anchored to substrate.

3.5 INSTALLATION - FRAMING TOLERANCES

A. Deviation from Indicated Position: 1/8 inch in 10 feet, maximum.

B. Deviation from Plumb and Level: 1/8 inch in 12 feet, maximum.

3.6 INSTALLATION - ELECTRICAL BOX SEALS

A. Install seals before installing gypsum board.

B. Overlap front edge of box so that seals will be compressed around edges of box as gypsum panels are installed.

C. Applications:

1. Electrical boxes in fire barriers, smoke barriers, and STC rated walls.
2. Electrical boxes at interior gypsum board faces of exterior walls.

3.7 INSTALLATION - INTERIOR GYPSUM BOARD

A. Follow ASTM C840.

1. Fire Rated Partitions: Install per tested designs referenced on Drawings.
2. Acoustically Rated Partitions: Install per tested designs referenced on Drawings.

B. Cut panels to fit obstructions and openings without tearing face paper or cracking core.

C. Install panels with face side out with lightly butted joints.

D. Stagger joints on opposite sides of partitions.

E. Locate panel ends over support framing.

F. Fit panels to ducts, pipes, conduit, and other penetrations and obstructions with maximum 1/4 inch joints.

G. Attach gypsum board to framing and to supplementary framing and blocking provided for additional support at openings and cutouts.

H. Form control joints and expansion joints with space between edges of boards, prepared to receive trim accessories.

I. Isolate perimeter of non-loadbearing drywall partitions from structural members. Provide 1/4 to 1/2 inch space and trim edge with edge bead. Seal joints with acoustical sealant.

J. Single Layer Installation:

1. Install panels vertically with long edges on continuous supports.
2. Attach panels to framing with screws.

K. Double Layer Installation:

1. Attach base layer to framing with screws.
2. Offset second layer joints and attach panels with screws.
3. At walls taller than 10 feet, install panels horizontally and provide control joints at floor lines.

3.8 INSTALLATION - TRIM

A. Vertical Trim: Install in single pieces where length is 9 feet or less.

B. Control Joints: Install where shown on Drawings and per ASTM C840 and as follows.

1. Locations of control and expansion joints in substrate or framing.
2. Walls:

    a. At changes in backup material.
    b. Above one jamb of doors, unless door frame extends to ceiling.
    c. Maximum 30 feet on center.

3. Ceilings:

    a. At locations where ceiling framing or furring changes direction.
    b. Maximum 30 feet on center.

C. Corner Bead: Outside corners.

D. Casings: Install at termination joints with other construction or where edges are exposed.

E. Reveals: Install trim plumb, level, accurately aligned, and fitted neatly with hairline joints.

1. Cut trim with sharp power saw and file cut edges to remove burrs.
2. Miter joint at changes in direction or plane, except that inside corners may be coped.
3. Apply masking tape or other protection to reveal surfaces before starting drywall finishing.
4. Rated Fire and Smoke Barriers and Non-Rated Smoke Partitions: Install reveals to maintain rating.
5. Routing of gypsum board to create reveals is not acceptable.

3.9 GYPSUM BOARD FINISHING

A. Gypsum Board Finishing: ASTM C840.

B. Finish panel joints, inside corners, trim flanges, fastener heads, and surface defects to provide smooth, continuous surfaces of monolithic appearance that are suitable for applied finishes.

C. Do not fill spaces around penetrations through fire resistive assemblies with joint compound. Leave space for firestopping.

D. Finish Levels:

1. Level 1: Surfaces in plenums and other concealed areas.
2. Level 2: Surfaces that receive tile and wall paneling.
3. Level 3: Surfaces that receive heavy texture finish or wall coverings.
4. Level 4: Surfaces that receive wall coverings.

E. Texture Finishes:

1. Prime surfaces.
2. Mask adjacent surfaces against overspray.
3. Apply to uniform texture and appearance matching approved field Sample.

3.10 IDENTIFICATION

A. Identify fire rated walls and partitions and other walls required to have protected openings or penetrations.

1. Locations: Within 4 feet of corners and maximum 12 feet between on both sides.

a. In spaces without ceilings, locate signs minimum 10 feet above finish floor and not blocked from view by ducts, structure, or other elements.

2. Signs: Painted stencil signs with minimum 4 inch high letters and 1/2 inch strokes, or as required by authorities having jurisdiction, or approved self adhesive signs.
3. Text: Use following or as required by authorities having jurisdiction.

a. 1-HOUR FIRE BARRIER – FIRESTOP ALL PENETRATIONS.
b. NON-RATED SMOKE PARTITION – SEAL ALL PENETRATIONS.

3.11 ADJUSTING

A. Water-Exposed Products: Remove entire panels; do not cut and patch gypsum board.

3.12 CLEANING

A. Remove spills, spatters, and misapplications of finishing materials as they occur.

B. Repair other finish surfaces damaged during drywall operations.

3.13 PROTECTION

A. Protect adjacent surfaces from gypsum panel compounds, adhesives, and sealants.

B. Protect finished gypsum panels from being marred from ongoing Work.

END OF SECTION 092116

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Tiling for exterior and interior floors and walls.

B. Principal Products:

1. Tile Products.
2. Trim and accessories.
3. Metal trim.
4. Mortar materials.
5. Grout materials.
6. Membranes.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting Attendees and Procedures:

1. Conduct meeting one week, minimum, before starting Work of this Section.
2. Interior Wall Tile: Conduct meeting before installing wall studs.
3. Additional Attendees:

a. Gypsum wallboard installer.

4. Additional Agenda Items:

a. Locating substrate expansion, movement, and cold joints.
b. Scheduling waterproof membrane cure times and testing.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Tile.
2. Tile trim and accessories.
3. Mortar.
4. Grout.

a. Provide initial selection color charts and Samples.

5. Membranes.
6. Metal trim.

B. Shop Drawings.

1. Locations of tile and tile patterns.

2. Locations of control and expansion joints.
3. Show field verified dimensions of disruptions in floor and wall surfaces; outlets, controls, vents, drains, switches, and other elements not covered by tile.

C. Samples:

1. Tile: Full sized Samples of each type and color.
2. Metal Trim: 12 inch long section of each profile and finish.
3. Assembly Samples: Tile mounted on rigid panel, joints grouted, 12 inches square, 4 tiles minimum.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Statements: Installer.

B. Manufacturer Reports: Field inspection reports.

1. Dynamic coefficient of friction.
2. Material compatibility, adhesion, and staining.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Materials:

1. Tile and Trim Units: Full size units equal to 3 percent of each product, minimum.
2. Grout: Unopened containers equal to 2 percent of each product and color, minimum.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Contractor Supervisor: International Masonry Institute Foreman Certification.
2. Individual Installers: Completed the International Masonry Institute Advanced Certification for Tile Installers, ACT, certification for installation of mud floors, mud walls, membranes, and large format tile.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:

1. Store tile and cementitious materials indoors, elevated above grade.
2. Prevent liquid materials from freezing.

1.8 FIELD CONDITIONS

A. Ambient Conditions: Perform Work within following limitations.

1. Building enclosed and environmental systems maintaining design conditions for Owner occupancy.

1.9 WARRANTY

A. Manufacturer Warranty:

1. Waterproofing System: Warrant against total system failure.
2. Warranty Includes:

a. Warranty Period: 5 years.
b. Dollar Limit: None.

PART 2 - PRODUCTS

2.1 TILE PRODUCTS

A. Ceramic Floor, Wall, and Shower Tile:: ANSI A137.1.

1. Manufacturers and Products: See Finish Schedule on Drawings.
2. Mounting: Manufacturer standard back mounted tile assemblies.

2.2 TRIM AND ACCESSORIES

A. Trim Units: Coordinated with colors, sizes, and coursing of adjoining flat tile.

B. Shapes: See Finish Schedule on Drawings.

2.3 METAL TRIM

A. Metal Strips: Angles, Transitions, Finishing Edges, and Ramps.

1. Manufacturers:

a. Blanke Corporation.
b. MAPEI Profilpas.
c. Schluter Systems.

2. Shapes: See Drawings.
3. Height: Align exposed surfaces with tile and setting bed thickness.
4. Material: See Drawings.
5. Finish: See Drawings.

2.4 MORTAR MATERIALS

A. Improved Modified Dry-Set Cement Mortar: ANSI A118.15.

1. Manufacturers and Products:

a. Custom Building Products ProLite.
b. LATICRETE 4-XLT.
c. MAPEI Ultralite Mortar.
d. Sika Tile 500 LHT Lite.

2.5 GROUT MATERIALS

A. Source Limitations:

1. Provide mortar and grout from single manufacturer.

B. Grout, General:

1. Sanded Grout: Joints over 1/8 inch wide.
2. Unsanded Grout: Joints 1/8 inch and less.

C. High Performance Cement Grout: ANSI A118.7.

1. Manufacturers and Products:

a. Custom Building Products Prism Ultimate Performance.
b. LATICRETE PERMACOLOR Select.
c. Or approved equal.

2. Color: See Drawings.

D. 100 Percent Solids Epoxy Grout: ANSI A118.3.

1. Manufacturers and Products:

a. Custom Building Products CEG Lite.
b. LATICRETE SPECTRALOCK PRO PREMIUM.
c. Or approved equal.

2. Color: See Drawings.

2.6 MEMBRANES

A. Contractor Option: Use fluid applied or chlorinated polyethylene sheet waterproofing and sound control crack isolation membrane.

B. Waterproofing Membranes:

1. Fluid Applied Waterproofing Membrane: ANSI A118.10, unreinforced latex rubber or elastomeric polymer.

a. Manufacturers and Products:

1) Ardex 8+9 or S1-K.
2) Custom Building Products RedGard.
3) LATICRETE HYDRO BAN.
4) MAPEI Mapelastic Aqua Defense or CI.
5) Merkrete Hydro Guard SP1 Waterproof Membrane.
6) SikaTile 100 Moisture Guard.

2. Sheet Waterproofing Membrane: ANSI A118.10, chlorinated polyethylene sheet.

a. Manufacturers and Products:

1) Noble Company NobleSeal SIS, NobleSeal CIS, or NobleDeck.
2) Or approved equal.

C. Crack Isolation Membranes:

1. Sound Control Crack Isolation Membranes: ANSI A108.13 and ANSI A118.12, bonded flexible sheet membrane.

a. Manufacturers and Products:

1) Custom Building Products EasyMat.
2) LATICRETE 170.3 and 170.5 Sound & Crack Isolation Mat.
3) Noble Company NobleSeal SIS.
4) MAPEI Mapesonic 2.
5) Protecto Wrap Whisper Mat CS.
6) Sika Tile 700 Sound Shield PNS.

D. Accessory Products: Membrane manufacturer primers, adhesives, reinforcing strips, transition mesh, joint sealants, and other products required for a complete installation.

2.7 MISCELLANEOUS MATERIALS

A. Vapor Retarders:

1. Polyethylene: ASTM D4397, 6 mil thickness.

B. Grout Sealer: Non-appearance-modifying water repellent.

1. Manufacturers and Products:

a. Custom Building Products Aqua Mix Penetrating Sealer.
b. LATICRETE STONETECH Sealer.
c. MAPEI UltraCare Penetrating Plus Stone Tile and Grout Sealer.
d. Or approved equal.

C. Metal Lath: ASTM C847 expanded flat mesh, 2.5 lb per sq yd, minimum.

2.8 SEALANTS

A. Joint Sealants: See Section 079200.

1. Color: Architect Selected.

2.9 PERFORMANCE

A. Dynamic Coefficient of Friction: Tested per ANSI A137.1 DCOF AcuTest.

1. Level Floor Surfaces: 0.42 minimum.
2. Stair Treads: 0.60 minimum.
3. Ramp Surfaces: 0.80 minimum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify substrates are ready to receive tile Work, are firm, dry, clean, free of incompatible coatings, and follow ANSI A108.01.

B. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.

3.2 PREPARATION

A. Concrete Substrates: Section 090561.

1. Fill cracks, voids, and depressions in substrate with leveling compound specified in Section 035400.
2. Grind off high spots and projections in substrate.
3. Remove loose and foreign matter that could impede performance of tile.

3.3 TILE INSTALLATION

A. General: Install tile and grout per ANSI A108.1 through ANSI A108.10 requirements and TCNA Handbook recommendations.

1. Install edge strips and trim.

B. Waterproofing and Sound Control Crack Isolation Membranes: Install per ANSI A108.13 and ANSI A108.17. Test waterproofing membrane for watertightness before installing tile.

1. Verify that liquid-applied waterproofing membranes have 20 mil dry film thickness, minimum.

C. Lay out tile to minimize pieces less than half size. Locate cuts to be inconspicuous.

D. Lay tile to patterns shown on Drawings. Do not interrupt tile pattern through openings.

E. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor, base and wall joints.

F. Place tile with joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.

G. Joint Widths: Manufacturer recommended minimums, and as follows:

H. Form internal angles square and external angles square.

I. Install ceramic accessories rigidly.

J. Sound tile after setting. Replace hollow sounding units.

K. Movement Joints: TCNA Method EJ-171. Provide at following locations:

1. Changes in backup material.
2. Changes in plane.
3. Over substrate joints.
4. Interior Locations: 24 feet on center, maximum except 8 feet on center, maximum at direct sunlight exposed surfaces.

L. Install joint backing and joint sealer per Section 079200.

M. Metal Edge Strips: Install where shown on Drawings, at exposed edges of tile, and at transitions between tile and other flooring material.

N. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes per Section 079200.

O. Grout Sealer: Apply to cementitious grout joints. Remove excess.

3.4 CLEANING

A. Cleaning: Clean tile and grout surfaces. Remove grout residue, smears and haze.

B. Protect tile with kraft paper or other covering to prevent damage and wear. Prohibit foot and wheeled traffic for seven days, minimum, after grouting.

3.5 INSTALLATION SCHEDULE - INTERIOR WALL TILE

A. Walls over Cementitious Backer Board on Metal Studs, Thinset: Installation Method TCNA W244C.

1. Membrane: Fluid applied.
2. Bond Coat: Improved Modified dry-set cement mortar.
3. Grout: High performance cement grout.

B. Walls over Glass Mat Faced Gypsum Backer Board on Metal Studs, Thinset: Installation Method TCNA W245.

1. Membrane: Fluid applied.
2. Bond Coat: Improved Modified dry-set cement mortar.
3. Grout: High performance cement grout.

END OF SECTION 093000

SECTION 099000 - PAINTING AND COATING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Exterior and interior painting and coating.

B. Principal Products:

1. Interior paint systems.
2. Exterior paint systems.

1.2 REFERENCES

A. Definitions:

1. Sheen Levels: ASTM D523.

a. Flat: Five gloss units at 60 degrees and 10 gloss units at 85 degrees, maximum.
b. Eggshell: 10 to 25 gloss units at 60 degrees and 10 to 35 gloss units at 85 degrees.
c. Satin: 20 to 35 gloss units at 60 degrees and 35 gloss units minimum at 85 degrees.
d. Semigloss: 35 to 70 gloss units at 60 degrees.
e. Gloss: 70 gloss units at 60 degrees, minimum.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting:

1. Conduct meeting one week, minimum, before starting Work of this Section.
2. Additional Agenda Items:

a. Review moisture testing requirements and results.
b. Review substrate preparation requirements and methods.

1.4 ACTION SUBMITTALS

A. Product Data.

1. Initial selection color charts and chip sheets.

B. Samples:

1. Draw Down Samples: Each type of paint system and each topcoat color and gloss.

a. Label each Sample for paint system, location, and substrate.
b. See Drawings for quantity.

C. Schedule of paint finishes per room and surface.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data:

1. Cleaning, touch up, and repair instructions for painted and coated surfaces.
2. Area summary with finish schedule and Samples, designating where each product, color and finish was used.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Materials:

1. Paint from same product run as installed materials. Extra stock materials to be unopened to qualify.

a. Quantity: 5 percent, but not less than 1 gallon of each material and color.

1.7 QUALITY ASSURANCE

A. Field Samples: Apply each paint systems to substrates shown on Drawings. Demonstrate texture, color, and pattern.

1. Approved Samples establish Work results standard.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:

1. Store paint products in sealed containers until ready for use.

1.9 FIELD CONDITIONS

A. Apply materials only when surface and ambient temperatures are within temperature ranges required by paint product manufacturer.

B. Apply exterior coatings when rain or snow are not occurring or forecasted, and when relative humidity is inside humidity ranges, and moisture content of surfaces is within acceptable levels required by paint product manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

1. Benjamin Moore.
2. Or approved equal.

2.2 PAINT, GENERAL

A. Colors: Basis of design manufacturer designations, see Finish Schedule on Drawings.

1. Finishes by basis of design: See Drawings.

B. Paint Systems: Primers, intermediate coats and topcoats compatible with substrates and one another.

C. Coatings: Ready mixed or field catalyzed.

D. Preparation:

1. Mix to soft paste consistency, capable of being readily and uniformly dispersed to homogeneous coating.
2. Blend tints and catalyzers to uniform consistency and color, capable of drying or curing free of streaks or sags.

2.3 SUSTAINABILITY CHARACTERISTICS

A. VOC Content: Follow VOC limits of authorities having jurisdiction.

B. Low Emitting Materials: Follow California Department of Public Health, Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers.

2.4 SOURCE QUALITY CONTROL

A. Tests:

1. Testing: Owner will engage a testing agency to sample paint materials delivered to Project site or taken from Supplier facility.
2. Acceptance Criteria: Products follow specified requirements.

B. Non-Conforming Work: Remove materials from substrates, pay for testing replacement products, and repaint surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Verify substrates are ready to receive Work.

B. Preinstallation Testing: Test moisture content of substrate does not exceed the following:

1. Concrete: 12 percent.
2. Fiber Cement Board: 12 percent.
3. Masonry: 12 percent.
4. Wood: 15 percent.
5. Portland Cement Plaster: 12 percent.
6. Gypsum Board and Plaster: 12 percent.

C. Gypsum Board: Verify finishing compound is dried and sanded smooth.

D. Plaster: Verify plaster is cured.

E. Concrete: Verify surface has cured at least 30 days and surface pH is between 6 and 9.

F. Masonry: Verify surface has cured at least 30 days and surface pH is between 6 and 9.

3.2 PREPARATION

A. Surface Preparation: Remove electrical plates, hardware, trim, escutcheons, and fittings. Correct defects in substrates capable of affecting Work.

B. Cleaning: Remove substances that could impair paint bond, including dust, oil, grease, and incompatible coatings.

1. Impervious Surfaces: Remove mildew by scrubbing with cleaning solution recommended by finish coating manufacturer. Rinse with clean water and allow surface to dry.
2. Aluminum Surfaces: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
3. Asphalt, Creosote, or Bituminous Surfaces: Remove foreign particles to permit adhesion of finishing materials. Apply compatible sealer or primer.
4. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.
5. Plaster Surfaces: Fill cracks, holes, and other imperfections with latex patching plaster. Blend texture with adjacent surfaces. Clean and allow to dry.
6. Concrete and CMU Surfaces: Remove dirt, loose mortar, scale, efflorescence and chalk. Remove oil and grease by scrubbing with cleaning solution recommended by finish coating manufacturer. Rinse with clean water and allow surface to dry.
7. Non-Passivated Galvanized Surfaces: Smooth and hand or power tool clean per ASTM D6386.
8. Passivated Galvanized Surfaces: Remove soluble and insoluble contaminants and corrosion. Sweep blast per ASTM D6386 to achieve uniform 1.0 to 2.0 mil anchor profile.
9. Uncoated Steel: Remove rust and loose mill scale. Clean per SSPC-SP6/NACE No. 3 Commercial Blast Cleaning.
10. Primed Steel: Clean field welds, fasteners, and abraded shop primer.
11. Wood Surfaces:

    a. Wipe off dust and grit. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried.
    b. Backprime concealed surfaces.

3.3 APPLICATION

A. Follow manufacturer instructions for application method, thickness of coatings, and number of coats.

1. Apply finishes when surfaces are dry. Allow applied coats to dry before next coat is applied.
2. Apply each coat of paint slightly darker than preceding coat.
3. Apply coatings to uniform appearance.
4. Sand wood and metal surfaces lightly between coats.
5. Leave testing agency, equipment identification, and performance labels unpainted.

B. Appearance:

1. Apply paints without imperfections.
2. Edges and Color Breaks: Produce sharp edges.

3.4 PAINTING MECHANICAL EQUIPMENT

A. Paint the following equipment to match adjacent surface when exposed in occupied spaces:

1. Electrical panelboards and switchgear.
2. Piping.
3. Ductwork.
4. Pipe hangers.
5. Conduit.
6. Unfinished.
7. Shop-primed equipment.

B. Paint interior surfaces of air ducts visible through grilles with one coat of flat black paint.

3.5 FIELD QUALITY CONTROL

A. Field Tests and Inspections: Engage inspectors to perform tests and inspections and prepare reports. Allow inspectors access to Work areas.

1. Failed Test Retest Cost: Contractor responsibility.

B. Testing: Dry film thickness.

C. Non-Conforming Work: Remove and replace or apply additional coats, and retest.

3.6 CLEANING

A. Remove rubbish, empty cans, rags, and other discarded materials.

B. Remove splattered paints. Protect adjacent surfaces from damage.

3.7 PROTECTION

A. Protect painted surfaces from subsequent Work. Touch up and restore damaged painted surfaces.

3.8 INTERIOR PAINTING SCHEDULE

A. Gypsum Board and Plaster Walls:

1. Latex Primer:

a. BEHR: Drywall Plus Interior Primer & Sealer 73.
b. Benjamin Moore: Ultra Spec 500 Interior Latex Primer N534.
c. PPG Paints: SPEEDHIDE zero Interior Latex Sealer 6-4900XI.
d. Sherwin-Williams: ProMar 200 Zero VOC Interior Latex Primer B28W02600.
e. Tnemec: Series 151 Elasto-Grip.

2. Acrylic Latex Enamel: Eggshell finish.

a. BEHR: Behr Pro i300 Interior.
b. Benjamin Moore: Ultra Spec 500 Series.
c. PPG Paints: SPEEDHIDE Zero Interior Latex.
d. Sherwin-Williams: ProMar 200 Zero VOC Interior Latex.
e. Tnemec: Series 1029 Enduratone low semigloss.

3. Epoxy Topcoat: Eggshell finish.

a. BEHR: Behr Pro Pre-Catalyzed Waterborne Epoxy.
b. Benjamin Moore: Corotech Pre Catalyzed Epoxy.
c. PPG Paints; PITT-GLAZE WB1 Interior Pre-Catalyzed Water-Borne Acrylic Epoxy.
d. Sherwin-Williams: Pro Industrial Pre-Catalyzed Water Based Epoxy.
e. Tnemec: Series 113/114 H.B. Tneme-Tufcoat.

B. Gypsum Board and Plaster Ceilings:

1. Latex Primer:

a. BEHR: Drywall Plus Interior Primer & Sealer 73.
b. Benjamin Moore: Ultra Spec 500 Interior Latex Primer N534.
c. PPG Paints: SPEEDHIDE zero Interior Latex Sealer 6-4900XI.
d. Sherwin-Williams: ProMar 200 Zero VOC Interior Latex Primer B28W02600.
e. Tnemec: Series 151 Elasto-Grip.

2. Acrylic Latex Enamel: Flat finish.

a. BEHR: Behr Pro i300 Interior.
b. Benjamin Moore: Ultra Spec 500 Series.
c. PPG Paints: SPEEDHIDE Zero Interior Latex.
d. Sherwin-Williams: ProMar 200 Zero VOC Interior Latex.
e. Tnemec: Series 1026 Enduratone matte.

C. Steel Doors and Frames:

1. Pre Primed Metal: Touch up with same shop primer product used by manufacturer.
2. Latex Primer:

    a. BEHR: Multi-Surface Interior/Exterior Primer & Sealer 436.
    b. Benjamin Moore: Ultra Spec HP Acrylic Metal Primer HP04.
    c. PPG Paints: Pitt-Tech Plus DTM 4020PF.
    d. Sherwin-Williams: Pro Industrial Pro-Cryl Universal Primer B66-1310 Series.
    e. Tnemec: Series 115 UniBond DF.

3. Acrylic Latex Enamel: Semigloss finish.

    a. BEHR: PREMIUM Interior/Exterior Direct to Metal Paint.
    b. Benjamin Moore: Ultra Spec HP D.T.M Acrylic Enamel.
    c. PPG Paints: Pitt-Tech Plus Interior/Exterior DTM Industrial Enamel 4216 SG or 90 Series.
    d. Sherwin-Williams: Pro Industrial Acrylic.
    e. Tnemec: Series 1029 Enduratone low semigloss.

4. Waterbased Alkyd Enamel: Semigloss finish.

    a. BEHR: Urethane Alkyd Enamel.
    b. Benjamin Moore: ADVANCE Waterborne Interior Alkyd.
    c. PPG Paints: SPEEDHIDE Interior/Exterior WB Alkyd.
    d. Sherwin-Williams: ProMar 200 Interior Waterbased Acrylic-Alkyd.
    e. Tnemec: Series 2H Hi-Build Tneme-Gloss.

5. Epoxy Topcoat: Semigloss finish.

    a. BEHR: Behr Pro Pre-Catalyzed Waterborne Epoxy.
    b. Benjamin Moore: Corotech Pre Catalyzed Epoxy.
    c. PPG Paints; PITT-GLAZE WB1 Interior Pre-Catalyzed Water-Borne Acrylic Epoxy.
    d. Sherwin-Williams: Pro Industrial Pre-Catalyzed Water Based Epoxy.
    e. Tnemec: Series 113/114 H.B. Tneme-Tufcoat.

D. Steel and Steel Railings:

1. Pre Primed Metal: Touch up with same shop primer product used by manufacturer.
2. Latex Primer:

    a. BEHR: Interior/Exterior Metal Primer, 435.
    b. Benjamin Moore: Ultra Spec HP Acrylic Metal Primer HP04.
    c. PPG Paints: Pitt-Tech Plus DTM 4020PF.
    d. Sherwin-Williams: Pro Industrial Pro-Cryl Universal Primer B66-1310 Series.
    e. Tnemec: Series 115 UniBond DF.

3. Acrylic Latex Enamel: Semigloss finish.

a. BEHR: PREMIUM Interior/Exterior Direct to Metal Paint.
b. Benjamin Moore: Ultra Spec HP D.T.M Acrylic Enamel.
c. PPG Paints: Pitt-Tech Plus Interior/Exterior DTM Industrial Enamel 4216 SG or 90 Series.
d. Sherwin-Williams: Pro Industrial Acrylic.
e. Tnemec: Series 1029 semigloss.

4. Waterbased Alkyd Enamel: Semigloss finish.

a. BEHR: Urethane Alkyd Enamel.
b. Benjamin Moore: ADVANCE Waterborne Interior Alkyd.
c. PPG Paints: SPEEDHIDE Interior/Exterior WB Alkyd.
d. Sherwin-Williams: ProMar 200 Interior Waterbased Acrylic-Alkyd.
e. Tnemec: Series 2H High Build Tneme-Gloss.

5. Epoxy Topcoat: Semigloss finish.

a. BEHR: Behr Pro Pre-Catalyzed Waterborne Epoxy.
b. Benjamin Moore: Corotech Pre Catalyzed Epoxy.
c. PPG Paints; PITT-GLAZE WB1 Interior Pre-Catalyzed Water-Borne Acrylic Epoxy.
d. Sherwin-Williams: Pro Industrial Pre-Catalyzed Water Based Epoxy.
e. Tnemec: Series 113/114 H.B. Tneme-Tufcoat.

E. Galvanized Steel:

1. Latex Primer:

a. BEHR: Multi-Surface Interior/Exterior Primer & Sealer 436.
b. Benjamin Moore: Ultra Spec HP Acrylic Metal Primer HP04.
c. PPG Paints: Pitt-Tech Plus DTM 4020PF.
d. Sherwin-Williams: Pro Industrial Pro-Cryl Universal Primer B66-1310 Series.
e. Tnemec: Series 115 UniBond DF.

2. Acrylic Latex Enamel: Semigloss finish.

a. BEHR: PREMIUM Interior/Exterior Direct to Metal Paint.
b. Benjamin Moore: Ultra Spec HP D.T.M Acrylic Enamel.
c. PPG Paints: Pitt-Tech Plus EP DTM.
d. Sherwin-Williams: Pro Industrial Acrylic.
e. Tnemec: Series 115 UniBond DF.

3.9 EXTERIOR PAINTING SCHEDULE

A. Cement Board Substrates:

1. Primer:

a. BEHR: Multi-Surface Interior/Exterior Primer & Sealer 436.
b. Benjamin Moore: Ultra Spec Masonry Interior/Exterior 100% Acrylic Sealer

608.

c. PPG Paints: PERMA-CRETE Interior/Exterior Alkali Resistant Primer.
d. Sherwin-Williams: Loxon Concrete and Masonry Primer/Sealer LX02.
e. Tnemec: Series 151 Elasto-Grip.

2. Exterior Acrylic Latex Topcoat: Eggshell finish.

a. BEHR: PRO e600 Exterior Paint.
b. Benjamin Moore: Ultra Spec Exterior Enamel.
c. PPG Paints: SPEEDHIDE Exterior Latex.
d. Sherwin-Williams: A-100 Series.
e. Tnemec: Series 1029 Enduratone low semigloss.

B. Unprimed Ferrous Metal:

1. Rust Inhibitive Alkyd Primer:

a. BEHR: Interior/Exterior Metal Primer 435.
b. Benjamin Moore: Super Spec HP Alkyd Metal Primer P06.
c. PPG Paints: Multiprime 4360.
d. Sherwin-Williams: Kem Bond HS, B50 Series.
e. Tnemec: Series V10 Tnemec Primer.

2. Latex Topcoat: Semigloss finish.

a. BEHR: PREMIUM Direct to Metal Semi-Gloss Paint 3200.
b. Benjamin Moore: Ultra Spec HP D.T.M. Acrylic HP29.
c. PPG Paints: Pitt-Tech Plus EP DTM 90-1610.
d. Sherwin-Williams: A-100 Series.
e. Tnemec: Series 1029 Enduratone.

C. Galvanized Steel:

1. Primer:

a. BEHR: Multi-Surface Interior/Exterior Primer & Sealer 436.
b. Benjamin Moore: Ultra Spec HP D.T.M. Acrylic HP29.
c. PPG Paints: Pitt-Tech Plus DTM Primer 4020PF.
d. Sherwin-Williams: Pro Industrial ProCryl Universal Primer B66-1300 Series.
e. Tnemec: Series 115 UniBond DF.

2. Latex Topcoat: Semigloss finish.

a. BEHR: PREMIUM Direct to Metal Semi-Gloss Paint 3200.
b. Benjamin Moore: Ultra Spec HP D.T.M. Acrylic HP29.
c. PPG Paints: Pitt-Tech Plus EP DTM 90-1610.
d. Sherwin-Williams: A-100 Series.
e. Tnemec: Series 1029 Enduratone.

D. Aluminum:

1. Primer:

    a. BEHR: Interior/Exterior Bonding Primer 432.
    b. Benjamin Moore: Corotech Waterborne Bonding Primer, V175.
    c. PPG Paints: Pitt-Tech Plus 4020PF.
    d. Sherwin-Williams: Pro Industrial ProCryl Universal Primer B66-1310 Series.
    e. Tnemec: Series N69 High Build Epoxoline II.

2. Latex Topcoat: Semigloss finish.

    a. BEHR: Interior/Exterior Direct To Metal Semi-Gloss Paint 3200.
    b. Benjamin Moore: Ultra Spec HP D.T.M. Acrylic HP29.
    c. PPG Paints: Pitt-Tech Plus EP DTM 90-1610.
    d. Sherwin-Williams: A-100 Series.
    e. Tnemec: Series 1028 Enduratone.

3.10 HIGH PERFORMANCE EXTERIOR PAINTING SCHEDULE

A. Shop Primed and Unprimed Ferrous Metal: Pigmented polyurethane over high build epoxy system.

1. Epoxy Primer:

    a. BEHR: US Coatings EpoxyGrip 2000 VOC Epoxy Mastic.
    b. Benjamin Moore: Corotech Surface Tolerant Epoxy Mastic, V160.
    c. PPG Paints: Amerlock 600.
    d. Sherwin-Williams: Macropoxy 646-100 Fast Cure Epoxy.
    e. Tnemec Series 135 Chembuild.

2. Polyurethane Topcoat: Semigloss finish.

    a. BEHR: US Coatings UreGrip 3010 VOC HS Polyester Polyurethane.
    b. Benjamin Moore: Corotech Aliphatic Acrylic Urethane.
    c. PPG Paints: Pitthane Ultra LS.
    d. Sherwin-Williams: Hi-Solids Polyurethane B65-300.
    e. Tnemec: Series 73 Endura-Shield.

B. Shop Primed and Unprimed Ferrous Metal, Shop Applied System: Pigmented polyurethane over zinc rich primer and high build epoxy system.

1. Inorganic Zinc Rich Primer:

    a. BEHR: US Coatings ZincGard 1000.
    b. PPG Paints: Dimetcote 9.
    c. Sherwin-Williams Zinc Clad DOT Inorganic Zinc-Rich Coating.
    d. Tnemec Series 90E-92 Tneme-Zinc.

2. High Build Epoxy Intermediate Coat:

    a. BEHR: US Coatings EpoxyGrip 2000 VOC Epoxy Mastic.

b. PPG Paints: Amerlock 600.
c. Sherwin-Williams: Macropoxy 646-100 Fast Cure Epoxy.
d. Tnemec: Series N69 High Build Epoxoline II.

3. Two Component Polyurethane Topcoat: Gloss finish.

a. BEHR: US Coatings UreGrip 3010 VOC HS Polyester Polyurethane.
b. PPG Paints: Pitthane Ultra.
c. Sherwin-Williams: Hi-Solids Polyurethane B65-300.
d. Tnemec: Series 1074 Endura-Shield II.

C. Shop Primed and Unprimed Ferrous Metal-1: Pigmented fluoropolymer over high build epoxy system.

1. High Build Epoxy Primer:

a. PPG Paints: Amerlock 600.
b. Sherwin-Williams: Macropoxy 646-100 Fast Cure Epoxy.
c. Tnemec: Series N69 High Build Epoxoline II.

2. Two Component Fluoropolymer Topcoat: Gloss finish.

a. PPG Paints: Coraflon ADS.
b. Sherwin-Williams: FluoroKem HS 100.
c. Tnemec: Series 1070V Fluoronar.

D. Shop Primed or Unprimed Ferrous Metal, Shop Applied System: Pigmented fluoropolymer over aliphatic urethane, zinc rich primer, and high build epoxy system.

1. Inorganic Zinc Rich Primer:

a. PPG Paints: Dimetcote 9.
b. Sherwin-Williams Zinc Clad II.
c. Tnemec Series 90E-92 Tneme-Zinc.

2. High Build Epoxy Second Coat:

a. PPG Paints: Amerlock 600.
b. Sherwin-Williams: Macropoxy 646-100 Fast Cure Epoxy.
c. Tnemec: Series N69 High Build Epoxoline II.

3. Aliphatic Urethane Third Coat:

a. PPG Paints: Pitthane Ultra.
b. Sherwin-Williams: B65W Series Acrolon 218 HS Polyurethane.
c. Tnemec: Series 1075 Endura-Shield II.

4. Two Component Fluoropolymer Topcoat: Gloss finish.

a. PPG Paints: Coraflon ADS.
b. Sherwin-Williams: FluoroKem HS 100.
c. Tnemec: Series 1070V Fluoronar.

E. Galvanized Ferrous Metal: Pigmented polyurethane over high build epoxy system.

1. Epoxy Primer:

a. BEHR: US Coatings EpoxyGrip 2000 VOC Epoxy Mastic.
b. Benjamin Moore: Corotech Surface Tolerant Epoxy Mastic, V160.
c. PPG Paints: Amerlock 600.
d. Sherwin-Williams: Macropoxy 646-100 Fast Cure Epoxy.
e. Tnemec: Series N69 High Build Epoxoline II.

2. Two Component Polyurethane Topcoat: Gloss finish.

a. BEHR: US Coatings UreGrip 3010 HS Polyester Polyurethane.
b. Benjamin Moore: Corotech Aliphatic Acrylic Urethane.
c. PPG Paints: Pitthane Ultra.
d. Sherwin-Williams: Hi-Solids Polyurethane B65-300.
e. Tnemec: Series 1074 Endura-Shield II.

F. Galvanized Metal: Pigmented fluoropolymer over urethane intermediate coat and high build epoxy system.

1. High Build Epoxy Primer:

a. PPG Paints: Amerlock 600.
b. Sherwin-Williams: Macropoxy 646-100 Fast Cure Epoxy.
c. Tnemec: Series N69 High Build Epoxoline II.

2. Aliphatic Urethane Intermediate Coat:

a. PPG Paints: Pitthane Ultra.
b. Sherwin-Williams: Acrolon 218 HS Polyurethane B65W Series.
c. Tnemec: Series 1075 Endura-Shield II.

3. Two Component Fluoropolymer Topcoat: Gloss finish.

a. PPG Paints: Coraflon ADS.
b. Sherwin-Williams: FluoroKem HS 100.
c. Tnemec: Series 1070V Fluoronar.

G. Aluminum: Fluoropolymer over epoxy primer and polyurethane intermediate coat.

1. Primer:

a. PPG Paints: Amerlock 600.
b. Sherwin-Williams: Macropoxy 646-100.
c. Tnemec: Series N69 High Build Epoxoline II.

2. Intermediate Coat:

a. PPG Paints: Pitthane Ultra.
b. Sherwin-Williams: Acrolon 218 HS Acrylic Polyurethane B65W651 Semi-Gloss.

c. Tnemec: Series 73 Endura-Shield.

3. Fluoropolymer Topcoate:

a. PPG Paints: Coraflon ADS.
b. Sherwin-Williams: Fluorokem HS 100 B65-1570 Semi-Gloss.
c. Tnemec: Series 1071V Fluoronar semigloss.

END OF SECTION 099000

SECTION 099623

ANTI-GRAFFITI COATING

PART 1 - GENERAL

1.1 Anti-Graffiti Coating Summary:

A. Description: This section includes the application of graffiti resistant coatings to protect above grade, vertical masonry and concrete surfaces.

1. “Coatings” as used herein means all graffiti resistant coating system materials, including base coatings and top coatings required to achieve the performance requirements of this section.

a. Included:

1) Clear (transparent) graffiti resistant coating
2) Water repellant sealer

1.2 References:

A. ASTM D 2369-92 – Test method for volatile organic content of coatings.

B. ASTM D 3960-93 – Practice for volatile organic compound (VOC) content of paints and related coatings.

1.3 Submittals:

A. Product Data: In accordance with the provisions of submittal section, submit complete manufacturer’s literature and specifications, include complete lists of materials proposed for use, giving the manufacturers name, product numbers, and product information sheets for each specific item. Submit description for protection of surrounding areas and non-masonry surfaces, surface preparation, application, and final cleaning.

B. Maintenance Requirements: Submit manufacturer’s instructions for graffiti removal procedures.

C. Application and Safety: Submit manufacturer’s recommendation methods of installation including limitations, safety and environmental cautions, and material safety data sheets.

1.4 Quality Assurance

A. Applicator Qualifications:

1. Applicator must be trained by manufacturer on application of protective coating, safety practices, clean up, removal of graffiti and ongoing maintenance of coating.

a. Outside applicator must be experienced applicator and have a history of successful applications within the past two years. Applicator must use skilled workers who are trained, experienced, and familiar with the specific requirements and methods of similar products.

B. Performance Requirements:

1. Graffiti resistant coating shall be a permanent coating. Products shall not require reapplication after removal for life of the warranty period provided that the manufacturer's specifications for removal have been followed throughout the life of the coating.
2. Product must be available to suit architectural aesthetics of substrate and must come in clear with a satin or gloss finish.
3. Coatings and removal products must have been in commercial use for a period of not less than five (5) years.

1.5 Environmental Regulations

A. Comply with the California Code of Regulations Title 24.

B. Comply with all applicable Federal, State, and local codes and regulations.

C. All products must not contain VOC (zero VOC), solvents or odors for the air quality management district where application takes place. Where those requirements conflict with this specification, comply with the more stringent provisions.

D. Reduction must be water.

E. Clean up with thinners and solvents. MEK, toluene, xylene will not be approved.

1.6 Test Panels

A. Before full-scale application, review the manufacturer's product data sheet and apply sealer and graffiti resistant coating to test panels to determine number of applications, coverage rates, mils thickness, compatibility, effectiveness, surface preparation, application procedures and desired results. Final specifications will be determined by this procedure.

B. Apply sealer and graffiti resistant coating to test panels in accordance with manufacturer's written instructions. Allow 48 hours or until test panels are thoroughly dry and tack free before evaluating final appearance and results. Do not begin full-scale application until test panels are reviewed and accepted by project official, architect, manufacturer, applicator and the construction manager.

C. Test Panel Requirements:

1. Size: minimum 4 feet each or as determined by project coordinator.
2. Locations: as determined by project coordinator.
3. Numbers: as required to completely test each sealer and graffiti resistant coating with each typical substrate to be protected.

a. Test panel shall be tested in accordance with the performance of this section for the removal of all graffiti from the coating. Removal agent shall also be demonstrated to the satisfaction of the section.
b. No evidence of ghosting, shadowing or staining shall remain after removal provided that all manufacturer's recommendations have been followed with regard to application of the coating and removal process.

D. Apply the system as specified in a designated area. This will serve an indication that the applicator can provide acceptable results and will be used as the standard for the rest of the work.

E. Retain and protect test panels approved by project manager in undisturbed condition during the work of this section, to be used as a standard for judging the graffiti resistance coating work.

1.7 Delivery, Storage, and Handling

A. Delivery: Deliver materials to site or specified address in manufacturer's original, unopened containers and packaging, bearing the manufacturer's label with the following information:

1. Name or title of material
2. Manufacturer's stock number and date of manufacturing (batch number)
3. Manufacturer's name
4. Contents by volume and weight
5. Application/instructions
6. Technical specifications
7. Color name number (if applicable)

B. Storage and Handling:

1. Store materials not in actual use, except those materials already catalyzed, in tightly covered containers. Maintain containers used in storage of paint in clean condition, free of foreign materials and residue.
2. Do not allow material to freeze. Protect from freezing where necessary, containers should be protected from prolonged exposure to hear or sunlight. Materials should be stored in an environment between 45 and 75 degrees Fahrenheit.
3. Keep storage area neat and orderly. Remove flammable rags and waste daily. Take all precautions to ensure that workman and work areas are adequately protected from the fire hazards and health hazards from handling, mixing, and application of paints.

1.8 Project Conditions

A. Apply Okon PLGR-5 CMU water repellant as base coat to provide water repellant surfaces, control pH and for overall aesthetics of surface. Follow manufacturer's directions for application.

B. Apply SCR 3 clear gloss top coat only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 90 degrees Fahrenheit. Allow first

coat to dry before applying second coat. Do not apply wet on wet.

C. Do not apply topcoat when relative humidity exceeds 80%. Do not apply earlier than 24 hours after rain or if rain is predicted for a period of 12 hours after application, unless otherwise indicated by manufacturer's written instructions.

D. Do not apply to frozen substrates. Allow adequate time for substrate to thaw, if freezing conditions exist before application.

E. Do not apply under windy conditions such that graffiti control coating may be blown to surfaces not intended to be treated.

1.9 Maintenance Products

A. Extra Products: Furnish County Coordinator with the following extra products below. Extra stock materials to be unopened to qualify.

1. Graffiti Resistant Coating: 5 percent, but not less than 1 gallon
2. Graffiti Removal Agent: 5 percent, but not less than 1 gallon

1.10 Warranty

A. Warranty shall cover the original purchaser for a period of up to ten (10) years from the date of purchase.

B. Manufacturer shall warrant the removal of all graffiti defacement, chemical staining, ghosting, shadowing and normal environmental effects, without exception, and will retain reasonable gloss and color stability so long as product is applied and maintained according to manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 Manufacturers

A. Design is based on products manufactured by: Genesis Coating Incorporated in California (800) 533-4273

B. Alternate Manufacturers:

1. Prosoco Sure Klean Wather Seal Blok-Guard & Graffiti Control WB 6.

2.2 Graffiti Control Coatings

A. Graffiti control coating must be tested and approved by the Project Coordinator.

B. Graffiti control coating must have the capability of having all types of paints and graffiti materials (currently known to the public) completely removed without damaging both the coating and the substrate when removed according to manufacturer's written recommendations.

C. Removal agent shall be non-toxic and have a PH level between 7 and 8.5. After removal is complete, no evidence of graffiti shall be present when used in accordance

with manufacturer's written recommendations.

D. The removal of graffiti materials shall not cause a change in appearance of the treated surface for the period of the warranty when removal is completed in compliance with manufacturer's written recommendations.

E. The graffiti control coating should follow the technical data as listed below:

1. Resin type of graffiti control coating should be aliphatic polyurethane.
2. Percent solids of mixed material should equal:

    a. Percent Solids by Weight: Clear 60%/Pigmented=66% (mixed)
    b. Percent Solids by Volume: Clear=58%/Pigmented=64% (mixed)

3. Specific gravity should equal 1.05.
4. Pot life of mixed material should be between 1.5 to 2 hours.
5. Full cure of applied material should be between 3 to 5 days depending on temperature and humidity.
6. Graffiti control coating should be a two-component coating system.
7. Graffiti control coating should be reducible with water.
8. Graffiti control coating should contain zero volatile organic compounds (VOC).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to the commencement of the Work of this Section, applicator must examine areas and conditions where graffiti control coating is to be applied. Applicator must notify Contractor in writing of conditions detrimental to proper and timely completion. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to the applicator.

B. Starting if coating Work will be construed as applicator's acceptance of the surfaces and conditions in any particular area.

C. Do not apply over dirt, rust, scale, grease, moisture, or conditions otherwise detrimental to formation of durable paint film as discussed in manufacturer's technical specifications.

3.2 Protection

A. Protect surrounding areas, landscaping, building occupants, pedestrians, vehicles, and non masonry surfaces not designated for protection during the Work from graffiti resistant coatings, masonry or concrete cleaners if used, residues, rinse water, fumes, wastes, and effluents in accordance with manufacturer's written specifications.

B. Cover finished work and materials of all other trades that may be affected by work of the Section during coating application. Protect all surrounding adjacent areas from overspray.

C. Divert and protect pedestrian and vehicle traffic.

3.3 Surface Preparation

A. General: Perform preparation and cleaning procedures in accordance with coating manufacturer's instruction and as herein specified for each particular substrate condition.

1. Clean surfaces to be painted before applying coating or surface treatments. Remove oil, grease, and other surface contaminants prior to mechanical cleaning. Program cleaning and painting so that contaminants from the cleaning process will not fall onto wet, newly surfaces.

B. Repair, patch, and fill all cracks, voids, defects, and damaged areas in surface as approved by Construction Manager. Allow repair materials to cure completely before application of graffiti resistant coatings.

C. Apply compatible sealant and caulking and allow to cure completely before application of graffiti resistance coating.

D. Seal all open joints

E. Apply new construction substrates to properly cure before graffiti control.

F. Properly clean the new substrates as specified in manufacturer's technical data.

3.4 Application of Graffiti Control Coating

A. General: Apply sealer and graffiti resistant coating in accordance with manufacturer's directions. Review material safety data sheets prior to use of material. Use application techniques best suited for substrate and type of material to be applied.

B. Applicator must know the substrate that is to be coated and understand the porosity, texture, and general conditions that will be present during the application to provide a correct bid and choose correct product acquisition.

C. Anti-graffiti coating must be reducible with clean, fresh water at a rate of 5%-20% depending on applications.

D. Do not mix two-component coating at any other rate than the ratio supplied by manufacturer.

E. Applicator must use caution when spraying materials. Applicator should wear OSHA approved respirator with organic vapor cartridge. Avoid over-spray and spillage. Mark all windows, move vehicles, cover air intakes, cover vegetation, and warn pedestrians prior to spraying. Applicator must make sure there is proper ventilation.

F. Do not apply in windy conditions.

G. Applicator shall do a test sample prior to application to confirm aesthetics, compatibility and coverage. Project Coordinator, architect and the construction manager must indicate acceptance of the test sample and sign off prior to full application.

H. Apply material between 50 degrees and 90 degrees Fahrenheit with a relative humidity

not to exceed 80%.

3.5 Application Rates

A. Use Okon PLGR-5 CMU Water Repellant sealer to achieve a proper profile for a pinhole free, continuous coating. Allow sealer to cure based on product manufacturer's direction.

B. Allow approximately 6-8 hours, or until tack free, dry time between each coat of GCR 3 Clear Top Coat. Full cure of material is approximately 3-5 days.

C. Temperature and humidity will affect and cure time of graffiti control coating.

D. Typically apply 2 mils dry (3-5 wet mil, do not exceed 7 wet mils) per coat to achieve optimal performance, however it is mandatory to determine the acceptable mils thickness for each specified job.

E. Mark time of application to establish pot life of material. Typical pot life is 1.5 to 2 hours depending on temperature and humidity. Exposure to direct sunlight, heat, or high humidity will decrease pot life of the material. Discard material after 2.5 hours.

F. Product should not be mixed with other products or containers of GCP 1000 Do not mix partial kits.

G. Follow manufacturer's specified mixing instructions and dwell time charts. Never add water directly to activator or unanalyzed polyol.

H. Apply coating in a crosshatch pattern. One vertical pass and on horizontal pass are considered one coat.

I. Spray applications are recommended by manufacturer for optimal coverage and appearance. Material sets up quickly and pulls easily, use caution when backrolling.

J. Coverage rates are affected by porosity, texture, method of application and environmental conditions. Average coverage rates should be approximately 250 top 280 square feet per gallon per coat. Application will require two coats of material. Coverage rates for extremely porous surfaces will be substantially lower than normal rates. Applicator should establish coverage rates for job under these conditions. Do not use universal spec to determine coverage.

K. More material is not better. Over application will result in microblistering, poor adhesion, and blushing.

3.6 Graffiti Removal

A. Use manufacturer's recommended graffiti remover for the specific system.

B. Spray vandalized area, allow 1-3 minutes before aggravating with a soft bristle brush or sponge.

C. Wash graffiti off with damp towels or pressure washer (1500psi)

3.7 Cleaning, Touching Up and Refinishing

A. General: Clean equipment immediately with solvents. Do not allow catalyzed material to stay in hoses beyond pot life. Clean material on shin and hair immediately with industrial soap and water.

B. Carefully remove all splatters, spots, and blemishes caused by work of this Section.

C. Upon completion of the Work, remove all rubbish, cans, and accumulated materials resulting from the Work. All areas must be left in a clean and orderly condition.

D. Runs, sags, misses, holidays, stains and other defects ion the coated surface, including inadequate coverage and mil thickness, will be satisfactorily touched up or refinished.

3.8 Field Quality Control

A. Inspection: Inspect the graffiti resistant coating Work with the construction manager, applicator, Project Coordinator and manufacturer’s representative, and compare with test panel results accepted by all of the above.

END OF SECTION

SECTION 10 21 00
TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Solid plastic toilet compartments including the following:
   1. Floor mounted overhead-braced toilet compartments.
   2. Floor-to-ceiling toilet compartments.

1.2 REFERENCES

A. ASTM A666 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

D. National Fire Protection Association (NFPA) 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Shop Drawings: Provide layout drawings and installation details with location and type of hardware required.

D. Verification Samples: For each finish product specified, two samples representing actual product, color, and patterns.

E. Sustainable Design Submittals:
   1. Recycled Content: Certify percentages of post-consumer and pre-consumer recycled content.
   2. Regional Materials: Certify distance between manufacturer and Project.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A company regularly engaged in manufacture of products specified in this section, and whose products have been in satisfactory use under similar service conditions for not less than 5 years.

B. Installer Qualifications: A company regularly engaged in installation of products specified in this Section, with a minimum of 5 years of experience.

C. Materials: Doors, panels and pilasters, constructed from high density polyethylene (HDPE) resins. Partitions to be fabricated from polymer resins compounded under high pressure, forming a single component which is waterproof, nonabsorbent and has a self-lubricating surface that resists marks from pens, pencils, markers and other writing instruments. Cover all plastic components with a protective plastic masking.

D. Performance Requirements:
   1. Fire Resistance: Partition materials shall comply with the following requirements, when tested in accordance with ASTM E 84, Class B:
      a. Tested to Meet ASTM E84, Class B flame spread/smoke developed rating.
   2. Material Fire Ratings:
      a. National Fire Protection Association (NFPA) 286: Pass.
      b. International Code Council (ICC): Class B.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

1.6 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by the manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.7 WARRANTY

A. Manufacturer guarantees its plastic against breakage, corrosion, and delamination under normal conditions for 25 years from the date of receipt by the customer. If materials are found to be defective during that period for reasons listed above, the materials will be replaced free of charge. Labor not included in warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Scranton Products, which is located at: 801 E. Corey St.; Scranton, PA 18505; Toll Free Tel: 800-445-5148; Fax: 855-376-6161; Email:request info (info@scrantonproducts.com); Web:http://www.scrantonproducts.com
   1. Fabricator: Santana Toilet Partitions.
   2. Fabricator: Comtec Toilet Partitions.
   3. Fabricator: Capitol Toilet Partitions.

B. Substitutions: Not permitted.

C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2 MATERIAL

A. Plastic Panels: High density polyethylene (HDPE) suitable for exposed applications, waterproof, non-absorbent, and graffiti-resistant textured surface.
   1. Recycled Content; Post Industrial: 25 percent.
   2. Recycled Content; Post Industrial: 100 percent.
   3. Recycled Content; Post Consumer: 100 percent.

B. Zinc Aluminum Magnesium and Copper Alloy (Zamac): ASTM B 86.

C. Stainless Steel Castings: ASTM A167, Type 304.

D. Aluminum: ASTM 6463-T5 alloy.

2.3 SOLID PLASTIC TOILET COMPARTMENTS

A. Basis of Design: Hiny Hiders Toilet Partitions as manufactured by and supplied by Scranton Products.
   1. Style: Floor mounted overhead-braced toilet compartments.

B. Doors, Panels, and Pilasters: 1 inch (25 mm) thick with all edges rounded to a radius. Mount doors and dividing panels based on height of specified system.
   1. Door and Panel Height: 55 inches (1397 mm).
   2. Aluminum heat sink fastened to bottom edges.
   3. Panel Edge: Standard.
   4. Pilasters: 82 inches (2083 mm) high and fastened to floor.

C. Panel Color: Bold series.
   1. Fossil - Orange Peel.

D. Pilaster Shoes: 3 inches (76 mm), 20 gauge stainless steel. Secured to pilasters with a stainless steel tamper resistant Torx head sex bolt.

E. Pilaster Shoes: 3 inches (76 mm) high one-piece molded HDPE. Secured to pilasters with a stainless steel tamper resistant Torx head sex bolt.
   1. Pilaster Plastic Shoe Color: Silver (Matches Stainless/Aluminum Hardware).

F. Headrail: Heavy-duty extruded 6463-T5 alloy aluminum with anti-grip design. Finish to be clear anodized. Fastened to headrail brackets with stainless steel tamper resistant Torx head sex bolt, and fastened at the top of the pilaster with stainless steel tamper resistant Torx head screws.
   1. Headrail Brackets: 20 gauge stainless steel with satin finish. Secured to the wall with stainless steel tamper resistant Torx head screws.

G. Wall Brackets:
   1. Aluminum Brackets: Heavy-duty aluminum 6463-T5 alloy.
   2. PVC Brackets: Extruded PVC plastic.
   3. Stainless Steel Brackets: Stainless steel type 201.
   4. Brackets are fastened to pilasters with stainless steel tamper resistant Torx head screws and fastened to the panels with stainless steel tamper resistant Torx head sex bolts.
   5. Bracket Type: Continuous 54 inches (1372 mm) stainless steel.
   6. Bracket Type: Continuous 54 inches (1372 mm) aluminum.

7. Bracket Type: Continuous 71 inches (1804 mm) aluminum.
8. Bracket Type: Continuous 71 inches (1804 mm) stainless steel.

H. Door Hardware:
1. Continuous Stainless Steel Helix Hinge:
   a. Length: 54 inches (1372 mm).
2. Continuous Stainless Steel Spring Loaded Hinge:
   a. Hinges: 54 inches (1372 mm).
3. Vault Hinge: Heavy-duty 304 stainless steel hinge having gravity-acting cams with a brushed finish and wrap around flanges.
4. Integral Hinges - Stealth: Fabricated in mount on inside of the toilet compartment on the door and pilaster. The door and pilaster is not to have exposed metal parts on the outside of the toilet compartment. Hinges operate with field adjustable nylon cams. Cams can be field adjusted to any degree. The pilaster and doors have to be fabricated to accept the hinge.
5. Wrap-Around Hinges: 8 inches (203 mm) and fabricated from heavy-duty extruded aluminum. Hinges are through-bolted to pilasters and doors with stainless steel tamper resistant Torx head sex bolts. Hinges operate with field adjustable nylon cams. Cams can be field set in 30, 60 or 9 degree increments.
6. Door Strike/Keeper: Heavy-duty extruded aluminum 6436-T5 alloy with a clear anodized finish. Secured to pilasters with stainless steel tamper resistant Torx head sex bolts. Bumper shall be made of extruded black vinyl.
   a. Style: 6 inches (152 mm) aluminum.
   b. Style: 54 inches (1372 mm) aluminum.
7. Latch Mechanism: Aluminum Slide Bolt Latch and Housing: Heavy-duty extruded 6463-T5 alloy aluminum. Latch and housing to have a clear anodized finish. Slide bolt and button to have a black anodized finish.
8. Latch Mechanism: Stainless Steel Slide Bolt Latch and Housing: Heavy-duty stainless steel type 304. The latch and housing to have a bright finish. The slide bolt and button to have a black anodized finish.
9. Latch Mechanism: Occupancy Indicator Latch and Housing:
   a. Material: Satin stainless steel.
   b. Occupancy indicators: Green for occupied and red not occupied.
   c. Slide bolt and button.
10. Doors supplied with one coat hook/bumper and door pull, clear anodized aluminum or stainless steel.
11. Equip outswing handicapped doors with second door pull and door stop.

2.4 SOLID PLASTIC PRIVACY SCREENS

A. Provide plastic privacy screens in urinal and entry toilet room applications as indicated or scheduled.

B. Panels, and pilasters, if required, 1 inch (25 mm) thick with edges rounded to a radius. Screens to be mounted at 14 inches (356 mm) above the finished floor. Color as selected by Architect from manufacturer's full line of current colors.
1. Aluminum heat sink fastened to bottom edges.
2. Recycled Content: Minimum 25 percent.

C. Screen Type: Wall mounted.
1. Urinal Screens: 18 inches (457 mm) wide by 42 inches (1067 mm) high.

D. Wall Brackets: Extruded PVC plastic. Fastened to the panel/pilaster with stainless steel tamper resistant torx head screws and fastened to wall with stainless steel tamper resistant torx head sex bolts.
   1. Length of Wall Brackets: 41 inches (1041 mm).
   2. Bracket Color: Match partition bracket color.

E. Aluminum Slide Bolt Latch and Housing: Heavy-duty extruded 6463-T5 alloy aluminum. Latch and housing to have a clear anodized finish. Slide bolt and button to have a black anodized finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Examine areas to receive toilet partitions, screens, and shower compartments for correct height and spacing of anchorage/blocking and plumbing fixtures that affect installation of partitions. Report discrepancies to the architect.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install partitions rigid, straight, plumb, and level manor, with plastic laid out as shown on shop drawings.

C. Clearance at vertical edges of doors shall be uniform top to bottom and shall not exceed 3/8 inch (9.5 mm).

D. No evidence of cutting, drilling, and/or patching shall be visible on the finished work.

E. Finished surfaces shall be cleaned after installation and be left free of imperfections.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 10 21 00

SECTION 102800

WASHROOM ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Washroom accessories as scheduled in this Section and as indicated on the Drawings.

1.2 RELATED REQUIREMENTS

A. Section 061053 - Rough Carpentry, coordination with blocking.

B. Section 088300 - Mirrors.

C. Section 092116 - Gypsum Board, coordination with blocking.

D. Section 093000 - Tiling, coordination with layout and installation.

E. Section 102100 - Toilet Compartments, coordination with accessories.

F. Section 102814 - Baby Changing Stations, for baby changing stations.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's data sheets for each product specified, including the following:

1. Installation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Cleaning and maintenance instructions.
4. Replacement parts information.

B. Schedule: Submit a toilet accessory schedule, indicating the type and quantity to be installed in each washroom. Use room numbers as indicated on the Drawings.

1.4 QUALITY ASSURANCE

A. Manufacturer: Provide products manufactured by a company with a minimum of 10 years successful experience manufacturing similar products.

B. Single Source Requirements: To the greatest extent possible provide products from a single manufacturer.

C. Accessibility Requirements: Comply with requirements applicable in the jurisdiction of the project, including but not limited to ADA and ICC/ANSI A117.1 requirement as applicable.

D. Hazardous Materials: Comply with EU Directive “Restrictions of Hazardous Substances (RoHS) requirements.”

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations. Protect from damage.

1.6 WARRANTY

A. Manufacturer’s Warranty for Washroom Accessories: Manufacturer’s standard 1 year warranty for materials and workmanship.

B. Manufacturer’s Warranty for Electric Hand Dryers: Manufacturer’s standard 5-year warranty on parts, except 3-year warranty on motor brushes from date of purchase.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Basis of Design Products: Based on the quality and performance requirements of the project, specifications are based solely on the products of Bobrick Washroom Equipment, Inc. www.bobrick.com. Location of manufacturing shall be the United States.

B. Substitutions: The Architect will consider products of comparable manufacturers as a substitution, pending the contractor's submission of adequate documentation of the substitution in accordance with procedures in Division 1 of the Project Manual. Documentation shall include a list of five similar projects of equivalent size where products have been installed for a minimum of two years, and manufacturer's certification that products are fabricated in the United States.

2.2 TOILET ACCESSORY SCHEDULE

A. Single-User Washroom, Standard Duty:

1. EQ-01: B-2888 Classic Series Surface-Mounted Multi-Roll Toilet Tissue Dispenser.
2. EQ-02: B-5806.99x42 Concealed Mounting Grab Bar – 1-1/4 inch diameter.
3. EQ-02A: B-5806.99x36 Concealed Mounting Grab Bar – 1-1/4 inch diameter.
4. EQ-03: KB300-01SS Koala Kare Surface Mount Horizontal Baby Changing Station with Stainless Veneer and External Bag Hook.
5. EQ-04: B-221 Classic Series Surface-Mounted Seat Cover Dispenser.
6. EQ-05: B-76717 Surface Mounted Hook, Stainless steel Satin-finish.
7. EQ-06: B-35139 Trime Line Series, Surface-Mounted Sanitary Napkin Disposal, Stainless steel Satin-finish.
8. EQ-07: B-828 Automatic, Countertop-Mounted Foam Soap Dispenser.
9. EQ-08: B-7179 Fino-Collection Surface-Mounted automatic Hand Dryer.
10. EQ-09: Toilet Partition, see Section 102100.
11. EQ-10: Urinal Partition, see Section 102100.
12. EQ-11: B-2908 Welded-Frame Tempered Glass Mirror, Satin Finish, reference Section 088300.
13. EQ-12: Fire Extinguisher Cabinet, see Section 104400.
14. EQ-13: B-298x18 Utility Shelf, 8”W x 18”L, Stainless steel Satin-finish.
15. EQ-14: 819298 Drinking Fountain Grab Bar, 1½" (38mm) Diameter Stainless Steel.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install products in strict compliance with manufacturer’s written instructions and recommendations, including the following:

1. Verify blocking has been installed properly.
2. Verify location does not interfere with door swings or use of fixtures.
3. Comply with manufacturer’s recommendations for backing and proper support.

4. Use fasteners and anchors suitable for substrate and project conditions.
5. Install units rigid, straight, plumb, and level, in accordance with manufacturer's installation instructions and approved shop drawings.
6. Conceal evidence of drilling, cutting, and fitting to room finish.
7. Test for proper operation.

3.2 CLEANING AND PROTECTION

A. Clean exposed surfaces of compartments, hardware, and fittings using methods acceptable to the manufacturer.

B. Touch-up, repair or replace damaged products until Substantial Completion.

END OF SECTION 102800

SECTION 102814
BABY CHANGING STATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Baby Changing Stations, Stainless Steel:
   1. Surface-mounted horizontal design. (Koala Model KB310-SSWM)

1.2 RELATED REQUIREMENTS

A. Section 061053 - Rough Carpentry, blocking in walls.

B. Section 092116 - Gypsum Board, coordination with blocking.

C. Section 093000 - Tiling, coordination with tile layout and installation.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's data sheets for each product specified, including the following.
   1. Installation instructions and recommendations, including templates and rough-in measurements.
   2. Storage and handling requirements and recommendations.
   3. Cleaning and maintenance instructions.

1.4 QUALITY ASSURANCE

A. Manufacturer: Provide products manufactured by a company with a minimum of 5 years successful experience manufacturing similar products.

B. Single Source Requirements: To the greatest extent possible provide products from a single manufacturer.

C. Accessibility Requirements: Comply with requirements applicable in the jurisdiction of the project, including but not limited to ADA, ICC A117.1, International Building Code (IBC), and state building code requirements as applicable.

D. Baby Changing Stations: Provide products which comply with the following standards and requirements.
   1. Antimicrobial Treatment: Changing surfaces embedded with Microban®, with antibacterial claim substantiated by Kirby-Bauer test or other manufacturer approved equivalent standard industry test methodology.
   2. Americans with Disabilities Act (ADA).
   3. ICC A117.1 - Accessible and Usable Building and Facilities.
   4. ANSI Z535.4 - Product Safety Signs and Labels.
   5. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use.
   6. ASTM G 21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

7. CPSIA: Conformity with the U.S. Product Safety Commission product safety rules, bans, standards and regulations that include applicable chemical compliance requirements.

E. Manufacturing Location: United States.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations. Protect from damage.

1.6 WARRANTY

A. Manufacturer’s Warranties: Submit manufacturer’s standard 5 year warranty for materials and workmanship and include a provision for replacement caused by vandalism.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Basis of Design Products: Based on the quality and performance requirements of the project, specifications are based solely on the products of Koala Kare Products, a Division of Bobrick, www.koalabear.com. Location of manufacturing shall be the United States.

B. Substitutions: The Architect will consider products of comparable manufacturers as a substitution, pending the contractor's submission of adequate documentation of the substitution in accordance with procedures in Division 1 of the Project Manual. Documentation shall include a list of five similar projects of equivalent size where products have been installed for a minimum of two years, and manufacturer's certification that products are fabricated in the United States.

2.2 BABY CHANGING STATIONS, STAINLESS STEEL

A. Surface-Mounted Horizontal Design Stainless Steel Baby Changing Station:
1. Basis of Design: Model KB310-SSWM with external stainless steel bag hook as manufactured by Koala Kare Products, a Division of Bobrick.
2. Handles: Station shall have two solid handles that allow operation with less than 5 lbs. of force. Handles rest below 27” for cane detection when unit is in the down position.
3. Front Panel shall be deep drawn, one-piece, seamless, 18-8, Type 304, 20 gauge (0.91mm) stainless steel with satin finish and laser etched logo with rounded corners.
4. Aesthetics: Unit shall have no plastic covering or visible plastic on the front of the unit and no adhesive labels applied to the front panel.
5. Flange: Deep drawn, one-piece seamless, 18-8, Type 304, 18 gauge (1.2 mm) stainless steel with satin finish. Flange edges and corners shall have

radii that complements the arc on the top, bottom, and side edges of the front panel.

6. Frame and Hinge Mechanism: Concealed 11-gauge chassis, compromised of 1” diameter integral steel-tubing that supports the changing bed and interacts with 11-gauge steel wall mounting bracket to provide steel-on-steel hinge stop. The wall frame shall serve as wall-mounting bracket.
7. External Diaper Bag Hook: 18-8, Type 304, 3/4 inch (19mm) diameter, wall-mounted, solid stainless steel rod with satin-finish.
8. Skirt: Shall be constructed of Type 304, 20 gauge (0.91mm) stainless steel with satin finish. Skirt corners shall have radii that complements the arc on the top, bottom, and side edges of the front panel.
9. Bed Surface: injection molded polypropylene with Microban® antimicrobial additive, and ISO 22196 tested for efficacy.
10. Surface is contoured, concave and smooth. Bed surface shall be minimum 535 sq. in.
11. Performance: Unit has minimal deflection from 90 degrees with a 200 lbs. static load placed in the center of the changing surface. Unit exceeds ASTM Standard F2285 static load requirement of 100 lbs.
12. Complies with requirements applicable in the jurisdiction of the project, including but not limited to ADA, ICC A117.1, International Building Code (IBC), and state building code requirements as applicable. Also complies with ASTM Standard F2285, Standard Consumer Safety Performance Specification for Diaper Changing Stations for Commercial use and EN 12221 for changing units for domestic use.
13. Dual Cavity Dispenser: Includes integral spring tab to make dispensing bed liners and diaper disposal sacks easier. Total 50 liner capacity. Equipped with tumbler lock, keyed alike Bobrick restroom accessories.
14. Operation: Concealed pneumatic cylinder providing controlled opening and closing of the changing station bed.
15. Instruction Graphics: Universal instruction graphics and safety messages in multiple languages.
16. Safety Straps: Replaceable, restraining straps.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install products in strict compliance with manufacturer’s written instructions and recommendations, including the following:
   1. Verify wall blocking has been installed properly.
   2. Verify wall location does not interfere with door swings or use of fixtures.
   3. Use fasteners and anchors suitable for wall substrate and project conditions.
   4. Install units at location and height indicated on the Drawings.
   5. Install units level, plumb and in proper relationship with adjacent construction.
   6. Adjust for proper operation.

3.2 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 102814

SECTION 104400

FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Results:

1. Surface mounted fire extinguisher cabinets, fire extinguishers, and accessories.

B. Principal Products:

1. Fire extinguishers.
2. Fire extinguisher cabinets.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting:

1. Conduct meeting one week, minimum, before starting Work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Extinguisher operational features.
2. Initial selection color Samples.
3. Initial selection color charts and Samples.

a. Include hardware, cabinets, trim, and panels.

B. Shop Drawings.

1. Show cabinet dimensions, details, fire ratings, and wall bracket mounting.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers and cabinets.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements:

1. Deliver fire protection specialties in manufacturers undamaged packaging.
2. Obtain bill of lading. Verify delivery is complete and products are undamaged.

1.6 WARRANTY

A. Manufacturer Warranty:

1. Fire Extinguishers: Warrant against product failure.

    a. Failure includes material and workmanship.
    b. Warranty Period: Five years.

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHERS

A. Fire Extinguishers, General:

1. Fire Extinguisher Fabrication and Labeling: NFPA 10.
2. FM Global approved.
3. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

B. Water Type:

1. Manufacturers and Products:

    a. Larsen's Manufacturing Company PW2-1/2, as basis of design.
    b. Amerex Model 240H.
    c. J.L. Industries Grenadier P.
    d. Potter Roemer 3202.

2. UL Rating: 2A.
3. Nominal Capacity: 2.5 gallon.
4. Container: Stainless steel container with pressure gage.

C. Multipurpose Dry Chemical:

1. Manufacturers and Products:

    a. Larsen's Manufacturing Company MP5, as basis of design.
    b. Amerex Model B424.
    c. J.L. Industries Cosmic 5E.
    d. Potter Roemer 3005.

2. UL Rating: 2A:10-B:C.
3. Nominal Capacity: 5 pounds.
4. Container: Enameled steel container with chrome plated brass valve.

2.2 FIRE EXTINGUISHER CABINETS

A. Cabinet Construction:

1. Nonrated.
2. 1 hour fire rated.
3. 2 hour fire rated.

B. Flush Framed Door Fire Extinguisher Cabinets:

1. Manufacturers and Products:

    a. J.L. Industries 1013.
    b. Potter-Roemer Alta 7000 Series.
    c. Safety One Industries Elite Architectural.

2. Cabinet: Cold rolled steel, sized for extinguisher; recessed and semirecessed types.

    a. Interior Finish: White baked enamel.

3. Door: Steel, powder coated, 0.097 inch thick.
4. Frames: Hollow metal, 1/2 inch thick.
5. Glazing: Full.
6. Glass Type: Acrylic.

    a. Glass Color: Clear.

7. Hardware: Piano hinge and Lever handle.
8. Trim: Material to match door, rolled edge, depth to suit mounting conditions.

2.3 PERFORMANCE

A. Fire Resistance:

1. Fire Rated Extinguisher Cabinets: ASTM E814; match rating of walls where installed.

2.4 MATERIALS

A. Steel Sheet: Cold rolled steel, ASTM A1008.

B. Aluminum Extrusions: ASTM B221.

C. Aluminum Sheet: ASTM B221, Alloy 6063-T5 minimum strength and durability.

D. Stainless Steel: ASTM A666, Type 304.

2.5 FABRICATION

A. Shop Fabrication: Provide cabinets with trim, frame, door, and hardware.

2.6 FINISHES

A. Shop Finishing Methods: Follow NAAMM AMP 500.

2.7 ACCESSORIES

A. Mounting Brackets: Steel, sized for specified fire extinguishers.

B. Cabinet Signs: Cabinet face applied.

1. Lettering: Vinyl adhesive.

    a. Legend: "FIRE EXTINGUISHER."

2. Arrangement: Vertical.
3. Color: Red.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Verify rough openings and blocking for cabinets are correctly sized and located.

3.2 INSTALLATION - GENERAL

A. General: NFPA 10.

B. Secure cabinets in place.

C. Place extinguishers in cabinets and on wall brackets.

D. Apply signage.

3.3 ADJUSTING

A. Adjust fire protection cabinet doors for smooth operation.

3.4 CLEANING

A. Clean interior and exterior surfaces.

END OF SECTION 104400

SECTION 13 31 23
PRE-ENGINEERED FABRIC SHADE STRUCTURES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections, apply to this section.

1.2 SUMMARY

A. A single fabric shade structure manufacturer shall be responsible for the design, wet-stamped engineering drawings, fabrication, and supply of the fabric shade structure specified herein. The installation shall comply with the manufacturer's instructions for assembly, installation, and erection, per approved drawings.

1.3 SUBSTITUTIONS

A. To qualify as an approved equal, please submit the following manufacturer, installer and product documentation at least ten days prior to the bid:
   a. 2 full sets of fabric samples
   b. Detailed material and performance specifications for ALL fabric, steel, hardware and cables used in shade structure
   c. 2 full sets of powder coating color metal "chips"
   d. List of at least 5 reference sites within 100 miles of bid location
   e. List of at least 5 customer references within 100 miles of bid location
   f. Proof of compliance with all quality assurance criteria, as per Section 1.5
   g. Full set of wet stamped (by an engineer in the state of California) engineering drawings for the proposed structures
   h. Proof of installation competency and/or certification for type and size of structure specified.
   i. List of any and all deviations from product specifications in section 2.1.

B. No substitutions will be allowed after the deadline. Any approval of alternate manufacturers and structures shall be by addendum prior to the bid date and shall not be allowed without written notification.

1.4 SUBMITTALS

With Bid Submittals:

A. Provide proof of existing reference sites with structures of similar project scope and scale.

B. Provide at least 18 fabric samples to show fabric color range and a digital (PDF) or paper document showing at least 9 powder coat color choices. Also, provide a

letter of authorization from the fabric manufacturer delineating authorized use of the specified fabric.

C. Manufacturer to provide proof of all quality assurance items, including;

1. A list of at least 5 reference projects in REGION that have been installed a minimum of 12 years.

2. Proof of General Liability, Professional Liability, and Umbrella insurance, as per Section 1.4B.

3. Proof of a minimum of $15,000,000 aggregate bonding capacity.

4. Proof of current IAS certification, as per Section 1.4D.

5. Proof of an Annual Maintenance Inspection Program.

6. Proof of a Corporate Safety and/or Injury & Illness Prevention Program.

1.5 QUALITY ASSURANCE

Fabrication and erection are limited to firms with proven specific area experience in the design, fabrication, and erection of fabric shade structures, and such firms shall meet the following minimum requirements. No substitutions shall be allowed for the following:

A. A single shade structure contractor shall design, engineer, and manufacture the fabric shade structures. If performing installation scope, this contractor shall provide a dedicated Project Manager throughout the entire Scope of Work related to the shade structure(s).

B. All bidders shall have at least 15 years' experience in the design, engineering, manufacture, and erection of fabric shade structures, engineered to CBC 2022 requirements with similar scope, and a successful construction record of in-service performance.

C. All bidders shall provide proof with bid submittal of a minimum of $2,000,000 (ag) General/Public Liability insurance, $3,000,000 Professional Liability (PL) insurance, and additional $10,000,000 Umbrella/Excess Liability insurance.

D. Manufacturer shall be accredited by the IAS (International Accreditation Service) for Structural Steel Fabrication under IBC 2006 Section 1704.2.5.2.

E. The fabric shade structure contractor shall have a Corporate Quality Control program/manual, which describes their complete quality assurance program.

1.6 WARRANTY

A. The successful installer shall provide a 12-month workmanship warranty on all installation labor and materials.

B. A supplemental warranty from the manufacturer shall be provided for 10 years (pro-rated) on fabric and 10 years (non-prorated) on the steel's structural integrity, from date of shade invoice.

C. The warranty shall not deprive the Owner of other rights the Owner may have under the provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 – PRODUCTS

2.1 GENERAL

A. The structures shall consist of:
Structure 1.1: (1 unit) custom stage cantilever 35’ 1” x 76’9” with 12’ entry height. Columns and upper framing to be in compliance with final HSS measurements shown in plans.

Structure 2.1: Two (2 units) custom cantilever ~ 60’ x 60’ with 12’ entry height. Columns and upper framing to be in compliance with final HSS measurements shown in plans.

B. The structures shall be manufactured by Shade Structures, Inc., d/b/a USA SHADE, or approved equal and include site specific city-approved stamped engineering drawings and structural calculations detailing structural steel frame, fabric roof, steel cables, all fasteners with full scope of work to include project management and foundation design as submitted at time of bid.

C. Contact: USA SHADE
1085 N. Main Street, Suite C
Orange, CA 92867
(714) 241 5567
Attn: Will King
will.king@usa-shade.com

D. The fabric shade structure(s) shall conform to the current adopted version of the California Building Code 2022

E. All fabric shade structures shall be designed and engineered to meet the minimum of 115mph “Ultimate” Wind Load, Risk Category II, Exposure C, seismic (earthquake) load based on Zone 4,and a Snow Load of 5 psf and Live Load of 5 psf. All fabric shade structures shall be engineered with a zero-wind pass-through factor on the fabric. When ASD Steel Design Method is used based on CBC Section 1605.3.1 the Dead + 0.75 of Live + 0.75 of Wind Load cases must be combined. NO EXCEPTIONS.

F. Steel:

1. All steel members of the fabric shade structure shall be designed in strict accordance with the requirements of the “American Institute of Steel Construction” (AISC) Specifications and the “American Iron and Steel Institute” (AISI) Specifications for Cold-Formed Members and manufactured in a IAS- (International Accreditation Service) accredited facility for Structural Steel Fabrication under IBC 2006 Section 1704.2.5.2.

2. All connections shall have a maximum internal sleeving tolerance of .0625” using high-tensile strength steel sections with a minimum sleeve length of 6”.

3. All non-hollow structural steel members shall comply with ASTM A-36. All hollow structural steel members shall be cold-formed, high-strength steel and comply with ASTM A-500-10, Grade B. All steel plates shall comply with ASTM A-572, Grade 50.

4. All galvanized steel tubing shall be triple-coated for rust protection using an in-line electroplating coat process. All galvanized steel tubing shall be internally coated with zinc and organic coatings to prevent corrosion.

G. Bolts:

1. All structural field connections of the shade structure shall be designed and made with high-strength bolted connections using ASTM A-325, Grade B.
2. Where applicable, all stainless steel bolts shall comply with ASTM F-593, Alloy Group 1 or 2. All bolt fittings shall include rubber washers for water-tight seal at the joints. All nuts shall comply with ASTM F-594, Alloy Group 1 or 2.

H. Welding:

1. All shop-welded connections of the fabric shade structure shall be designed and performed in strict accordance with the requirements of the “American Welding Society” (AWS) Specifications. Structural welds shall be made in compliance with the requirements of the “pre-qualified” welded joints, where applicable and by certified welders. No onsite or field welding shall be permitted.

2. All full penetration welds shall be continuously inspected by an independent inspection agency and tested to the CBC 2022.

I. Powder Coating:

1. Galvanized steel tubing preparation prior to powder coating shall be executed in accordance with solvent cleaning SSPC-SP1. Solvents such as water, mineral spirits, xylol, and toluol, which are to be used to remove foreign matter from the surface. A mechanical method prior to solvent cleaning, and prior to surface preparation, shall be executed according to Power Tool Cleaning SSPC-SP3, utilizing wire brushes, abrasive wheels, needle gun, etc.

2. Carbon structural steel tubing preparation prior to powder coating shall be executed in accordance with commercial blast cleaning SSPC-SP6 or NACE #3. A commercial blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, mill scale, rust, coating, oxides, corrosion, and other foreign material.

3. Powder coating shall be sufficiently applied (minimum 3 mils thickness) and cured at the recommended temperature to provide proper adhesion and stability to meet salt spray and adhesion tests, as defined by the American Society of Testing Materials.

4. Raw powder used in the powder coat process shall have the following characteristics:
   a. Specific gravity: 1.68 +/- 0.05
   b. Theoretical coverage: 114 +/- 4ft^2/mil
   c. Mass loss during cure: <1%
   d. Maximum storage temperature: 80^{o}F
   e. Interpon® 800 is a high-durability TGIC powder coating designed for exterior exposure. Tested against the most severe specifications, Interpon 800 gives significantly improved gloss retention and resistance to color change.

5. When the fabric shade structure(s) will be located within potentially corrosive environments such as (pools, reclaimed water irrigation, saltwater bodies, other standing bodies of water) hot dip galvanizing of Carbon steel or rust protection undercoat primer will be required on all structures at USA SHADE'S discretion. The rust protection primer shall be Sherwin-Williams® POWDURA® epoxy powder coating Z.R Primer and shall be applied to Carbon steel in accordance with the manufacturer's specifications. Primer should be fused only and then top coated with the selected powder coat to ensure proper inter-coat adhesion.

   a. The primer's attributes shall be:

i.	Specific gravity (g/ml):	2.37
ii.	Coverage at 1.0 mil (ft^2/lb):	81.6
iii.	Adhesion: ASTM D-3359	5B
iv.	Flexibility: ASTM D-552	Pass 1/8"
v.	Pencil hardness: ASTM D-3363	H-2H
vi.	Impact resistance (in.lb): ASTM D-2794	Dir & Rev, 120 in-lbs
vii.	Salt spray resistance: ASTM B-117	1000 hours
viii.	Humidity resistance: ASTM D-4585	2000 hours
ix.	60° Gloss: ASTM D-523	50 ~ 70
x.	Cure schedule (metal temp):	10min @ 200°C (390°F) 25min @ 135°C (275°F)
xi.	Film thickness range (mils):	2.0 ~ 3.0

J. Tension Cable: Steel wire rope cable is determined based on calculated engineering loads. Standard cabling is galvanized. Stainless steel cabling required when hot dip galvanized frame or primer frame are required.

1. 0.25” (nominal) galvanized 7x19 strand core wire rope shall be used for tension loads up to 4,500 lbs.

2. 0.375” (nominal) galvanized 7x19 strand core wire rope shall be used for tension loads up to 9,000 lbs.

3. 0.5” (nominal) galvanized 6x19 strand core wire rope shall be used for tension loads up to 13,500 lbs.

K. Fabric Roof Systems:

1. UV Shade Fabric:
   a. Colourshade® FR UV shade fabric is made of a UV-stabilized, high-density polyethylene (HDPE), as manufactured by Multiknit® (Pty) Ltd. HDPE mesh shall be a heat-stentered, three bar Rachel-knitted, lockstitch fabric with one monofilament and two tape yarns to ensure that the material will not unravel if cut. Raw fabric rolls shall be 9.8425 feet wide.
2. Fabric Properties:
   a. ~ Life Expectancy: minimum 8 years with continuous exposure to the sun
   b. ~ Fading: minimum fading after 5 years (3 years for Red)
   c. ~ Fabric Mass: 5.31 oz/yd^2 ~ 5.6 oz/yd^2 (180gsm ~ 190gsm)
   d. ~ Fabric Width: 9.8425 feet (3m)
   e. ~ Roll Length: 164.04 feet (50m)
   f. ~ Roll Dimensions: 62.99 inches x 16.5354 inches (160cm x 42cm)
   g. ~ Roll Weight +/- 66 lbs (+/- 30kg)
   h. ~ Minimum Temp: -13°F (-25°C)
   i. ~ Maximum Temp: +176°F (80°C)
   j. Fabric shall meet the following flame spread and fire propagation tests:
      i. ASTM E-84
      ii. NFPA 701 Test Method 2
      iii. California’s Office of the State Fire Marshal, Registered Flame Resistant Product

3. Stitching & Thread:
   a. All sewing seams are to be double-stitched.
   b. The thread shall be GORE® TENARA® mildew-resistant sewing thread, manufactured from 100% expanded PTFE (Teflon™). Thread shall meet or exceed the following:
      i. Flexible temperature range
      ii. Very low shrinkage factor
      iii. Extremely high strength, durable in outdoor climates
      iv. Resists flex and abrasion of fabric

v. Unaffected by cleaning agents, acid rain, mildew, salt water, and is unaffected by most industrial pollutants
vi. Treated for prolonged exposure to the sun
vii. Rot resistant

4. Shade and UV Factors:
   a. Shade protection and UV screen protection factors shall be as follows:

Color	Shade Factor %	UV Factor%
Blue	80%	85%
Green	80%	85%
Red	80%	86%
Silver	80%	81%
Terracotta	75%	82%
Yellow	80%	89%
Desert Sand	80%	92%

PART 3 – EXECUTION

3.1 INSTALLATION

A. The installation shall comply with the manufacturer's instructions for assembly, installation, and erection, per approved drawings. All installation personnel must have experience in the erection of tension fabric structures.

B. Concrete:

1. Unless noted otherwise for footings and piers by the Project Engineer, the concrete specification for footings, piers, slabs, curbs, and walkways shall meet a minimum 2,500 psi at 28-day strength.

2. Concrete work shall be executed in accordance with the latest edition of American Concrete Building Code ACI 318-14.

3. Concrete specifications shall comply in accordance with the Section 03300 Cast-in-Place Concrete, detailed as per plans, and shall be as follows:
   a. 28 Days Strength F'c = 2,500 psi
   b. Aggregate: Pea Gravel
   c. Slump: 3 ~ 5 inch
   d. Portland Cement shall conform to C-150
   e. Aggregate shall conform to ASTM C-33

4. All reinforcement shall conform to ASTM A-615 grade 60.

5. Reinforcing steel shall be detailed, fabricated, and placed in accordance with the latest ACI Detailing Manual and Manual of Standard Practice.

6. Whenever daily ambient temperatures are below 80 degrees Fahrenheit, the contractor may have mix accelerators and hot water added at the batch plant (See Table 1).

7. The contractor shall not pour any concrete when the daily ambient temperature is to be below 55 degrees Fahrenheit.

TABLE 1

Temperature Range	% Accelerator	Type Accelerator
75~80 degrees F	1%	High Early (non calcium)
70~75 degrees F	2%	High Early (non calcium)
Below 70 degrees F	3%	High Early (non calcium)

D. Foundations:

1. All anchor bolts set in new concrete shall comply with ASTM F1554 GR 55.

2. All anchor bolts shall be Hot-Dip Galvanized.

3. Footings and full rebar cages shall be drilled or dug, set, and poured as per manufacturer's specifications.

END OF SECTION 13 31 23

SECTION 22 05 18

ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.

2. Floor plates.

1.3 WORK INCLUDED

A. Furnish all labor, materials, services, testing, transportation and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:

1. C.C.R., Title 24, Part 5 (2022 CPC).

2. 2022 California Plumbing Code.

3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.

4. National Fire Protection Association.

5. California State Division of Industrial Safety.

6. County Health Department.

7. Any other legally constituted body-having jurisdiction thereof.

B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been

obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.5 DRAWINGS

A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.

B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.

C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.

D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.6 PERMITS, INSPECTIONS AND LICENSES

A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.7 EXAMINATION OF PREMISES

A. Before bidding on this work, Contractors shall make a careful examination of the premises and shall thoroughly familiarize themselves with the requirements of the contract. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and that he is familiar with and accepts all conditions of the site.

1.8 PROTECTION

A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe

openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.

B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.9 LOCATIONS

A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.

B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.

C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.10 SUBMITTAL DATA

A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, six (6) copies of valid submittal data on all fixtures, material, equipment and devices. Each submitted item shall be indexed and referenced to these specifications and to identification numbers on fixtures and equipment schedules.

2. Manufacturers’ submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.

3. Submittals will be checked for general conformance with the design concept of the project but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.

4. To be valid, all submittals must:

a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.

b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.

c. Include all pertinent construction, installation, performance and technical data.

d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.

1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.

2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page and item numbers.

e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings, unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternate.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.

a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.

1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".

b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.

2. It shall be the Contractor’s responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved and resubmittal will not be allowed.

3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.

4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.

5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.

6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.11 UNINSPECTED WORK

A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.

B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.12 RECORD DRAWINGS

A. Contractor shall provide and keep up-to-date a complete "as-built" record set of blueline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducibles shall be delivered to the Architect.

1.13 GUARANTEES

A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.

B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.

C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.

c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.

d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.

e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish.

f. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.

2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 22 05 18

SECTION 22 05 23

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Ductile-iron, single-flange butterfly valves.
3. Bronze lift check valves.
4. Bronze swing check valves.
5. Bronze gate valves.
6. Iron gate valves

B. Related Sections:

1. Division 2 water distribution piping Sections for general-duty and specialty valves for site construction piping.
2. Division 15 plumbing piping Sections for specialty valves applicable to those Sections only.
3. Division 15 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 WORK INCLUDED

A. Furnish all labor, materials, services, testing, transportation and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.5 QUALITY ASSURANCE

A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:

1. C.C.R., Title 24, Part 5 (2022 CPC).

2. 2022 California Plumbing Code.

3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.

4. National Fire Protection Association.

5. California State Division of Industrial Safety.

6. County Health Department.

7. Any other legally constituted body-having jurisdiction thereof.

B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.6 DRAWINGS

A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.

B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when

Architect's approval is given, in writing, shall Contractor proceed with installation of the work.

C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.

D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.7 PERMITS, INSPECTIONS AND LICENSES

A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.8 EXAMINATION OF PREMISES

A. Before bidding on this work, Contractors shall make a careful examination of the premises and shall thoroughly familiarize themselves with the requirements of the contract. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and that he is familiar with and accepts all conditions of the site.

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A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.

B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.10 LOCATIONS

A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.

B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.

C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.11 SUBMITTAL DATA

A. Submittal Requirements:

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2. Manufacturers’ submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.

3. Submittals will be checked for general conformance with the design concept of the project but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.

4. To be valid, all submittals must:

a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer’s review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.

b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.

c. Include all pertinent construction, installation, performance and technical data.

d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.

1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.

2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page and item numbers.

e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings, unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternate.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.

a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.

1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled “SPECIFIED ITEM, NOT SUBMITTED”. Product data sheets for the corresponding proposed substitution item shall be clearly labeled “PROPOSED SUBSTITUTION”.

b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.

2. It shall be the Contractor’s responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved and resubmittal will not be allowed.

3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.

4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.

5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.

6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.12 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

2. ASME B31.1 for power piping valves.

3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61-G and NSF-372 for valve materials for potable-water service.

1. Valves for domestic water must comply with the Federal Reduction of Lead in Drinking Water Act.

a. “Lead Free” refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤ 0.25%.

b. All valves must be 3rd party certified.

c. Bronze valves shall be made of dezincification-resistant material.

1.13 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.

2. Protect threads, flange faces, grooves, and weld ends.

3. Set angle, gate, and globe valves closed to prevent rattling.

4. Set ball and plug valves open to minimize exposure of functional surfaces.

5. Set butterfly valves closed or slightly open.

6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.

2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

1.14 UNINSPECTED WORK

A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.

B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.15 RECORD DRAWINGS

A. Contractor shall provide and keep up-to-date a complete "as-built" record set of blueline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducibles shall be delivered to the Architect.

1.16 GUARANTEES

A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.

B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.

C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Piping systems shall be supplied with valves arranged so as to give complete and regulating control of each building and piping systems throughout the building, and located so all parts are easily accessible and maintained.

1. Valve Design: Rising stem or outside screw and yoke stems. Non-rising stem valves may be used where space conditions prevent full extension of rising stems.

2. Sizes: Same size as upstream pipe, unless otherwise indicated.

3. Extended stems: Where piping insulation is indicated or specified, valves shall be equipped with 2” extended handles of non-thermal conductive material. Also provide a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation. Supply with memory stops, which are fully adjustable after insulation is applied.

4. End Connection: 2 inch and under shall be threaded, 2-1/2 inches and larger shall be flanged or full lug style.

C. Valves for Potable Water must comply with California Lead Free Law, effective January 1, 2010.

1. “Lead Free” refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤ 0.25%. Source: California Health & Safety Code (116875).

2. All valves must be 3rd party certified.

3. Bronze valves shall be made with dezincification-resistant material.

D. Where possible, valves of one manufacturer shall be used.

E. Provide Class 150 valves meeting the valve specifications where Class 125 valves are specified but are not available.

F. Bronze valves shall be made with dezincification-resistant materials, (Bronze ASTM B62, B61, or B584 Alloy C87850). This includes body, ball, stem and / or trim.

G. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.

H. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.

I. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

J. Valve Sizes: Same as upstream piping unless otherwise indicated.

K. Valve Actuator Types:

1. Hand-wheel: For valves other than quarter-turn types.

2. Hand-lever: For quarter-turn valves NPS 6 and smaller.

L. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied.

a. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Nib-seal handle extension or comparable product by one of the following:

b. General valves:

1) NIBCO

2) Hammond

3) Milwaukee

c. Below grade domestic water shut-off valves (gate valves) 2” and larger:

1) NIBCO.

2) Clow.

3) Mueller.

d. Butterfly Valves:

1) NIBCO.

2) Demco.

3) Dezuric.

e. Plug Valves:

1) Hammond.

2) Milwaukee.

f. Check valves, lift type:

1) Hammond.

2) Milwaukee.

g. Below grade backwater valve isolation valves:

1) NIBCO.

2) Clow.

3) Mueller.

2. Butterfly Valves: With extended neck.

M. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves, ASME B16.5 for steel valves.

2. Grooved: With grooves according to AWWA C606.

3. Solder Joint: With sockets according to ASME B16.18.

4. Threaded: With threads according to ASME B1.20.1.

N. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim & Nib-Seal Handle:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-595-Y-66-LF or T-595-Y-66-LF or a comparable product by one of the following,

    a. Milwaukee Valve Company.

    b. Apollo.

2. Description:

    c. Standard: MSS SP-110, NSF 61-G.

    d. CWP Rating: 600 psig.

    e. Body Design: Three piece with threaded body packnut design (no threaded stem designs allowed) with adjustable stem packing.

    f. Body Material: Bronze ASTM B 584 Alloy C87850 or C87600.

    g. Ends: Threaded or Solder.

    h. Seats: PTFE or TFE.

    i. Stem: 316 Stainless steel.

    j. Ball: 316 Stainless steel, vented.

    k. Port: Full.

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim & Nib-Seal Handle:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-585-66-LF or T-585-66-LF or a comparable product by one of the following:

    a. Conbraco Industries, Inc.; Apollo Div.

    b. Milwaukee Valve Company.

2. Description:

    a. Standard: MSS SP-110, NSF 61-G.

    b. CWP Rating: 600 psig.

    c. Body Design: Two piece with threaded body packnut design (no threaded stem designs allowed) with adjustable stem packing.

    d. Body Material: Bronze ASTM B 584 Alloy C87600.

e. Ends: Threaded or Solder.

f. Seats: PTFE or TFE.

g. Stem: 316 Stainless steel.

h. Ball: 316 Stainless steel, vented.

i. Port: Full.

C. 200 CWP, Sizes 2-1/2" – 24", Ductile Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model LD-2000-3/5, or a comparable product by one of the following:

a. Cooper Cameron Corp.; Cooper Cameron Valves Div.

b. Tyco International, Ltd.; Tyco Valves & Controls

2. Description:

a. Standard: MSS SP-67, Type I, IAPMO.

b. NPS 24 (DN 300) and Smaller CWP Rating: 200 psig (1380 kPa).

c. Body Design: Full Lug type; Bubble tight shutoff, suitable for bidirectional dead-end service at rated pressure without use of downstream flange.

d. Body Material: ASTM A 536, ductile iron.

e. Seat: EPDM.

f. Stem: One- or two-piece stainless steel.

g. Disc: Aluminum bronze

D. Retain one or more of six paragraphs in this article if iron, single-flange butterfly valves are required. MSS SP-67 covers iron, single-flange butterfly valves NPS 1-1/2 to NPS 72.

2.3 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Nonmetallic TFE Disc:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-480-Y-LF or T-480-Y-LF or a comparable product by one of the following:

    a. Hammond.

    b. Milwaukee.

2. Description:

    a. Standard: MSS SP-80, Type 2, NSF 61-G.

    b. CWP Rating: 200 psig.

    c. Body Design: Vertical flow.

    d. Body Material: ASTM B 584 Alloy C87850, lead free bronze.

    e. Ends: Threaded or Solder.

    f. Disc: PTFE, or TFE.

2.4 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Nonmetallic TFE Disc:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-413-Y-LF or T-413-Y-LF or a comparable product by one of the following:

    a. Crane Co.; Crane Valve Group; Crane Valves.

    b. Powell Valves.

2. Description:

    a. Standard: MSS SP-80, Type 4, NSF 61-G.

    b. CWP Rating: 200 psig.

    c. Body Design: Y-pattern Horizontal flow.

    d. Body Material: ASTM B 584 Alloy C87850, lead free bronze.

    e. Ends: Threaded or Solder.

    f. Disc: PTFE or TFE.

2.5 BRONZE GATE VALVES

A. NRS Bronze Gate Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-113-LF or T-113-LF or a comparable product by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.

b. Powell Valves.

2. Description:

a. Standard: MSS SP-139, Type 2, NSF 61-G.

b. CWP Rating: 200 psig.

c. Body Material: ASTM B 584, dezincification-resistant bronze with integral seat and threaded bonnet.

d. Ends: Threaded or Solder.

e. Stem: Lead free Silicon Bronze.

f. Disc: Solid wedge; lead free bronze.

g. Packing: Asbestos free.

h. Handwheel: Malleable iron.

B. RS Bronze Gate Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-111-LF or T-111-LF or a comparable product by one of the following:

a. Crane Co.; Crane Valve Group; Crane Valves.

b. Powell Valves

2. Description:

a. Standard: MSS SP-80, Type 2, NSF 61-G.

b. CWP Rating: 200 psig.

c. Body Material: ASTM B584 C87850 dezincification resistant bronze with integral seat and threaded bonnet.

d. Ends: Threaded or Solder.

e. Stem: Lead free silicon bronze.

f. Disc: Solid wedge, lead free bronze.

g. Packing: Asbestos free.

h. Handwhell: Malleable iron.

2.6 IRON GATE VALVES

A. Class 125, Ductile-Iron Resilient Wedge Gate Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-619-RWS (NRS) or F-607-RWS (OS&Y) or a comparable product by one of the following:

a. Clow

b. Mueller

2. Description:

a. Standard: AWWA C-509 and C-515,

b. CWP Rating: 300 psig.

c. Body Material: ASTM A-536 ductile iron, fusion-bonded epoxy coating inside and out.

d. Ends: Flanged.

e. Trim: stainless steel.

f. Disc: Rubber encapsulated ductile iron wedge.

g. Packing and Gasket: Asbestos free.

2.7 MANUAL CIRCUIT BALANCING VALVES

A. Bronze, Fixed Orifice, Balancing Valves (2” and smaller):

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model T/S-1810-LF or a comparable product by one of the following:

    a. Or approved equal

2. Description:

    a. CWP Rating: 300 psig

    b. Maximum Operating Temperature: 260°F.

    c. Body Material: Bronze or dezincification-resistant brass, lead free, Y-pattern globe type with fixed orifice (venture) for precise regulation and control. NO QUARTER TURN VALVES WILL BE ACCEPTED.

    d. Plug: Bronze or dezincification-resistant brass with EPDM O-Rings.

    e. Seat: Bronze or dezincification-resistant brass.

    f. Ends: Threaded or Solder.

    g. Pressure Gage Connections: Shall have two metering test ports with internal check and protective caps for use with portable differential pressure metering stations.

    h. Handle Style: Calibrated hand wheel equipped with visual position readout and hidden memory stops for repeatable regulation and control.

B. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves (2-1/2” and larger):

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F/G 737A or a comparable product by one of the following:

    a. Tour & Andersson

2. Description:

a. CWP Rating: 240 psig

b. Maximum Operating Temperature: 250°F.

c. Body Material: Cast-iron or steel body, globe pattern with calibrated orifice. NO BUTTERFLY VALVES.

d. Stem Seals: EPDM O-Rings

e. Disc: EPDM coated cast-iron disc.

f. Seat: Bronze or dezincification brass.

g. Ends: Flanged or grooved.

h. Pressure Gage Connection: Integral seals for portable differential pressure meter.

i. Handle Style: Calibrated hand wheel equipped with visual position readout and concealed memory stops for repeatable regulation and control.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

2. Check Valves: In horizontal or vertical position, between flanges.

3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly valves.

2. Butterfly Valve Dead-End Service: Single-flange (lug) type.

3. Throttling Service: Ball or Butterfly valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends.

2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends.

3. For Steel Piping, NPS 2 and Smaller: Threaded ends.

4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: Threaded ends.

2. Ball Valves: Two piece, full port, bronze with stainless-steel trim.

3. Bronze Lift Check Valves: Class 125, nonmetallic TFE disc.

4. Bronze Swing Check Valves: Class 150, nonmetallic TFE disc.

5. Bronze Gate Valves: Class 150, RS.

B. Pipe NPS 2-1/2 and Larger:

1. Ductile-Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.

END OF SECTION 22 05 23

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.

2. Trapeze pipe hangers.

3. Thermal-hanger shield inserts.

4. Fastener systems.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 WORK INCLUDED

A. Furnish all labor, materials, services, testing, transportation and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.6 QUALITY ASSURANCE

A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:

1. C.C.R., Title 24, Part 5 (2022 CPC).

2. 2022 California Plumbing Code.

3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.

4. National Fire Protection Association.

5. California State Division of Industrial Safety.

6. County Health Department.

7. Any other legally constituted body-having jurisdiction thereof.

B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.7 DRAWINGS

A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.

B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.

C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.

D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.8 PERMITS, INSPECTIONS AND LICENSES

A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.9 EXAMINATION OF PREMISES

A. Before bidding on this work, Contractors shall make a careful examination of the premises and shall thoroughly familiarize themselves with the requirements of the contract. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and that he is familiar with and accepts all conditions of the site.

1.10 PROTECTION

A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.

B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.11 LOCATIONS

A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.

B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire

installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.

C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.12 SUBMITTAL DATA

A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, six (6) copies of valid submittal data on all fixtures, material, equipment and devices. Each submitted item shall be indexed and referenced to these specifications and to identification numbers on fixtures and equipment schedules.

2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.

3. Submittals will be checked for general conformance with the design concept of the project but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.

4. To be valid, all submittals must:

a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.

b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.

c. Include all pertinent construction, installation, performance and technical data.

d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.

1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.

2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page and item numbers.

e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings, unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternate.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.

a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.

1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled “SPECIFIED ITEM, NOT SUBMITTED”. Product data sheets for the corresponding proposed substitution item shall be clearly labeled “PROPOSED SUBSTITUTION”.

b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.

2. It shall be the Contractor’s responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved and resubmittal will not be allowed.

3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.

4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of

modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.

5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.

6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.13 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.14 UNINSPECTED WORK

A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.

B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.15 RECORD DRAWINGS

A. Contractor shall provide and keep up-to-date a complete "as-built" record set of blueline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducibles shall be delivered to the Architect.

1.16 GUARANTEES

A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.

B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.

C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 Pipe Supports: Unless otherwise indicated on the drawings, shall be as follows:

A. The Contractor shall furnish and install all miscellaneous iron work including angles, channels, etc., required to appropriately support the various piping systems. Hanger spacing and location shall conform to 2022 California Plumbing Code Table 313.1.

B. All horizontal runs of piping within the building to be supported from the structural framing with steel rods and split ring hangers, B-Line, Grinnell Company, Tolco, or approved equal. Steel rods shall be secured to overhead framing with side beam connectors. Where necessary, install angle iron between framing to accommodate hanger rods. Where several pipes are running together, Unistrut, B-Line or Powerstrut channels with clamps may be used in lieu of individual pipe hangers, and supported from structure as herein specified. Submit test data for type of hanger supports to be provided. For support conditions other than specified herein, the Contractor shall submit method of support for approval prior to any installation.

C. Horizontal Piping Hangers and Supports:

1. General: Provide factory fabricated horizontal hangers and supports complying with one of the following MSS types listed to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.

   a. Adjustable Steel Clevis Hangers: (MSS Type 1.) B-Line B 3100

   b. Adjustable Swivel Pipe Rings: (MSS Type 5) B-Line B3690

D. Vertical-Piping Clamps:

1. General: Provide factory fabricated vertical-piping clamps complying with the following types listed, to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.

2. Two-Bolt Riser Clamps: (MSS Type 8) B-Line B3373

E. Hanger-Rod Attachments:

1. General: Provide factory fabricated hanger-rod attachments B-Line, Tolco or approved equal, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-58 and manufacturer's published product information. Select size of hanger-rod attachment to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.

2. Side beam eye socket, Tolco Fig. #57 for rod sizes 3/8" dia. and Tolco Fig. #25-30-251 for rod sizes 1/2" dia.

F. Building Attachments:

1. General: Provide factory fabricated building attachments, selected by Installer to suit building structural framing conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.

G. Hanger Rods and Spacing shall conform to the following table:

Pipe Sizes	Spacing	Rods
2 Inch and Smaller	6 Feet	3/8 Inch
2-1/2 Inch to 3 Inch	8 Feet	1/2 Inch
4 Inch and larger	8 Feet	5/8 Inch

H. Hangers and Supports shall be adequate to maintain alignment and prevent sagging and shall be placed within 18 inches of joint. Support shall be provided at each horizontal branch connection.

I. Provide lateral bracing as manufactured by B-Line or approved equal for all piping to prevent swaying or movement in accordance with SMACNA "Guidelines for Seismic Restraints of Piping Systems". Piping smaller than indicated in the guidelines shall be provided with bracing as specified for the smallest size indicated. The entire water distribution system shall be properly braced and will not move due to the action of quick closing of valves.

J. Miscellaneous Supports, Wall Brackets, Etc.: Provide where required in accordance with the best standard practices of the trade. Submit shop drawings for all fabricated supports.

2.2 Isolators. All piping which is not isolated from contact with the building by its insulation shall be installed with a manufactured type isolator. Isolators shall be B-Line vibra clamp and cushion, Super Strut, Stoneman "Trisolator", or approved equal. Piping shall be installed and supported in a manner to provide for expansion without strains. Guides shall be properly installed to ensure this requirement.

2.3 Shields:

A. General: Provide shields at piping hangers and supports, factory-fabricated, for all insulated piping as manufactured by Pipeshields Incorporated or approved equal. Size shields for exact fit to mate with pipe insulation.

1. Protection Shields: MSS Type 40; provide high density insert of same thickness of insulation or equal 100-psi average compressive strength, waterproofed calcium silicate, encased with a sheet metal shield. Insert and shield shall cover entire circumference of the pipe and shall be of length indicated by manufacturer for pipe size and thickness of insulation.

2.4 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.

3. Nonmetallic Coatings: Plastic coating, jacket, or liner.

4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.5 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.6 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ERICO International Corporation.

2. PHS Industries, Inc.

3. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.

4. Piping Technology & Products, Inc.

B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig ASTM C 552 or Type II cellular glass with 100-psig minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.7 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:

1. Attach clamps and spacers to piping.

a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.

b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.

b. NPS 4: 12 inches long and 0.06 inch thick.

4. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099123 "Interior Painting."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.

2. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.

2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.

4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

5. C-Clamps (MSS Type 23): For structural shapes.

6. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.

7. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.

8. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

9. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

2. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 22 05 29

SECTION 22 05 53

IDENITIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.
5. Warning tags.

1.3 WORK INCLUDED

A. Furnish all labor, materials, services, testing, transportation and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:

1. C.C.R., Title 24, Part 5 (2022 CPC).
2. 2022 California Plumbing Code.
3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
4. National Fire Protection Association.

5. California State Division of Industrial Safety.

6. County Health Department.

7. Any other legally constituted body-having jurisdiction thereof.

B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.5 DRAWINGS

A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.

B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.

C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.

D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.6 PERMITS, INSPECTIONS AND LICENSES

A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.7 EXAMINATION OF PREMISES

A. Before bidding on this work, Contractors shall make a careful examination of the premises and shall thoroughly familiarize themselves with the requirements of the

contract. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and that he is familiar with and accepts all conditions of the site.

1.8 PROTECTION

A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.

B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.9 LOCATIONS

A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.

B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.

C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.10 SUBMITTAL DATA

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

F. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, six (6) copies of valid submittal data on all fixtures, material, equipment and devices. Each submitted item shall be indexed and referenced to these specifications and to identification numbers on fixtures and equipment schedules.

2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.

3. Submittals will be checked for general conformance with the design concept of the project but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.

4. To be valid, all submittals must:

a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.

b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.

c. Include all pertinent construction, installation, performance and technical data.

d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.

1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.

2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page and item numbers.

e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this

drawing show a complete layout of the system except that which is identical to the contract drawings, unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternate.

G. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.

    a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.

        1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled “SPECIFIED ITEM, NOT SUBMITTED”. Product data sheets for the corresponding proposed substitution item shall be clearly labeled “PROPOSED SUBSTITUTION”.

    b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.

2. It shall be the Contractor’s responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved and resubmittal will not be allowed.

3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.

4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.

5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.

6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.11 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

1.12 UNINSPECTED WORK

A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.

B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.13 RECORD DRAWINGS (Also see General Conditions)

A. Contractor shall provide and keep up-to-date a complete "as-built" record set of blueline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducibles shall be delivered to the Architect.

1.14 GUARANTEES

A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.

B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.

C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.

2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

4. Fasteners: Stainless-steel rivets or self-tapping screws.

5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.

2. Lettering Size: At least 1-1/2 incheshigh.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.

2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.

2. Fasteners: Brass grommet and wire.

3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.

2. Stencil Paint: Use for pipe marking.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.

2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.

3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.

6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:

1. Domestic Water Piping:

a. Background Color: White.

b. Letter Color: Black.

2. Sanitary Waste and Storm Drainage Piping:

a. Background Color: White.

b. Letter Color: Black.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Cold Water: 1-1/2 inches, round.

b. Hot Water: 1-1/2 inches, round.

2. Valve-Tag Color:

a. Cold Water: Natural.

b. Hot Water: Natural.

3. Letter Color:

a. Cold Water: Black.

b. Hot Water: Black.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 22 05 53

SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.

2. Domestic hot-water piping.

3. Supplies and drains for handicap-accessible lavatories and sinks.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation."

1.3 WORK INCLUDED

A. Furnish all labor, materials, services, testing, transportation and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:

1. C.C.R., Title 24, Part 5 (2022 CPC).

2. 2022 California Plumbing Code.

3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.

4. National Fire Protection Association.

5. California State Division of Industrial Safety.

6. County Health Department.

7. Any other legally constituted body-having jurisdiction thereof.

B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.5 DRAWINGS

A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.

B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.

C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.

D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.6 PERMITS, INSPECTIONS AND LICENSES

A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.7 EXAMINATION OF PREMISES

A. Before bidding on this work, Contractors shall make a careful examination of the premises and shall thoroughly familiarize themselves with the requirements of the contract. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and that he is familiar with and accepts all conditions of the site.

1.8 PROTECTION

A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.

B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.9 LOCATIONS

A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.

B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.

C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.10 SUBMITTAL DATA

A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, six (6) copies of valid submittal data on all fixtures, material, equipment and devices. Each submitted item shall be indexed and referenced to these specifications and to identification numbers on fixtures and equipment schedules.

2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.

3. Submittals will be checked for general conformance with the design concept of the project but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.

4. To be valid, all submittals must:

    a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.

    b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.

    c. Include all pertinent construction, installation, performance and technical data.

    d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.

        1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.

        2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page and item numbers.

    e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings, unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternate.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.

    a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.

        1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled “SPECIFIED ITEM, NOT SUBMITTED”. Product data sheets for the corresponding proposed substitution item shall be clearly labeled “PROPOSED SUBSTITUTION”.

    b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.

2. It shall be the Contractor’s responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved and resubmittal will not be allowed.

3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.

4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.

5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.

1.11 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.12 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.13 UNINSPECTED WORK

A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.

B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.14 RECORD DRAWINGS (Also see General Conditions)

A. Contractor shall provide and keep up-to-date a complete "as-built" record set of blueline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducibles shall be delivered to the Architect.

1.15 GUARANTEES

A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.

B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.

C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

1.16 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.17 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.18 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Hot Water Pipe Insulation: All hot water supply and return piping, except exposed connections to plumbing fixtures, flanges and unions shall be insulated with ASTM C547, Class I, "Johns-Manville" "Micro-Lock" 850-APT, Owens-Corning Fiberglass Corp., ASJ/SL-11 or approved equal, 1" thick for sizes up to 1" and 1-1/2" thick for sizes 1 1/4" and larger with “Johns-Manville” “Zeston” pre-formed insulation inserts for

all fittings. Insulation at all fittings shall be equal in thickness to insulation for piping. Insulation shall have a flame spread of not more than 25 and a smoke density not exceeding 50 per 2022 CMC

1. Exposed insulated piping in occupied areas and exposed outside the building shall be covered with Johns-Manville" "Zeston" 30-mil thick white PVC jacketing material per ASTM D1784 with "Johns-Manville" "Zeston" pre-formed insulation inserts for all fittings. Insulation at all fittings shall be equal in thickness to insulation for piping. Jacketing shall comply with ASTM E84, and shall have a flame spread of not more than 25 and a smoke density not exceeding 50 per 2022 CMC.

2. Hot water piping below slab shall have insulation protected by a 10-mil thick polyethylene plastic sleeve sealed watertight with poly vinyl chloride tape.

B. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

C. Products shall not contain asbestos, lead, mercury, or mercury compounds.

D. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

G. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Johns Manville; Micro-Lok.

   b. Knauf Insulation; 1000-Degree Pipe Insulation.

   c. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Armacell LLC; Tubolit.

b. Nomaco Insulation; IMCOLOCK and NOMALOCK.

I. Condensate Pipe Insulation: All condensate piping within the building shall be insulated with "Imcoa" "Imcolock" ¾" nominal wall thickness closed-cell insulation. Insulation shall have a flame spread of not more than 25 and a smoke density not exceeding 50 per 2022 CMC. All joints shall be mitered and secured with black duct tape.

J. Indirect Waste Pipe Insulation: All indirect waste drains from refrigerated kitchen equipment shall be insulated with "Armacell" "Armaflex" insulating tape.

K. All insulation shall be continuous through supports and hangers.

L. All fixtures complying with the provisions of the Americans with Disabilities Act shall be provided with Prowrap insulation for exposed hot water pipe, tailpiece, and trap as manufactured by McGuire, and secured per manufacturers recommendations. No tape wrapping shall be permitted.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.

b. Eagle Bridges - Marathon Industries; 225.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96.

b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-33.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.

b. Eagle Bridges - Marathon Industries; 225.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide the following:

a. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
    a. ABI, Ideal Tape Division; 428 AWF ASJ.
    b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    c. Compac Corporation; 104 and 105.
    d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:
    a. ABI, Ideal Tape Division; 370 White PVC tape.
    b. Compac Corporation; 130.
    c. Venture Tape; 1506 CW NS.
2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.4 SECUREMENTS

A. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

2.5 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers,:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. McGuire Manufacturing.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

   1. Verify that systems to be insulated have been tested and are free of defects.

   2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

   1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

   2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.

2. Testing agency labels and stamps.

3. Nameplates and data plates.

4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.

4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.

4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.

2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.

3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

4. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.

2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.

2. Underground piping.

3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Hot and Recirculated Hot Water:

1. NPS 1” and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1” inch thick.

2. NPS 1-1/4” and Larger: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 1/2" inch thick.

B. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be the following:

a. McGuire pre-insulated trap and supply covers.

END OF SECTION 22 07 19

SECTION 221100

FACILITY WATER DISTRIBUTION

PART 1 – GENERAL

1.1 SUMMARY

A. Provide FACILITY WATER DISTRIBUTION as indicated, specified, and required.

B. Work In This Section: Principal items include:

1. Water piping
2. Valves and valve boxes
3. Hydrants with valves.
4. Lateral services extended to 5-feet from building.
5. Connections of laterals to existing mains or municipal water system.
6. Connection of building water system to laterals 5-feet from building
7. Trenching, backfilling and compaction for FACILITY WATER DISTRIBUTION
8. Testing and sterilization.

C. Related Work Not in This Section:
1. Storm drainage system.
2. Gas and electric lines.

1.2 SUBMITTALS

A. Material List: Submit list of materials proposed for use accompanied by manufacturer's latest printed literature with technical data.

B. Certificates: Manufacturers' certification that materials meet specified requirements.

1.3 RECORD DRAWINGS

A. Provide complete record drawings showing dimensioned locations and depths of all piping, and exact locations of all accessories.

1.4 INSPECTION AND TESTING

A. Refer to Division 1 for procedures.

B. Inspection: Soils Engineer will inspect and test the backfilling work of this section. Notify Soils Engineer prior to commencement of work.

C. Testing: Soils Engineer will make tests to determine degree of compaction in accordance with the following ASTM test methods:

1. Maximum Density and Optimum Moisture Content: ASTM D1557, 5 layers.

2. Density of soil in place: ASTM D1556.

D. Report: Soils Engineer will submit a written report that trenches were backfilled with acceptable material, and that compaction meets the requirements of these specifications.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Pipe:

1. Ductile iron pipes, conforming to the "Standard Specifications" Section 207-9, or thick wall Ringtite Class 150 polyvinyl chloride, meeting the requirements of AWWA C900 "Polyvinyl Chloride (PVC) Pressure Pipe".
2. Plastic Pipe and Fittings: Ringtite Class 165 polyvinyl chloride, meeting the requirements of AWWA C900 "Polyvinyl Chloride (PVC) Pressure Pipe", extruded of an improved polyvinyl chloride virgin pipe compound. Pipe and fittings shall conform to AWWA C900 Schedule 80.

    a. Solvent cement or rubber-gasket joints for pipe and fittings shall be in accordance with the manufacturer's instructions.
    b. Fittings shall be PVC Schedule 80, injection-molded of an improved PVC compound. Fittings shall conform to ASTM D 1784, Cell Classification 12454-B. Threaded nipples shall be standard weight Schedule 80 with molded threads.
3. Hard Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) or approved equal, water tube, drawn temper.

    a. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought- copper fittings if indicated.
    b. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
    c. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

B. Gate Valves: Conform to AWWA C500, iron body, bronze trim, double disc, non-rising stem, with parallel or inclined seat. Valve stems and stem nuts shall be bronze. Wedging mechanism shall be solid bronze, designed to allow the gates to function properly when water pressure is exerted from either or both directions. Valves shall open to counterclockwise rotation of the valve stem. Stuffing boxes shall have O-ring stem seals and shall be bolted and constructed so as to permit easy removal of parts for repair. Valves shall have push-on joint ends and gaskets conforming to AWWA C500. Valves shall be of one make.

1. Valves shall be suitable for a working pressure of 200 psi. The working pressure and the name of the manufacturer cast in plain letters on the body of the valve.
2. Equip with flanged ends, 125 lb., ASA drilled, for cast iron and ductile iron pipe. For PVC pipe, valves shall have push-on ends and gaskets.

C. Check valves: Swing type spring loaded, 200 psi working pressure, seat readily and tightly with the face of the closure elements made of a non-corrodible material such as bronze composition conforming to ASTM B62.

D. Valve boxes: Cast iron, slip adjustment type of appropriate size for valve, Alhambra No. A-3009 or equal. Valve box covers shall have round head, not less than 5-1/4" diameter, with word "WATER" cast in the top using sharp-faced letters of 1 " minimum height. Boxes shall be given a heavy coat of bituminous paint.

E. Fire hydrants: Conforming to AWWA Specifications C503, wet barrel design, equipped with a 6" flange inlet connection, two 2-1/2" outlet and a 4" suction outlet with National Standard thread. Provide 6" diameter bury, with joint to match pipe joints. The extension piece of the hydrant shall be of such length that the hydrant barrel bottom flange or top hydrant bury shall be 3" above the top of the sidewalk or curb grade. Apply two coats of paint (OSHA "Yellow" #633). The outlets of all fire hydrants, including operating nuts and threads, shall be as approved by the serving fire department. Apply a field coat of paint to all hydrants after installation.

F. Post indicators: U.L. approved type.

G. Tracer Wire for Non-Metallic Piping: Tracer wire shall be bare copper or aluminum wire not less than 0.10 inch in diameter and shall be provided in sufficient length to be continuous over all runs of non-metallic piping.

H. Pipe bedding and backfill shall conform to requirements of Subsections 306-1.2 and 306-1 .3 of the Standard Specifications.

I. Thrust blocks: Portland cement concrete conforming to requirements of Section 03300.

2.2 PROTECTION OF METAL SURFACES & PIPE WRAPPING

A. All exposed surfaces of the valves, flanges, bolts, nuts, tie-rods, turn buckles, etc. in contact with the earth and backfill materials shall be coated with a minimum of 30 mils of bitumastic coating prior to backfilling. In addition to this bitumastic coating, all iron or steel surfaces such as valves, flanges, bolts, nuts, couplings, shall be encased in 8 mil polyethylene wrapping in accordance with AWWA C105 ”American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems”. Stainless Steel bolts and nuts are to be protected following Section 2.01 L.3.

PART 3 – EXECUTION

3.1 TRENCH EXCAVATION

A. Perform all excavation for the construction of trenches and all additional excavation required for structures forming a part of the pipeline. Trench excavation shall conform to the requirements of Section 306-1 of Standard Specifications. Trenches shall be inspected by the Soils Engineer before proceeding with the work.

3.2 PIPE LAYING, JOINTING AND TESTING

A. Survey line and grade: Grade controls and survey lines shall be provided by a licensed land surveyor obtained by the Contractor.

B. Pipe Installation: Pipe will be inspected in the field by the inspector before and after laying. Installation of pipe shall conform to the requirements of Section 306-1.2 of the Standard Specifications. Use care not to damage pipe wrapping. Field wrap joints and fittings as the work progresses, comply with manufacturer's recommendations for cleaning surfaces and application of wrapping. Installation of polyvinyl chloride plastic pipe shall also be in accordance with recommendations of pipe and jointing materials manufacturers. Install tracer wire over all non-metallic pipe.

C. Backfill and compaction: Perform in accordance with Section 306-1.3 of the Standard Specifications. In backfilling the trench take all necessary precautions to protect the pipe from any damage or shifting.

D. Testing of pipelines: Perform all tests required by governing agencies. Testing shall be performed in accordance with Section 306-1.4 of Standard Specifications. Furnish all water, materials and labor for making the required tests. All tests shall be made in the presence of the Inspector. Notify the Inspector at least 48 hours before performing the required tests.

E. Install concrete thrust blocks against undisturbed soil at bends, tees, crosses, valves, pipe ends and where changes in pipe diameters occur at reducers or in fittings.

3.3 CONNECTIONS TO EXISTING MAINS

A. Where connections are made between new work and existing mains, the connections shall be made by using special couplings, Rockwell Clamp and Coupling-Tapping Sleeves, or , and other fittings to suit the on-site conditions. Methods of connections to existing mains shall be as required by local codes.

3.4 HYDROSTATIC TESTING

A. Test pipe line in accordance with Code and serving water department requirements.

3.5 ACCEPTANCE BY LOCAL GOVERNMENTAL AGENCY

A. Prior to final acceptance of the work obtain acceptance of the work from the serving utility and submit copies of their certificate or letter of approval to the Owner.

3.6 STERILIZATION OF MAINS

A. Sterilization: Before any use of a system is made for domestic purposes, it shall be sterilized with water to which a sterilizing agent has been applied with a minimum of 20 PPM of chlorine to be determined by a residual chlorine test at any part or parts of the line. After the lines have been filled for 24 hours, a residual chlorine test shall show not less than 20 PPM. If less than 20 PPM is indicated, the line shall be flushed and sterilization shall be repeated until a test has indicated a residual of not less than 20 PPM. The line shall then be flushed out until all traces of chemical have been removed.

B. Flushing of Fire Service Lines: Additional flushing of fire service lines will be required. Such shall be conducted in conformance with the procedures set forth in NFPA Standard 24 (Contained in Vol. 6 of the National Fire Code, Section 98).

3.7 CLEANUP

A. Upon completion of work, leave the site clean and clear of debris and construction materials.

END OF SECTION 221100

SECTION 22 11 16

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.

2. Encasement for piping.

B. Related Requirements:

1. Section 221113 "Facility Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.3 WORK INCLUDED

A. Furnish all labor, materials, services, testing, transportation and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:

1. C.C.R., Title 24, Part 5 (2022 CPC).

2. 2022 California Plumbing Code.

3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.

4. National Fire Protection Association.

5. California State Division of Industrial Safety.

6. County Health Department.

7. Any other legally constituted body-having jurisdiction thereof.

B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.5 DRAWINGS

A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.

B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.

C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.

D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.6 PERMITS, INSPECTIONS AND LICENSES

A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.7 UTILITIES

A. See Drawings for Points of Connection.

B. Certain site utilities are to be connected to and extended. Before laying of any pipe or digging of any trenches, Contractor shall determine by actual excavation and measurement exact location and depth of lines to which he is to connect. In event depth of lines is not sufficient to permit connection in manner indicated, Contractor shall obtain direction from the Owner's representative before proceeding with this work.

C. Verify that utility companies size their services and meters to suit ultimate demand indicated on the drawings.

D. Domestic Water: The Contractor shall be responsible for the domestic water service outside of the building within five feet (5') of the foundation, and within the building itself. See Civil Engineer's plans for onsite domestic water system.

1.8 EXAMINATION OF PREMISES

A. Before bidding on this work, Contractors shall make a careful examination of the premises and shall thoroughly familiarize themselves with the requirements of the contract. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and that he is familiar with and accepts all conditions of the site.

1.9 PROTECTION

A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.

B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.10 LOCATIONS

A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.

B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional

cuttings are found to be required, the cost of the same shall be charged to this Contractor.

C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.11 SUBMITTAL DATA

A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, six (6) copies of valid submittal data on all fixtures, material, equipment and devices. Each submitted item shall be indexed and referenced to these specifications and to identification numbers on fixtures and equipment schedules.

2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.

3. Submittals will be checked for general conformance with the design concept of the project but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.

4. To be valid, all submittals must:

a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.

b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.

c. Include all pertinent construction, installation, performance and technical data.

d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.

1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.

2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page and item numbers.

e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings, unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternate.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.

a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.

1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled “SPECIFIED ITEM, NOT SUBMITTED”. Product data sheets for the corresponding proposed substitution item shall be clearly labeled “PROPOSED SUBSTITUTION”.

b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.

2. It shall be the Contractor’s responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved and resubmittal will not be allowed.

3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.

4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for

review. Submittals which do not comply with the requirements of these specifications or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.

5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.

1.12 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.13 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.14 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of water service.

2. Do not interrupt water service without Architect's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.

C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

E. Copper Unions:

1. MSS SP-123.

2. Cast-copper-alloy, hexagonal-stock body.

3. Ball-and-socket, metal-to-metal seating surfaces.

4. Solder-joint or threaded ends.

F. Piping within the building and above grade shall be Type "L" ASTM B88, hard drawn copper tubing with wrought copper sweat fittings ANSI B16.18 and B16.22.

G. Outdoor underground piping in sizes 2-1/2" and 3" shall be Type "L" ASTM B88, hard drawn copper as specified for water piping within the building. Piping 2" and smaller shall be Type "K" ASTM B88, hard drawn copper with wrought copper sweat fittings ANSI B16.18 and B16.22.

H. Piping below the building floor shall be Type "K" soft annealed copper tubing with no fittings below the slab.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.

2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 VALVE ACCESSORIES AND SPECIALTIES

A. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. For service shut-off valves on domestic water; for pressure regulator assemblies, shall be Brooks Products or Fraser Cement Products Co., rectangular concrete type with vandal-proof cast iron cover and name of service clearly marked on

cover. Box shall be of size to permit full range of valve operation and to permit easy removal of valve assembly. Vaults shall be sectional type

2. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

2.5 CORROSION PROTECTION:

1. General.

a. Corrosion protection shall be provided for all below grade copper piping and associated valves and fittings. Such piping shall be protected from corrosion by encasement in a polyethylene protective wrapping, referred to hereafter as polywrap. Although not intended to be a completely air and water tight enclosure, the polywrap shall provide a continuous barrier between the pipe and surrounding bedding and backfill.

2. Materials.

a. Copper piping encasement.

1) The polywrap shall be minimum 6 mil. in thickness, group 2, linear low density, flat tube, natural (clear) virgin polyethylene film formed into tubes or sheets as required. Material shall conform to the requirements of ASTM D1248.

2) The polywrap shall be as manufactured by Northtown Company or approved equal.

b. The minimum Polywrap flat tube width for each pipe diameter shall be as follows:

Pipe Size / Type	Polywrap Flat Tube Width
½” to ¾” copper	2”
1” to 1-½ copper	3”
2” copper	4”
2-1/2” copper	5”
3” copper	6”

c. The polywrap shall be secured as specified with 2 inch wide pressure sensitive plastic tape not less than 10 mils thick.

1) Tape shall be Scotchwrap No. 50, Polyken No. 900, Tapecoat CT, Johns-Manville No. V-10 Trantex or approved equal.

d. Piping through exterior walls shall be sealed using Link Seal modular seal with nitrile seal elements and stainless steel bolts.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

D. Install shutoff valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

E. Install shutoff valve immediately upstream of each dielectric fitting.

F. Install domestic water piping level without pitch and plumb.

G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

H. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

J. Install piping to permit valve servicing.

K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

L. Install piping free of sags and bends.

M. Install fittings for changes in direction and branch connections.

N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

O. Install thermometers on outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

S. Corrosion Protection:

1. The polyethylene tubing shall be cut into lengths approximately 2 feet longer than the pipe sections. Slip the tube around the pipe, centering it to provide a 1-ft overlap on each adjacent pipe section, and bunching it accordion fashion lengthwise until it clears the pipe ends. Lower the pipe into the trench and make up the pipe joint with the preceding section of pipe. A shallow bell hole must be made at each joint to facilitate installation of the poly-wrap. The bunched-up poly-wrap shall be pulled from the preceding length of pipe, slipped over the end of the new length of pipe, and secured in place with one circumferential turn of tape plus enough overlap to assure firm adhesion. The end of the poly-wrap shall be slipped from the new pipe section over the end of the first wrap until it overlaps the joint at the end of the preceding length of pipe and tape it in place. The loose wrapping on the barrel of the pipe shall be pulled snugly around the barrel of the pipe and excess material folded over the top of the pipe and the folds held in place by means of short strips of adhesive tape, at about 3 foot intervals along the pipe.

2. Rips, punctures or other damage to the tube shall be repaired with the adhesive tape or pieces of tube material secured with tape. Bends and reducers in the line shall be covered with polyethylene in the same manner as pipe.

3. Valves, tees, crosses and outlets shall be wrapped with flat sheets of the same material. The sheets shall be passed under valves and brought up around the body to the stem. Edges shall be brought together, folded twice and secured with the adhesive tape.

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.

2. Individual, Straight, Horizontal Piping Runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2 and Smaller: 72 inches with 3/8-inch rod.

2. NPS 2-1/2 to NPS 3: 8 feet with 1/2-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.5 CONCRETE VAULT INSTALLATION

A. Install precast concrete vaults according to ASTM C 891.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.

3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.7 PIPE AND EQUIPMENT IDENTIFICATION

A. Each operating and service line shut-off valve shall be identified by a 19 ga. brass tag with stamped, engraved type of service identified and area served, complete with hole and brass chain mounted on valve stem or handle. Tag shall be a minimum of one and one-half inch (1-1/2") in diameter.

B. All piping systems shall be readily identifiable by appropriate labeling with the name of the piping contained. Such labeling shall be by means of metal tags, stenciling, stamping, or with adhesive markers, in a manner that is not readily removable. Labeling shall appear on the piping at intervals of not more than 20 ft and at least once in each room and each story traversed by the piping system.

C. Provide on exterior wall of each building opposite the building's main gas service a sign reading "Gas Shut Off". Sign shall be metal with minimum 1-1/2" high-embossed letters.

1. All equipment shall be provided with name plate indicating all pertinent information on it

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.

b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.

2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.

d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.

c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.

d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.

Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

Schedule of Test Pressures:

System Tested	Gauge	Test	Duration
Water	100 PSI	Water	4 Hours

e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.

f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.

2. Open shutoff valves to fully open position.

3. Open throttling valves to proper setting.

4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.

b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.

6. Remove and clean strainer screens. Close drain valves and replace drain plugs.

7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.

8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

b. Fill and isolate system according to either of the following:

1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours. Operate all valves during the retention period.

2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours. Operate all valves during the retention period.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

d. Repeat procedures if biological examination shows contamination.

e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 OPERATION INSTRUCTION

A. Prior to occupancy or prior to the date of final inspection, whichever may occur first, the Contractor shall prepare two (2) sets of typewritten instructions for the operation of all equipment, valves, etc., specified and furnished as a part of the work under this section, and shall assign a competent person, thoroughly familiar with the job, to demonstrate and instruct a representative of the Owner in the operation of the equipment. The time of said demonstration and instructions shall be arranged with the Owner's representative approximately one (1) week in advance. Verbal instructions shall include shut-off location of gas and water. The Contractor shall assemble all operation and maintenance data supplied by the manufacturers of the various pieces of equipment, all keys and special wrenches required to operate and service the equipment (including keys for yard boxes, gas stops and fixture stops), and all

equipment warranties and deliver same to the representative of the Owner on date of said instructions.

3.12 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.

E. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:

1. Soft copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed joints.

F. Aboveground domestic water piping shall be the following:

1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

3.13 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly valves with flanged ends for piping NPS 2-1/2 and larger.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 22 11 16

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Temperature-actuated, water mixing valves.
2. Hose bibbs.
3. Water-hammer arresters.
4. Trap-seal primer valves.
5. Trap-seal primer systems.

B. Related Requirements:

1. Section 223200 "Domestic Water Filtration Equipment" for water filters in domestic water piping.
2. Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.
3. Section 224300 "Medical Plumbing Fixtures" for thermostatic mixing valves for sitz baths, thermostatic mixing-valve assemblies for hydrotherapy equipment, and outlet boxes for dialysis equipment.
4. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.
5. Section 224713 "Drinking Fountains" for water filters for water coolers.
6. Section 224716 "Electric Water Coolers" for water filters for water coolers.

1.3 WORK INCLUDED

A. Furnish all labor, materials, services, testing, transportation and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:

1. C.C.R., Title 24, Part 5 (2022 CPC).
2. 2022 California Plumbing Code.
3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
4. National Fire Protection Association.
5. California State Division of Industrial Safety.
6. County Health Department.
7. Any other legally constituted body-having jurisdiction thereof.

B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.5 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.6 DRAWINGS

A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.

B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.

C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.

D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.7 PERMITS, INSPECTIONS AND LICENSES

A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.8 UTILITIES

A. See Drawings for Points of Connection.

B. Certain site utilities are to be connected to and extended. Before laying of any pipe or digging of any trenches, Contractor shall determine by actual excavation and measurement exact location and depth of lines to which he is to connect. In event depth of lines is not sufficient to permit connection in manner indicated, Contractor shall obtain direction from the Owner's representative before proceeding with this work.

C. Verify that utility companies size their services and meters to suit ultimate demand indicated on the drawings.

D. Domestic Water: The Contractor shall be responsible for the domestic water service outside of the building within five feet (5’) of the foundation, and within the building itself.

See Civil Engineer's plans for onsite domestic water system.

E. Domestic Water Service: The Contractor shall arrange with the serving utility company for the installation of all water meter assemblies and reduced pressure backflow devices, including the service mains and vaults, and all required appurtenances as indicated on the drawings and in accordance with serving utility standards and shall pay all costs incurred. All required capacity fees, frontage fees and inspections, shall be paid for by the Owner. Contractor shall provide necessary tap-in connections in water main for sterilizing of domestic water system. Contractor shall connect into the main water service line as indicated on the drawings. The installation shall be in accordance with the serving utility company's standards.

1.9 EXAMINATION OF PREMISES

A. Before bidding on this work, Contractors shall make a careful examination of the premises and shall thoroughly familiarize themselves with the requirements of the contract. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and that he is familiar with and accepts all conditions of the site.

1.10 PROTECTION

A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.

B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.11 LOCATIONS

A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.

B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional

cuttings are found to be required, the cost of the same shall be charged to this Contractor.

C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.12 SUBMITTAL DATA

A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, six (6) copies of valid submittal data on all fixtures, material, equipment and devices. Each submitted item shall be indexed and referenced to these specifications and to identification numbers on fixtures and equipment schedules.

2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.

3. Submittals will be checked for general conformance with the design concept of the project but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.

4. To be valid, all submittals must:

a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.

b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.

c. Include all pertinent construction, installation, performance and technical data.

d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.

1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.

2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page and item numbers.

e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings, unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternate.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.

a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.

1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled “SPECIFIED ITEM, NOT SUBMITTED”. Product data sheets for the corresponding proposed substitution item shall be clearly labeled “PROPOSED SUBSTITUTION”.

b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.

2. It shall be the Contractor’s responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved and resubmittal will not be allowed.

3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.

4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has

considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.

5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.

1.13 UNINSPECTED WORK

A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.

B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.14 RECORD DRAWINGS (Also see General Conditions)

A. Contractor shall provide and keep up-to-date a complete "as-built" record set of blueline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducibles shall be delivered to the Architect.

1.15 GUARANTEES (Also see General Conditions)

A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.

B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.

C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

1.16 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 and NSF 14.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Symmons Industries, Inc.

b. Bradley.

3. Standard: ASSE 1017.

4. Pressure Rating: 125 psig (860 kPa).

5. Type: Thermostatically controlled, water mixing valve.

6. Material: Bronze body with corrosion-resistant interior components.

7. Connections: Threaded[**union**] inlets and outlet.

8. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

9. Tempered-Water Setting: 120°F.

10. Tempered-Water Design Flow Rate: 0.35 GPM.

11. Valve Finish: Rough bronze.

B. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Symmons Industries, Inc.

    b. Bradley.

3. Standard: ASSE 1017.

4. Pressure Rating: 125 psig (860 kPa)minimum unless otherwise indicated.

5. Type: Exposed-mounted or Cabinet-type (Refer to Plumbing Fixture Schedule), thermostatically controlled, water mixing valve.

6. Material: Bronze body with corrosion-resistant interior components.

7. Connections: Threaded**[union]** inlets and outlet.

8. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

9. Tempered-Water Setting: 120°F.

10. Tempered-Water Design Flow Rate: 0.35 GPM.

11. Selected Valve Flow Rate at 45-psig (310-kPa) Pressure Drop: 0.35 GPM.

12. Valve Finish: Rough bronze.

13. Piping Finish: Copper.

14. Cabinet: Factory fabricated, stainless steel, for recessed or surface **(**Refer to Plumbing Fixture Schedule) mounting and with hinged, stainless-steel door.

C. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Symmons Industries, Inc.

    b. Bradley.

3. Standard: ASSE 1016, thermostatically controlled, water tempering valve.

4. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.

5. Body: Bronze body with corrosion-resistant interior components.

6. Temperature Control: Adjustable.

7. Inlets and Outlet: Threaded.

8. Finish: Rough or chrome-plated bronze.

9. Tempered-Water Setting: 110°F**.**

10. Tempered-Water Design Flow Rate: 0.35 GPM.

D. Primary Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Symmons Industries, Inc.

   b. Bradley.

3. Standard: ASSE 1017, thermostatically controlled, water tempering valve, listed as tempering valve.

4. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.

5. Body: Bronze.

6. Temperature Control: Manual.

7. Inlets and Outlet: Threaded.

8. Selected Primary Water Tempering Valve Size: See plans.

9. Tempered-Water Setting: 120°F**.**

10. Tempered-Water Design Flow Rate: See plans.

11. Tempered-Water Outlet Size: See plans for end connection.

12. Cold-Water Inlet Size: See plans for end connection.

13. Hot-Water Inlet Size: See plans for end connection.

14. Valve Finish: Rough bronze.

2.4 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.

2. Body Material: Bronze.

3. Seat: Bronze, replaceable.

4. Supply Connections: NPS 3/4 threaded or solder-joint inlet.

5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.

6. Pressure Rating: 125 psig.

7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.

8. Include operating key with each operating-key hose bibb.

2.5 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Precision Plumbing Products, Inc.

b. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.

2. Standard: ASSE 1010 or PDI-WH 201.

3. Type: Metal bellows.

4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.6 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. MIFAB, Inc.

b. Precision Plumbing Products, Inc.

c. Sioux Chief Manufacturing Company, Inc.

2. Standard: ASSE 1018.

3. Pressure Rating: 125 psig minimum.

4. Body: Bronze.

5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.

6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.

7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.7 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Precision Plumbing Products, Inc.

2. Standard: ASSE 1044.

3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.

4. Cabinet: Surface-mounted steel box with stainless-steel cover.

5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.

a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

6. Vacuum Breaker: ASSE 1001.

7. Number Outlets: Four.

8. Size Outlets: NPS 1/2.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install water-hammer arresters in water piping according to PDI-WH 201.

B. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

C. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 Access Panels:

A. Wall access panels shall be minimum 12" x 12" for concealed valves and other equipment unless otherwise specified or indicated. Ceiling access panels shall be 18" x 18" minimum. Access panels shall be located and positioned for ready access and service of equipment housed within. Where access panels are specified with keyed cylinder locks, all such locks shall be identically keyed.

1. Wall, Non-Fire Rated: Elmdor/Stoneman DW-SS-CL, drywall, stainless steel finish, cylinder lock.

2. Ceiling, Non-fire Rated: Elmdor/Stoneman DW, drywall, prime coated finish, screwdriver latch.

3. Wall, Fire Rated: Elmdor/Stoneman FR-SS-CL, fire rated, stainless steel finish, cylinder lock.

4. Ceiling, Fire rated: Elmdor/Stoneman FRC, Fire rated, prime coated finish, return latch.

5. Wall, Non-Fire Rated: Elmdor/Stoneman DW-SS-AKL, drywall, stainless steel finish, allen key latch.

6. Ceiling, Non-fire Rated: Elmdor/Stoneman DW, drywall, prime coated finish, screwdriver latch.

7. Wall, Fire Rated: Elmdor/Stoneman FR-SS, fire rated, stainless steel finish, return latch.

8. Ceiling, Fire rated: Elmdor/Stoneman FRC, Fire rated, prime coated finish, return latch.

3.3 Yard Boxes & Vaults: For service shut-off valves on gas and domestic water; for pressure regulator assemblies and for cleanouts, shall be Brooks Products or Fraser Cement Products Co., rectangular concrete type with vandal-proof cast iron cover and name of service clearly marked on cover. Box shall be of size to permit full range of valve operation and to permit easy removal of valve assembly. Vaults shall be sectional type.

3.4 CONNECTIONS

A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

3.5 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Supply-type, trap-seal primer valves.

2. Trap-seal primer systems.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.6 FIELD QUALITY CONTROL

A. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports.

3.7 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 22 11 19

SECTION 221300

FACILITY SANITARY SEWERAGE

PART 1 – GENERAL

1.1 SUMMARY

A. Division 1 applies to this Section. Provide sanitary sewers as indicated, specified, and required.

B. Work In This Section: Principal items include:

1. Sanitary sewer pipe and fittings.
2. Lateral services extended to 5-feet from building.
3. Connections of laterals to existing mains or municipal sewer system.
4. Connection of building sewer system to laterals 5-feet from building.
5. Trenching, backfilling and compaction for sewer system.

C. Related Work Not in This Section:

1. Storm drainage lines.
2. Water, gas and electric lines.
3. Earthwork.

1.2 REFERENCE SPECIFICATIONS

A. Perform all work in accordance with applicable provisions of "Standard Specifications" Section 306. Mention herein of section numbers refers to sections of the "Standard Specifications" unless otherwise indicated. For the purpose of this Section, the Owner's authorized representative shall be referred to as the Inspector.

1.3 SUBMITTALS

A. Layout Drawings: Submit drawings for layout of piping systems. Indicate locations of fittings and other accessories on layout drawings; detail cleanouts. Do not deliver pipe, fittings, and accessories until layout drawings have been approved.

B. Shop Drawings: Submit shop drawings for the following:

1. Metal work.
2. Concrete reinforcement in accordance with ACI 315.

C. Manufacturer's Data: Submit manufacturer's standard drawings or catalog cuts of the following items:

1. Fittings.
2. Joints and Couplings.
3. Piping.

D. Standards Compliance: Submit manufacturer's certificates of conformance or compliance for each of the following materials which are specified to conform to publications referenced under paragraph "Materials" in this section:

1. Pipe and fittings, including factory-applied linings.
2. Pipe joint materials.
3. Cast iron frames, covers, and gratings.
4. Concrete aggregates.
5. Concrete admixtures.

1.4 QUALITY CONTROL

A. All tests required by the applicable referenced publications shall have been performed, whether specified in that publication to be mandatory or otherwise. For tests which are not specified in the referenced publication to be performed at definite intervals, during manufacture, the tests shall have been performed within three years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

1.5 RECORD DRAWINGS

A. Provide complete record drawings showing dimensioned locations and depths of all piping, and exact locations off all accessories.

1.6 INSPECTION AND TESTING

A. Refer to Division 1 for procedures.

B. Inspection: Soils Engineer will inspect and test the backfilling work of this section. Notify Soils Engineer prior to commencement of work.

C. Testing: Soils Engineer will make tests to determine degree of compaction in accordance with the following ASTM test methods:

1. Maximum Density and Optimum Moisture Content: ASTM D1557, 5 layers.
2. Density of soil in place: ASTM D1556.

D. Report: Soils Engineer will submit a written report that trenches were backfilled with acceptable material, and that compaction meets the requirements of these specifications.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Polyvinyl-Chloride (PVC) Plastic Piping: Conform to ASTM D3033 or D3034, shall be SDR 35, with ends suitable for elastomeric gasket joints.

B. Pipe jointing materials for polyvinyl chloride plastic piping: Joints shall conform to ASTM D3212. Gaskets shall conform to ASTM F477.

C. Concrete Materials: Concrete materials shall be as specified in Section, "Cast-in-Place Concrete."

D. Frames, Covers, and Gratings: Frames, covers, and gratings shall con-form to Federal Specification RR-F-621 and shall be of cast iron; figure numbers shall be as shown on the sketches accompanying this section as indicated.

E. Cleanouts: in accordance with the drawings, of the sizes and at locations indicated.

PART 3 – EXECUTION

3.1 TRENCHING EXCAVATION

A. Perform all excavation for the construction of trenches and all additional excavation required for structures forming a part of the pipeline. Trench excavation shall conform to the requirements of Section 02200 and of Section 306-1 of Standard Specifications. Trenches shall be inspected by the Soils Engineer before proceeding with the work.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Location of Piping: Where the location of the sewer is not clearly defined by dimensions on the drawings, lay sewer line not closer horizontally than 10 feet from a water main or service line. Where sanitary sewer lines pass above water lines, encase sewer in concrete for a distance of 10 feet on each side of the crossing, or substitute rubber-gasket pressure pipe for the pipe being used for the same distance. Where sanitary sewer lines pass below water lines, lay pipe so that no joint in the sewer line will be closer than 3 feet, horizontal distance, to the water line. Install a continuous length of tracer wire for the full length of nonmetallic pressure pipe. Attach wire to top of pipe in such a manner that it will not be displaced during construction operations.

B. Survey line and grade: Grade controls and survey lines shall be provided by a licensed land surveyor obtained by the Contractor.

C. Pipe Laying and Jointing: Each pipe and fitting will be inspected before and after installation and those found defective will be rejected. Provide proper facilities for lowering sections of pipe into trenches. Lay non-pressure pipe with the bell or groove ends in the upgrade direction. Adjust spigots in bells and tongues in grooves to give a uniform space all around. Blocking or wedging between bells and spigots or tongues and grooves will not be permitted. Replace by one of the proper dimensions any pipe or fitting that does not allow sufficient space for proper caulking or installation of joint material. At the end of each day's work, close open ends of pipe temporarily with wood blocks or bulkheads.

D. Connections to Existing Lines: Make connections to existing lines in an approved manner. Conduct work so that there is minimum interruption of service to existing line.

3.3 INSTALLATION OF PVC PLASTIC PIPING

A. Install pipe and fittings in accordance with the general requirements for installation of pipelines and with the requirements of UNI-B-5 for laying and joining pipe and fittings. Make joints with the gaskets previously specified for joints with this piping; assemble these joints in accordance with the requirements of UNI-B-5 for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.4 METAL WORK

A. Workmanship and Finish: Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide necessary rabbets, lugs, and brackets wherever necessary.

B. Field Painting: After installation, clean cast-iron frames, covers, and gratings of mortar, rust, grease, dirt, and other deleterious materials and give a coat of bituminous paint. Do not paint surfaces subject to abrasion.

3.5 BACKFILL AND COMPACTION

A. Perform in accordance with requirements of Section 02200 and with Section 306-1.3 of the Standard Specifications. In back-filling the trench, take all necessary precautions to protect the pipe from damage or shifting.

3.6 CONNECTIONS TO EXISTING MAINS

A. Where connections are made between new work and existing mains, the connections shall be made by using special couplings, Rockwell Clamp and Coupling-Tapping Sleeves, and other fittings to suit the on-site conditions. Methods of connections to existing mains shall be as required by local codes.

3.7 FIELD TESTS AND SURVEYS

A. General: Conduct field tests in presence of Architect, as specified herein.

1. Pipelines: Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically full circle of light through the pipeline when viewed from the adjoining end of line.

a. Leakage Tests: Test lines for leakage by exfiltration test. Fill the line to be tested with water so that the head will be at least 4 feet above top of pipe at upper end of pipeline section being tested. Allow filled pipe-line to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, re-establish the head and measure amount of water needed to maintain this water level during a two-hour test period. Amount of leakage, as measured by either infiltration or exfiltration test shall not exceed 0.2 gallon per inch of diameter per hour per 100 feet of pipeline. When leakage exceeds the amount specified, make satisfactory correction and retest pipeline section in the same manner as previously specified. Correct all visible leaks regardless of leakage test results.

b. Deflection Testing: Make a deflection test an entire length of installed plastic pipeline on completion of all work adjacent to and over the pipeline, including leakage tests, backfilling, or placement of fill, grading, paving, concreting, or any other superimposed loads. Deflection of pipe in the installed pipeline under all external loads shall not exceed 4.5 percent of the normal inside diameter of pipe. Testing may be by either pull-through device or deflection measuring device.

3.8 CLEANUP

A. Upon completion of work, leave the site clean and clear of debris and construction materials.

END OF SECTION

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

B. Related Sections:

1. Section 221313 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.

1.3 WORK INCLUDED

A. Furnish all labor, materials, services, testing, transportation and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:

1. C.C.R., Title 24, Part 5 (2022 CPC).
2. 2022 California Plumbing Code.
3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
4. National Fire Protection Association.

5. California State Division of Industrial Safety.

6. County Health Department.

7. Any other legally constituted body-having jurisdiction thereof.

B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.5 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.6 DRAWINGS

A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.

B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.

C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.

D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.7 PERMITS, INSPECTIONS AND LICENSES

A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.8 UTILITIES

A. See Drawings for Points of Connection.

B. Certain site utilities are to be connected to and extended. Before laying of any pipe or digging of any trenches, Contractor shall determine by actual excavation and measurement exact location and depth of lines to which he is to connect. In event depth of lines is not sufficient to permit connection in manner indicated, Contractor shall obtain direction from the Owner's representative before proceeding with this work.

C. Verify that utility companies size their services and meters to suit ultimate demand indicated on the drawings.

D. Sanitary Sewer: The Contractor shall be responsible for the soil and waste piping outside of the building within five feet (5’) of the foundation, and within the building itself. See Civil Engineer’s plans for onsite sewer system.

1.9 EXAMINATION OF PREMISES

A. Before bidding on this work, Contractors shall make a careful examination of the premises and shall thoroughly familiarize themselves with the requirements of the contract. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and that he is familiar with and accepts all conditions of the site.

1.10 PROTECTION

A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.

B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.11 LOCATIONS

A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.

B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.

C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.12 SUBMITTAL DATA

A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, six (6) copies of valid submittal data on all fixtures, material, equipment and devices. Each submitted item shall be indexed and referenced to these specifications and to identification numbers on fixtures and equipment schedules.

2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.

3. Submittals will be checked for general conformance with the design concept of the project but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.

4. To be valid, all submittals must:

a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.

b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.

c. Include all pertinent construction, installation, performance and technical data.

d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.

1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.

2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page and item numbers.

e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings, unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternate.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.

a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.

1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled “SPECIFIED ITEM, NOT SUBMITTED”. Product data sheets for the corresponding proposed substitution item shall be clearly labeled “PROPOSED SUBSTITUTION”.

b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.

2. It shall be the Contractor’s responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved and resubmittal will not be allowed.

3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.

4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.

5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.

1.13 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.14 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

1.15 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of sanitary waste service.

2. Do not proceed with interruption of sanitary waste service without Architect's written permission.

1.16 UNINSPECTED WORK

A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.

B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.17 RECORD DRAWINGS (Also see General Conditions)

A. Contractor shall provide and keep up-to-date a complete "as-built" record set of blueline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducibles shall be delivered to the Architect.

1.18 GUARANTEES (Also see General Conditions)

A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.

B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.

C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. ASTM C 1540, Heavy Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ANACO-Husky SD 4000 series.

b. MIFAB MI-QXHUB.

2. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Soil and waste piping within the building itself and outside within five feet (5') of the foundation, shall be no-hub cast iron pipe and fittings, asphaltum coated, free from defects, and shall comply with CISPI. Standard 301, ASTM A-888 or ASTM A-74. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute. Fittings shall be made up with "Husky" SD 4000 series or “MIFAB MI-QXHUB” series stainless steel type 304 couplings and shall conform to ASTM C1540 & ASTM C564 except all above ground vent pipe fittings may be made with "Anaco" or "MIFAB" stainless steel two band couplings conforming to CISPI Standard 310.

D. Except where otherwise indicated on the plans, building sewer piping from five feet (5') outside of the building to connections at the sewer shall be PVC (polyvinyl chloride) ASTM D3034, SDR-35 sewer pipe with locked-in gasket (ASTM F477, Elastomeric Seal.

E. Grease waste piping underground shall be cast iron pipe and fittings as specified for soil and waste piping.

2.3 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Cleanouts to Grade: Jay R. Smith No. 4258 or Jay R. Smith No. 4253 with X-H bronze plug and X-X-H non-skid cover with lifting device set flush with surface for concrete areas. Asphalt or nonsurfaced areas shall be installed with ring of concrete poured around the bottom flange six inches (6") below surface. Use cast iron soil pipe on cleanout risers. For cleanouts in non-traffic areas, terminate cleanout plug in concrete yard box

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Smith, Jay R. Mfg. Co.

b. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

3. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

4. Top-Loading Classification(s): Light Duty Medium Duty Heavy Duty and Extra-Heavy Duty.

5. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. Yard Boxes & Vaults: For service for cleanouts, shall be Brooks Products or Fraser Cement Products Co., rectangular concrete type with vandal-proof cast iron cover and name of service clearly marked on cover. Box shall be of size to permit full range of valve operation and to permit easy removal of valve assembly. Vaults shall be sectional type.

2.4 CORROSION PROTECTION

A. General.

1. Corrosion protection shall be provided for all below grade cast iron and copper piping and associated valves and fittings. Such piping shall be protected from corrosion by encasement in a polyethylene protective wrapping, referred to hereafter as polywrap. Although not intended to be a completely air and water tight enclosure, the polywrap shall provide a continuous barrier between the pipe and surrounding bedding and backfill.

B. Materials.

1. Cast iron piping encasement.

a. The polywrap shall be minimum 8 mil. in thickness, group 2, linear low density, flat tube, natural (clear) virgin polyethylene film formed into tubes or sheets as required. Material shall meet or exceed the requirements of AWWA C105, ANSI A21.5 and ASTM A674.

b. The polywrap shall be as manufactured by Northtown Company or approved equal.

2. The minimum Polywrap flat tube width for each pipe diameter shall be as follows:

Pipe Size / Type	Polywrap Flat Tube Width
2” to 3” cast iron	14”
4” cast iron	16”
6” cast iron	20”
8” cast iron	24”

3. The polywrap shall be secured as specified with 2 inch wide pressure sensitive plastic tape not less than 10 mils thick.

   a. Tape shall be Scotchwrap No. 50, Polyken No. 900, Tapecoat CT, Johns-Manville No. V-10 Trantex or approved equal.

4. Piping through exterior walls shall be sealed using Link Seal modular seal with nitrile seal elements and stainless steel bolts.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

M. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.

2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

O. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."

2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

T. Below-grade piping through exterior walls shall be sealed using Link Seal modular seal with nitrile seal elements and stainless steel bolts and sleeves as manufactured by Century Line.

U. Corrosion Protection:

a. The polyethylene tubing shall be cut into lengths approximately 2 feet longer than the pipe sections. Slip the tube around the pipe, centering it to provide a 1-ft overlap on each adjacent pipe section, and bunching it accordion fashion lengthwise until it clears the pipe ends. Lower the pipe into the trench and make up the pipe joint with the preceding section of pipe. A shallow bell hole must be made at each joint to facilitate installation of the polywrap. The bunched-up polywrap shall be pulled from the preceding length of pipe, slipped over the end of the new length of pipe, and secured in place with one circumferential turn of tape plus enough overlap to assure firm adhesion. The end of the polywrap shall be slipped from the new pipe section over the end of the first wrap until it overlaps the joint at the end of the preceding length of pipe and tape it in place. The loose wrapping on the barrel of the pipe shall be pulled snugly around the barrel of the pipe and excess material folded over the top of the pipe and the folds held in place by means of short strips of adhesive tape, at about 3 foot intervals along the pipe.

b. Rips, punctures or other damage to the tube shall be repaired with the adhesive tape or pieces of tube material secured with tape. Bends and reducers in the line shall be covered with polyethylene in the same manner as pipe.

c. Valves, tees, crosses and outlets shall be wrapped with flat sheets of the same material. The sheets shall be passed under valves and brought up around the body to the stem. Edges shall be brought together, folded twice and secured with the adhesive tape.

3.3 JOINT CONSTRUCTION

A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.

2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.

3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.

4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.

5. Vertical Piping: MSS Type 8 or Type 42, clamps.

6. Install individual, straight, horizontal piping runs:

   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

   c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.

2. NPS 3: 60 inches with 1/2-inch rod.

3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.

4. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.

2. NPS 1-1/2: 108 inches with 3/8-inch rod.

3. NPS 2: 10 feet with 3/8-inch rod.

4. NPS 2-1/2: 11 feet with 1/2-inch rod.

5. NPS 3: 12 feet with 1/2-inch rod.

6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.

2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.

3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.

4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.

2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.

3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.

4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. No piping work shall be concealed or covered until piping has been tested, inspected and approved by the Inspector. All piping for plumbing systems shall be completely installed and tested as required by the California Plumbing Code. Test pressures and times indicated are a minimum only. All tests shall be as required by the governing authority as wellTest for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

6. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping shall be the following:

1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.

C. Aboveground, vent piping shall be the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.

D. Underground, soil, waste, and vent piping shall be the following:

1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.

END OF SECTION 22 13 16

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Floor drains.
3. Miscellaneous sanitary drainage piping specialties.

B. Related Requirements:

1. Section 221423 "Storm Drainage Piping Specialties" for storm drainage piping inside the building, drainage piping specialties, and drains.
2. Section 224300 "Medical Plumbing Fixtures" for plaster sink interceptors.
3. Section 334100 "Storm Utility Drainage Piping" for storm draining piping and piping specialties outside the building.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. HDPE: High-density polyethylene plastic.

1.4 WORK INCLUDED

A. Furnish all labor, materials, services, testing, transportation and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true

intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.5 QUALITY ASSURANCE

A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:

1. C.C.R., Title 24, Part 5 (2022 CPC).
2. 2022 California Plumbing Code.
3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
4. National Fire Protection Association.
5. California State Division of Industrial Safety.
6. County Health Department.
7. Any other legally constituted body-having jurisdiction thereof.

B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.6 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.7 DRAWINGS

A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.

B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.

C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.

D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.8 PERMITS, INSPECTIONS AND LICENSES

A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.9 EXAMINATION OF PREMISES

A. Before bidding on this work, Contractors shall make a careful examination of the premises and shall thoroughly familiarize themselves with the requirements of the contract. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and that he is familiar with and accepts all conditions of the site.

1.10 PROTECTION

A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.

B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.11 LOCATIONS

A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.

B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.

C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.12 SUBMITTAL DATA

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:

1. Grease interceptors.

B. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, six (6) copies of valid submittal data on all fixtures, material, equipment and devices. Each submitted item shall be indexed and referenced to these specifications and to identification numbers on fixtures and equipment schedules.

2. Manufacturers’ submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the

work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.

3. Submittals will be checked for general conformance with the design concept of the project but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.

4. To be valid, all submittals must:

   a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer’s review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.

   b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.

   c. Include all pertinent construction, installation, performance and technical data.

   d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.

      1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.

      2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page and item numbers.

   e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings, unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternate.

C. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty five (35) days

of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.

a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.

1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled “SPECIFIED ITEM, NOT SUBMITTED”. Product data sheets for the corresponding proposed substitution item shall be clearly labeled “PROPOSED SUBSTITUTION”.

b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.

2. It shall be the Contractor’s responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved and resubmittal will not be allowed.

3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.

4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.

5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.

1.13 INFORMATIONAL SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that grease interceptors**,** accessories, and components will withstand seismic forces defined in Sec-

tion 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

    a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

    b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.14 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.15 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.16 UNINSPECTED WORK

A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.

B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.17 RECORD DRAWINGS (Also see General Conditions)

A. Contractor shall provide and keep up-to-date a complete "as-built" record set of blueline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducibles shall be delivered to the Architect.

1.18 GUARANTEES

A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.

B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.

C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

1.19 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate size and location of roof penetrations.

1.20 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Cultures: Provide 1-gal. bottles of bacteria culture recommended by manufacturer of FOG disposal systems equal to 200 percent of amount installed, but no fewer than 2 1-gal. bottles.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Zurn
    b. JR Smith
    c. Watts
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Zurn
    b. JR Smith
    c. Watts
2. Standard: ASME A112.36.2M for cast-iron soil pipe with cast-iron ferrule threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Cast-iron soil pipe with cast-iron ferrule Threaded, adjustable housing.

5. Body or Ferrule: Cast iron.

6. Outlet Connection: Threaded.

7. Closure: Brass plug with tapered threads.

8. Adjustable Housing Material: Cast iron with set-screws or other device.

9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.

10. Frame and Cover Shape: Round.

11. Top Loading Classification: Heavy Duty.

12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Zurn

   b. JR Smith

   c. Watts

2. Standard: ASME A112.36.2M. Include wall access.

3. Size: Same as connected drainage piping.

4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.

5. Option for drilled-and-threaded plug in first subparagraph below is for a screw for a wall cover plate.

6. Closure: Countersunk, brass plug.

7. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

8. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

9. Wall Access: stainless-steel wall-installation frame and cover.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Zurn

   b. JR Smith

   c. Watts

3. Standard: ASME A112.6.3.

4. Pattern: Floor drain.

5. Body Material: Gray iron.

6. Seepage Flange: Required.

7. Anchor Flange: Required.

8. Clamping Device: Required.

9. Outlet: Bottom.

10. Coating in first subparagraph below is usually used only on sanitary floor drains.

11. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.

12. Sediment Bucket: Not required.

13. Top or Strainer Material: Nickel bronze.

14. Top of Body and Strainer Finish: Nickel bronze.

15. Top Shape: Round.

B. Stainless-Steel Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Josam Company.

3. Standard: ASME A112.3.1.

4. Outlet: Bottom.

5. Top or Strainer Material: Stainless steel.

6. Top Shape: Round.

7. Trap-Primer Connection: Required.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.

2. Size: Same as connected stack vent or vent stack.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Mounting:

1. Install grease interceptors on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete." Section 03 30 53 "Miscellaneous Cast-in-Place Concrete."

2. Comply with requirements for vibration isolation and seismic control devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment"

3. Comply with requirements for vibration isolation devices specified in Section 22 05 48.13 "Vibration Controls for Plumbing Piping and Equipment."

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.

2. Locate at each change in direction of piping greater than 45 degrees.

3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.

4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.

2. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.

G. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

H. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

I. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

J. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.

2. Size: Same as floor drain inlet.

K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

L. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

M. Install vent caps on each vent pipe passing through roof.

N. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

O. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

P. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

Q. Install grease interceptors, venting according to authorities having jurisdiction and with clear space for servicing.

1. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor

2. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.

R. Install wood-blocking reinforcement for wall-mounting-type specialties.

S. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.

D. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.

2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.

2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.

3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 07 62 00 "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Grease interceptors.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain grease removal devices. Refer to Section 01 79 00 "Demonstration and Training."

END OF SECTION 22 13 19

SECTION 22 16 16
CONDENSATE DRAIN PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

B. Related Sections:

1. Section 221619 “Condensate Drain Piping Specialties" for sanitary sewerage piping and structures outside the building.

1.3 WORK INCLUDED

A. Furnish all labor, materials, services, testing, transportation and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:

1. C.C.R., Title 24, Part 5 (2022 CPC).
2. 2022 California Plumbing Code.
3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
4. National Fire Protection Association.
5. California State Division of Industrial Safety.
6. County Health Department.
7. Any other legally constituted body-having jurisdiction thereof.

B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been

obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.5 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Single-Wall Piping Pressure Rating: 10-foot head of water.

A. Delegated Design: Design seismic restraints for aboveground piping, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.6 DRAWINGS

A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.

B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.

C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.

D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.7 PERMITS, INSPECTIONS AND LICENSES

A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.8 EXAMINATION OF PREMISES

A. Before bidding on this work, Contractors shall make a careful examination of the premises and shall thoroughly familiarize themselves with the requirements of the contract. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and that he is familiar with and accepts all conditions of the site.

1.9 PROTECTION

A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.

B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.10 LOCATIONS

A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.

B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.

C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the

housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.11 SUBMITTAL DATA

A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, six (6) copies of valid submittal data on all fixtures, material, equipment and devices. Each submitted item shall be indexed and referenced to these specifications and to identification numbers on fixtures and equipment schedules.
2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
3. Submittals will be checked for general conformance with the design concept of the project but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
4. To be valid, all submittals must:

    a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
    b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
    c. Include all pertinent construction, installation, performance and technical data.
    d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.

        1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
        2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page and item numbers.

    e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings, unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternate.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.

    a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.

        1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled “SPECIFIED ITEM, NOT SUBMITTED”. Product data sheets for the corresponding proposed substitution item shall be clearly labeled “PROPOSED SUBSTITUTION”.

    b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.

2. It shall be the Contractor’s responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.

1.12 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.13 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

1.14 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Architect's written permission.

1.15 UNINSPECTED WORK

A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.

B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.16 RECORD DRAWINGS (Also see General Conditions)

A. Contractor shall provide and keep up-to-date a complete "as-built" record set of blueline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducibles shall be delivered to the Architect.

1.17 GUARANTEES (Also see General Conditions)

A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.

B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.

C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Indirect Waste Piping.

1. Shall be Type "L" copper as specified for water piping.

C. Air Conditioning Condensate Drain Piping.

1. Shall be Type "M" copper as specified for water piping.

2.2 COPPER TUBE AND FITTINGS:

A. Hard Copper Tube: ASTM B 88, Type M tube, drawn temper.

B. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

C. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends

2.3 SPECIALTY PIPE FITTINGS

A. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:

a. Manufacturers: Subject to compliance with requirements, provide products by the following:

1) Wilkins; a Zurn company.

b. Description:

1) Standard: ASSE 1079.
2) Pressure Rating: 150 psig.
3) End Connections: Solder-joint copper alloy and threaded ferrous.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of condensate drain piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install condensate drain piping with 1 percent slope downward toward drain.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping at indicated slopes.

G. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Install unions in copper tubing at connection to each piece of equipment, machine, and specialty.

L. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

M. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.2 JOINT CONSTRUCTION

A. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

B. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

3.3 SPECIALTY PIPE FITTING INSTALLATION

A. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:
    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:
    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 72 inches with 3/8-inch rod.

2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect drainage and vent piping to the following:

1. Plumbing Specialties: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.

2. Install test tees (wall cleanouts) in conductors near floor.

3. Equipment: Connect drainage piping as indicated. Provide union for each connection.

C. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

D. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

3.6 IDENTIFICATION

A. Identify exposed condensate drain piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.

d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill condensate drain piping. Check components to determine that they are not air bound and that piping is full of water.
b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
d. Cap and subject piping to static water pressure of 50 psig. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Condensate drain piping will be considered defective if it does not pass tests and inspections

C. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

D. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

3.8 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, condensate drain piping NPS 2 and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type M copper, soilder-joint fittings; and soldered joints.

END OF SECTION 22 16 16

SECTION 22 33 00

ELECTRIC DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Commercial, electric, storage, domestic-water heaters.

2. Domestic-water heater accessories.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.4 WORK INCLUDED

A. Furnish all labor, materials, services, testing, transportation and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.5 QUALITY ASSURANCE

A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:

1. C.C.R., Title 24, Part 5 (2022 CPC).

2. 2022 California Plumbing Code.

3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.

4. National Fire Protection Association.

5. California State Division of Industrial Safety.

6. County Health Department.

7. Any other legally constituted body-having jurisdiction thereof.

B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.6 DRAWINGS

A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.

B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.

C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.

D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.7 PERMITS, INSPECTIONS AND LICENSES

A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.8 EXAMINATION OF PREMISES

A. Before bidding on this work, Contractors shall make a careful examination of the premises and shall thoroughly familiarize themselves with the requirements of the contract. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and that he is familiar with and accepts all conditions of the site.

1.9 PROTECTION

A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.

B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.10 LOCATIONS

A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.

B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.

C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.11 SUBMITTAL DATA

A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, six (6) copies of valid submittal data on all fixtures, material, equipment and devices.

Each submitted item shall be indexed and referenced to these specifications and to identification numbers on fixtures and equipment schedules.

2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.

3. Submittals will be checked for general conformance with the design concept of the project but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.

4. To be valid, all submittals must:

   a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.

   b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.

   c. Include all pertinent construction, installation, performance and technical data.

   d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.

      1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.

      2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page and item numbers.

   e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings, unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternate.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.

    a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.

        1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled “SPECIFIED ITEM, NOT SUBMITTED”. Product data sheets for the corresponding proposed substitution item shall be clearly labeled “PROPOSED SUBSTITUTION”.

    b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.

2. It shall be the Contractor’s responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved and resubmittal will not be allowed.

3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.

4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.

5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.

6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.12 UNINSPECTED WORK

A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.

1.13 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE/IESNA Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.

C. ASME Compliance:

1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.14 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.15 RECORD DRAWINGS (Also see General Conditions)

A. Contractor shall provide and keep up-to-date a complete "as-built" record set of blueline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducibles shall be delivered to the Architect.

1.16 WARRANTY

A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.

B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.

C. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.

b. Faulty operation of controls.

c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:

1) Storage Tank: Five years.

2) Controls and Other Components: Two years.

b. Compression Tanks: Five years.

c.

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, domestic-WATER HEATERS

A. Commercial, Electric, Storage, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AO Smith

b. Bradford White

c. Rheem

d. Lochinvar

2. Standard: UL 1453.

3. Factory-Installed Storage-Tank Appurtenances:

a. Anode Rod: Replaceable magnesium.

b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.

c. Insulation: Comply with ASHRAE/IESNA 90.1.

d. Jacket: Steel with enameled finish.

e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.

f. Temperature Control: Adjustable thermostat.

g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.

h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

4. Special Requirements: NSF 5 construction.

2.2 domestic-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. AMTROL Inc.

b. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.

c. Taco, Inc.

2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

3. Construction:

a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.

b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.

c. Air-Charging Valve: Factory installed.

B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain

outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

C. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

D. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.

E. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

F. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

G. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.

H. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete."

1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.

2. Maintain manufacturer's recommended clearances.

3. Arrange units so controls and devices that require servicing are accessible.

4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

7. Install anchor bolts to elevations required for proper attachment to supported equipment.

8. Anchor domestic-water heaters to substrate.

B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."

C. Install commercial, electric, domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

F. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

G. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

H. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

I. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping," and comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

J. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

K. Fill electric, domestic-water heaters with water.

L. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial, electric, domestic-water heaters.

END OF SECTION 22 33 00

SECTION 22 42 13 13

COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Water closets.

2. Flushometer valves.

3. Toilet seats.

1.3 WORK INCLUDED

A. Furnish all labor, materials, services, testing, transportation and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:

1. C.C.R., Title 24, Part 5 (2022 CPC).

2. 2022 California Plumbing Code.

3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.

4. National Fire Protection Association.

5. California State Division of Industrial Safety.

6. County Health Department.

7. Any other legally constituted body-having jurisdiction thereof.

8. Plumbing fixtures and accessories provided in a toilet room or bathing room required to comply with CBC Section 11B-213.2 shall comply with CBC Section 11B-213.3.

9. Access plumbing fixtures shall comply with all of the requirements of CBC Division 6.

10. Clearance around accessible water closets and in toilet compartments shall be 60 inches minimum measured perpendicular from the side wall and 56 inches minimum measured perpendicular from the rear wall per CBC Section 11B-604.3.1.

11. Heights and location of all fixtures shall be mounted according to CBC Sections 11B-602 through 11B-612.

12. Accessible fixture controls shall comply with CBC Sections 11B-604.6 for water closets and 11B-604.9.5 for children's water closets.

B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.5 DRAWINGS

A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.

B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.

C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.

D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.6 PERMITS, INSPECTIONS AND LICENSES

A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.7 EXAMINATION OF PREMISES

A. Before bidding on this work, Contractors shall make a careful examination of the premises and shall thoroughly familiarize themselves with the requirements of the contract. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and that he is familiar with and accepts all conditions of the site.

1.8 PROTECTION

A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.

B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.9 LOCATIONS

A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.

B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.

C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.10 SUBMITTAL DATA

A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, six (6) copies of valid submittal data on all fixtures, material, equipment and devices. Each submitted item shall be indexed and referenced to these specifications and to identification numbers on fixtures and equipment schedules.

2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.

3. Submittals will be checked for general conformance with the design concept of the project but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.

4. To be valid, all submittals must:

a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.

b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.

c. Include all pertinent construction, installation, performance and technical data.

d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.

1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.

2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page and item numbers.

e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings, unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternate.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.

   a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.

      1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled “SPECIFIED ITEM, NOT SUBMITTED”. Product data sheets for the corresponding proposed substitution item shall be clearly labeled “PROPOSED SUBSTITUTION”.

   b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.

2. It shall be the Contractor’s responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved and resubmittal will not be allowed.

3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.

4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.

5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.

6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.11 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than six of each type.

1.12 UNINSPECTED WORK

A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.

B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.13 RECORD DRAWINGS (Also see General Conditions)

A. Contractor shall provide and keep up-to-date a complete "as-built" record set of blueline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducibles shall be delivered to the Architect.

1.14 GUARANTEES (Also see General Conditions)

A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.

B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.

C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 WALL-MOUNTED WATER CLOSETS

A. Water Closets: Wall mounted, top spud.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. American Standard America.

   b. Kohler Co.

2. Bowl:

   a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.

   b. Material: Vitreous china.

   c. Type: Siphon jet.

   d. Style: Flushometer valve.

   e. Height: Standard.

   f. Rim Contour: Elongated.

   g. Water Consumption: 1.28 gal. (4.8 L) per flush.

   h. Spud Size and Location: NPS 1-1/2 (DN 40); top.

3. Support:

   a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

      1) ZURN 1200 SERIES “EZCARY” CARRIERS

   b. Standard: ASME A112.6.1M.

   c. Description: Waste-fitting assembly as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

2.2 FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Sloan Valve Company.

2. Standard: ASSE 1037.

3. Minimum Pressure Rating: 125 psig (860 kPa).

4. Features: Include integral check stop and backflow-prevention device.

5. Material: Brass body with corrosion-resistant components.

6. Exposed Flushometer-Valve Finish: Chrome plated.

7. Panel Finish: Chrome plated or stainless steel.

8. Style: Exposed.

9. Consumption: 1.28 gal. (4.8 L) per flush.

10. Minimum Inlet: NPS 1 (DN 25).

11. Minimum Outlet: NPS 1-1/4 (DN 32).

2.3 TOILET SEATS

A. Toilet Seats:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Bemis Manufacturing Company.

   b. Olsonite Seat Co.

2. Standard: IAPMO/ANSI Z124.5.

3. Material: Plastic.

4. Type: Commercial (Standard).

5. Shape: Elongated rim, open front.

6. Hinge: Self-sustaining, check.

7. Hinge Material: Noncorroding metal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Locations and Accessibility: Install equipment for ease of maintenance and repair. If changes in the indicated locations or arrangements are made by the Contractor, they shall be made without additional charges.

B. Openings: Furnish information to the other trades on size and location of openings which are required in walls, slabs, roof, for piping and equipment at the proper times.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Closing-In of Uninspected Work: Do not allow or cause any of the work to be covered up or enclosed until it has been inspected, tested, and approved by the Architect. Any work enclosed or covered prior to such inspection and test shall be uncovered and, after it has been inspected, tested, and approved, make all repairs with such materials as may be necessary to restore all work, including that of other trades, to its original and proper condition.

3.2 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.

2. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.

2. Use carrier supports with waste-fitting assembly and seal.

3. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.

2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.

3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.

2. Install deep-pattern escutcheons if required to conceal protruding fittings.

3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.

2. Match sealant color to water-closet color.

3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

3.6 PLUMBING FIXTURES

A. Accessible plumbing fixtures shall comply with all of the requirements of CBC Division 6.

B. Heights and location of all accessible fixtures shall be mounted according to CBC Sections 11B-602 through 11B-612.

C. Fixture controls shall comply with CBC Sections 11B-604.6 for water closets

END OF SECTION 22 42 13 13

SECTION 22 42 13 16

COMMERCIAL URINALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Urinals.

2. Flushometer valves.

1.3 WORK INCLUDED

A. Furnish all labor, materials, services, testing, transportation and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:

1. C.C.R., Title 24, Part 5 (2022 CPC).

2. 2022 California Plumbing Code.

3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.

4. National Fire Protection Association.

5. California State Division of Industrial Safety.

6. County Health Department.

7. Any other legally constituted body-having jurisdiction thereof.

8. Plumbing fixtures and accessories provided in a toilet room or bathing room required to comply with CBC Section 11B-213.2 shall comply with CBC Section 11B-213.3.

9. Access plumbing fixtures shall comply with all of the requirements of CBC Division 6.

10. Heights and location of all fixtures shall be mounted according to CBC Sections 11B-602 through 11B-612.

11. Accessible fixture controls shall comply with CBC Sections 11B-605.4 for urinals.

B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.5 DRAWINGS

A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.

B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.

C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.

D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.6 PERMITS, INSPECTIONS AND LICENSES

A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.7 EXAMINATION OF PREMISES

A. Before bidding on this work, Contractors shall make a careful examination of the premises and shall thoroughly familiarize themselves with the requirements of the contract. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and that he is familiar with and accepts all conditions of the site.

1.8 PROTECTION

A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.

B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.9 LOCATIONS

A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.

B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.

C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.10 SUBMITTAL DATA

A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, six (6) copies of valid submittal data on all fixtures, material, equipment and devices. Each submitted item shall be indexed and referenced to these specifications and to identification numbers on fixtures and equipment schedules.

2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.

3. Submittals will be checked for general conformance with the design concept of the project but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.

4. To be valid, all submittals must:

a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.

b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.

c. Include all pertinent construction, installation, performance and technical data.

d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.

1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.

2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page and item numbers.

e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings, unless the unchanged portions must be

shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternate.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.

    a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.

        1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled “SPECIFIED ITEM, NOT SUBMITTED”. Product data sheets for the corresponding proposed substitution item shall be clearly labeled “PROPOSED SUBSTITUTION”.

    b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.

2. It shall be the Contractor’s responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved and resubmittal will not be allowed.

3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.

4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.

5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.

6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.11 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than six of each type.

1.12 UNINSPECTED WORK

A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.

B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.13 RECORD DRAWINGS

A. Contractor shall provide and keep up-to-date a complete "as-built" record set of blueline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducibles shall be delivered to the Architect.

1.14 GUARANTEES (Also see General Conditions)

A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.

B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.

C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 WALL-HUNG URINALS

A. Urinals: Wall hung, back outlet, siphon jet.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. American Standard

b. Kohler Co.

2. Fixture:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.

b. Material: Vitreous china.

c. Type: Siphon jet.

d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.

e. Water Consumption: Water saving.

f. Spud Size and Location: NPS 3/4 (DN 20); top.

g. Outlet Size and Location: NPS 2 (DN 50); back.

h. Color: White.

3. Waste Fitting:

a. Standard: ASME A112.18.2/CSA B125.2 for coupling.

b. Size: NPS 2 (DN 50).

4. Support: ASME A112.6.1M, Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.

a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1) ZURN CARRIERS

2.2 URINAL FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Sloan Valve Company.

2. Standard: ASSE 1037.

3. Minimum Pressure Rating: 125 psig (860 kPa).

4. Features: Include integral check stop and backflow-prevention device.

5. Material: Brass body with corrosion-resistant components.

6. Exposed Flushometer-Valve Finish: Chrome plated.

7. Panel Finish: Chrome plated or stainless steel.

8. Style: Exposed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Locations and Accessibility: Install equipment for ease of maintenance and repair. If changes in the indicated locations or arrangements are made by the Contractor, they shall be made without additional charges.

B. Openings: Furnish information to the other trades on size and location of openings which are required in walls, slabs, roof, for piping and equipment at the proper times.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Closing-In of Uninspected Work: Do not allow or cause any of the work to be covered up or enclosed until it has been inspected, tested, and approved by the Architect. Any work enclosed or covered prior to such inspection and test shall be uncovered and, after it has been inspected, tested, and approved, make all repairs with such materials as may be necessary to restore all work, including that of other trades, to its original and proper condition.

3.2 INSTALLATION

A. Urinal Installation:

1. Install urinals level and plumb according to roughing-in drawings.

2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.

3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.

4. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for wall-hung urinals.

2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.

3. Use carriers without waste fitting for urinals with tubular waste piping.

4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

C. Flushometer-Valve Installation:

1. Install flushometer-valve water-supply fitting on each supply to each urinal.

2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.

3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.

4. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

D. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.

2. Install deep-pattern escutcheons if required to conceal protruding fittings.

3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Joint Sealing:

1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.

2. Match sealant color to urinal color.

3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

3.5 CLEANING AND PROTECTION

A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed urinals and fittings.

C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

3.6 Completion of Installation:

A. Cleaning and Flushing: Clean all equipment and materials thoroughly. Leave surface to be painted smooth and clean, ready for painting.

B. Flush each unit of water supply and distribution system thoroughly with clean water at the highest velocities attainable.

C. Clean all piping, valves, traps, water heaters, fixtures and other devices thoroughly and flush or blow out until free of scale, oil silt, sand, sediment, pipe dope and foreign matter of any kind.

3.7 PLUMBING FIXTURES

A. Accessible plumbing fixtures shall comply with all of the requirements of CBC Division 6.

B. Heights and location of all accessible fixtures shall be mounted according to CBC Sections 11B-602 through 11B-612.

C. Fixture controls shall comply with CBC Sections 11B-605.4 for urinals.

END OF SECTION 22 42 13 16

SECTION 22 42 16 13

COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Lavatories.

2. Faucets.

1.3 WORK INCLUDED

A. Furnish all labor, materials, services, testing, transportation and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:

1. C.C.R., Title 24, Part 5 (2022 CPC).

2. 2022 California Plumbing Code.

3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.

4. National Fire Protection Association.

5. California State Division of Industrial Safety.

6. County Health Department.

7. Any other legally constituted body-having jurisdiction thereof.

8. Plumbing fixtures and accessories provided in a toilet room or bathing room required to comply with CBC Section 11B-213.2 shall comply with CBC Section 11B-213.3.

9. Access plumbing fixtures shall comply with all of the requirements of CBC Division 6.

10. Heights and location of all fixtures shall be mounted according to CBC Sections 11B-602 through 11B-612.

11. Accessible fixture controls shall comply with CBC Sections 11B-611.3 for lavatories and sinks.

12. Accessible lavatories and sinks shall be mounted with the front of the higher of the rim or counter surface 34” maximum above the finish floor or ground. Depth of lavatories or sinks shall not interfere with knee an toe clearance provided in accordance with CBC 11B-306 when forward approach is required CBC Sections 11B-606.3 and 11B606.7.

13. Water supply and drain pipes under accessible lavatories and sinks shall be insulated or otherwise configured to protect against contact. There shall be no sharp or abrasive surfaces under accessible lavatories or sinks. CBC Section 11B-606.5.

B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.5 DRAWINGS

A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.

B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.

C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities,

the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.

D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.6 PERMITS, INSPECTIONS AND LICENSES

A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.7 EXAMINATION OF PREMISES

A. Before bidding on this work, Contractors shall make a careful examination of the premises and shall thoroughly familiarize themselves with the requirements of the contract. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and that he is familiar with and accepts all conditions of the site.

1.8 PROTECTION

A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.

B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.9 LOCATIONS

A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.

B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional

cuttings are found to be required, the cost of the same shall be charged to this Contractor.

C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.10 SUBMITTAL DATA

A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, six (6) copies of valid submittal data on all fixtures, material, equipment and devices. Each submitted item shall be indexed and referenced to these specifications and to identification numbers on fixtures and equipment schedules.

2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.

3. Submittals will be checked for general conformance with the design concept of the project but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.

4. To be valid, all submittals must:

a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.

b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.

c. Include all pertinent construction, installation, performance and technical data.

d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.

1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.

2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page and item numbers.

e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings, unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternate.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.

a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.

1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled “SPECIFIED ITEM, NOT SUBMITTED”. Product data sheets for the corresponding proposed substitution item shall be clearly labeled “PROPOSED SUBSTITUTION”.

b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.

2. It shall be the Contractor’s responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved and resubmittal will not be allowed.

3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.

4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for

review. Submittals which do not comply with the requirements of these specifications or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.

5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.

6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.11 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1.12 UNINSPECTED WORK

A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.

B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.13 RECORD DRAWINGS (Also see General Conditions)

A. Contractor shall provide and keep up-to-date a complete "as-built" record set of blueline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducibles shall be delivered to the Architect.

1.14 GUARANTEES

A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.

B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.

C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory: Vitreous china, wall mounted, with back.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. American Standard America.

b. Kohler Co.

2. Fixture:

a. Standard: ASME A112.19.2/CSA B45.1.

b. Type: For wall hanging.

c. Faucet-Hole Location: Top.

d. Color: White.

e. Mounting Material: Chair carrier.

3. Support: ASME A112.6.1M, Type II, concealed-arm lavatory carrier.

a.

2.2 SOLID-BRASS, MANUALLY OPERATED FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.

B. Lavatory Faucets: Manual-type, single-control mixing, commercial, solid-brass valve.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Chicago Faucets.

2. Standard: ASME A112.18.1/CSA B125.1.

3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.

4. Body Material: Commercial, solid brass.

5. Finish: Polished chrome plate.

6. Mounting Type: Deck, exposed.

2.3 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Chicago

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Chicago

E. Operation: Loose key.

F. Risers:

1. NPS 3/8.

2. Chrome-plated, rigid-copper-pipe and brass straight or offset tailpieces riser.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Locations and Accessibility: Install equipment for ease of maintenance and repair. If changes in the indicated locations or arrangements are made by the Contractor, they shall be made without additional charges.

B. Openings: Furnish information to the other trades on size and location of openings which are required in walls, slabs, roof, for piping and equipment at the proper times.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Closing-In of Uninspected Work: Do not allow or cause any of the work to be covered up or enclosed until it has been inspected, tested, and approved by the Architect. Any work enclosed or covered prior to such inspection and test shall be uncovered and, after it has been inspected, tested, and approved, make all repairs with such materials as may be necessary to restore all work, including that of other trades, to its original and proper condition.

3.2 INSTALLATION

A. Install lavatories level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

G. Point of use mixing valve in cabinet to be recessed in wall, under lavatory.

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

3.6 PLUMBING FIXTURES

A. Accessible plumbing fixtures shall comply with all of the requirements of CBC Division 6.

B. Heights and location of all accessible fixtures shall be mounted according to CBC Sections 11B-602 through 11B-612.

C. Fixture controls shall comply with CBC Sections 11B-606.4 for lavatories and sinks.

D. Accessible sinks shall be 6-1/2” deep maximum. Sinks shall be mounted with front of the higher of the rim and counter surface 34” maximum above the finish floor or ground.

E. Water supply and drain pipes under lavatories and sinks shall be insulated or otherwise configured to protect against contact. There shall be no sharp or abrasive surfaces under lavatories and sinks. CBC Section 11B-606.

END OF SECTION 22 42 16 13

SECTION 22 47 16

ELECTRIC WATER COOLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes electric water coolers and related components.

1.3 WORK INCLUDED

A. Furnish all labor, materials, services, testing, transportation and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:

1. C.C.R., Title 24, Part 5 (2022 CPC).

2. 2022 California Plumbing Code.

3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.

4. National Fire Protection Association.

5. California State Division of Industrial Safety.

6. County Health Department.

7. Any other legally constituted body-having jurisdiction thereof.

8. Access plumbing fixtures shall comply with all of the requirements of CBC Division 6.

9. Heights and location of all fixtures shall be mounted according to CBC Sections 11B-602 through 11B-612.

10. Accessible fixture controls shall comply with CBC Sections 11B-602.3 for drinking fountains.

11. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.5 DRAWINGS

A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.

B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.

C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.

D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.6 PERMITS, INSPECTIONS AND LICENSES

A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.7 EXAMINATION OF PREMISES

A. Before bidding on this work, Contractors shall make a careful examination of the premises and shall thoroughly familiarize themselves with the requirements of the contract. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and that he is familiar with and accepts all conditions of the site.

1.8 PROTECTION

A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.

B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.9 LOCATIONS

A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.

B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.

C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.10 SUBMITTAL DATA

A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, six (6) copies of valid submittal data on all fixtures, material, equipment and devices.

Each submitted item shall be indexed and referenced to these specifications and to identification numbers on fixtures and equipment schedules.

2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.

3. Submittals will be checked for general conformance with the design concept of the project but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.

4. To be valid, all submittals must:

    a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.

    b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.

    c. Include all pertinent construction, installation, performance and technical data.

    d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.

        1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.

        2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page and item numbers.

    e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings, unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternate.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.

    a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.

        1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled “SPECIFIED ITEM, NOT SUBMITTED”. Product data sheets for the corresponding proposed substitution item shall be clearly labeled “PROPOSED SUBSTITUTION”.

    b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.

2. It shall be the Contractor’s responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved and resubmittal will not be allowed.

3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.

4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.

5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.

6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.11 UNINSPECTED WORK

A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.

B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.1 CLOSEOUT SUBMITTALS

A. Maintenance Data: For drinking fountains to include in maintenance manuals.

1.2 RECORD DRAWINGS (Also see General Conditions)

A. Contractor shall provide and keep up-to-date a complete "as-built" record set of blueline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducibles shall be delivered to the Architect.

1.3 GUARANTEES

A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.

B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.

C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 ELECTRIC WATER COOLERS

A. Electric Water Coolers: Stainless steel, wall mounted.

1. Stainless-Steel Electric Water Coolertains:

a. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1) Elkay Manufacturing Co.

2) Haws Corporation.

2. Standards:

a. Comply with NSF 61.

b. Comply with UL 1951.

c. Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.

3. Type Receptor: On horizontal support.

4. Back Panel: Stainless-steel wall plate behind electric water cooler.

5. Bubblers: Two, with adjustable stream regulator, located on deck.

6. Control: Push button.

7. Drain: Grid type with NPS 1-1/4 tailpiece.

8. Supply: NPS 3/8 with shutoff valve.

9. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 chrome-plated brass P-trap and waste.

10. Support: ASME A112.6.1M, Type III lavatory carrier.

11. Capacities and Characteristics:

12. Cooled Water: 8 gph.

13. Ambient-Air Temperature: 90 deg F.

14. Inlet-Water Temperature: 80 deg F.

15. Cooled-Water Temperature: 50 deg F.

16. Electrical Characteristics:

17. Motor Horsepower: 1/5.

18. Volts: 115-V ac.

19. Phase: Single.

20. Hertz: 60.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.

B. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."

D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Install ball, gate, or globe shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

3.5 CLEANING

A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

3.6 PLUMBING FIXTURES

A. Accessible plumbing fixtures shall comply with all of the requirements of CBC Division 6.

B. Heights and location of all accessible fixtures shall be mounted according to CBC Sections 11B-602 through 11B-612.

C. Fixture controls shall comply with CBC Sections 11B-601.3 for drinking fountains.

D. Accessible sinks shall be 6-1/2” deep maximum. Sinks shall be mounted with front of the higher of the rim and counter surface 34” maximum above the finish floor or ground.

E. Water supply and drain pipes under lavatories and sinks shall be insulated or otherwise configured to protect against contact. There shall be no sharp or abrasive surfaces under lavatories and sinks. CBC Section 11B-606.

END OF SECTION 22 47 16

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Mechanical sleeve seals.
3. Sleeves.
4. Escutcheons.
5. Grout.
6. Equipment installation requirements common to equipment sections.
7. Painting and finishing.
8. Concrete bases.
9. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Mechanical sleeve seals.
2. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Metraflex Co.
    d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Plastic. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.

C. One-Piece, Floor-Plate Type: Cast-iron floor plate.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:

1. New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type with spring clips.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast-brass type with polished chrome-plated finish.
g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Steel Pipe Sleeves: For pipes smaller than NPS 6.

b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.9 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 230500

SECTION 23 05 16

EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Expansion-compensator packless expansion joints.
2. Flexible-hose packless expansion joints.
3. Grooved-joint expansion joints.
4. Pipe loops and swing connections.
5. Alignment guides and anchors.

1.3 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.

4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of expansion joint, from manufacturer.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 PACKLESS EXPANSION JOINTS

A. Rubber, Expansion-Compensator Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, :provide products by one of the following:

a. Mason Industries, Inc.
b. Metraflex Company (The).
c. Flex-Hose Co., Inc.

2. Material: Twin reinforced-rubber spheres with external restraining cables.
3. Minimum Pressure Rating: 225 psig at 170 deg F unless otherwise indicated.
4. End Connections for NPS 2 and Smaller: Threaded.

B. Flexible-Hose Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Flex-Hose Co., Inc.
b. Mason Industries, Inc.
c. Metraflex Company (The).
d. Unisource Manufacturing, Inc.

2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.

    a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.

5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with solder-joint end connections.

    a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.

2.2 GROOVED-JOINT EXPANSION JOINTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Anvil International, Inc.
2. Shurjoint Piping Products.
3. Victaulic Company.

B. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.

C. Standard: AWWA C606, for grooved joints.

D. Nipples: Galvanized, ASTM A 53/A 53M, Schedule 40, Type E or S, steel pipe with grooved ends.

E. Couplings: Seven, flexible type for steel-pipe dimensions. Include ferrous housing sections, EPDM gasket suitable for cold and hot water, and bolts and nuts.

2.3 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Flex-Hose Co., Inc.
    b. Mason Industries, Inc.
    c. Metraflex Company (The).

2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.

    a. Stud: Threaded, zinc-coated carbon steel.
    b. Expansion Plug: Zinc-coated steel.
    c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

B. Install rubber packless expansion joints according to FSA-NMEJ-702.

C. Install grooved-joint expansion joints to grooved-end steel piping

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.

C. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.

D. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one guide on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 230516

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

B. Related Sections:

1. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
2. Section 230548 "Vibration and Seismic Controls for HVAC for vibration isolation devices.
3. Section 233113 "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.
5. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Allied Tube & Conduit.
    b. Cooper B-Line, Inc.
    c. Flex-Strut Inc.
    d. GS Metals Corp.
    e. Thomas & Betts Corporation.
    f. Unistrut Corporation; Tyco International, Ltd.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Electroplated zinc.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Allied Tube & Conduit.
    b. Cooper B-Line, Inc.
    c. Flex-Strut Inc.

d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut Corporation; Tyco International, Ltd.

2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Coating: Zinc.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, **zinc-coated** steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Plastic.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.

E. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

F. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

G. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, **NPS 2-1/2** and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

O. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
b. NPS 4: 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.

5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Restrained-spring isolators.
2. Spring hangers.
3. Snubbers.
4. Restraint channel bracings.
5. Restraint cables.
6. Seismic-restraint accessories.
7. Mechanical anchor bolts.
8. Adhesive anchor bolts.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an

evaluation service member of ICC-ES, OSHPD, or an agency acceptable to authorities having jurisdiction.

b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer and testing agency.

C. Welding certificates.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:

1. Manufacturers: Subject to compliance with requirements, products by one of the following:

    a. Ace Mountings Co., Inc.
    b. California Dynamics Corporation.
    c. Isolation Technology, Inc.
    d. Kinetics Noise Control, Inc.
    e. Mason Industries, Inc.
    f. Vibration Eliminator Co., Inc.
    g. Vibration Isolation.
    h. Vibration Mountings & Controls, Inc.

2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.

    a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    b. Top plate with threaded mounting holes.
    c. Internal leveling bolt that acts as blocking during installation.

3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.2 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Ace Mountings Co., Inc.
    b. California Dynamics Corporation.
    c. Kinetics Noise Control, Inc.
    d. Mason Industries, Inc.
    e. Vibration Eliminator Co., Inc.
    f. Vibration Isolation.

g. Vibration Mountings & Controls, Inc.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.3 SNUBBERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Kinetics Noise Control, Inc.
2. Mason Industries, Inc.
3. Vibration Mountings & Controls, Inc.

B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.

2.4 RESTRAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hilti, Inc.
3. Mason Industries, Inc.
4. Unistrut.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.5 RESTRAINT CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Kinetics Noise Control, Inc.
2. Loos & Co., Inc.
3. Vibration Mountings & Controls, Inc.

B. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.6 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:

1. Cooper B-Line, Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.
4. TOLCO.

B. Hanger-Rod Stiffener: Reinforcing steel angle clamped to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.7 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hilti, Inc.
3. Kinetics Noise Control, Inc.
4. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic- and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES, OSHPD, or an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

D. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.

2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES, OSHPD, or an agency acceptable to authorities having jurisdiction that provides required submittals for component.

E. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

F. Install cables so they do not bend across edges of adjacent equipment or building structure.

G. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES, OSHPD, or an agency acceptable to authorities having jurisdiction that provides required submittals for component.

H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

I. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

J. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

K. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 232113 "Hydronic Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. Test and adjust restrained-air-spring isolator controls and safeties.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION 230548

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Valve numbering scheme.

D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's unique equipment number.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, manufacturer, model number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.3 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

D. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

E. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

F. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in other sections.

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.

2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:

1. Refrigerant Piping:

a. Background Color: Orange.
b. Letter Color: Black.

3.4 DUCT LABEL INSTALLATION

A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

C. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Constant-volume air systems.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. TAB: Testing, adjusting, and balancing.

C. TAB Specialist: An entity engaged to perform TAB Work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. Certified TAB reports.

E. Sample report forms.

F. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC as a TAB technician.

B. TAB Conference: Meet with Owner on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Coordination and cooperation of trades and subcontractors.
d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard TAB contractor's forms approved by Architect.

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

G. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 233113 "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine operating safety interlocks and controls on HVAC equipment.

K. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Automatic temperature-control systems are operational.
3. Equipment and duct access doors are securely closed.
4. Balance, smoke, and fire dampers are open.
5. Isolating and balancing valves are open and control valves are operational.
6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, and SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation" and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

    a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    b. Measure static pressure directly at the fan outlet or through the flexible connection.

c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

   a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

   a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

3.7 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

3.8 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.

8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.

i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
j. Number, make, and size of belts.
k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Preheat-coil static-pressure differential in inches wg.
g. Cooling-coil static-pressure differential in inches wg.
h. Heating-coil static-pressure differential in inches wg.
i. Outdoor airflow in cfm.
j. Return airflow in cfm.
k. Outdoor-air damper position.
l. Return-air damper position.
m. Vortex damper position.

F. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.

e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

G. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated air flow rate in cfm.
h. Indicated velocity in fpm.
i. Actual air flow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

H. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.9 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:

a. Measure airflow of at least 10 percent of air outlets.

b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
c. Verify that balancing devices are marked with final balance position.
d. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Owner.
3. Owner shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.10 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following HVAC piping systems:

1. Condensate drain piping, indoors and outdoors.
2. Refrigerant suction and hot-gas piping, indoors and outdoors.

B. Related Sections:

1. Section 230713 "Duct Insulation."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Aeroflex USA, Inc.; Aerocel.
    b. Armacell LLC; AP Armaflex.
    c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Ramco Insulation, Inc.; Super-Stik.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Aeroflex USA, Inc.; Aeroseal.
    b. Armacell LLC; Armaflex 520 Adhesive.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
    d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    b. Eagle Bridges - Marathon Industries; 225.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    b. Eagle Bridges - Marathon Industries; 225.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
    d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
b. Eagle Bridges - Marathon Industries; 550.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
d. Mon-Eco Industries, Inc.; 55-50.
e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
c. Vimasco Corporation; 713 and 714.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Color: White.

2.6 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b. Eagle Bridges - Marathon Industries; 405.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
d. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile

Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
   b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
   c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

   a. Factory cut and rolled to size.
   b. Finish and thickness are indicated in field-applied jacket schedules.
   c. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
   d. Factory-Fabricated Fitting Covers:

      1) Same material, finish, and thickness as jacket.
      2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      3) Tee covers.
      4) Flange and union covers.
      5) End caps.
      6) Beveled collars.
      7) Valve covers.
      8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 491 AWF FSK.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.10 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C & F Wire.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [2 inches] [4 inches] o.c.

a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket

flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.9 FINISHES

A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

    a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water:

1. All Pipe Sizes: Insulation shall be the following:

    a. Flexible Elastomeric: 1 inch thick.

B. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:

    a. Flexible Elastomeric: 1 inch thick.

3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:

    a. Flexible Elastomeric: 2 inches thick.

3.14 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

A. Loose-fill insulation, for belowground piping, is specified in Section 232113.13 "Underground Hydronic Piping".

3.15 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:

1. None.

3.16 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:

1. Painted Aluminum, Corrugated: 0.024 inch thick.

3.17 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 230719

SECTION 23 23 00

REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-454B:

1. Suction Lines for Air-Conditioning Applications: 300 psig.
2. Hot-Gas and Liquid Lines: 535 psig.

1.4 ACTION SUBMITTALS

A. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.7 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type L.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Brazing Filler Metals: AWS A5.8.

2.2 REFRIGERANTS

A. ASHRAE 34, R-454B

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-454B

A. Suction Lines for Conventional Air-Conditioning Applications: Copper, Type L, drawn-temper tubing and wrought-copper fittings with brazed joints.

B. Hot-Gas and Liquid Lines: Copper, Type L, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and

calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

J. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

K. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

L. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Liquid lines may be installed level.

M. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

N. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

O. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."

P. Install sleeves for piping penetrations of walls, ceilings, and floors.

Q. Install sleeve seals for piping penetrations of concrete walls and slabs.

R. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.

D. Support multifloor vertical runs at least at each floor.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.

    a. Fill system with nitrogen to the required test pressure.
    b. System shall maintain test pressure at the manifold gage throughout duration of test.
    c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.6 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.7 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Verify that compressor oil level is correct.
2. Open compressor suction and discharge valves.
3. Open refrigerant valves except bypass valves that are used for other purposes.
4. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.

2. Sealants and gaskets.
3. Seismic-restraint devices.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Lindab Inc.
    b. McGill AirFlow LLC.
    c. SEMCO Incorporated.
    d. Sheet Metal Connectors, Inc.
    e. Spiral Manufacturing Co., Inc.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. CertainTeed Corporation; Insulation Group.
   b. Johns Manville.
   c. Knauf Insulation.
   d. Owens Corning.

2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

   a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

    a. Fan discharges.
    b. Intervals of lined duct preceding unlined duct.
    c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

    a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.

7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2.7 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Ductmate Industries, Inc.
3. Hilti Corp.
4. Mason Industries.
5. TOLCO; a brand of NIBCO INC.
6. Unistrut Corporation; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by the Office of Statewide Health Planning and Development for the State of California.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for

restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems" and ASCE/SEI 7.

1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
2. Brace a change of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by the Office of Statewide Health Planning and Development for the State of California.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
b. Supply, Return, Outdoor Air, Exhaust Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 DUCT CLEANING

A. Clean new and existing duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.

2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated.

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units

   a. Pressure Class: Positive 2-inch wg.
   b. Minimum SMACNA Seal Class: C.
   c. SMACNA Leakage Class for Rectangular: 24.
   d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Air-Handling Units:

   a. Pressure Class: Positive 2-inch wg.
   b. Minimum SMACNA Seal Class: C.
   c. SMACNA Leakage Class for Rectangular: 24.
   d. SMACNA Leakage Class for Round and Flat Oval: 12.

3. Ducts Connected to Equipment Not Listed Above:

   a. Pressure Class: Positive 2-inch wg.
   b. Minimum SMACNA Seal Class: C.
   c. SMACNA Leakage Class for Rectangular: 24.
   d. SMACNA Leakage Class for Round and Flat Oval: 12.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

   a. Pressure Class: Positive or negative 2-inch wg.
   b. Minimum SMACNA Seal Class: C.
   c. SMACNA Leakage Class for Rectangular: 24.
   d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Air-Handling Units:

   a. Pressure Class: Positive or negative 2-inch wg.
   b. Minimum SMACNA Seal Class: C.
   c. SMACNA Leakage Class for Rectangular: 24.
   d. SMACNA Leakage Class for Round and Flat Oval: 12

3. Ducts Connected to Equipment Not Listed Above:

   a. Pressure Class: Positive or negative 2-inch wg.
   b. Minimum SMACNA Seal Class: C.
   c. SMACNA Leakage Class for Rectangular: 24.
   d. SMACNA Leakage Class for Round and Flat Oval: 12

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

   a. Pressure Class: Negative 2-inch wg.
   b. Minimum SMACNA Seal Class: C.

c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: C.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: C.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: C.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: C.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg.
b. Minimum SMACNA Seal Class: C.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 12

F. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

G. Liner:

1. Supply and Return Air Ducts and Plenums: Fibrous glass, Type I, 1-1/2 inches thick.
2. Transfer Ducts: Fibrous glass, Type I, 2 inches thick.

H. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

    a. Velocity 1000 fpm or Lower:

        1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
        2) Mitered Type RE 4 without vanes.

    b. Velocity 1000 to 1500 fpm:

        1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
        2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
        3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

    c. Velocity 1500 fpm or Higher:

        1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
        2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
        3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

    a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

    a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

        1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
        2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.

3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

I. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Flange connectors.
5. Turning vanes.
6. Duct-mounted access doors.
7. Flexible connectors.
8. Flexible ducts.
9. Duct accessory hardware.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control-damper installations.
d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.

e. Duct security bars.
f. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Pottorff.
3. Ruskin Company.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2500 fpm.

D. Maximum System Pressure: 2-inch wg.

E. Frame: Hat-shaped, 18-gage galvanized sheet steel, with welded corners or mechanically attached and mounting flange.

F. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Extruded vinyl, mechanically locked.

I. Blade Axles:

1. Material: Plated steel.
2. Diameter: 0.20 inch.

J. Tie Bars and Brackets: Galvanized steel.

K. Return Spring: Adjustable tension.

L. Bearings: Synthetic pivot bushings.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Chain pulls.
4. Screen Mounting: Front mounted in sleeve.
    a. Sleeve Thickness: 20 gage minimum.
    b. Sleeve Length: 6 inches minimum.
5. Screen Mounting: Rear mounted.
6. Screen Material: Galvanized steel.
7. Screen Type: Bird.
8. 90-degree stops.

2.4 BAROMETRIC RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Pottorff.
3. Ruskin Company.

B. Suitable for horizontal or vertical mounting.

C. Maximum Air Velocity: 2000 fpm.

D. Maximum System Pressure: 2-inch wg.

E. Frame: Hat-shaped, 16-gage, galvanized sheet steel with welded corners or mechanically attached and mounting flange.

F. Blades:

1. Multiple, 0.025-inch- thick, roll-formed alumrinum.
2. Maximum Width: 6 inches.
3. Action: Parallel.
4. Balance: Gravity.
5. Eccentrically pivoted.

G. Blade Seals: Vinyl.

H. Blade Axles: Plated steel.

I. Tie Bars and Brackets:

1. Material: Galvanized steel.
2. Rattle free with 90-degree stop.

J. Return Spring: Adjustable tension.

K. Bearings: Ball.

L. Accessories:

1. Flange on intake.
2. Adjustment device to permit setting for varying differential static pressures.

2.5 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Nailor Industries Inc.
b. Pottorff.
c. Ruskin Company.
d. Trox USA Inc.

2. Standard leakage rating.
3. Suitable for horizontal or vertical applications.
4. Frames:

a. Frame: Hat-shaped, 20-gage, galvanized sheet steel.
b. Mitered and welded corners.
c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Stiffen damper blades for stability.
d. Galvanized-steel, 0.064 inch thick.

6. Blade Axles: Plated steel.
7. Bearings:

a. Molded synthetic.
b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

2.6 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.7 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.
4. SEMCO Incorporated.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

E. Vane Construction: Double wall.

2.8 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Greenheck Fan Corporation.
3. Pottorff.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Vision panel.
d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
b. Access Doors up to 18 Inches Square: Continuous and two sash locks.

c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.
d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Single wall or double wall with insulation fill with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set.
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.9 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. 3M.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 11-gage carbon steel.

D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.10 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd..
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.

1. Minimum Weight: 16 oz./sq. yd..
2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

H. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.

1. Minimum Weight: 14 oz./sq. yd..
2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

I. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.11 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, polyethylene film supported by helically wound, galvanized-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 5500 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

C. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

2. Non-Clamp Connectors: Adhesive plus sheet metal screws.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Connect ducts to duct silencers rigidly.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot spacing.
8. Upstream from turning vanes.
9. Upstream or downstream from duct silencers.
10. Control devices requiring inspection.
11. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

O. Connect flexible ducts to metal ducts with draw bands.

P. Install duct test holes where required for testing and balancing purposes.

Q. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 23 34 23

HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. In-line centrifugal fans.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual project site elevations.

B. Operating Limits: Classify according to AMCA 99.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set for each belt-driven unit.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.9 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 IN-LINE CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Loren Cook Company.
3. Aerovent; a division of Twin City Fan Companies, Ltd.

B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.

D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

F. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
3. Companion Flanges: For inlet and outlet duct connections.
4. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
5. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
6. Vibration Isolators:

a. Type: Spring hangers.
b. Static Deflection: 1 inch.

2.2 MOTORS

A. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Enclosure Type: Totally enclosed, fan cooled.

2.3 SOURCE QUALITY CONTROL

A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Equipment Mounting:

1. Install power ventilators on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in other sections.
2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

C. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.

D. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

E. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Section 230548 "Vibration and Seismic Controls for HVAC."

F. Install units with clearances for service and maintenance.

G. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION 233423

SECTION 23 37 13

AIR DIFFUSERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Adjustable Bar Grille

B. Related Sections:

1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 REGISTERS AND GRILLES

A. Adjustable Bar Grille:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Price Industries.
   b. Titus.
   c. Anemostat Products; a Mestek company.

2. Material: Steel.
3. Finish: Baked enamel, color selected by Architect.
4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
5. Core Construction: Integral.
6. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in

lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 23 81 26

SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set for each air-handling unit.
2. Gaskets: One set for each access door.
3. Fan Belts: One set for each air-handling unit fan.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor: Five year(s) from date of Substantial Completion.
b. For Parts: One year from date of Substantial Completion.
c. For Labor: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Daikin.
2. LG
3. Carrier Corporation.
4. Mitsubishi Electric & Electronics USA, Inc.
5. Trane.

2.2 INDOOR UNITS (5 TONS OR LESS)

A. Wall-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Fan: Direct drive, centrifugal.
4. Fan Motors:

    a. Multitapped, multispeed with internal thermal protection and permanent lubrication.
    b. Enclosure Type: Totally enclosed, fan cooled.
    c. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
    d. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
    e. Mount unit-mounted disconnect switches on exterior of unit.

5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
6. Filters: Permanent, cleanable.
7. Condensate Drain Pans:

    a. Fabricated with **one** percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

        1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
        2) Depth: A minimum of 1 inch deep.

    b. Single-wall, galvanized-steel sheet.
    c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

1) Minimum Connection Size: NPS 1.

d. Pan-Top Surface Coating: Asphaltic waterproofing compound.

2.3 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

   a. Compressor Type: Scroll.
   b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
   c. Refrigerant Charge: R-410A.
   d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.

3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 45 deg F.
7. Mounting Base: Polyethylene.

2.4 ACCESSORIES

A. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
4. Fan-speed selection including auto setting.

B. Automatic-reset timer to prevent rapid cycling of compressor.

C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

D. Drain Hose: For condensate.

E. Additional Monitoring:

1. Monitor constant and variable motor loads.
2. Monitor variable-frequency-drive operation.
3. Monitor cooling load.
4. Monitor air distribution static pressure and ventilation air volumes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Equipment Mounting:

1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in other sections.
2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.

D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 26 05 00

ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation, and services necessary for and incidental to performing all operations in connection with furnishing, delivery, and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to, the following:

1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
2. Electrical General Provisions and Requirements for electrical work.
3. Division-1; General Requirements; General Conditions.

B. Organization of the Specifications into Divisions, Sections and Articles, and Arrangement of Drawings shall not control the Contractor in dividing the Contract Work among Subcontractors or in establishing the extent of work to be performed by any trade.

1.2 GENERAL SUMMARY OF ELECTRICAL WORK

A. The Specifications and Drawings are intended to cover a complete installation of systems. The omission of expressed reference to any item of labor or material for the proper execution of the work in accordance with present practice of the trade shall not relieve the Contractor from providing such additional labor and materials.

B. Refer to the Drawings and Shop Drawings of other trades for additional details, which affect the proper installation of this work. Diagrams and symbols showing electrical connections are diagrammatic only. Wiring diagrams do not necessarily show the exact physical arrangement of the equipment.

C. Before submitting a bid, the Contractor shall become familiar with all features of the Building Drawings and Site Drawings, which may affect the execution of the work. No extra payment will be allowed for failure to obtain this information.

D. If there are Omissions or Conflicts between the Drawings and Specifications, clarify these points with the Owner’s Representative before submitting bid and before commencing work.

E. Provide Work and Material in Conformance with the Manufacturer’s published recommendations for respective equipment and systems.

1.3 LOCATIONS OF EQUIPMENT

A. The Drawings indicate diagrammatically the desired locations or arrangements of conduit runs, outlets, equipment, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the work to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structure conditions encountered.

B. Where Outlets are placed on a Wall, locate symmetrically with respect to each other, furniture, cabinets, and other features or finishes on the wall.

C. In the event Changes in the indicated locations or arrangements are necessary, due to developed conditions in the building construction or rearrangement of furnishings or equipment, such changes shall be made without cost to the Contract, providing the change is ordered before the conduit runs, etc., and work directly connected to same is installed and no extra materials are required.

D. Lighting Fixtures in Mechanical Spaces are shown in their approximate location only. Do not install light outlets or fixtures until mechanical piping and ductwork is installed; then install lights in a location to provide best lighting.

E. Coordinate and cooperate in every way with other trades to avoid interference and ensure a satisfactory job.

F. The Location of the Existing Utilities, Building, Equipment and Conduit shown on the Drawings is approximate.

G. The Locations of Existing Underground Utilities, where shown on Drawings, are shown diagrammatically and have not been independently verified by the Owner, the Owner's Representative, the Architect/Engineer. The Owner, the Owner's Representative, and the Owner's Architect/Engineer are not responsible for the location of underground utilities or structures, whether or not shown or detailed and installed under this or any other Contracts. The Contractor shall identify each existing utility line prior to excavation and mark the locations on the ground of each existing utility line.

1.4 AIR CONDITIONING, HEATING, PLUMBING EQUIPMENT WIRING

Provide Electrical Work, Materials, and Control Components required for proper operation of the air conditioning, heating and plumbing systems as indicated on the Electrical, Mechanical, and Plumbing Contract Documents and specified herein.

1.5 POWER, TELEPHONE AND OTHER SIGNAL SERVICES

A. Southern California Edison Co. (SCE) electric service and metering facilities shall conform to the requirements of SCE. Contractor shall verify service locations and Requirements, and information relative to this project directly from SCE.

B. Location of transformer pad and or manholes and pull boxes and routing of service conduits indicated on the Drawings are approximate and shall be verified with the Edison Co. prior to installation. Installation of service shall not begin until approved Drawings have been received from the SCE.

C. Contact the local representative of the telephone company and coordinate the point of connection to the existing conduit stub out.

1.6 PERMITS

Arrange for and schedule all required inspections and examinations without additional cost to the Owner.

1.7 QUALITY ASSURANCE

A. All materials shall be manufactured in the United States unless the material is not manufactured in the United States.

B. Work and Materials shall be in full accordance with the latest Rules and Regulations. The publications shall be included in the Contract Documents Requirements. If a conflict occurs between the following publications and any other part of the Contract Documents, the Requirements describing the more restrictive provisions shall become the applicable Contract definition:

1. California Code of Regulations Title 24.
2. California Part 3 "California Electrical Code" CEC, Title 24 and Title 8 "Division of Industrial Safety".
3. California Building Code – CBC.
4. California Fire Code – CFC
5. The National Electrical Code – NEC/NFPA 70.
6. The Life Safety Code – NFPA 101.
7. The Uniform Building Code – UBC.
8. International Building Code – IBC.
9. National Fire Protection Agency – NFPA.
10. National Fire Alarm Code – NFAC/NFPA 72.
11. Underwriter's Laboratory – UL.
12. Other applicable State and Local Government Agencies Laws and Regulations.
13. Electrical Installation Standards National Electrical Contractors Association (NECA) and National Electrical Installation Standards (NEIS):

    a. NECA/NEIS-1: Standard of Practices for Good Workmanship in Electrical Contracting
    b. NECA/NEIS-101: Standard for Installing Steel Conduit (Rigid, IMC, etc.)
    c. NECA/NEIS-104: Recommended Practice for Installing Aluminum Building Wire and Cable
    d. NECA/NEIS-105: Recommended Practice Installing Metal Cable Trays
    e. NECA/NEIS-111: Recommended Practice Installing Nonmetallic Raceways
    f. NECA/NEIS-230: Recommended Practice for Installing Motors
    g. NECA/FOA-301: Standards for Installing and Testing Fiber Optic Cables
    h. NECA/NEIS-305: Standard for Fire Alarm System Job Practice
    i. NECA/NEIS–331: Standards for Installing Building and Service Entrance Grounding
    j. NECA/NEIS-400: Recommended Practice for Installing and Maintaining Switch-boards
    k. NECA/NEIS-402: Recommended Practice for Installing and Maintaining Motor Control Centers

l. NECA/NEIS-407: Recommended Practice for Installing Panel-boards
m. NECA/NEIS-408: Recommended Practices for Installing Busway
n. NECA/NEIS-409: Recommended Practice for Installing and Maintaining Dry-Type Transformers
o. NEIS/NECA and IESNA-500: Recommended Practice for installing Indoor Commercial Lighting Systems
p. NEIS/NECA and IESNA-501: Recommended Practice for installing Exterior Lighting Systems
q. NEIS and IESNA-502: Recommended Practice for Installing Industrial Lighting Systems
r. NECA/BICSI-568: Standards for Installing Commercial Building Telecommunications System

C. All Material and Equipment shall be new and shall be delivered to the site in unbroken packages. All material and equipment shall be listed and labeled by Underwriters Laboratories or other recognized Testing Laboratories, where such listings are available. Comply with all installation Requirements and restrictions pertaining to such listings.

D. Work and Material shown on the Drawings and in the Specifications are new and included in the Contract unless specifically indicated as existing or N.I.C. (not in Contract).

E. Keep a copy of all Applicable Codes and Standards available at the Job Site at all times for reference while performing work under this Contract. Nothing in Plans or Specifications shall be construed to permit work not conforming to the most stringent of Building Codes.

F. Where a Conflict or Variation occurs between applicable Codes, Standards and/or the Contract Documents, the provisions of the most restrictive provision shall become the Requirement of the Contract Documents.

1.8 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. General

1. Review of Contractor’s submittals is for General Conformance with the Design Concept of the Project and General Compliance with the information given in the Contract Documents. Any action shown is subject to the Requirements of the Plans and Specifications. Contractor is responsible for quantities; dimensions which shall be confirmed and correlated at the Job Site; fabrication processes and techniques of construction; coordination of work with that of all other trades and satisfactory performance of their work.
2. The Contractor shall review each submittal in detail for compliance with the Requirements of the Contract Documents prior to submittal. The Contractor shall "Ink Stamp" and sign each item of the submittal with a statement "CERTIFYING THE SUBMITTAL HAS BEEN REVIEWED BY THE CONTRACTOR AND COMPLIES WITH ALL THE REQUIREMENTS OF THE CONTRACT DOCUMENTS". The Contractor shall clearly and specifically identify each individual proposed substitution, substitution of equal or proposed deviation from

the Requirements of the Contract Documents with a statement "THIS ITEM IS A SUBSTITUTION".
The burden of research, preparation of calculations and the furnishing of adequate and complete Shop Drawings information to demonstrate the suitability of Contractor's proposed substitutions and suitability of proposed deviations from the Contract Documents is the responsibility of the Contractor.

3. The Contractor at no additional cost or delays to the Contract shall remove any work, material and correct any deficiencies resulting from deviations from the Requirements of the Contract Documents not approved in advance by the Owner prior to commencement of work.

B. Material Lists and Shop Drawings

1. Provide name of manufacturer, brand name, type and/or catalog number of each item. Listing more than one Manufacturer for any one item of equipment, or listing items "As Specified", without both make and model or type designation, is not acceptable. The right is reserved to require submission of samples of any material whether or not particularly mentioned herein.
2. Shop Drawings shall be submitted in completed groups of materials (i.e., all lighting fixtures or all switchgear, etc.). The Contractor shall verify dimensions of equipment and be satisfied as to fit and that they comply with all Code Requirements relating to clear working space about electrical equipment prior to submitting Shop Drawings for review. Submittals, which are intended to be reviewed as substitution or departure from the Contract Document s, must be specifically noted as such. The Requirements of the Contract Documents shall prevail regardless of the acceptance of the submittal.
3. Submittal Identification

    a. Each submittal shall be dated: with submittal transmission date; sequentially numbered and titled with submittal contents identification and applicable Specification/Drawing.
    b. Each resubmittal shall be dated: with original submittal date and resubmittal transmission dates; sequentially numbered with original submittal number and sequential resubmittal revision number and titled with submittal contents identification and applicable Specifications/Drawing references.
    c. Contractor shall provide a written response narrative with each resubmittal. Describe each response-action, resubmittal addition, change and deletion. Correspond each response to A/E specific review comment.

C. The Contractor shall be responsible for incidental, direct and indirect costs resulting from the Contractor's substitution of; or changes to; the specified Contract Materials and Work.

D. Maintenance and Operating Manuals

1. The Contractor shall furnish three bound hard copies plus a pdf copy of type-written Maintenance and Operating Manuals for all electrical equipment, fire alarm equipment, sound system equipment, etc., to the Owner.

2. Instruct Owner’s Personnel in correct operation of all equipment at completion of Project. Provide the quantity and duration of instruction class as specified; but in no case less than four 4-hour duration separate instruction classes for each individual equipment group furnished as part of the Contract. Instruction classes shall be presented by Manufacturer’s Authorized Field Service Engineer at the Project Site. Instruction class size shall be at the Owner’s discretion, not less than one or more than fifteen students shall attend each instruction session.
3. Maintenance and Operating Manuals shall be bound in three-ring, hard-cover, plastic binders with table of contents. Manuals shall be delivered to the Owner’s Representative, with an itemized receipt.

E. Portable or Detachable Parts: The Contractor shall retain in his possession and shall be responsible for all portable and detachable parts or portions of the installation such as fuses, keys, locks, adapters, locking clips, and inserts until final completion of Contract Work. These parts shall then be delivered to the Owner’s Representative with an itemized receipt.

F. Record Drawings (Additional Requirements)

1. Provide and maintain in good order a complete set of Electrical Contract "Record" prints. Changes to the Contract to be clearly recorded on this set of prints. At the end of the Project, transfer all changes to one set of transparencies to be delivered unfolded to the Owner’s Representative.
2. The actual location and elevation of all buried lines, boxes, monuments, vaults, stub-outs and other provisions for future connections shall be referenced to the building lines or other clearly established base lines and to approved benchmarks. If any necessary dimensions are omitted from the Record Drawings, the Contractor shall, at the Contractor’s own expense, do all excavation required to expose the buried work and to establish the correct locations.
3. The Contractor shall keep the "Record" Prints up to date and current with all work performed.
4. Refer to Division-1 for Additional Requirements.

1.9 CLEANING EQUIPMENT, MATERIALS, PREMISES

All parts of the equipment shall be thoroughly cleaned of dirt, rust, cement, plaster, etc., and all cracks and corners scraped out clean. Surfaces to be painted shall be carefully cleaned of grease and oil spots and left smooth, clean and in proper condition to receive paint finish.

1.10 JOB CONDITIONS - PROTECTION

Protect all Work, Materials and Equipment from damage from any cause whatever and provide adequate and proper storage facilities during the progress of the work. Provide for the safety and good condition of all the work until final acceptance of the work by the Owner and replace all damaged or defective work, materials, and equipment before requesting final acceptance.

1.11 EXCAVATION, CUTTING, BACKFILL AND PATCHING ADDITIONAL REQUIREMENTS

A. General

1. Perform excavation, cutting, backfill, core drilling, directional boring, and patching of the construction work required for the proper installation of the electrical work.
2. Patching shall be of the same material, thickness, workmanship, and finish as existing and accurately match-surrounding work to the satisfaction of the Owner's Representative.

1.12 IDENTIFICATION

A. Equipment Nameplates

1. Panelboards, terminal cabinets, circuit breakers, disconnect switches, starters, relays, time switches, contactors, push-button control stations, and other apparatus used for the operation or control of feeders, circuits, appliances, or equipment shall be properly identified by means of descriptive nameplates or tags permanently attached to the apparatus and wiring.
2. Electrical equipment including switchgear, switchboards, electric panels and control panels, motor starters, transformers, disconnects, etc., shall each be labeled by the Manufacturer with "Electric-Arc-Flash" warning signs. The signs shall explain a hazard to personnel may exist if the equipment is worked on while energized or operated by personnel while energized. The sign shall instruct Personnel to wear the correct Protective Equipment/clothing (PPE) when working "Live" or operating "Live" electrical equipment and circuits.
3. Nameplates shall be engraved laminated phenolic. Shop Drawings with dimensions and format shall be submitted before installation. Attachment to equipment shall be with escutcheon pins, rivets, self-tapping screws or machine screws. Self-adhering or adhesive backed nameplates shall not be used.
4. Provide black-on-white laminated plastic nameplates engraved in minimum ¼-inch high letters to correspond with the designations on the Drawings. Provide other or additional information on nameplates where indicated.

B. Plates: Cover and device plates shall be furnished with engraved or etched designations where indicated on the drawings (minimum character size not less than 0.188 inch. Engraving shall indicate circuits and equipment controlled or connected):

D. Wire and Cable Identification

1. Provide identification on individual wire and cable including signal systems, fire alarm, electrical power systems (each individual phase, neutral and ground), empty conduit pull ropes, and controls circuit.
2. Permanent identification shall be provided at each termination location, splice location, pullbox, junction box and equipment enclosure.

    a. Individual wire and cable larger than #6 AWG or 0.25-inch diameter, shall be provided with polypropylene identification tag holders, with yellow polypropylene tags interchangeable black alphanumeric characters, character height 0.25 inch. Attach identification tags with plastic "tie" wraps, minimum of two for each tag. As manufactured by Almetek Industries - "EZTAG" Series; or TECH Products - "EVERLAST" Series.

b. Individual wire and cable #6 AWG and smaller or smaller than 0.25-inch diameter, shall be provided with water and oil resistant, flexible, self-laminating pressure sensitive machine embossed plastic tags that wrap a minimum of 360 degrees around the wire/cable diameter. The entire tag shall then be covered with a clear flexible waterproof plastic cover wrapped a minimum of 540 degrees around the wire/cable diameter and completely covering the identification. As manufactured by: Brady Identification; or 3M; or Panduit.
c. Each identification tag location shall indicate the following information: circuit number, circuit phase, source termination and destination termination equipment name (or outlet number as applicable).

3. Install permanent identification after installation/pulling of wire/cable is complete, to prevent loss or damage to the identification.

E. Cardholders and Cards shall be provided for circuit identification in panelboards. Cardholders shall consist of a metal frame retaining a clear plastic cover permanently attached to the inside of panel door. List of circuits shall be typewritten on card. Circuit description shall include name or number of circuits, area, and connected load.

1.13 TESTING AND ENERGIZATION

A. The Contractor shall obtain an independent Testing Laboratory to provide all instrumentation and personnel required to perform ground resistance tests on the electrical system and equipment as hereinafter described. All Tests shall be recorded and documented and submitted to the Owner’s Representative for review.

B. The Testing Laboratory shall meet Federal OSHA Criteria for accreditation of Nationally Recognized Testing Laboratories (NRTL) Title 29 Part 1907 and 29 CFR-1910. Membership in the National Electrical Testing Association (NETA) shall also constitute acceptance of meeting said criteria, for Testing of electrical systems.

C. Method of Obtaining Ground Resistance shall be in accordance with the 2006 IEEE Power and Energy Society recommendations:

1. Measure and record resistance to ground of the building UFER ground bus.
2. Measure and record the resistance to ground of the neutral buses in Panel P1.
3. Measure and record the resistance to ground of the neutral at the main switchboard after all ground connections are made and the neutral-ground link installed.

D. The Contractor shall complete the following work before any electrical equipment is energized.

1. All equipment shall be permanently anchored.
2. All bus connections and conductor/wire connections shall be tightened per Manufacturer's instructions and witnessed by the project Inspector.
3. All ground connections shall be completed and identified.
4. Feeders shall be connected and identified.
5. The interiors of all electrical enclosures including busbars and wiring terminals shall be cleaned of all loose material and debris, paint, plaster, cleaners or other

abrasives over spray removed and equipment vacuumed clean. The Owner's Representative shall observe all interiors before covers are installed.

6. All wall, ceiling, and floor work and painting shall be completed within areas containing electrical equipment prior to installation of equipment. The equipment indoor rooms and spaces shall be weathertight, and weather protected from environmental incursions.
7. All doors to electrical equipment rooms shall be provided with locks to restrict access to energized equipment.
8. Electrical spaces and rooms shall not be used as construction storage rooms after power is energized.

1.14 ELECTRICAL WORK CLOSEOUT

A. Prepare the following items and submit to the Owner’s Representative before final acceptance.

1. Two copies of all Test results as required under this Section.
2. Two copies of Local and/or State Code Enforcing Authority’s final inspection certificates.
3. Copies of Record Drawings as required under the General Conditions, pertinent Division One Sections and Electrical General Provisions.
4. Two copies of all receipts transferring portable or detachable parts to the Owner’s Representative when requested.
5. Notify the Owner’s Representative in writing when installation is complete and that a final inspection of this work can be performed. In the event any defect or deficiencies are found during this final inspection they shall be corrected to the satisfaction of the Owner’s Representative before final acceptance can be issued.

END OF SECTION 260500

SECTION 260501

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation, and services necessary for and incidental to performing all operations in connection with furnishing, delivery, and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:

1. Examine all other Sections for work related to those other Sections and required to be included as work under Division 26.
2. General Provisions and Requirements for electrical work.

1.2 SUBMITTALS (ADDITIONAL REQUIREMENTS)

Submit Product Data Sheets for all outlet boxes, floor boxes, wiring devices, device plates, relays, contactors, safety switches and fuses.

PART 2 - PRODUCTS

2.1 OUTLET AND JUNCTION BOXES

A. General:

1. Flush or concealed outlet boxes and junction boxes.

a. Non-masonry and/or non-concrete locations provide pressed steel boxes. Steel thickness not less than 0.062-inch, hot-dip galvanized. Knockout (KO) type with conduit entrances and quantities size to match conduits shown connecting to respective junction box and outlet box.
b. UL-514 listed and labeled.
c. Minimum required box depth is exclusive of extension-ring depth.
d. Provide all boxes with matching cover plates. Cover plates shall be gasketed water-tight in wet and outdoor locations.
e. Boxes installed in masonry or concrete shall be UL "Concrete-Tight" approved for installation in concrete and shall allow the placing of conduit without displacing reinforcing bars.

2. Provide boxes of proper Code size for the number of wires or conduits passing through or terminating therein. In no case shall box be less than 4.0-inches square by 2.125-inches deep, unless specified elsewhere or noted otherwise on the Drawings. 2.5-inches minimum depth for box width exceeding 2-gang.
3. Increase the minimum outlet box size to 4.69-inches square by not less than 2.125-inches deep, where one or more of the following conditions occurs:

a. More than two conduits connect to the outlet box.
b. Circuit or Conduit “Homerun” connects to outlet box.

4. Signal, Communication and Low Voltage:

   a. Computer outlets: 4.69-inches square by 2.125-inches deep minimum with 1-gang extension ring on flush boxes.

5. Junction boxes shall be sized to comply with the following:

   a. Code Requirements size based on the conduit quantities, conduit sizes and wire-fill connected to the junction box.
   b. Junction box minimum size shall not be less than 4.69-inches by 4.69-inches by 2.5-inches deep, but not less than size indicated on the Drawings or required by Code.

6. Provide extension rings on flush outlets to finish face of extension ring flush with finished building surfaces. Extension ring shall match outlet box construction and contain "Attachment Mounting-Tabs" for wiring devices. Extension rings shall be "Screw-Attached" to respective outlet box and maintain "Ground" bonding continuity.
7. Outlet boxes installed in outdoor locations shall be UL rated for wet locations. Outdoor flush floor box shall be as detailed on plans. Die-cast aluminum or cast aluminum water-tight electrical outlet boxes with threaded hubs may be provided at the marquee sign.
8. Provide fixture-supporting devices in outlet boxes for surface mounted fixtures as required.

2.2 SHEET METAL PULLBOXES

A. Sizes as indicated on the Drawings and in no case of less size or material thickness than required by the Governing Code and AHJ.

B. UL listed and labeled for electrical circuits.

C. General purpose sheet steel pull boxes: Install only in dry protected locations with removable screw covers. Manufacturer's standard rust proofing and baked enamel finishes.

D. Weatherproof sheet steel pull boxes: Fabricate of Code gauge steel. All surfaces interior and exterior hot-dip galvanized steel. Gasketed weather-tight cover of same material. Manufacturer's standard baked exterior enamel finish.

2.3 CONCRETE PULL BOXES

A. General

1. Each Concrete Precast Section shall be identified by having the Manufacturer's name and address, along with respective Section weight cast into an interior face or permanently attached thereto. As manufactured by Jensen Precast Products; or Old Castle Precast; or equal.

2. The precast steel reinforced concrete structure walls, floor and roof shall safely sustain the loads and pressure resulting from vertical and lateral earth loading and vehicular loading. Based on the following criteria:

    a. Minimum earth density shall be 120-pounds Per Square Foot (PSF).
    b. Minimum equivalent fluid pressure for lateral pressure due to earth shall be 85-pounds Per Square Foot (PSF) undrained earth conditions; minimum safety factor for buoyancy shall be 1.25.
    c. Vehicular load rating shall be H-20 in compliance with latest AASHO Specifications.
    d. Design shall be based on maximum depth of fill over the structure as indicated on the Drawings, but not less than 36-inches.
    e. Design and details shall comply with minimum ACI 318-14 Code Requirement. Minimum concrete 28-day cure strength shall be 3000-psi.

3. Precast structure shall be designed to withstand forces due to additional inward load of 4,000 pounds (working load) with safety factor of two acting perpendicular to the surface at any pulling iron.
4. Structures shall be single piece or horizontal multi-section construction as required for field installation conditions. Multi-sections shall interlock with "Tongue and groove" joint mating surfaces to ensure a rigid assembly.
5. Seals and waterproof

    a. All structure precast joints shall be sealed with preformed cold field applied plastic joint sealing compound. Joint sealing compound shall not leak, sag, or flow at the joints with 10psi water pressure applied for 24 hours.
    b. Weatherproof coating, the entire pre-cast exterior walls, exterior bottom, exterior roof and neck. Continuous application of bituminous waterproof coating material. Apply bituminous primary cold-coating and bituminous finish cold-coating not less than 0.10-millimeter total overall thickness, pressure applied in two coats over the entire exterior of the precast concrete structure.
    c. Seals and waterproofing shall be chemically resistant to acid, alkalis and saturated hydrogen-sulfide.

6. Each precast structure section shall have suitable knockouts or openings in the vertical walls for the duct banks and conduits entering the structure.
7. Pullboxes shall have deep recess conduit knockout concrete extensions at two opposite end walls. Additional shallow recess knockouts shall be provided on the other two walls for conduit entrances.
8. Pullboxes shall be provided with a minimum of one precast concrete 6-inch extension grade ring "tongue and groove" matting surfaces to ensure rigid assembly.
9. The Pullbox Floor Sump shall extend through the concrete floor into the gravel bedding, below the pullbox.
10. Traffic Rated cover and frame per AASHO for H520 Loading. Covers shall comply with Federal ADA, UL, State, and Local AHJ for slip resistance.

    a. Hot dip galvanized steel single piece flush fitting with threaded flush hold down, slotted head, stainless steel studs.

b. Topping frame shall be hot dip galvanized steel angle frame where the pullbox is installed in paving or concrete work.
c. Top ring frame shall be armor band type where the pull box is installed in exposed earth or landscaping.
d. Cover openings larger then 5-square feet of surface area, shall be provided with "split" two-piece cover type. Each "split" cover shall be hinged open-close with Torsion-Spring type cover, to assist in the ease of opening and closing the cover.
e. Cover openings 5-square feet or smaller surface area shall be single piece covers.

11. Covers shall be permanently marked in the cover metal as indicated on plans.

2.4 LINE VOLTAGE SWITCHES

A. General

1. Provide circuit switches totally enclosed, electrical insulating Bakelite or electrical insulating composition base, manual operator type with 277-volt 60Hz AC rating for full capacity contacts rated for all loads. Switch mounting-ears for screw attachment to outlet box. Switches shall be UL listed and labeled; conform to NEMA-WD1 and WD6.
2. Switch ratings shall be 20 amp, unless indicated otherwise.
3. All switches shall be of the same Manufacturer.
4. Wiring devices shall be listed and labeled for connection of both “Solid” and “Stranded” copper circuit conductors.

B. Line Voltage Switches Heavy Duty (Toggle – Type)

1. Single Pole Switches – 20 amp at 277V

Manufacturer	Toggle Type	Lock Type
Hubbell	#HBL1221	#HBL1221-L
Legrand/P&S	#20AC1	#20AC1-L
Leviton	#1221	#1221-L
Cooper-Arrow/Hart	#AH1221	#AH1221-L

C. Other Switches, Receptacles, Devices, and Outlets

1. Special devices outlets and outlet locations shall be as indicated on the Drawings. Modify device and outlet characteristics to accommodate the actual install location conditions for each outlet.

2.5 RECEPTACLES

A. General

1. All receptacles in flush type outlet boxes shall be installed with a bonding jumper to connect the box to the receptacle ground terminal. Grounding through the receptacle mounting straps is not acceptable. The bonding jumper shall be sized in accordance with the branch circuit protective device as tabulated herein under "Grounding". Bonding jumpers shall be attached at each outlet to the back of the

box using drilled and tapped holes and washer head screws 6-32 or larger (except isolated ground receptacles). For receptacles in surface mounted outlet boxes direct metal-to-metal contact between receptacle mounting strap (if it is connected to the grounding contacts) and outlet box may be used. Receptacle mounting-ears for screw attachment to outlet box. Receptacle shall be UL listed and labeled; conform to NEMA-WD1 and WD6.

2. All receptacles shall be same Manufacturer.
3. Receptacle colors shall be as selected by OWNER'S Representative. Multiple colors will be required including black for all receptacles on the stage.
4. Wiring devices shall be listed and labeled for connection of both "Solid" and "Stranded" copper circuit conductors.
5. Duplex convenience receptacles and 120-volt single phase branch circuits shall be NEMA 5-20R 20 amp..
6. Devices shall additionally be listed and labeled as UL-All Weather-Resistant, provide weather and tamper resistant receptacles for the following install locations:

    a. Devices indicated on Drawings as Weatherproof (W.P.).
    b. Devices installed in outdoor locations.
    c. Devices installed in classified as damp or wet locations both indoor and outdoor.
    d. All GFCI (ground-fault) receptacles at all locations.

7. Receptacles with ampere and voltage ratings different than described for duplex convenience receptacles. The different rated receptacles shall have the same characteristics and performance as the respective duplex convenience receptacles, except for differing ampere and voltage characteristics.

B. Duplex Convenience Receptacles.

1. Shall be grounding type, 120 volt and shall have two current carrying contacts and one grounding contact which are internally connected to the frame. Outlet shall accommodate standard parallel blade cap and shall be side wired.
2. GFCI receptacles shall be all Weather-Resistant and wet location rated. Rated 120-volt 60Hz AC, 20 amp, unless indicated otherwise on Drawings.
3. Heavy Duty Industrial Grade as follows except tamper resistant as described in Part A.5 above:

	Manufacturer	NEMA 5-20R	NEMA 5-20R-GFCI
a.	Legrand/P&S . …….	#5362 . …. ..….	.#2095HG
b.	Leviton . . ……..……..	#5362 …. . ……	.#W7899
c.	Hubbell . . …. ……..	#5362 . . ….……	#GFR8300
d.	Cooper-Arrow/Hart…	#AH5362……	.#WRVGF20

C. Weather-Proof (W.P.) Receptacle

1. Outdoor receptacles shall be duplex convenience GFCI type rated 20-amp 120-volt 60Hz AC weatherproof, GFCI, unless indicated otherwise on Drawings. Test-reset buttons and visual pilot.

2. Weatherproof receptacles not located under soffits or building overhangs shall have weatherproof lockable metal “In-Use” covers equal to Hubbell #MX4280S Series.

D. Other Switches, Receptacles, Devices, and Outlets.

1. Special devices, outlets and outlet locations shall be as indicated on the Drawings. Modify device and outlet characteristics to accommodate the actual install location conditions for each outlet.

2.6 PLATES

A. Cover Plates for Devices

1. Provide cover plates for every switch, receptacle, computer, and other device outlets. Provide cover-plates for junction boxes.
2. All plates shall be metal as manufactured by P&S, Hubbell, Leviton or equal, outdoor cover plates shall be gasketed.

2.7 STRUCTURAL AND MISCELLANEOUS STEEL

Structural and miscellaneous steel used in connection with electrical work and located out-of-doors or in damp locations, shall be hot-dip galvanized unless otherwise specified. Included are underground pull box covers and similar electrical items. Galvanizing averages 2.0 ounce per square foot and conforms to ASTM A123.

2.8 SAFETY SWITCHES

A. General

1. Disconnect switches shall all be rated:

a. 250 volt, 60Hz AC.
b. Quick-make, quick-break, H.P.-rated, lockable.
c. NEMA Type HD heavy duty.
d. Fused Class "R" NEMA I enclosure, lockable.
e. Number of poles and amperage as indicated on the Drawings.

2. Provide internal ground-lug and conductor landing lugs, size to match conductors shown on Drawings. Switch access door shall be interlocked with switch to prevent access inside switch when switch is “ON” closed position.
3. Maximum voltage, current, and horsepower rating clearly marked on the switch enclosure and switches having dual element fuses shall have rating indicated on the nameplate.
4. Provide fuses for each switch.

2.9 WIREWAY

A. General:

1. Unobstructed lay in type, metal wireway, fittings and connectors UL listed for use as wireway and auxiliary gutter. Length, elbows and "T-S" as shown on Drawings. Minimum cross-section size 4-inches by 4-inches, but not less than shown on the Drawings. Suitable for mounting in any position orientation.

B. Construction:

1. Minimum metal gauge shall not be less than 14-gauge.
2. Cover shall be hinged entire length of cover. Cover shall be held in the closed position with bolts and nuts.
3. Provide spring nuts on all hardware fastener penetrations into the interior of the wireway to protect against wire insulation damage.
4. The inside of 90-degree corners in the wireway shall be a 45-degree bevel.
5. Grounding continuity between wireway sections and fittings shall be continuous the entire length of the wireway.

C. Finish:

1. Indoor non-raintight, rust inhibitor phosphatizing base coating and baked enamel finish, Manufacturer's standard color.
2. Raintight outdoor-galvanized metal, with corrosion resistant phosphate primer and baked enamel finish, Manufacturer's standard color, NEMA 3R construction.
3. All hardware shall be plated to prevent corrosion.

PART 3 - EXECUTION

3.1 GROUNDING (ADDITIONAL REQUIREMENTS)

A. Grounding shall be executed in accordance with all applicable Codes and Regulations, both of the State of California and local Authorities Having Jurisdiction.

B. Each Pullbox or Any other Enclosure in which Several Ground Wires are Terminated shall be equipped with a ground bus secured to the interior of the enclosure. The bus shall have a separate lug for each ground conductor. No more than one conductor shall be installed per lug.

C. The Maximum Resistance to Ground shall not exceed 25 ohms.

3.2 OUTLET AND JUNCTION BOXES

A. General:

1. Accurately place boxes and securely fastens structural members. Where outlets are shown at same location but at different mounting heights, install outlets in one vertical line. Where outlets are shown at same location and mounting height, mount outlets as close together in a horizontal row as possible. Where the outlet boxes for switches and receptacles are shown at the same location and mounting height, mount in common outlet box with barriers between devices. Provide single piece multi-gang cover plate for close mounted outlet boxes.

Where switches are shown on wall adjacent to hinge side of doors, box shall be installed to clear door when door is fully opened.

2. Flush mounted boxes shall be attached to not less than two parallel studs or structure members by means of metal supports. The support shall span between and attach to the structure members.
3. Boxes above accessible ceilings shall be attached to structural members. Where boxes are suspended, they shall be supported independently of conduit system by means of hanger rods and/or preformed steel channels. Boxes shall be supported independently of all piping, duct-work, equipment, ceiling hanger wires and suspended ceiling grid system.
4. Surface mounted outlets shall be attached to concrete or masonry walls by means of expansion shields.
5. Floor boxes shall be installed at the level with finished floor and within adjustable limits of floor ring.
6. Provide metal outlet boxes for each device. Install devices in metal outlet boxes. Typical for all wiring devices including switches, receptacles, line voltage devices, and low voltage / signal system devices.

3.3 SWITCHES AND RECEPTACLES-DEVICES

A. General

1. Provide outlet boxes for all devices, switches, receptacles, both line-volt-age and low-voltage.
2. Devices installed in wireways shall be installed flush in wireway assembly.
3. Install and screw attach devices into outlet boxes and wireways.
4. Provide ground circuit connections to all devices.
5. Provide branch circuit connections to all devices.
6. Provide Testing and Commissioning for proper operation and phase/ ground connectors.

    a. Test each GFCI device after installation and circuit connection is complete.
    b. Test all devices for correct polarity and proper electrical energization.

7. Install and adjust all cover-plates to be flush and level, with correct device identification.
8. Were one or more devices occurring at the proximity with other similar devices, all the devices shall be “Ganged” under one common cover-plate as follows:

    a. Duplex convenience receptacles with other proximity (within 18-inches) duplex convenience receptacles.
    b. Lighting control switches not exceeding 20-amp switch rating with other proximity (within 18-inches) similar switches.

B. Line-voltage Plug-In Type Receptacle Installation Orientation:

1. The “Ground-Pin” shall face “down” at the receptacle top location (double duplex) 4-plex, individual and vertically mounted individual duplex receptacles.
2. The “Neutral-Blade” shall face “Up” at the receptacle top location on horizontally mounted duplex receptacles.

3.4 WIREWAY INSTALLATION

Wireway Hangers shall provide clamp type, hanger rod type, direct bolted bracket type from ceiling or walls as indicated on the Drawings and required for field installation locations. Support shall be installed a minimum of 5-feet on center.

END OF SECTION 260501

SECTION 260533
CONDUIT AND WIRE

PART 1 - GENERAL

1.1 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation, and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:

1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
2. General Provisions and Requirements for electrical work.

1.2 SUBMITTALS (ADDITIONAL REQUIREMENTS)

Submit Product Data Sheets for all Wire, Supports, Conduit, Fittings and Splicing Materials.

PART 2 - PRODUCTS

2.1 CONDUIT

A. General

1. The interior surfaces of conduits and fittings shall be continuous and smooth, with a constant interior diameter. Conduits and conduit fittings shall provide conductor raceways of fully enclosed circular cross section. The interior surfaces of conduits and fittings shall be without ridges, burrs irregularities or obstructions. Conduits and fittings of the same type shall be of the same uniform weight and thickness.
2. All fittings for metal conduit shall be suitable for use as a grounding means, pursuant to the applicable Code Requirements.
3. Steel conduits shall have protective corrosion resistant hot-dip galvanized zinc coating on all interior and exterior surfaces, with clear organic polymer outer topcoat layer. Threads shall be hot-dip zinc coated after machine fabrication.
4. Threads for metal conduit and metal conduit fittings shall be taper-pipe-thread, National Pipe Standards (NPS) and shall comply with ANSI-B1.20.1.
5. Metal conduit termination connector fittings shall be provided with a Manufacturer installed, insulating throat bushing inside the fitting. The bushing shall protect the wire conductor insulation from cutting, nicks and abrasion during conductor installation and electrical load “cycling” after installation is complete. The bushing shall comply with UL 94V-0 flammability.
6. Provide conduit bonding/grounding jumper from metal enclosures with “Concentric Ring” knockouts, to positively ground/bond each respective conduit(s) to the metal enclosure.

B. Rigid Metal Conduit (RMC)

1. Rigid metal, round tubing, machine threaded at both ends and rated for use as an equipment grounding conductor pursuant to applicable Codes.
2. RMC raceway types shall be Rigid Galvanized Steel Conduit (RGS) and/or Intermediate Steel Conduit (IMC).
3. RMC fittings shall be steel and compatible with RGS and IMC, rated for use as an equipment grounding conductor pursuant to applicable Codes.
liquid and concrete tight, and appropriate for each application used.

C. Electrical Metallic Tubing (EMT)

1. Rigid metal round tubing, “Thin Wall” steel construction, with non-threaded ends, and rated for use as an equipment grounding conductor pursuant to applicable Codes.
2. EMT fittings shall be steel and compatible with EMT, rated for use as an equipment grounding conductor pursuant to applicable Codes. Couplings and connectors shall be exclusively compression type. Set screw type connectors shall not be used.

D. Flexible Metal Conduit (FMC)

1. Round flexible conduit, fabricated from a single continuous steel strip. The steel shall be factory formed into continuous interlocking convolutions to form a complete lock between steel strips and provide raceway flexibility.
2. FMC Fittings shall be malleable iron construction or steel and shall automatically cause the FMC raceway throat opening to be centered with respect to the fitting throat opening. Direct FMC conduit-to-FMC conduit coupling of FMCs shall not be permitted.

E. Liquid Tight Flexible Metal Conduit (LTFMC)

1. The metal conduit core of LTFMC shall comply with the same Requirements as FMC conduit, with the addition of a thermoplastic exterior flexible jacket over the metal core.
2. The exterior jacket shall be positively locked to the metal core to prevent jacket “Sleeving”.
3. The LTFMC shall be rated for installation and operating service temperatures of between minus 20 degrees centigrade through plus 90 degrees centigrade.
4. The LTFMC jacket shall be suitable for continuous exposure to sunlight, rainwater, water vapor, mineral oils and liquid solvents, without penetrating into the conduit and without deteriorating the jacket.
5. Direct LTFMC conduit-to-LTFMC conduit coupling of LTFMC shall not be permitted.
6. LTFMC fittings

    a. Fittings shall include an external mechanical ground/bond wire connector.
    b. The attachment of the fitting to LTFMC shall be threaded compression type onto the conduit core with locknut and liquid tight jacket compression seal.

The fitting shall automatically prevent “Sleeving” of the jacket.F. Rigid Non-Metallic Conduit (RNMC)

1. General

    a. Conduit and fittings shall be 90-degree centigrade conductor rated. Fabricated from homogeneous material, free from visible cracks, holes or foreign inclusions, with integral “End-Bell”. The conduit and conduit fittings shall be watertight and airtight.
    b. Conduit, conduit fittings and conduit fitting assembly “Solvent Cement” shall all be the product of the same Manufacturer. Conduit fittings shall be solvent cement welded watertight.
    c. Conduit and fittings shall be identified with legible markings showing ratings, size and Manufacturers name.
    d. RNMC and fitting shall be corrosion resistant, watertight.
    e. Conduit shall be suitable for conductor operating temperatures from minus 20 degrees centigrade to 90 degrees centigrade.
    f. RNMC shall comply with NEMA TC-2 (PVC 40 conduit, latest revision) and NEMA TC-3 (fittings, latest revision); UL 514 and UL 651 (latest revision).

2. Polyvinyl Chloride (PVC)-RNMC shall be PVC-schedule 40 heavy wall construction.

2.2 CONDUIT SUPPORTS

A. General

1. Conduit Supports, hangers and fasteners for metal conduit shall be steel, hot dip zinc galvanized.
2. Threaded hardware shall be continuous, free running threads.
3. Conduit support systems, including support channels, pipe clamps, braces, anchors, hardware, fasteners, shall be sized to support the full capacity circuit conductors’ weight, plus the installed conduit weight, plus the conduit fitting weight and support hardware weight, plus a 300 percent additional weight capacity safety factor.
4. Provide lock washer at each “bolted”/threaded connection.
5. Conduit supports, fasteners, channels, braces, hardware, anchors, pipe clamps, and hangers as manufactured by Unistrut or Kindorf.
6. Supports shall be free of “BURRS” and sharp edges.
7. Metal supports cut in the field shall be zinc galvanized after cutting to prevent rust.

B. Conduit Hangers

1. Threaded steel hanger rods.

    a. Hanger rods smaller than 0.375-inches in diameter shall not be used for support of individual conduits.
    b. Hanger rods smaller than 0.5-inches in diameter shall not be used for support of multiple conduits.

2. Conduit hanger wires shall be not less than 12-gauge steel.
3. Conduit hangers shall attach to structure fasteners with steel “Clevis” or “Swing” hangers and shall provide a minimum of 45 degrees of angular movement in any direction at the point of the conduit hanger attachment to the structure fasteners.
4. Conduits individually suspended by conduit hangers shall fasten to the respective hangers with “Clevis” type pipe hangers. The pipe hangers shall be steel, adjustable to fit conduit size and shall completely enclose the conduit circumference.

C. Conduit Support Channels

1. “C” Channels shall be factory preformed with a minimum 12-gauge thickness metal. The channel shall be factory “Punched” with regularly spaced slotted holes for fastener attachments along the length of the channel.
2. Conduit support channels suspended from conduit hangers shall attach to conduit hangers with treaded connections. Provide a minimum of two hangers (trapeze style) connected to each channel.
3. Non-suspended conduit support channels shall connect to structure fasteners with threaded connectors.

D. Fasteners, Seismic Earthquake Rated

1. Channel fasteners:

   a. Channel fasteners shall “prelocate” and lock into the channel “turned lips” and channel “walls”.
   b. A separate metal strap shall “tie” each conduit to each channel with conduit channel fasteners.

2. Structure fasteners:

   a. Structure fasteners for wall and floor mounted conduit attachments shall attach to existing masonry and concrete structures with structure fasteners using drilled, mechanical, expansion shield anchors.
   b. Structure fasteners for wall and floor mounted conduit attachments shall attach to new masonry and concrete structures with structure fasteners using steel threaded inserts precast into the structures.
   c. Structure fasteners shall center the support load above or below the beam flanges and reduce torsion-rotation forces exerted on the structural beam. Attach to steel structural members with “Swing-Beam Clamps”, with set-locking screw structure fasteners.

      1) Beam clamps shall include integral safety rod, strap or “J”-Hook to secure the attachment clamp to the beam flanges on both sides of the beam, with integral hanger rod attachment.
      2) Or double-ended beam clamp to secure the attachment clamp to the beam flanges on both sides of the beam, with integral hanger rod attachment.

d. Structure fasteners for wall and floor mounted conduit attachments shall attach to wood structural members with flush “Through-Bolted” wood beam/wood framing stud structure fasteners.
e. Structure fasteners for wall mounted conduit attachments shall attach to steel framing studs and steel structural elements with spot welded steel structure fasteners or drilled and bolted structure fasteners.

E. Brace Connectors

1. Provide lateral brace connectors to resist horizontal, lateral and vertical movement of suspended conduits during seismic earthquakes.
2. The braces shall connect from each conduit support, attach as close to the conduit as possible, and attach to fixed rigid, non-suspended building “Main” structural elements with fixed anchoring.
3. Brace attachment connectors and fasteners shall be rigid preformed steel channels or flexible #10-gauge steel hanger wire.
4. Connect and attach the brace connectors to fixed structural elements in the same manner as conduit support hangers. The connection of braces to structural elements shall be independent of the conduit support hanger structure fasteners.

2.2 ELECTRICAL POWER WIRE AND CABLE

A. General

1. All wire and cable shall be single-conductor, annealed copper, insulated 600 volt, #12 AWG minimum unless specifically noted otherwise on the Drawings. Aluminum conductors shall not be used.
2. Conductors #12 AWG and smaller shall be solid. Conductors #10 AWG and larger shall be stranded.

B. Conductor Insulation

1. 600 Volt AC insulated conductors installed entirely inside conduits, or enclosed inside wireways, or enclosed inside raceways, insulation shall be rated 90 degrees C.

a. Indoor above Grade locations:

1) Dual rated THHN and THWN
2) Individually rated THHN-2
3) Individually rated THWN-2

b. Outdoor underground locations:

1) XHHW-2 for feeders
2) THWN-2 for branch circuits

C. Insulation Color Coding and Identification

1. The following color code for branch circuits:

a. Neutral . . . White (Tape feeder neutrals with white tape near connections)
b. Normal Power

120/208 Volt
Ground Green
Phase A Black
Phase B Red
Phase C Blue

2. The color code for the neutral conductors shall be as follows:

a. 120/208 volt; Phase A - White with Black stripe; Phase B - White with Red stripe; Phase C - White with Blue stripe.
b. 277/480 volt; Phase A - White with Brown stripe; Phase B - White with Orange stripe; Phase C - White with Yellow stripe.

3. Feeders identified as to phase or leg in each, switchboard, switchgear, panelboard and junction location with printed identifying tape.

PART 3 - EXECUTION

3.1 TRENCHING AND FOOTINGS

A. Provide Trenching, Concrete Encasement of Conduits, Backfilling, and Compaction for the underground electrical work, in accordance with applicable Sections of this Specification.

B. Provide Footings for all Post and/or Pole-Mounted Lighting Fixtures: concrete shall conform to the applicable Sections of this Specification.

3.2 GROUNDING

A. Grounding shall be executed in accordance with all applicable Codes and Regulations, both of the State and local Authorities Having Jurisdiction.

B. Provide proper sized copper ground wire in the conduit with the feeder for use as equipment ground. Metallic raceway systems shall be grounded to this ground wire.

C. The maximum ground resistance of the grounding electrode to earth shall not exceed 25 ohms.

D. Ground/Bond Conductors

1. Provide dedicated green insulation equipment ground/bond wire inside each conduit type and raceway as follows. Size the ground/ bond conductors to comply with CEC Requirements. The metal conduit or raceway shall not be permitted to serve (function) as the only (exclusive) electrical ground return path:

a. All types of nonmetallic conduit and all types of non-metallic raceways including but not limited to: RNMC - Rigid Nonmetallic Conduit.
b. FMC - Flexible Metal Conduit.

c. LTFMC - Liquid Tight Flexible Metal Conduit.
d. Metal and non-metal raceways.
e. RMC - Rigid Metal Conduit.
f. EMT - Electrical Metal Tubing.

2. The equipment ground/bond wire shall be continuous from the electrical circuit source point of origin to the electrical circuit end termination utilization point as follows:

   a. Every conduit and raceway path containing any length of the above identified conduits or raceway.
   b. Every conduit path and raceway path connected to any length of the above-identified conduits and raceways.

4. Splices in ground/bond wires shall be permitted only at the following locations:

   a. Ground buses with listed and approved ground lugs.
   b. Where exothermic welded ground/bond wire splices are provided.

5. Provide ground/bond wire jumpers for conduit fittings with ground lugs, expansion and deflection conduit fittings at conduit fittings connecting between metallic and non-metallic raceways and to bond metal enclosures to conduit fittings with ground lugs.

E. Ground Conductors for Branch Circuit Wiring shall be attached at each outlet to the back of the box using drilled and tapped holes and washer head screws, 6-32 or larger.

F. Each Panelboard, Switchboard, Pullbox or any other Enclosure in which several Ground Wires are Terminated shall be equipped with a ground bus secured to the interior of the enclosure. The bus shall have a separate lug for each ground conductor. No more than one conductor shall be installed per lug.

G. UFER Ground

1. Provide main ground system(s) of the UFER ground style as indicated on the Drawings.
2. The “UFER” grounding electrode, embedded in concrete, shall be exothermically welded to each steel reinforcing bar (rebar) and each steel anchor bolt located within 18-inches of the grounding electrode inside the concrete. Note: Reinforcing steel (rebar), in concrete foundations, attached with metal “Tie-Wraps” and in direct physical contact to other adjacent rebar that is in turn exothermic welded to the UFER grounding electrode, may be classified as attached to the UFER grounding electrode, and does not require additional exothermic weld connections to the UFER grounding electrode.
3. Provide a Separate Ground/Bond Insulated Grounding Electrode Conductor, Copper Wire from the UFER ground bus in each building to each location indicated on the Drawings. Bond the UFER ground bus to the main cold-water pipe serving the building.

3.3 CONDUIT

A. General

1. The sizes of the conduits for the various circuits shall be as indicated on the Drawings, but not less than the conduit size required by Code for the size and quantity of conductors to be installed in the conduit.
2. Conduits shall be installed concealed from view. Install conduits concealed in walls, concealed below floors and concealed above ceilings, except as specifically noted otherwise. Conduits shall not be installed embedded in concrete floors.
3. Conduits shall be provided complete with conduit bends, conduit fittings, outlet boxes, pullboxes, junction boxes, conduit anchors/supports, grounding/bonding for a complete and operating conductor/wire raceway system.
4. Metal and nonmetal conduits shall be provided mechanically continuous between termination connection points. Metal conduit shall be provided electrically continuous between termination connection points.
5. Metal conduit terminating to nonmetal enclosures; terminating into metal enclosures with “Concentric.ring” knockouts; terminating into metal enclosures with knockout reducing washers, including but not limited to equipment housings, outlet boxes, junction boxes, pull boxes, cable trenches, manholes, shall be provided with a ground/bonding lug integrated with the conduit termination conductor fitting construction, by the Fitting Manufacturer. The lug shall provide for connection of a grounding/bonding conductor (insulated or uninsulated). The grounding lug shall be located on the fitting, inside the termination enclosure.
6. The type of conduit, type of conduit fittings, and type of conduit supports, and method of conduit installation shall be suitable for the conditions of use and conditions of location of installation based on the Manufacturer’s recommendations; based on the applicable Codes and based on the Requirements of the Contract Documents.

B. RMC Installation Locations

RGS, IMC conduits and RGS, IMC fittings shall be installed in the following locations:

1. Embedded in walls and foundations constructed with brick and masonry.
2. Exterior of building for exposed conduit locations.
5. Damp or wet locations exposed or concealed locations.
4. RMC conduit and RMC fittings may be installed in any location where EMT and FMC conduit is permitted to be installed.

C. EMT Installation Locations

EMT conduit and EMT fittings may be installed in the following locations, for circuit conductors operating below 600 volts to ground; locations containing only “Non-Hazardous Materials”; only dry locations:

1. Concealed in hollow non masonry/non-concrete, metal stud frame and wood stud frame walls and floors.
2. Concealed above ceilings.
3. Exposed interior locations placed 9-feet or higher above finished floor.

4. Exposed on walls and ceilings (any height) in the electrical room
5. Any location where FMC is described to be installed, except as the final connection to rotating or vibrating equipment.

D. FMC Installation Locations

FMC conduit and FMC fittings may be installed in the following locations for circuit conductors operating below 600 volts to ground; locations containing only “Non-Hazardous Materials”; only dry, interior locations:

1. Concealed in hollow non-masonry metal stud frame and wood stud frame fully enclosed walls.
2. Concealed above fully enclosed ceiling spaces.
3. FMC conduit shall be installed in continuous lengths between termination points. FMC shall not be “spliced” or coupled directly to FMC or any other conduit type under any circumstance.
4. The maximum continuous length of FMC that shall be installed on any conduit run is 18-inches.

E. LTFMC conduit and LTFMC fittings may be installed for final connection to the marquee sign.

F. RNMC conduit and RNMC fittings shall be installed underground and concealed in concrete pole bases.

G. Conduit Installation

1. Conduit Supports

a. Securely and rigidly support all raceways/conduits from the building structure. Raceways/Conduits shall be supported independent of all piping, air ducts, equipment ceiling hanger wires, and suspended ceiling grid systems. Secure conduit to structural element by means of UL listed and approved hangers, fasteners, “C” Channels and pipe clamps.
b. Provide conduit supports spaced along the length of the conduit as follows:

1) RMC and EMT conduit, maximum not to exceed 96-inches on center; within 24-inches of each conduit bend and conduit termination location.
2) FMC and LTFMC conduit, maximum not to exceed 24-inches on center; within 6-inches of each conduit bend and conduit termination location.

c. Individual, suspended raceways/conduits separated by more than 12-inches from any other conduit and suspended from ceilings and roofs by means of hanger rods or hanger wires.
d. Non-suspended conduit methods:

1) Individual raceway/conduits placed against wall/ceiling/ floors, placed inside hollow wall/ceiling construction or structure framing (i.e., “Dry-Wall” or plaster hollow wall construction), shall be secured by means

of individual pipe clamps and fasteners attached to the framing studs or other structural members and the conduit/raceway.

2) Provide common “C" Channel supports for all multiple raceways/ conduits placed against vertical or horizontal surfaces and positioned within 24-inches of other raceways/ conduits. Attach channels to the framing studs or other structural members. Attach the conduits/ raceway individually to common channels, side-by-side, with pipe clamps.

3) The use of toggle bolts is prohibited.

e. Conduit shall not be installed in cast-in-place concrete floor slabs.

2. Conduit separation:

a. Conduit installed underground or below building slab without full concrete encasement: Shall be separated from adjacent conduits of identical systems (i.e., signal to signal, data to data, power to power, control to control etc.) by a minimum of 3-inches. Conduits of non-identical systems (i.e., signal to power; data to power; power to control; signal to control, etc.) shall be separated by a minimum of 12-inches.

b. Conduit installed underground with full concrete encasement; shall be separated from adjacent conduits of similar systems (100 volt and less) by a minimum of 2-inches; conduits for non-power systems (100 volts and less to ground) shall be separated by a minimum of 6-inches from power circuits (over 100 volts to ground); conduits for power circuits shall be separated from adjacent conduits of similar power systems (over 100 volts to ground) by a minimum of 3-inches.

c. Separation of conduits entering termination points or crossing other conduits may be reduced as required within 60-inches of the termination or crossing points.

d. Conduits containing Utility Company service circuits (i.e., electrical power or telephone) shall be separated a minimum of 12-inches from all other utilities and conduits, with or without concrete encasement, metallic or non-metallic conduit, above grade or underground conduit locations.

e. Conduits shall be separated from hot water piping, exhaust flues/ chimneys, steam piping, boilers, furnaces, ovens by a minimum of 12-inches.

3. Conduit stubs:

a. Conduits stubbed underground outside for electric vehicle chargers shall be capped. Provide concrete monument, 6-inches diameter by 15-inches deep, buried flush with grade over the capped ends. The top face of monument shall be furnished with a 3-inch square brass plates anchored with expansion bolts and engraved: EV CHARGER

c. Conduits stubbed between accessible ceiling spaces for low voltage cabling shall be provided with an insulated throat bushing, on the end of each conduit.

4. Conduit concrete encasement:

    a. Conduits which are run underground exterior to building slab shall be continuously concrete encased except where run under paved areas or tree wells
    b. Conduits located below or adjacent to structural foundations shall be separated from the foundation by a minimum of 12-inches. Conduits located below structural foundations shall be fully and continuously concrete backfilled and encased between the bottom of the foundation to the bottom of the conduits. The concrete shall be 4000 PSI 28-day cure strength.

5. Underground conduits:

    a. Three or more underground conduits larger than 1-inch in size and occupying the same trench shall be separated and supported on factory fabricated, non-metallic, duct/conduit support spacers. The spacers shall be modular, keyed interlocking type, "Built-Up" to accommodate quantity, size orientation and spacing of installed conduits. The spacers shall maintain a constant distance between adjacent conduit supports and hold conduits in place during trench backfill operations. Minimum support spacer installation interval along with length of the conduits shall be as follows:

        1) Concrete encased conduits, not less than 8-feet on center.
        2) Non-concrete encased conduits, not less than 5-feet on center.

    b. Provide trenching, excavation, shoring and Backfilling required for the proper installation of underground conduits. Tops of backfill shall match finish grade.
    c. Bottoms of trenches shall be cut parallel to “Finish Grade” elevation. Make trenches 12-inches wider than the greatest diameter of the conduit.
    d. Back-filling Trenches for Conduits without Concrete Encasement:

        1) Conduits which are not required by the Contract Documents to be concrete encased and are located exterior to building slab, shall be set on a 3-inch bed of damp clean sand. Conduit trenches shall be backfilled to within 12-inches of finished grade with damp sand after installation of conduit is completed. Remainder of backfill shall be native soil or as specified for type of finished surface on grade.
        2) Conduits located under a building which are not required by the Contract Documents to be concrete encased, shall be completely backfilled and compacted with clean damp sand to the same level as the building foundation pad.
        3) Provide a continuous red wide flat plastic tracer tape with magnetic stripe located 12-inches above the conduits in the trench. The tracer tape shall be imprinted with “Warning-Electric Circuits” a minimum of 24-inches on center.

e. Backfilling trenches for conduits with Concrete Encasement Requirements by the Contract Documents:

   1) Trenches with all conduits concrete encased shall be back-filled with clean damp sand when located under building pads.
   2) Trenches with all conduits concrete encased and not located under a building pad and not located under paved areas shall be backfilled with clean damp sand or native soil.

f. Backfill material:

   1) Sand and native soil backfill of trenches shall be machine vibrated in 6-inch lifts to provide not less than 90% compaction of backfill.
   2) Concrete and slurry mix shall be machine vibrated during installation to remove “Air-Voids”.
   3) Soil shall have no stones, organic matter of aggregate greater than 3-inches.
   4) The slurry mix shall consist of concrete, clean sand and clean water mixture. Maximum shrinking of slurry mix shall not exceed 5% wet to dry.

g. Do not backfill until Owner’s Representative has approved Installation and As-Built Drawings are up to date. Promptly install conduits after excavation has been done, so as to keep the excavations open as short a time as possible. Excess soil from trenching shall be removed from the site.
h. Install underground conduit, except under buildings, not less than 24-inches below finished grade in non-traffic areas and 30-inches below finished grade in traffic areas, including roads and parking areas. Dimensions shall be measured to the top of the conduit.
i. Provide long radius horizontal bends (minimum radius of 36-times the conduit diameter) in underground conduits where the conduit is in excess of 100-feet long.
j. Conduits installed below grade and on grade below buildings, shall not be smaller than 0.75-inches.
k. Underground conduits entering a building shall be sloped. The conduit direction of slope shall be away from the building and shall prevent water in the conduit from “Gravity Draining” towards the building. The conduit slope “high point” shall originate from the building, out to the first exterior pullbox, manhole etc. exterior conduit termination “Low Point”. The minimum slope angle shall be a constant 8-inches (or greater) of fall for each 100-feet of conduit length.
l. Dewatering:

   1) Provide pumping to remove, maintain and dispose of all water entering the excavation during the time the excavation is being prepared, for the conduit laying, during the laying of the conduit, and until the backfill at the conduit zone has been completed. These provisions shall apply on a continuous basis. Water shall be disposed of in a manner to prevent damage to adjacent property. Trench water shall not be drained through the construction. Groundwater

shall not be allowed to rise around the pipe until joining compound has firmly set.

2) The Owner's Representative shall be notified 48 hours prior to commencement of dewatering.

6. Raceway/Conduits, which are installed at this time and left empty for future use, shall have 0.25-inch diameter polyvinyl rope left in place for future use. The pull rope shall be 500-pound minimum tensile strength. Provide a minimum of 5-feet of slack at each end of pull ropes.
7. Conduit bends risers and offsets:

   a. The minimum bend radius of "Factory or Field" fabricated conduit bends shall not be less than the following. The bend radius shall be measured at the surface, inside radius of the conduit wall:

      1) FMC and LTFMC conduit - conduit minimum bend radius 12-times the conduit diameter.
      2) RMC and EMT conduit minimum bend radius - conduit for power circuits over 100 volts and less than 600 volts, 8-times conduit diameter. Conduit for power circuits over 600 volt, 12-times conduit diameter. Conduit for low voltage, signal and fiber optic circuits, 10-times conduit diameter.
      3) RNMC conduit - conduit minimum bend radius 36-times the conduit diameter. Under building reduce minimum bend radius to 10-times the conduit diameter.
      4) Conduits for Utility Company conductors. Conduit minimum bend radius shall comply with the respective Utility Company Requirements.

   b. Bends and offsets in conduits shall be kept to an absolute minimum. The total summation of all bends and offsets permitted in a conduit segment, occurring between two conduit termination/ connection end points, shall not exceed the following, including conduit fittings:

      1) RMC and EMT conduit - 360 angular degrees
      2) FMC and LTFMC conduit - 180 angular degrees
      3) RNMC conduit - 270 angular degrees

   c. Each field fabricated conduit offset, bend and elbow which are not the standard product of the Raceway/Conduit Manufacturer shall be mandrel tested. The test shall be conducted after the conduit installation is complete and prior to pulling-in any wire, in the same manner as for underground conduits.
   d. Factory manufactured angle connector conduit fittings shall be installed in exposed conduit locations only. Installation in locations normally concealed from view shall not be permitted. Not more than one factory manufactured angle connector shall be permitted in any length of conduit between conduit termination end points.

8. Provide two locknuts and an insulated throat bushing at each metal conduit terminating at enclosures, including but not limited to outlet boxes, junction boxes, terminal cabinets, transformers, switchboards, distribution panels and panelboards.
9. Provide metallic or plastic closure caps on all conduit ends during construction, until installation of conductors in the respective conduit.
10. Conduit run exposed, shall be run at right angles or parallel to the walls or structures. All changes in direction, either horizontally or vertically, shall be made with conduit outlet bodies as manufactured by Crouse Hinds, OZ or equal. Conduits run on exposed shall be painted to match surrounding surfaces.
11. RNMC conduit:

    a. Joints and fittings shall be solvent welded to RNMC conduit. Joints and fittings shall be watertight and airtight after fabrication.

12. Tighten each conduit fittings and fitting appurtenance, to the “Torque” (allowable tolerance ±5%) value recommended by the Fitting Manufacturer and applicable Code. If three or more conduit fittings are found to not follow the Manufacturer’s “Torque” (tightness) recommendations, the following corrective actions shall occur:

    a. The Contractor shall tighten “Re-Torque” the defective fittings and all similar conduit fittings installed as part of the Contract Documents in the presence of the Owner’s Representative.
    b. If the respective conduit fittings similar to the deficient “Torque Tightness” fittings are installed concealed in walls, floors, above ceilings or below grade, the Contractor shall expose the fitting, to allow retightening each similar conduit fitting to the Manufacturers recommended “Torque” values.
    c. All the cost to repair the direct, indirect, incidental damages and Contract delays resulting from complying with these Requirements shall be the sole responsibility of the Contractor and shall be included in the bid price.

H. Conduit Bodies

1. Conduit bodies shall be installed in exposed conduit locations only or above accessible ceilings.
2. Conduit bodies shall be accessible for removing body cover and pulling wire through the conduit body.
3. Conduit bodies shall not be installed inside enclosed walls.

3.4 WIRE AND CABLE

A. Branch Circuit and Fixture Joints for #10 AWG and Smaller Wire shall be made with UL-approved connectors listed for 600 volts, approved for use with copper and/or aluminum wire. Connector to consist of a cone-shaped, expandable coil spring insert, insulated with a nylon shell and two wings placed opposite each other to serve as a built-in wrench or shall be molded one-piece as manufactured by 3M-"Scotchlok".

B. Branch Circuit Joints of #8 AWG and Larger shall be made with screw pressure connectors made of high strength structural aluminum alloy and UL-approved for use

with both copper and/or aluminum wire as manufactured by Thomas & Betts. Joints shall be insulated with plastic splicing tape, tapered half-lapped and at least the thickness equivalent to 1.5-times the conductor insulation. Tapes shall be fresh and of quality equal to Scotch.

C. Use UL Listed Pulling Compound for Installation of Conductors in Conduits.

D. Correspond each Circuit to the Branch Number Indicated on the Panel Schedule shown on the Drawings except where departures are approved by the Owner's Representative.

E. All Wiring, including low voltage, shall be installed in conduit.

F. All Splices in Exterior Pull Boxes and Light Poles shall be cast resins encapsulated.

1. Power conductor splices - 3M Scotchcast Series 82/85/90; Plymouth or equal.
2. Audio circuits 3M Scotchcast series 8981 thru 8986, or equal.

H. Neatly Group and Lace all wiring in panelboards and terminal cabinets with plastic ties at 3-inches on centers. Tag all spare conductors.

3.5 TESTING

A. Testing Conduit and Conduit Bends

The Contractor shall demonstrate the usability of all underground raceways, and field fabricated conduit bends installed as part of this Contract.

1. A round tapered segmented semi-rigid mandrel with a diameter approximately ¼-inch smaller than the diameter of the raceway, shall be pulled through each new raceway.
2. The mandrel shall be pulled through after the raceway installation is completed. Conduits which stubout only, may have the mandrel pulled after the concrete encasement is completed, but prior to completing the backfill.
3. Owner's Representative shall witness the Raceway Testing for usability. A Representative of the respective Utility Company shall witness the Raceway Testing where applicable.
4. Contractor shall repair/replace any conduit and conduit bend provided under this Contract which will not readily pass the mandrel during this Test.

END OF SECTION 260533

SECTION 262413
SWITCHBOARDS

PART 1 - GENERAL

1.1 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery, and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:

1. Examine all other Specification Sections and Drawings for related work required to be included as work under Division 26.
2. General Provisions and Requirements for electrical work.

1.2 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit Manufacturer's Shop Drawings for switchboard showing details of construction, elevation, dimensional data, weight, and electrical ratings of the switchboard and all overcurrent devices and accessories contained inside.

B. Switchboard Supplier shall submit details of construction directly to serving utility company and obtain approval of all termination and metering provisions and bus ratings.

C. Provide nameplate engraving schedule.

D. Short Circuit and Arc-Flash.

1. Provide electrical system short circuit and arc flash calculations based on available fault current, feeders, and overcurrent devices installed in the system. Assume available fault current is equal to the AIC rating of the main switchboard with no motor contribution. Use results of calculations to determine appropriate level of personal protective equipment required at each location.
2. Calculate incident energy levels at the main switchboard and at each panel.
3. Submit proposed arc flash warning labels.

E. Factory Tests: Equipment Tests - ANSI C37.20. Certified copies of Design Tests, Production Tests, and Conformance Tests of the equipment shall be submitted, and review comments shall be received before delivery of equipment to the Project Site. In lieu of the above tests, a report of these tests previously performed on identical units of each rating will be acceptable.

1.3 APPLICABLE STANDARDS

A. The Switchboard and switchgear Equipment shall be Designed, Tested and Assembled to comply with ANSI, IEEE, and NEMA and UL.

B. Seismic Earthquake and Wind Loading Withstand, Testing and Certification (Additional Requirements).

1. The complete switchboard/switchgear assembly; including circuit protection devices, meter, housing/enclosures, accessories, supports/anchors etc., shall be designed, manufactured and tested.

    a. Wind loading all outdoor equipment locations.
    b. Earthquake Seismic Requirements of CBC/IBC Seismic withstand all indoor and all outdoor equipment locations.

2. Shall withstand, survive and maintain continuous non-interrupted energized operation during seismic event occurrences and wind event occurrences. Continued normal energized operation after the wind event and seismic event occurrences have abated.
3. Shall include demonstrations of successful operation and run test after completion of seismic event shake-table simulation. Acceptance test seismic qualification of proposed switchboard and/or switchgear shall employ triple axis shake-table simulation of the Required Response Spectrum (RRS) seismic event motion, certified and approved by the AHJ.
4. Provide three-dimensional finite element analysis demonstrating anchorage and operational withstand of wind loading not less than as follows and as required by AHJ:

    a. 110MPH-West Coast USA and Hawaii, per ASCE/SEI 7-16.

5. Seismic Test shall be performed by a third-party independent Test Laboratory. Wind Analysis and Seismic Testing and Reports shall be certified, signed and “Stamped” by PE Professional Engineer licensed and in good standing in the State, Civil Engineer or Structural Engineer.

C. Equipment Components/Devices, Switchboards, and/or Switchgear shall be manufactured by: Eaton; or Square–D; or Siemens.

PART 2 - PRODUCTS

2.1 BUSSING

A. Horizontal and vertical buses shall be full lengths in each Equipment Section. Buses shall have a minimum short circuit fault withstand rating equal to available fault current indicated on Drawings.

B. Provide interconnected full capacity neutral bus in each section with the same ratings and construction as the phase buses.

C. Provide interconnected ground bus in each Section.

D. Provide space and all hardware and mounting attachments for future devices as indicated on the Drawings.

E. Main horizontal phase and neutral bussing shall be full capacity in all equipment sections. The through bus of the end Distribution Section shall be extended and pre-drilled to allow the addition of future Sections.

F. Vertical riser buss full capacity, non-tapered.

G. The equipment bussing shall be of sufficient cross-sectional area to meet UL Standard 891 on temperature rise Bus shall be copper with silver-plated bus joints or extruded aluminum with tin plated bus joints. The through bus shall have provisions for the addition of future sections. The through-bus supports, connections and joints are to be bolted with grade 5-hex head bolts and Belleville washers to minimize Maintenance Requirements.

2.2 CIRCUIT BREAKERS

A. General

1. Circuit protective devices as indicated on the Drawings. All devices shall have a short circuit interrupting capacity of not less than the maximum available fault current at the circuit breaker and as indicated on the Drawings.
2. Provide padlock-off devices on each device. Breakers shall provide automatic time over-current and instantaneous circuit protection. Shall be suitable for use as “Main” service disconnect, “Feeder” and “Branch-Circuit” functions.
3. Circuit breakers shall employ a self-powered stored energy, quick make-quick break, and trip free operating system on each phase, with common trip. Circuit breakers shall not trip in the event of short term or long-term electrical power failure. Dead front covers accessible close-open controls, monitors and visual indicator flags.
4. Provide conductor lugs for circuit protection devices to accept conductor temperature rating, sizes and quantities shown on Drawings. Circuit protection devices shall be UL-listed suitable for normal and reverse feed.
5. Circuit breakers shall be Molded Case Circuit Breaker type with the specified circuit breaker protection time/ current performance characteristics.

    a. NEMA-AB1 and AB3 comply with latest revision.
    b. UL-1087, UL-489 and IEC-60.947.2 rated devices, comply with latest revision.
    c. 5Hz AC closing and 3Hz AC trip and clear.
    d. Sealed enclosed housing.

2.3 GENERAL CONSTRUCTION

A. Switchboard shall be floor mounted, dead-front, dead-rear type, front and rear aligned, self-supporting, consisting of several vertical sections with bussing, utility company instrumentation, and cable termination facilities. Switchboard shall comply with UL Standard #UL-891 and NEMA-PB2.

B. Switchboard shall include but not be limited to the following:

1. Main disconnect device.
2. Section and termination facilities for utility company supply conductors.

3. Bussing and termination facilities for load side feeder.

C. Switchboard Sections

1. Floor standing, self-supporting, of the universal frame type using die-formed, 12-gauge steel members bolted and welded together.
2. Provide ventilation openings required for maintaining nominal operating temperature.
3. Provide removable steel cover plates for all usable device spaces. Provide lifting means and provisions for moving by means of rollers or skids to installation location.
4. Bolt individual Sections together to form a single rigid switchboard assembly.
5. Provide full height, hinged, vertical wireway metal covers, on each vertical wireway, of each Distribution Section of the switchboard.

PART 3 - EXECUTION

3.1 GENERAL

A. Install equipment in accordance with Manufacturer's written instructions and applicable portions of NECA's "Standards of Installations" for switchboards, switchgear and motor control centers.

B. Prior to Energizing and Testing, Manufacturer’s Field Engineer shall visually inspect and verify devices that are operational, and bus connects complete.

3.2 ANCHORING

A. Bolt equipment to concrete pad.

B. Equipment anchoring shall be designed for compliance with the earthquake seismic vertical and lateral acceleration of the equipment installation location.

3.3 ARC FLASH LABELS

A. Provide permanent warning labels on each equipment location. The labels shall describe arc flash safety precautions and protective clothing.

END OF SECTION 262413

SECTION 262415
PANELBOARDS

PART 1 - GENERAL

1.1 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery, and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:

1. Examine all other Specification Sections and Drawings for related work required to be included as work under Division 26.
2. General Provisions and Requirements for electrical work.

1.2 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Provide Manufacturers Catalog Data for Panels, and Circuit Breakers.

B. Provide Shop Drawing showing Panel Circuit Arrangements, size, voltage, ampacity, overcurrent protective devices, etc.

C. Provide Nameplate Engraving Schedule.

PART 2 - PRODUCTS

2.1 PANELBOARDS

A. Shall be surface mounting as indicated with group-mount circuit protection devices as shown on panel schedule, hinged lockable doors, index cardholders, and proper bussing.

1. Panelboards shall comply with the latest versions:

a. NEMA – PB1.
b. UL – 50 and 67.
c. CEC/NEC.
d. ASTM-B187.

2. Where indicated on the Drawings shall be furnished with sub-feed breakers and/or additional conductor lugs, split bussing, contactors, time switches, relays, etc., as required.

a. Branch circuit panels up through 54-circuits shall be single sections, to accommodate all the circuits and components.

B. Housing and Painting

1. Shall be finished with one coat of rust inhibitor zinc chromate and coat of primer sealer after a thorough cleaning.
2. Manufacturer's standard color in electrical rooms/closets, janitors, HVAC, and storage rooms.
3. Shall be fabricated of sheet steel of the following minimum gauges.

    a. Full height hinged, locking door. Trim #12-gauge steel; enclosure - Code gauge steel.
    b. Panels installed in indoor dedicated electrical equipment rooms and dedicated electrical equipment closets provide panel doors without locks.

4. NEMA-1 Metal Housing, for indoor locations.
5. Fasten the trim to panel and terminal cabinets by means of concealed, bolted or screwed fasteners accessible only when the door is open.

C. Panels 208/120 volt, three phase, 4 wire, S/N as manufactured by:

1. Eaton "Pow-R-Line 1 or 2" Series
2. Siemens "P1/P2" Series
3. Equal by Square D.

E. Top and Bottom Gutter Space shall not be less than 6-inches high. Provide 6-inches additional gutter space in all panels where double lugs are required, or where cable ampere size exceeds bus ampere size.

F. Panel Dimensions shall be 20-inches wide with depth 5.75-inches nominal. Height of panel as required for devices.

G. Panels shall have a circuit index cardholder removable type, with clear plastic cover. Index card shall have circuit numbers imprinted to match circuit breaker numbers.

1. The panel identification nameplate shall describe the respective panel name and voltage, corresponding to the contract documents.
2. The electrical power source, name, and location of each panel supply-feeder and supply equipment name shall also be identified and described on the respective panel nameplate.

H. Seismic Earthquake and Wind Loading Withstand, Testing and Certification (Additional Requirements)

1. The complete panel/panelboard assembly; including circuit protection devices, housing/ enclosures, accessories, supports/anchors etc., shall be designed, manufactured and tested for wind loading and earthquake seismic install location withstand.
2. Shall withstand, survive, and maintain continuous non-interrupted energized operation (running) during the seismic event occurrences. Continued normal energized operation after the wind event and seismic event occurrences have abated.
3. Shall include demonstrations of successful operation and run test after completion of seismic event shake-table simulation.

2.2 SHORT CIRCUIT RATING

Circuit Protective Devices and Bussing as indicated on the Drawings. All devices and bussing shall have a short circuit fault withstand and interrupting capacity not less than the maximum available fault current at the panel and as indicated on the Drawings.

2.3 PANEL CIRCUIT BREAKERS, CIRCUIT PROTECTION DEVICES

A. Circuit Breakers General, for Distribution Panels and Panelboards

1. NEMA-AB1 and AB3, comply with latest revision.
2. UL-1087, UL-489 and IEC-60.947.2 rated devices, comply with latest revision.
3. 5Hz AC closing and 3Hz AC trip and clear.
4. Circuit breakers smaller than 100-amp trip shall be Molded Case Circuit Breakers type-MCCB and/or Current Limiting Circuit Breakers type-CLCB.
5. All circuit breakers 100 amp and larger trip shall employ sensors and solid state digital electronic automatic trip system. Short-time and long-time time/current curve shaping field adjustable functions and adjustable instantaneous trip.

B. Circuit breakers shall be manufactured by the same company as the panel.

C. Configuration

1. Circuit breakers shall be arranged in the panels so that the breakers of the proper trip settings and numbers correspond to the numbering in the panel schedules on the Drawings.
2. Circuit numbers of breakers shall be black-on-white micarta tabs or other previously approved method. Circuit number tabs, which can readily be changed from front of panel, will not be accepted. Circuit number tabs shall not be attached to or be a part of the breaker.
3. Panelboard circuit protection devices shall be bolted on type for connection to panel bus. Removable and installable without disturbing adjacent devices.
4. Provide conductor wire terminations (lugs) on each circuit protection device for incoming main feeder, branch circuits and outgoing feeder circuits. Dual rated copper/aluminum and compatible with the respective conductor size, type, and quantity.
5. Where 2-pole or 3-pole breakers occur in the panels, they shall be common trip units. Single pole breakers with tie-bar between handles will not be accepted.
6. Branch circuit panels shall be field convertible for bottom entry main incoming feeder or top entry main incoming feeder.

D. Lock-Off and Lock-On

1. All circuit breakers shall be pad-lockable in the "OFF" position.
2. Where branch circuit breakers supply the power to motors and signal systems, the breakers shall also be furnished with lockout clips, mounted in the “ON” position. The breakers shall be able to trip automatically with lockout clips in place.
3. Provide lock-on clips on branch circuit breakers supplying fire alarm equipment and fire alarm panels. Provide identification of the dedicated "Fire Alarm" circuit

function and operation. Color-code the circuit breakers to comply with AHJ Requirements.

4. Locking facilities shall be riveted or mechanically attached to the circuit breaker (submit sample for approval). Other means of attachment shall not be accepted without prior written approval of the Owner's Representative.

2.4 PANEL BUSSING

A. Bus Material

1. Bussing shall be rectangular cross section tin-plated copper. Aluminum bussing shall not be used.
2. Bussing shall be non-tapped, full length of the enclosure.

B. Ground Bus

1. Each panel shall be equipped with a ground bus secured to the interior of the enclosure. The bus shall have a separate lug for each ground conductor. No more than one conductor shall be installed per lug. Panels designated with isolated ground busses shall have a second ground bus not bonded to the panel enclosure,

C. Provisions

1. Provide space and all hardware and bus mounting attachments for future devices as indicated on the Drawings.

PART 3 - EXECUTION

3.1 MOUNTING

A. Surface Mounted Panels and Terminal Cabinets shall be secured to walls by means of preformed galvanized steel channels securely fastened to at least two studs or structural members.

B. Panelboards and Terminal Cabinets shall be installed to ensure the top circuit protective device (including top compartment control devices) are not more than 6-feet-6-inches above finish floor in front of the panel and the bottom device is a minimum of 12-inches above the floor.

3.2 IDENTIFICATION (ADDITIONAL REQUIREMENTS)

A. Manufacturer shall stencil the panel/cabinet number identification on the inside of door to correspond with the designation on the Drawings.

B. Identification Plates and Numbers shall be attached with screws or twist lock fasteners. Adhesive attachment of any kind shall not be used.

END OF SECTION 262415

SECTION 265005
LIGHTING FIXTURES

PART 1 - GENERAL

1.1 SCOPE

A. Work Included:

All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery, and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:

1. Examine all other Specification Sections and Drawings for related work required to be included as work under Division 26.
2. General Provisions and Requirements for electrical work.

1.2 SUBMITTALS (ADDITIONAL REQUIREMENTS)

Provide complete Manufacturers Catalog Data Information for each light fixture (luminaire), driver, lamp, materials, auxiliary equipment/devices, finishes and photo-metrics.

1.3 QUALITY ASSURANCE (ADDITIONAL REQUIREMENTS)

A. Work and Materials shall be in full accordance with the latest Rules and Regulations. The publications shall be included in the Contract Document Requirements. If a conflict occurs between the following publications and any other part of the Contract Documents, the Requirements describing the more restrictive provisions shall become the applicable Contract definition:

1. UL – Underwriters' Laboratory:

   a. UL – 8750 and 1598C: Light Emitting Diode – LED Equipment for use in Lighting Products and Replacements

2. NEMA – National Electrical Manufacturers Association:

   a. NEMA – LE4: Recessed Luminaries Ceiling Compatibility
   b. NEMA – SSL #1, #3 and #6: Electronic Drivers for LED; LED and Incandescent Lamp Replacement
   c. NEMA – LSD #44, #45, #49 and #51: SSL-solid state lighting

3. United States Federal Government:

   a. FCC – Part 18: EMI and RFI emissions limitations.
   b. EPA: Energy conservation publications and waste disposal regulations.

4. ETL and C.B.M. Certified and Approved.

5. Electrical installation standards, National Electrical Contractors' Association:

    a. NEIS/NECA/IESNA – 500: Recommended Practice for installing Indoor Commercial Lighting Systems.
    b. NEIS/NECA/IESNA – 501: Recommended Practice for installing Exterior Lighting Systems
    c. NEIS/NECA/IESNA - 502: Recommended Practice for installing Industrial Lighting Systems.

6. Illuminating Engineering Society – IES (IESNA):

    a. IES – LM41: Photometric and Reporting.
    b. IES – 587: Transient Surge Protection.
    c. IES – LM79: Solid State Lighting (SSL) Testing and Measurement.
    d. IES – LM80: Testing for Lifetime of LED.

7. ANSI-American National Standards Institute:

    a. ANSI – C81
    b. ANSI – C82
    c. ANSI – C62.41: Transient Withstand
    d. ANSI – C78: Lamps

8. State California Code of Regulations - Title-24: Energy Code

PART 2 - PRODUCTS

2.1 GENERAL

A. Complete Fixture

1. Provide light fixtures complete including lamps, drivers, housings, ceiling and wall trim "rings" for each ceiling type, mounting and adapter support brackets, diffusers/lenses and outlet boxes.
2. Include an allowance of $800.00 to furnish a light fixture for each lighting fixture outlet shown on Drawings without a fixture type designation. Include installation costs in base bid.

B. Specific Fixture Requirements and Fixture Schedule Information

1. The catalog numbers included in the description of the various types of lighting fixtures shall be considered to establish the type or class of the fixture with a particular Manufacturer only. The fixture length, lumen outputs, component materials, accessories, mounting type, ceiling, wall and install adapters, operation voltage, and all other components required to fulfill the total description of the fixture based on all drawing information, branch circuits, voltages, Specification information, and shall be included in the Contract Requirements regardless of whether or not the catalog number specifically includes these components.

2. Lighting fixtures shall be the types as indicated in fixture schedule on the Drawings and as described in the Specifications.
3. All fixtures of the same fixture type shall be the same Manufacturer and of identical finish and appearance, unless indicated otherwise on Drawings.

C. Manufacturer Certification of Operation

1. Lamps and power supplies (drivers) shall be recommended and certified by the respective Manufacturer(s), to be "matched" to operate correctly together, within the published characteristics, for efficacy, lamp starting, operating life hours, lumen output, power factor, power input, operating line ampere, sound intensity, and temperature.

2.2 LIGHT FIXTURES (LUMINARIES)

A. Lighting fixtures shall have all parts, drivers, sockets, support attachments, trim flanges and fittings necessary to complete and properly install the fixture at the indicated installation locations. All fixtures shall be provided with lamps of size and type specified.

B. Where fixture color is indicated to be selected by the Architect and/or Owner's Representative, provide two color chip samples for each color for review.

PART 3 - EXECUTION

3.1 LIGHT FIXTURE INSTALLATION

A. General

1. The Contractor shall verify actual ceiling and wall construction types as defined on the Architectural Drawings and furnish all lighting fixtures with the correct mounting devices, trim rings, brackets whether or not such variations are indicated by fixture catalog number. The Contractor shall verify depth of all recessed lighting fixtures with Architectural Drawings prior to ordering fixtures. Any discrepancies that would cause recessed lighting fixtures not to fit into ceiling shall be reported to the Owner's Representative prior to release of order to the supplier of the fixtures.

C. Fixture Supports

1. The support wires for light fixture support shall be 12-gauge steel (minimum). The wires including their building and light fixture attachments shall provide support capacity of not less than four times the weight of the light fixture assembly. Provide additional light fixture support wires and building anchors to meet these Requirements, as part of the Contract. The support wires shall be anchored to the building structural elements above the ceiling.
2. Pendant mounting fixtures shall be supplied with swivel hangers. Fixtures shall swing in any direction a minimum of 45-degrees of gravity, position. Fixtures shall have special stem lengths to give the mounting height indicated on the Drawings. Stem to be single continuous piece without coupling, and to be

finished the same color as the canopy and the fixture, unless otherwise noted. The Contractor shall check all lock nuts and set screws to rigidly secure the swivel socket to the stem, and the stem to the outlet box.

3. Fixtures shall be plumb and vertical. Where obstructions occur restricting 45-degrees free-swing of fixtures, the fixtures shall be "guy" wired to prevent fixtures from striking obstructions. The Owner's Representative shall approve method of guying. Swinging fixtures shall have an additional safety hanger cable attached to the structure and the fixture at each support, with the capacity of supporting four times the vertical weight of the light fixture assembly.
4. Suspended fixtures weighing in excess of 40-pounds shall be supported independently of the fixture outlet box. Provide "aircraft" (minimum 12 gauge) steel hanger cable for suspended fixtures route cable concealed or in pendant where possible. Each cable attachment shall support four times the weight of the fixture assembly. Securely attach the cable to the building structure.
5. Surface mounted fixtures installed on drywall or plaster ceilings and weighing less than 40-pounds may be supported from outlet box. Provide structural supports above drywall or plaster ceilings for installation of fixtures weighing more than 40-pounds and secure fixture to structural supports. The use of toggle bolts is prohibited.

END OF SECTION 265005

SECTION 272000
STRUCTURED CABLING

PART 1 - GENERAL

1.1 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:

1. Examine all other Specifications Sections and Drawings for related work required to be included as work under Division 26.
2. General Provisions and Requirements for electrical work.

B. Provide Structured Cabling Infrastructure for the following systems:

1. Computer Data Networks
2. Telephone Voice Communications.

C. Provide MDF rack and Category 6A connectors in outlet boxes and on patch panels in equipment racks as shown on Plans. Using the conduits and pathways shown on the Plans provide the following:

1. Metal rack to contain network electronic equipment and cabling.
2. Category 6A copper cables from MDF to outlets shown on plans.
3. Patch panel, patch cords, powert outlet, grounding, and accessories at MDF.
4. Rack space in the MDF for City-furnished network electronic equipment and file servers.

1.2 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit Manufacturer's standard catalog data for each component. The submittal shall list the name, the proposed model and Manufacturer for each item as well as a reference indicating the specific piece of data which can be easily located in the brochure. The Manufacturer's data sheets shall be marked to indicate the specific item being proposed in cases where the sheet covers several types or sizes of items.

B. Submit extended warranty statements that will be in effect when the installation is complete.

C. Submit installer qualifications.

1.3 APPLICABLE STANDARDS

A. Individual Component Production/Manufacturer Testing and Labeling.

1. The equipment shall be UL listed, labeled, and approved for the application shown in the Contract Documents.
2. ETL (USA) each network systems infrastructure component.

B. The complete system material, equipment, testing, installation, workmanship and installed performance shall comply with the Mandatory Requirements and the Guideline/ Recommendation Requirements of the following latest published version, supplements, latest revision including Addendums and TSB. Both the mandatory and advisory criteria shall be included as Requirements of the Contract Documents:

1. TIA 526 – Optical Power and loss measurements – multimode and single mode fiber.
2. ANSI/TIA-568C - Commercial Building Telecommunications Standards.
3. ANSI/TIA-569B – Commercial Building Standards for Telecommunications Pathways.
4. ANSI/TIA-570A - Residential Telecommunications Standard.
5. ANSI/TIA-598B - Optical Fiber Cabling Color-coding.
6. ANSI/TIA-606A - Administrative Standard for Commercial Telecommunications Infrastructure.
7. ANSI/TIA-607 - Commercial Buildings Grounding and Bonding Requirements for Telecommunications.
8. FCC – FYU/FT6.
9. ISO/IEC 11801
10. National Electrical Code (NEC) and California Electrical Code (CEC) including Articles 770 and 800 with ETL verified testing and local Code Jurisdictions.
11. NECA/NEIS, National Electrical Contractors Association, National Electrical Installation Standards:

    a. 301 – Standard for Installation and Testing for Fiber Optic.
    b. 568 – Standard for Installing Building Telecommunications Bonding and Grounding.
    c. 607 – Telecommunications

C. The entire completed Electronic Network Systems Infrastructure shall be tested and provide electronic data/network and telephone/voice multi-channel communications latest Revisions, Standards and Addendums for the following protocols:

1. IEEE 802.3/ETHERNET latest revisions:

    a. 10Mbps 10Base-T, 100Mbps 100Base-Tx, and 1000Mbps (1Gbps) 1000 Base-Tx for copper wire; 100-meter communications pathway distance.
    b. 10Mbps 10Base-F1, 100Mbps 100Base-FX, 1000Mbps 1000Base-Lx-Sx and 10,000 Mbps (10Gbps) for fiber optics; 550-meter communications pathway distance, OM4 Standard.
    c. IEEE-802.3 for Power Over Ethernet (POE) and Power Over Ethernet-Plus (POE

D. The complete telephone/voice infrastructure system shall be suitable for the telephone / voice analog and digital communications and VoIP protocols.

E. Installation of all infrastructure equipment, devices, splices, terminations, cables, outlets, etc. shall comply with Manufacturer's recommendations.

1.4 EQUIPMENT QUALIFICATIONS

A. Equipment

1. The Supplier of the equipment shall be the factory authorized Distributor and service facility for the brands of equipment and material provided.
2. Network systems, infrastructure, equipment and materials shall all be the product of one of the individual same Manufacturers as follows. Typical unless specifically described otherwise:

   Belden – 10GX series; or CommScope-Systimax X10D Series:

   or AMP/Tyco – NetConnect Series.

   or Ortronics/Legrand – NetClear Series

   or equal.

B. Installation Certification

1. Work and material for cables, cable terminations, outlets and related components for infrastructure systems shall be performed by Certified Installers. The Installer shall be certified by the Respective Product Manufacturers.
2. The Manufacturers of the indicated work and material shall provide an Installer education/ training and certification program for the supplied products.
3. The Installers performing the Contract work for the indicated products shall have attended and successfully completed each of the respective Manufacturer's installation training education programs for the specified products.

C. Extended Material and Performance Warranties

1. In addition to the warranty Requirements described elsewhere in the Contract Documents, provide extended material and performance warranties. The warranty period shall be for not less than 20-years from the Contract Notice of Completion.
2. Warranty scope includes materials and performance for network cables and terminations, network workstation plug-in outlets, and patch panel plug-in outlets, cable splices, and connectors.
3. Repair or replace the defective material with new material at the project premises, to comply with the performance standards outlined in the Contract Documents during the warranty period.

1.5 ABBREVIATIONS

Abbreviation	Terminology
ACR	Attenuation to Cross Talk.
AHJ	Authority Having Jurisdiction.
Backbone	Circuit interconnections between MDF and IDF patch panel locations.
dB	Decibel.
dBm	Decibel referenced to a milliwatt.

Demarc	Demarcation location where operational control change occurs, or ownership change occurs.
ft.	Feet.
GHz	Gigahertz.
Gbps	Gigabits per second.
Horizontal Connection, and/or Horizontal wiring	Circuit interconnections between individual workstation outlet location to respective IDF or MDF equipment rack patch panel.
IDF	Intermediate Distribution Frame (horizontal or vertical cross connect) for an individual building area/floor.
km	Kilometer-lkm.
kPSI	1000 pounds per square inch.
m	Meter = 39.37 inches.
Mbps	Megabits per second.
MDF	Main Distribution Frame (central/main cross connect) for multi-building site or for a single individual building.
MHz	Megahertz.
MIC	Micrometer
mm	Millimeter = $l0^{-3}$ meter.
NEXT	Near end cross talk.
nm	Nanometer = 10^{-9} meter.
pF	Picofarad = 10^{-12} farad.
Provide	Furnish, install, and connect.
RTDE	Equipment rack-mount fiber optic termination distribution enclosure, with fiber optic patch panel.
RMSE	Equipment rack mount fiber optic enclosure, splice only (without patch panel).
STP	Shielded individual twisted pairs copper wire.
ScTP	Shield Screened Twisted Pairs copper wire.
um	Micrometer = 10^{-6} meter.
USE	Universal Splice Enclosure.
UTP	Unshielded twisted pairs copper wire.
VoIP	Voice communications Over Internet Protocol.
WGNA	Wide Band Gigabit Networking Alliance.
Workstation or Workstation location	Spaces remote from the MDF/IDF terminal room/closet, where user equipment interacts and connects with the electronic systems infrastructure equipment connection outlet device.
WMIC	Wall Mount fiber optic cable Interface Cabinet.

1.6 MATERIALS AND METHODS

A. Material and Labor not complying with the Contract Documents shall be removed by the Contractor from the Project Site. Material and labor complying with the Contract Documents shall be provided.

B. All the cost to remove deficient work and material, provide work and material complying with the Contract Documents and the direct, indirect, incidental damages and Contract delays resulting from complying with these Requirements shall be the sole responsibility of the Contractor and shall be included in the bid price.

C. System Performance Requirements

1. The work, performance and type of materials provided as part of the Contract shall comply with ANSI/TIA-568C and related Standards for Category 6e cabling systems.

PART 2 - PRODUCTS

2.1 COPPER WIRE CABLES (TWISTED PAIRS)

A. General

1. Conductors shall be copper wire, individually insulated and color-coded, with multiple conductors arrange in twisted pairs.
2. An overall non-conductive jacket shall encase the copper wires and any shielding (where shielding is specified) shall also be encased by the jacket.
3. Cables shall be UL listed, complying with CEC – California Electrical Code, National Fire Protection Agency and NFPA Requirements for each installation location shown. ETL tested and certified to comply with or exceed Specified Requirements.

    a. NEC – MPP/CMP, FHC-25/50 (plenum type locations and locations where not continuously enclosed inside conduit).
    b. CEC – MPR/CMR (Vertical riser type locations).
    c. ANSI/TIA-568C; including related Standards, Amendments, and TSB.

4. The outer cable jacket shall be imprinted with date, Manufacturer’s model and catalog number and agency (AHJ) listing identification.
5. Cables installed in raceways or conduits below grade, through in-grade manholes and pullboxes shall be rated for installation in water/wet locations.
6. Copper Wire Electronic Network Systems Infrastructure cable shall be a product of the same Manufacturer, including portable patch cables.

B. Category-6A Computer/Data Cables – UTP

1. Category-6A cables shall be tested and shall pass the ANSI/TIA test recommendations for Category-6A.

2.2 COPPER WIRE OUTLET CONNECTORS

A. Connectors shall be Category 6A complying with ANSI/TIA 568C, female modular jack 8-position/contact "RJ-45" style, related Standards, Amendments.

B. Connectors shall comply with FCC part-68 Subpart F for gold plating.

C. Shall be UL listed and shall comply with UL94V-0

D. Provide a connector on each end of each cable.

2.3 COPPER WIRE PATCH PANELS

A. General

1. Copper wire patch panels shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed Specified Requirements, ANSI/TIA-568C including related Standards, Amendments and TSB.
2. Copper wire patch panels shall be the product of the same Manufacturer.

B. Equipment Rack Mounted Patch Panel

1. Standard EIA 19-inches wide metal panel, Manufacturers standard color. Pre-punched for copper wire outlet connectors. Panel shall mount on an EIA Standard 19 inches wide enclosed or open frame equipment rack assembly. Nominal 24-copper wire outlet connectors in a horizontal row, quantity of rows as required for total quantity of connectors. Provide not less than two spare empty rows for future copper wire outlet connectors.
2. The copper wire connector installed in the patch panel shall be the same configuration, Manufacturer and type as the corresponding copper wire connector provided in the remote workstation outlet locations connecting to the respective patch panel outlet, unless indicated otherwise.

2.4 EQUIPMENT RACK

A. Rack shall be Chatsworth Products “Cube-It” series or equal, 48”H. x 24”D. with black finish and tempered glass locking door.

1. Rack shall be designed by the Manufacturer for the specified purpose and constructed of steel. Rack shall have swing out design feature with fixed rear panel, hinged swing-out center section, and locking hinged tempered glass door with extruded metal frame. Overall size shall be 48-inches H. x 24-inches W. x 24-inches D. Finish shall be powder coat black.
2. Rack shall be listed under UL 2416 rated to carry 300 pounds.
3. Rack shall have aluminum predrilled EIA equipment mounting rails front and rear to support specified cable termination and patch panels plus District-installed network electronic equipment.
4. Rack shall be equipped with a minimum 100CFM fan, filter, and vent cover to pressurize the interior and force warm air out vents in the cabinet. Fan noise shall not exceed 39dB at 3ft. from rack. Fan shall be 120-volt and be furnished with cord and plug. Provide one 5-pack of replacement filters for each rack.
5. Rack shall have vertically mounted cabling section on each side of mounting rails for copper wire cable management.
6. An equipment grounding bus, UL labeled as a ground terminal bus, shall be provided in each equipment rack. The ground bus shall be bolted to the rack main metal frame member with 1-inch standoff non-insulating bolts.
7. Rack shall have surge-protected power receptacles in rack mounted housing equal to Eaton “Tripp Lite” # ISOBAR12ULTRA series with 12-outlets including 2 on front face and 10 on rear face. Unit shall provide full normal mode (H-N) and common mode (N-G/H-G) line surge suppression and filter out disruptive

EMI/RFI line noise per IEEE 587 Category A and B surge suppression specifications.

2.5 PORTABLE PATCH CORDS

A. General

1. Provide portable patch cords for all copper wire connectors at the MDF rack.
2. Patch cords shall be factory assembled tested and certified with factory terminated plugs at each end. Field terminated portable patch cords shall not be permitted. Terminated plugs shall incorporate integral bending radius limiting molded “boots” and strain relief. Patch cord assemblies shall be rated for "heavy duty", “high-abuse” service.
3. Patch cords shall be UL listed, complying with CEC – California Electrical Code, ETL tested and certified to comply with or exceed Specified Requirements. ANSI/T1A 568C related Standards, Addendums and TSB.

    a. CEC - MPP/CMP/CMR/CMG/MPG for copper wire twisted pair portable patch cords.

4. Patch cords which are not installed shall be delivered to the Owner in cardboard boxes. The patch cords shall be neatly bundled and tied together. Mark each box with quantity and type of cords contained in the box.
5. Patch cords shall comply with the same Cable Communication Performance Requirements, Protocol Requirements and Testing Requirements as the respective infrastructure cables and outlets to which the patch cords are intended to be connected (plug-in). Patch cords shall be the product of the same Manufacturer.
6. The outer jacket of each portable patch cord shall be imprinted with date, Manufacturer’s model and catalog number, and AHJ listing identification.
7. Provide a permanent, visible, factory applied identification number on each end of each patch cord. The identification number shall be the same on each end. However, the numbers shall increase sequentially on each patch cord and shall be unique and not duplicated on other patch cords. Permanently apply the identification numbers on the cable jacket or connectors.

B. Copper Wire Portable Patch Cords

1. Twisted Pairs portable patch cords, general:

    a. "Male" eight positions modular "RJ" male style jacks install on each end of the patch cord cable. The jack shall be provided with a rear "fin" to prevent the plug tab from snagging when pulled backwards through adjacent wiring.
    RJ-45 style “male” jack, typical unless noted otherwise.
    b. Patch cord cable shall be UTP ANSI-Category 6A rating, shall match respective premise wiring, 4-pair twisted, stranded copper individually insulated wires, thermoplastic jacket over all the wires.
    c. Connectors shall comply with FCC 68.5 and Part 68 Subpart F.
    d. Connectors UL listed and shall comply with UL-94V-O.

t. Cable jacket color shall be blue.

2. Portable patch cord quantities and lengths as follows:

a. Provide one complete 3 feet long patch cord assembly for each rack mounted copper outlet in patch panels at the MDF.

PART 3 - EXECUTION

3.1 STRUCTURED CABLE TESTING (ADDITIONAL REQUIREMENTS)

A. General

1. In addition to the testing recommended in ANSI/TIA-568C and related Standards, Amendments and TSB. End-to-End pass-fail test 100% of all individual copper wire conductors, each outlet and each connector in all terminated and unterminated cables, portable patch cord, outlets and patch panels provided.
2. The test equipment and (Tester) shall comply with the Accuracy Requirements for Field Testers as defined in the ANSI/TIA Standards for the specific cable type. The Tester including the appropriate interface adapter shall meet the specified Accuracy Requirements. The Tester shall be within the calibration period recommended by the Vendor to achieve the vendor-specified measurement accuracy. The Tester shall be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. If requested, the Contractor shall provide proof that the interface has been calibrated within the period recommended by the Vendor.
3. The Pass or Fail condition for the channel pathway link-under-test is determined by the results of the required individual tests (ANSI/TIA) any Fail result yields a Fail for the link-under-test. To achieve an overall Pass condition, the results for each individual test parameter must Pass.
4. Provide all Test Equipment, Certified Testing Personnel, and setups. Shall comply with ANSI/TIA and Equipment Manufacturer’s recommendations and Standards of Practice.
5. The Contractor shall repair or replace equipment, cables, outlets, connectors, splices, terminations, etc. identified during testing as not complying with the Contract Documents, without additional cost to the Contract. Retest all replaced or repaired components at Contractor's expense.

3.2 CABLE INSTALLATION

A. General

1. Cables connecting to equipment racks and terminal blocks shall be installed with not less than 6-feet of slack cable between the equipment rack/terminal block and terminal back board. The slack cable shall be coiled and supported on the backboard and/or cable tray.
2. Cables in terminal closets and terminal rooms shall be trained, dressed and racked on the plywood backboards. Provide cable, metal support arms and re-enterable type cable support rings not less than 12-inches on center mounted onto the plywood along the entire length of all cables.

3. Provide cables installed from workstation outlets to MDF rack continuous without cutting or splices.

B. Cable Installation:

1. Minimum bending radius and maximum pulling tension of fiber optic cables shall not exceed the cable manufacturer's recommendations.
3. The minimum bending radius for copper wire cables shall be ten times the cable outside diameter. The maximum pulling tension and minimum bending radius shall not violate Manufacturer's recommendations.
4. Cables shall be pulled in a continuous, smooth operation without jerking or stop-start motion after initiation of pull.
8. Electronic network cables containing non-dielectric components shall be installed with a minimum separation from other electrical power conductors and equipment as follows:

	Equipment Type	Minimum Separation
a.	Lighting fixtures	12 inches
b.	Electric motors, electric solenoids, electric Heaters	40 inches
c.	Transformers	48 inches
d.	Circuits over 100 volts to ground, in metallic raceways	5 inches
e.	Circuits over 100 volts to ground, in non-metallic raceway or without any raceway	12 inches
f.	Circuits over 100 volts to ground, suspended on overhead pole lines	48 inches

3.3 CABLE SPLICES

A. General

1. Splice(s) in cables shall occur only at equipment racks.
2. Polarity and color-coding shall be maintained consistently through splices, terminations, and outlets for the entire electronic network system.

3.4 CABLE TERMINATIONS

A. General

1. Cat 6e twisted wire pairs shall not be untwisted for a length of more than 0.4 inches at any location and the cable jacket shall not be striped back not more than 0.5 inches at any location including splices and terminations.
3. Unless specifically directed otherwise by the Owner's Representative, Pin assignment for Cat 6e wiring terminations shall comply with ANSI/TIA 568C type T568A or Type T568B as required for compatibility with the electronic network equipment. The termination type shall be consistent throughout the Project Contract area.
4. Copper wire terminations shall be performed to maintain the transmission rates specified for the respective entire system.

3.5 EQUIPMENT RACKS

A. Install, assemble, mount and connect devices and equipment in the respective equipment racks, bolted securely to the rack frame with stainless steel hardware. "Star" style lock washers shall be provided to ensure an electrically continuous ground path between the equipment/devices and rack frames.

B. Provide blank metal filler panels to close unused equipment "front" mounting space in equipment racks, Manufacturer's standard finish color.

C. Provide a copper wire outlet connector in the respective equipment rack for each remote copper wire infrastructure workstation outlet and copper wire cable shown connected to the respective equipment rack, plus the spare copper wire outlet connectors required in the Contract Documents. The copper wire outlet connectors in the equipment racks shall be provided in equipment rack mounted copper wire patch panels. In no case shall the quantity of equipment rack mounted copper wire outlet connectors be less than the quantity of cables indicated on the Drawings, plus required spaces/spares.

D. Terminal racks, equipment locations, patch panels, and cross connects shall be arranged to allow for natural cabling progression, minimize crossing of cables and allow easy access to each system component.

3.6 MDF CIRCUIT TERMINAL ROOMS AND CLOSETS

A. Terminal Backboard

1. Provide 0.709-inch-thick sanded plywood backboard in the MDF room on the wall next to the rack. Plywood shall extend continuously from the finish floor to 8 feet above the finish floor. Sanded side of plywood shall face the interior of the room.
2. Attach plywood to wall structural framing with mechanical fasteners a minimum 6-inches on center vertically on walls at each framing vertical member, and along the length of the wall, but not less than 16 inches on center horizontally along the length of the wall.
3. Paint plywood terminal backboards after installation and prior to mounting any equipment. One coat of fire-resistant primer and two coats of fire resistant/ intumescent, non-conductive paint. Finish color matte/flat white.

3.7 GROUND (ADDITIONAL REQUIREMENTS)

A. Provide #6AWG copper ground wire in 3/4-inchC. from ground bus in MDF rack to UFER ground bus in same room.

B. Equipment Racks:

1. Provide a separate 12AWG copper stranded green insulated ground conductor from each individual equipment element in the rack to the respective rack ground bus.

END OF SECTION 272000

SECTION 274110
SPEAKER SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:

1. Examine all other Sections for work related to those other Sections and required to be included as work under Division 26.
2. General Provisions and Requirements for electrical work.

B. Provide speakers, brackets, poles, outlets and cabling as indicated on plans.

1.2 RELATED WORK:

A. Documents affecting work of this Section include but are not necessarily limited to General Conditions, Supplementary Conditions and Sections of Divisions 1 and 26 of these Specifications.

B. The work described by this part includes the furnishing of all materials, equipment, supplies, labor and the performing of all operations necessary for the installation of complete and operating systems.

1.3 INSTALLER QUALIFICATIONS

The Installing Communications Contractor shall be regularly engaged in the business of installing permanent sound reinforcement systems.

1.4 QUALITY ASSURANCE:

A. Electrical Component Standard: Provide work complying with applicable Requirements of NFPA 70 "National Electrical Code" including, but not limited to:

1. Article 250, Grounding.
2. Article 300, Part A. Wiring Method.
3. Article 310, Conductors for General Wiring.
4. Article 725, Remote Control, Signaling Circuits.
5. Article 800, Communication Systems.

B. EIA Compliance: Comply with the following Electronics Industries Association Standards:

1. Sound Systems, EIA-160.
2. Loudspeakers, Dynamic Magnetic Structures, and Impedance, EIA-299-A.

3. Speakers for Sound Equipment, SE-103.

1.5 SUBMITTAL AND MANUALS (ADDITIONAL REQUIREMENTS)

A. General

1. Submittal shall include Installer qualifications.
2. Submittal shall include Manufacturer's product data sheets for all system components including mounting and wiring accessories.

PART 2 - PRODUCTS

2.1 GENERAL OPERATION

The completed system shall be idle until a third party connects the output of an amplifier to the speaker input terminal box at the stage. When the amplifier is connected, the audio program shall sound uniformly over the listening area. The amplifier and audio program are by others.

2.2 SPEAKERS

System speakers shall be JBL AWC129 series all-weather compact 2-Way Coaxial Loudspeaker with 12-inches low frequency driver, 1-inch compression driver, and 200-watt 70-volt multi-tap transformer, with gray U-bracket.

2.3 CABLE

Speaker cable shall be Belden #1311A or equal 2 Conductor 12 AWG (168 x 34) Oxygen-Free Bare Copper (High Conductivity), PE Insulation, PVC Jacket, CM, and rated for direct burial.

2.4 ACCESSORIES

A. Provide speaker mounting bracket for each pole as indicated on plans. Brackets are required for 2-speaker and 3-speaker per pole.

B. Speaker input jacks at stage shall be ¼-inch phone jack mounted on a panel inside a Pass & Seymour / Legrand #4600 series weatherproof flush locking wall box. Furnish six keys to Owner.

PART 3 - EXECUTION

3.1 GENERAL

Position speakers to ceiling at approximate locations shown on Plans and adjusted for best sound coverage. Set transformer taps to 16 watts. Adjust taps up or down during testing to achieve best results.

3.2 INSTALLATION

A. The wiring of the system shall be executed in accordance with the Drawings and the Equipment Manufacturer's Wiring Diagrams.

B. Furnish all conductors, equipment plugs, terminal strips, etc., and labor to install a complete and operable system.

C. The labor employed by the Contractor shall be regularly employed in the installation and repair of communication systems and shall be acceptable to the Owner and Architect to engage in the installation and service of this system. The systems shall be installed in accordance with NFPA 70 and other applicable Codes.

3.3 TESTING AND TRAINING

Provide test amplifier, pre-amp, and audio source and connect to system speakers at the input jack on the stage to test and demonstrate the functionality of the system. Aim speakers for coverage of the area to satisfaction of Owner's Representative. Adjust transformer taps to achieve sound level acceptable to Owner's Representative.

3.4 PROTECTION AND CLEANING

A. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the Manufacturer.

B. Repair or replace damaged components before substantial completion of the Project.

C. Remove temporary tags, coverings, and construction debris from interior and exterior surfaces of the equipment. Remove construction debris from equipment area and dispose of properly.

END OF SECTION 274710

SECTION 275133
LINE VOLTAGE OCCUPANCY MOTION SENSORS

PART 1 - GENERAL

1.1 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:

1. Examine all other Specification Sections and Drawings for related work required to be included as work under Division 26.
2. General Provisions and Requirements for electrical work.

1.2 SUBMITTALS (ADDITIONAL REQUIREMENTS)

Submit Manufacturer's Data Sheets on sensors.

1.3 APPLICABLE STANDARDS (ADDITIONAL REQUIREMENTS)

A. General

1. All ultrasonic sensors shall comply with the State of California Safety and Health Requirements. Decibel levels for ultrasonic sensors shall comply with the following criteria and the State of California Energy Commission for ultrasonic emissions.
2. The Contractor and Manufacturer shall certify in writing that all proposed and installed occupancy motion sensors comply with the Federal Environmental Protection Agency (EPA) and State of California Energy Commission criteria.
3. Occupancy motion sensors shall be:

a. UL listed and labeled.
b. Certified for compliance with Federal-EPA and State of California Title-24 Energy Commission Requirements.

PART 2 - PRODUCTS

2.1 MOTION SENSORS

A. General

1. Motion sensors and power supply shall be self-contained. The motion sensors shall be solid state low voltage devices designed specifically for energy conservation lighting control. Combined dual function ultrasonic and infrared motion sensing.

a. Ultrasonic crystal controlled to within ±0.01% motion sensor technology.

b. Passive Infrared (PIR) motion sensor technology.

2. Occupancy motion sensor shall also include available ambient light sensor, in addition to the motion sensor. The ambient light sensor shall prevent the occupancy motion sensor from automatically turning “ON” the respective lighting when the ambient day lighting intensity detected by photoelectric cell contained in the motion sensor exceeds a selected intensity. The ambient light sensor circuit shall not control the automatic off function. The ambient lighting intensity detection sensitivity shall be adjustable in the sensor, adjustment range not less than 15 through 140-ambient day lighting footcandles.
3. Automatic-off: sensor shall automatically turn "OFF" lighting when there is no movement after the preset time delay interval. Lights shall remain "on" with movement. There shall be a "dead band" time period after the unit turns itself off (because of lack of motion) during which a new motion will automatically turn lights on without the manual switch having to be activated.
4. Automatic-on: Sensor shall automatically turn “ON” lighting when movement is detected in the monitored space. Lights shall remain on with movement. An internal control shall provide a mechanism to bypass the automatic-on control feature and allow only automatic-off functions. Where manual on/off dimming lighting control switches are shown on the Drawings, in addition to the occupancy motion sensors in the same space, the manual controls shall override the automatic "ON" control feature of the occupancy motion sensor. Override of the automatic "off" feature shall not be affected by the respective manual switches.
5. Motion detection sensitivity, time delays to turn “ON” after activation and time delays to turn “OFF”, shall be adjustable to ensure there will be no nuisance on/off switching of the lights by the motion sensor while the room is occupied. Adjustable settings shall be tamper-resistant, concealed behind an access protection cover.
6. Automatic self-adjusting Adaptive-Learning for time delay and sensitivity variable conditions in the monitored space.
7. Fail-to-on, the failure of a sensor shall cause the occupancy motion sensor load relay contacts to activate, so the occupancy motion sensor function is automatically by passed and lighting is turned-on.
8. All occupancy motion sensors shall be provided with an indicator light to display when motion is being detected and the unit is operating correctly.
9. Non-volatile internal memory shall store and maintain in memory all occupancy motion sensor settings during any electric power failure.
10. Where multiple occupancy motion sensors are installed with overlapping monitoring spaces, the sensors shall not cause false triggering or malfunctions to adjacent occupancy motion sensors.
11. Occupancy motion sensors shall incorporate mechanical vibration-damping. The vibration damping shall prevent normal building vibrations from causing “False” sensor operation.
12. As manufactured by WattStopper; or Leviton; or equal.

B. Area Control Coverage

1. Space coverage of motion sensor transponder shall remain constant after sensitivity control has been set. No automatic reduction/increase in cover-age nor sensitivity shall occur when air motion caused by air conditioning or heating

fans are in operation nor when the occupancy motion sensor has turned off lighting due to not detecting any motion.

2. Occupancy motion sensors in spaces 300-square feet area or less may be a wall switch mounted unit.

    a. Wall switch sensors shall provide detection of motion at desktop, for up to 300-square feet, 180-degree range within a volume dimension of up to approximately 20-feet by 15-feet by 10-feet high, extending from the wall mounting height of the unit to the finish floor.
    b. Wall switch occupancy motion sensors shall be a minimum load capacity of 500 watts 120V; 1000 watts 277V, but in no case shall the load rating be less than the lighting loads shown on the Drawings.
    c. Refer to Drawings for sensor locations and switching

        1) The wall motion sensor switch shall be supplemental control to the external manual control lighting wall switch(es) shown on the Drawings in the same room as the respective wall switch occupancy motion sensor.
        2) The wall motion sensor switch shall be provided in place of the manual control switch(es). Wall switch occupancy motion sensors shall be equipped with manual override internal switch accessible on the front of the enclosure housing. The internal manual override switch shall turn "ON" the lights and turn "OFF" the lights when manually activated.

3. Motion sensors in spaces exceeding 300-square feet in size and where shown on the Drawing as mounted on the ceiling, shall be ceiling mounted. The sensor shall not protrude more than 1.6-inches below the ceiling line.

    a. Sensor area coverage shall be 360-degrees three-dimensional diameter surrounding the sensor installation location.
    b. The sensor shall be rated to provide coverage of the space volume/room length/width/height shown in the Contract Documents. Provide additional ceiling mounted motion sensors to provide complete coverage of each area.
    c. Corridor/hallway sensor area coverage shall not be less than 80-linear feet extending from the sensor installation location. Sensor shall be bi-directional or unidirectional to provide complete area motion detection at the installation location shown on the Drawings.

2.2 CONTROL UNITS

A. General

1. Control unit shall be an integrated, self-contained unit consisting internally of load switching control relay(s), internal power supply and power supply transformer. The power supply shall be sufficient capacity to provide low-voltage power to a minimum of two motion sensors.

2. Occupancy motion sensors directly controlling line voltage electrical loads, the line voltage load relay contacts shall be “Dry” type electrically isolated, with load ratings as follows:

   a. 15A – 120-volt single phase 60Hz AC.
   b. 15A – 277-volt single phase 60Hz AC.

3. Load relay contacts shall be rated to control LED drivers up to the full ampere rating.
4. The quantity of individual internal load switching relays shall be not less than the quantity of individual “Switch-leg” circuits to be controlled shown on the Drawings.

2.3 OCCUPANCY MOTION SENSOR HOUSING ENCLOSURE

A. General

1. Enclosures for occupancy motion sensor control units shall be pressed steel or high impact resistant nonflammable non-metallic enclosure. Enclosure finish color white. Semi-flush mounting installation, NEMA 1 “Dead Front” construction with mounting plates and barriers to provide separation between line voltage and low voltage wiring.

B. Mounting

1. Flush mounting 4.67-inches square by 2.125-inches deep outlet junction box with extension ring and occupancy motion sensor cover mounting plate.
2. Occupancy sensor shall be semi-flush mount into outlet box with tamper resistant attachment of the sensor and the outlet box.
3. Motion sensor shall be approved for installation in environmental air plenum.

PART 3 - EXECUTION

3.1 MOTION SENSOR QUANTITIES AND TYPES

A. General

1. The Contractor shall provide the quantity and types of motion sensors required for complete and proper volumetric coverage without gaps within the range of coverage(s) of controlled areas.
2. Rooms shall be 90% to 100% volumetric coverage of the sensing cover-age area, to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). Motion sensing detection coverage shall extend from the finish floor to not less than 48-inches above finish floor.
3. The locations and quantities of sensors shown on the Drawings are diagrammatic and indicate only rooms which are to be provided with sensors. The Contractor shall provide additional sensors if required to properly cover the respective rooms.

4. Ceiling mounted sensors shall also be pendant-mounted in rooms in which the controlled lighting fixtures are chain, cable, or pendant suspension mounted. The mounting height of the sensor shall be approximately 6-inches below the bottom of the light fixtures to be controlled.
5. Occupancy sensors may be affected by various conditions in the room. Make adjustments, change the location and/or type of occupancy motion sensor to obtain proper operation in each specific room location.
6. Install occupancy motion sensors a minimum of 72-inches horizontal distance from environmental air supply/return registers, fans and moving objects.

3.2 SETUP AND TESTING

A. Provide system programming and setup of all control sequences for lighting control system.

B. Adjust sensitively, time-delay, location and orientation of each occupancy motion sensor; test each sensor/control unit all in accordance with the Manufacturer's recommendations. Be certain that no obstructions block proper sensor coverage of detection areas and limit sensor pickup zone to the respective room.

C. Test all control system functions after the installation and connections are complete and the system has been energized. Verify each control sequence of operation and each device to be controlled are operating correctly.

END OF SECTION 275133

SECTION 311000

SITE CLEARING

PART 1 – GENERAL – NOT USED

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION

3.1 SITE CLEARING

A. Coordinate with the Demolition Contractor for the demolition and removal of the existing piles and pile caps, grade beams and asphalt paving and base course from areas to receive the new building as shown on the drawings as indicated. Asphalt paving may be pulverized and blended with site soils to be used for engineered fill material, provided the specified results of compaction and grading are obtained.

3.2 REMOVAL AND REPLACEMENT OF UNSUITABLE SOILS

A. General: As indicated in the soils report, unsuitable soils conditions may be encountered in the area of the building to depth of approximately 6'-0". If any of the following conditions occur, the provisions of this paragraph shall apply:

1. Dissimilar native materials are encountered across the building footprint.
2. Incompetent zones are encountered.
3. The subgrade becomes disturbed during construction.
4. Creation of a level pad requires a cut/fill transition within the building pad.
5. The Soils Engineer determines that field conditions require procedures specified herein.

B. In the event that any of the above conditions occur, the following procedures shall be performed.

1. After removal of existing paving, remove all uncontrolled fill soils, all upper loose, firm, porous or disturbed natural soils from areas to receive footings, slabs, walks and paving to a distance of 5 feet beyond edges of same.
2. Soils shall be removed to a depth that will provide not less than 2 feet of compacted soil below building slabs and 5 feet beyond, and 18 inches below exterior paving, walks, and new asphalt paving
3. After excavating, the exposed soils shall be inspected to verify removal of all unsuitable deposits. Remove all rocks larger than 8" in largest dimension.
4. The exposed soils shall be scarified to a depth of 6", moisture added as required, and re-compacted to not less than 90 percent of the maximum dry density at optimum moisture content in accordance with ASTM D1557. Fill shall be placed in loose lifts not exceeding 8" in thickness and compacted to 90 percent as defined above. Compaction shall be accomplished

continuously over the entire area. Sufficient passes shall be made to ensure that specified density is obtained.

3.3 EXCAVATION AND BACKFILLING FOR FOUNDATIONS AND STRUCTURES:

A. Foundation Soils: Excavate for foundations to sizes indicated, clean, and leave in condition recommended by Geotechnical Investigation Report. Prior to placement of forms, reinforcing, or concrete, obtain approval of Soils Engineer and building department as required, for proper conditions and suitable bearing materials.

B. Perform excavation to the dimensions and elevations indicated on drawings, with additional space allowed as required for the installation and stripping of forms, and inspection of the various types of work, except where approval may be given to deposit certain miscellaneous concrete directly against earth banks.

C. Provide lateral support for excavations within and adjacent to structures, foundations and slabs-on-grade to prevent caving, earth movement or loosening of subgrade materials.

D. Adverse Subsurface Conditions: Notify Architect should unsuitable bearing soil or other adverse subsurface conditions be found which are not indicated by the drawings or specifications.

E. Unauthorized Excavation: If excavations are carried below the elevations indicated without written authorization, provide satisfactory construction to correct the fault as approved, at no additional contract cost.

F. Backfill Beside Foundations:

1. Backfilling against concrete shall not be done until concrete has attained its 28 day compressive strength, unless specifically approved otherwise.
2. Moisten or aerate backfill material as required to attain specified moisture content. Place backfill material adjacent to structures and compact in a manner that prevents wedging action or eccentric loading upon or against the structures. Step or serrate slopes bounding or within areas to be backfilled to prevent sliding of the fill. Do not place material on surfaces that are muddy. Do not use equipment for backfilling operations or for the formation of embankments against structures that will overload the structure.

END OF SECTION 311000

SECTION 312000

EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. Backfill: Soil material approved by Geotechnical Engineer of Record used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Course placed between the subbase course and asphalt concrete paving.

C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe or conduit.

D. Borrow or Import Soil: Soil approved by Geotechnical Engineer of Record imported from off-site for use as fill or backfill.

E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water and also provides a break in horizontal hydrostatic pressure at vertical wall applications.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

G. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

H. Fill: Soil material approved by Geotechnical Engineer of Record used to raise existing grades.

I. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Surface or elevation remaining after completing excavation, or top surface

of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

1.3 PROJECT CONDITIONS

A. A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.

B. Per geotechnical report, the on-site soils are moderately corrosive to ferrous metals and copper.

C. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by Owner and then only after acceptable temporary utility services have been provided.

1. Provide a minimum 48 hours' notice to the Project Civil Engineer and utility owners and receive written notice to proceed before interrupting any utility.

D. Where subsurface utilities are shown on the plans to be removed, the Contractor, at its option, may either completely remove or abandon said utility in place. However, the Contractor shall completely remove said utility beneath any proposed building or where said utility would interfere with any proposed improvement (including landscaping). Should the Contractor elect to abandon any utility in place he shall completely backfill said utility with 1-1/2 sack sand-cement slurry mixture. Coordinate with utility companies to shutoff services if lines are active.

E. Noise and Dust Abatement: Exercise all reasonable and necessary means to abate dust, dirt rising and undue noise. Perform necessary sprinkling and wetting of construction site to allay dust as required by applicable codes and ordinances.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: All soils materials to be used throughout the site shall be approved for use by the geotechnical testing engineer. Provide approved borrow soil materials from off site when sufficient approved soil materials are not available from excavations.

No earthwork analysis has been completed with respect to the volumes of soils to be excavated, placed, or imported in order to provide the finished grades shown on the plans. The Contractor is solely responsible for verifying the earthwork quantities necessary to complete the project.

Furthermore, there has been no analysis to determine footing spoils and/or bulking or shrinkage during earthwork operations.

B. Provide soils materials approved by Geotechnical Engineer of Record, free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

D. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

E. Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

F. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

G. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

2.2 ACCESSORIES

A. Provide acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect and maintain required erosion and sedimentation controls during earthwork operations.

C. Provide dewatering as required to keep tranches, excavation for footings and sub-slats areas free of water.

D. Prior to grading, all construction debris shall be removed and haulded away from the site (at contractors expense).

E. Any site grading shall be performed under observation by a geotechnical engineer or his representative.

F. Contractor shall have a full-time field superintendent with authority to make decisions on the project and shall cooperate fully with the Geotechnical Engineer in carrying out the work.

G. A Pre-Grading meeting is required prior to grading, in the presence of the Owner,

Architect, Geotechnical Engineer, Contractor, and DSA Inspector to review the project schedule and construction sequencing.

3.2 EXCAVATION

A. Site Grading consists of demolishing the existing asphalt pavement and earthwork for removal and re-compaction as required.

B. No excavation shall be performed and no fill should be placed, spread, or rolled during unfavorable weather. If work is interrupted by rain, operations should not be resumed until the Geotechnical Engineer indicates that conditions will permit satisfactory results.

C. The top 24-inches of subgrade soil shall be excavated, moisture conditioned, and re-compacted to 90% of the ASTM D-1557 laboratory standard for all the areas within walkways, parking lots, and driveways prior to placing the rock base and concrete. The horizontal limits of over-excavation shall extend to a minimum horizontal distance of 2-feet beyond the perimeter of the proposed flatwork improvements unless specifically shown different on the plans.

D. Prior to compacting subgrade soil, exposed bottom surfaces shall be observed and approved by the Geotechnical of Record and then to be scarified to a depth of at least 6-inches, watered or air dried as necessary to achieve near optimum moisture conditions, and then compacted to a minimum relative compaction of 90 or 95 percent where applicable. The laboratory maximum dry density and optimum moisture content for each change in soil type should be determined in accordance with Test Method ASTM D-1557.

E. If bottom of excavation is too wet and in yielding condition; subgrade soil shall be aerated by waiting and discing or stabilizing providing at least 12-inches of aggregate base subject to inspection and approval of Geotechnical Engineer of Record.

F. Any new fill shall be brought to near optimum moisture, placed in layers not exceeding 6-inches thick, and compacted to at least 90 or 95 percent where applicable for subgrade per current ASTM D-1557 standards.

G. Any imported soil shall consist of clean, granular, non-expansive soil, free of vegetation and other debris with an Expansion Index of 20 or less. No soil or aggregate base shall be imported to the site without prior approval by the Geotechnical Engineer.

H. No jetting or water tamping of fill soils shall be permitted.

I. Excavate to required subgrade elevations and as recommended by geotechnical engineer regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for solid rock excavation and removal, boulder removal or removal of obstructions.

3.3 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations. Allow for any required bedding course.

B. Excavate trenches to uniform widths to provide required clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom. Shape trench bottoms to provide uniform bearing and support of pipes and conduit.

3.4 SUBGRADE INSPECTION

A. Proof-roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Geotechnical Engineer of Record, without additional compensation.

3.5 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust. Do not store within drip line of remaining trees.

3.6 UTILITY TRENCH BACKFILLI

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Backfill utility trenches and compact as recommended by the Geotechnical Engineer of Record.

D. Place and compact final backfill of satisfactory soil to final subgrade elevation.

E. Install warning tape directly above utilities, within 24 inches of surface.

3.7 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.8 SUBBASE AND BASE COURSES

A. Place subbase and base course as required by Geotechnical Engineer of Record on subgrades free of mud, frost, snow, or ice.

3.9 FIELD QUALITY CONTROL

A. Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable.

D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction required by Geotechnical Engineer of Record, scarify and moisten or aerate, or remove and replace soil to depth required by Geotechnical Engineer of Record; recompact and retest until required compaction is obtained.

E. Geotechnical Engineer of Record will certify to Owner and governing authorities that earthwork and compaction densities conform to Project requirements.

3.10 PROTECTION

A. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing, to meet required finish grades. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.11 DISPOSAL OF SURPLUS WASTE MATERIALS

A. Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose off Owner's property.

END OF SECTION 312000

SECTION 321216

ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cold milling of existing hot-mix asphalt pavement.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving.
4. Hot-mix asphalt paving overlay.
5. Asphalt surface treatments.
6. Pavement-marking paint.

B. Related Requirements:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. Division 31 Section “Earth Moving” for aggregate subbase and base courses and for aggregate pavement shoulders.

1.2 DEFINITIONS

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

C. Material Certificates: For each paving material, from manufacturer.

D. Material Test Reports: For each paving material.

1.4 QUALITY ASSURANCE

A. Requirements: Comply with materials, workmanship, and other applicable

requirements of Standard Specifications for Public Works Construction for asphalt paving work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F.
2. Tack Coat: Minimum surface temperature of 60 deg F.
3. Slurry Coat: Comply with weather limitations in ASTM D 3910.
4. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
5. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

1.7 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

C. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: ASTM D 242, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt Cement: Standard Specifications, Subsection 203-6, PG 64-10, 3/8” maximum aggregate size and compacted to 95 percent of Hveem laboratory test.

B. Tack Coat: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

C. Water: Potable.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Sand: ASTM D 1073, Grade Nos. 2 or 3.

C. Joint Sealant: ASTM D 6690, Type I, hot-applied, single-component, polymer-modified bituminous sealant.

D. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than three minutes.

1. Color: White unless otherwise specified.

E. Wheel Stops: Precast, air-entrained concrete, 2500-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4-inch diameter, 10-inch minimum length.

2.4 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical

area where Project is located.

2. Provide mixes complying with composition, grading, and tolerance requirements in ASTM D 3515.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall be responsible for laying out and installing all pavements in the correct locations and to the proper cross sections and in accordance with the lines and grades as specified herein and the on the Drawings and/or in accordance with the directions of the Site/Civil Engineer. Pavements which are not constructed to the proper section, grade and/or alignment shall be corrected by repair or replacement by the Contractor in accordance with the directions of the Site/Civil Engineer and at no additional cost to the Owner.

3.2 SUBGRADE PREPARATION: Refer to Section 312000 Earth Moving.

A. General: Conform to Standard Specifications for Public Works Construction, Latest Edition Subsections 301-1.2 through 301-1.4, inclusive, performed under the supervision of the Soils Engineer.

B. Maintenance of subgrade: The subgrade shall be maintained in a smooth, compacted condition, in conformity with the required section and established grade until the concrete is placed.

3.3 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

D. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

3.4 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

1. Mill to a depth of 1-1/2 inches.
2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
3. Control rate of milling to prevent tearing of existing asphalt course.
4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
6. Transport milled hot-mix asphalt to asphalt recycling facility.
7. Keep milled pavement surface free of loose material and dust.

3.5 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.

1. Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

E. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.6 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.

1. Clean cracks and joints in existing hot-mix asphalt pavement.
2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.7 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd.. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.8 PAVING GEOTEXTILE INSTALLATION

A. Apply tack coat uniformly to existing pavement surfaces at a rate of 0.20 to 0.30 gal./sq. yd..

B. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches and transverse joints 6 inches.

1. Protect paving geotextile from traffic and other damage and place hot-mix asphalt paving overlay the same day.

3.9 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at minimum temperature of 250 deg F.
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.10 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.

4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.11 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927, but not less than 94 percent nor greater than 100 percent.
2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.12 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.
2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.
2. Surface Course: 1/8 inch.
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

C. Traffic-Calming Devices: Compact and form asphalt to produce the contour indicated and within a tolerance of plus or minus 1/8 inch of height indicated above pavement surface.

3.13 SURFACE TREATMENTS

A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. to existing asphalt pavement and allow to cure. With fine sand, lightly dust areas receiving excess fog seal.

B. Slurry Seals: Apply slurry coat in a uniform thickness according to ASTM D 3910 and allow to cure.

1. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

3.14 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. Broadcast glass beads uniformly into wet pavement markings at a rate of 6 lb/gal..

3.15 WHEEL STOPS

A. Install wheel stops in bed of adhesive as recommended by manufacturer.

B. Securely attach wheel stops to pavement with not less than two galvanized-steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.16 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

    a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
    b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

E. Replace and compact hot-mix asphalt where core tests were taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.17 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow milled materials to accumulate on-site.

END OF SECTION 321216

SECTION 321313

CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Provide exterior concrete work, including curbs, ramps, gutters, driveway aprons, swales, walks, and pavement, as indicated, specified, and required.

1.2 SUBMITTALS

A. Layout Drawings: Provide a layout drawing showing locations of each type of pavement and construction, and dimensioned locations of all expansion and control joints.

B. Product Data: Submit for expansion and control joint material.

C. Site Samples

1. Prepare following samples at the site, cast in the directed locations and orientations. Prepare as many samples of each type of concrete as are required for approval. Remove samples from the site when no longer needed and removal is approved. Approved samples may be part of permanent construction if meeting all other requirements shown and specified and are so approved.

2. Slab Samples: Prepare minimum 4-foot square samples of each required slab finish. Include a transverse expansion joint, scoring, and edging. Where paving adjoins other materials such as pavers, include one edge of sample constructed of the other materials.

1.3 QUALITY ASSURANCE

A. Conform to Division 3 for requirements not specified in detail herein.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete:

1. Portland cement: ASTM C150, Type II, low alkali. Use Type V where concrete is in contact with earth.
2. Aggregates: ASTM C33, from approved source to ensure uniform quality and grading. Deliver so that moisture content variations will not decrease production of reasonably uniform concrete. Do not use aggregates that are reactive with alkalis.
3. Water: Clean, fresh, and potable.

B. Strength: Minimum ultimate compressive strength of 4,000 psi (minimum per geotechnical engineer's recommendation). Refer to Division 1 for testing requirements.

C. Reinforcing:

1. Bars: ASTM A615, grade 60.
2. Wire: ASTM A82.
3. Wire mesh: ASTM A185.

D. Expansion and Control Joints:

1. Expansion joints for slabs: Conform to Standard Specifications for Public Works Construction, Latest Edition. Subsection 201-3.
2. Expansion joints for curbs and gutters: Asphalt impregnated fiber filler material, 1/2 inch thick.
3. Control Joints: "Zip Strip" as distributed by S.C.A. Construction Supply, Santa Fe Springs, Calif., or equal.

E. Curing Compound: Conform to Standard Specifications for Public Works Construction, Latest Edition Subsection 201-4.

F. Polyethylene Film: Clear, 10 mil thick, "Visqueen", or equal. Provide compatible tape for sealing joints. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

PART 3 - PRODUCTS

3.1 ON-SITE CONCRETE WORK

A. Construct all site concrete of 4,000 psi concrete (minimum per geotechnical engineer's recommendation) unless otherwise indicated or specified. Provide reinforcing bars or mesh where indicated. Form accurately to profiles shown, using wood, metal or plastic forms as approved. Place and handle concrete in manner that will avoid segregation of ingredients. Refer to Section 03300 for additional requirements.

3.2 SUBGRADE PREPARATION: Refer to Section 312000 Earth Moving.

A. General: Conform to Standard Specifications for Public Works Construction, Latest Edition Subsections 301-1.2 through 301 - 1.4, inclusive, performed under the supervision of the Soils Engineer.
B. Maintenance of subgrade: The subgrade shall be maintained in a smooth, compacted condition, in conformity with the required section and established grade until the concrete is placed.

3.3 CONCRETE SLABS, PADS, WALKS, DRIVEWAY APRONS, CURBS, GUTTERS,

AND OTHER EXTERIOR CONCRETE FLATWORK

A. Form Setting: Conform to Standard Specifications for Public Works Construction, Latest Edition Subsection 303-5.2.1. Concrete surfaces, where left exposed, shall be formed on all sides with plywood with taped joints to give a smooth, uniform straight finish.

B. Reinforcing steel shall be securely tied in place. Do not use bars with kinks or bends not shown on drawings. Reinforcing steel shall be clean, free from rust, oil, scale, or any foreign material. Place all reinforcing as detailed and comply with typical detail for bends, splices, clearance, etc., and with requirements of the Uniform Building Code.

C. Placing Concrete: Conform to Standard Specifications for Public Works Construction, Latest Edition Subsection 303-5.3 and Section 03300.

D. Expansion Joints:

1. Concrete Curbs: Provide 1/2" thick expansion joints at beginning and at end of curves, intersections, and 20-foot intervals between, set plumb, square, and to same profile as the curbs. Edge curb tops to 1/2" radius and vertical joints to 1/4" radius.
2. Concrete Gutters: Provider 1/2” thick expansion joints as above for curbs.
3. Concrete Walks: Provide 1/2" expansion joints as specified for curbs and where walks abut rigid structures, aligned with joints in curbs where adjoining. Provide expansion joints at 20-foot intervals in concrete walks.
4. Exterior Slabs: Provide ½” thick expansion joints at 6-foot intervals or less.

E. Control Joints shall be formed joints. Tops of joints shall be installed flush with the concrete surface. Depth of joint shall be a minimum of 1 /4 the thickness of slab. Use control joints on all curbs, curbs and gutters, and cross gutters at maximum intervals of 20 feet on center. Sawed joints may be used in lieu of the above, providing they are at least one inch deep.

F. Concrete Ramps: Construct pedestrian and disabled ramps of profile indicated. Excavate below bottoms of ramps to allow for full thickness of concrete throughout. Do not feather the concrete unless specifically indicated. Reinforce with No. 4 bars or mesh. Provide smooth transitions between ramps and adjoining surfaces. Provide uniform slopes throughout. Provide grooved pavement as detailed.

3.4 FINISHES

A. Walks and Pavement: Medium broom finish perpendicular to longitudinal direction of the walk. Score walks in direction and pattern indicated or directed.
B. Gutters: Light broom finish with 3-inch-wide steel trowel finish at flowlines.
C. Curbs: Steel trowel finish, followed by fine hairbrush finish.
D. Ramps: Heavy broom finish where slope is 6 percent or greater; medium broom finish

where slope is less than 6 percent.

E. Paving: Medium broom finish, unless otherwise directed.
F. Driveway Aprons: Medium broom finish, unless otherwise directed.
G. See Landscape Drawings for any additional architectural finishes.

3.5 CURING

A. Concrete work shall be properly cured and protected against injury and defacement of any nature during construction operations. If weather is hot or surface has dried out, spray surface with fine mist of water, starting not later than 2 hours after final troweling. Surface of finish shall be kept continuously wet for at least 10 days. Wetting is considered emergency work and shall be performed on weekends and holidays if necessary.
B. In lieu of water curing, within 24 hours after finishing, the concrete which is not to receive special finishes, may be cured with an approved clear liquid curing compound, applied in accordance with the manufacturer's recommendations.

3.6 BACKFILLING

A. After curing, debris shall be removed and the area adjoining the work shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.7 PROTECTION

A. Completed work shall be protected from damage until accepted. The Contractor shall remove damaged concrete and clean concrete discolored during construction. Work that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints at no expense to the owner. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

3.8 REMOVAL OF FORMS

A. Do not remove forms until the concrete has attained adequate strength to prevent damage. Take extreme care in stripping to avoid breaking off corners, marking concrete or defacing the finish surface in any way. Minimum stripping time at walls shall be 3 days.

3.9 CLEANING AND PATCHING

A. After stripping forms, clean all exposed concrete surfaces and all adjoining work stained by leakage of concrete. Remove all fins, burrs, and projections by grinding. Patch all voids, rock pockets, holes, cracks, etc., by chipping loose concrete and exposing clean sound aggregate. After inspection, dampen prepared recesses for 2 hours minimum and fill with drypack to within 1/4" of surface. Keep drypack damp for 2 days minimum. Apply mortar to final surface and keep patch damp for 5 days minimum. Entire surface of concrete to be sacked with neat cement and water after

surface is cleaned and patched.

3.10 FLOOD TEST

A. All concrete gutters and concrete pavement shall be given a flood test. All concrete work where water ponds and does not run off in a reasonable amount of time, shall be removed to the nearest score or joint line and replaced to provide proper drainage.

3.11 DEFECTIVE CONCRETE

A. If concrete tests indicate that the strengths do not meet those specified, or if concrete has excessive pockets, or if reinforcing steel is exposed, or if concrete does not comply with the drawings and specifications, the defective concrete shall be removed and replaced as directed.
B. Concrete paving that shows evidence of cracking prior to completion of the project or during the 60-day maintenance period shall be replaced at no cost to the Owner. Such replacement shall include the entire panel of concrete in which the cracking occurs, to the nearest expansion or control joints, as approved.

3.12 OFFSITE CONCRETE WORK

A. Replace existing items are damaged by Contractor's operations. Secure and pay for required permits, inspections, engineering, and surveying. Offsite concrete work shall comply with rules and regulations of local authorities.

END OF SECTION 321313

SECTION 321313.1

DECORATIVE CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes concrete paving including the following:

1. Natural color concrete pads and Walks.

B. Related Requirements:

1. Section 321316 Craftsmen specification exposed aggregate finish
2. Geotechnical Investigation Report dated 9-17-2024. All construction shall adhere to the investigation report and recommendations provided.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1. Review methods and procedures related to concrete paving, including but not limited to, the following:

a. Concrete mixture design.
b. Quality control of concrete materials and concrete paving construction practices.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete paving Subcontractor.
e. Manufacturer's representative of stamped concrete paving system used for stamped detectable warnings.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party Certified Life Cycle Assessment: For each product.

C. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.

D. Samples for Verification: For each type of product or exposed finish, prepared as Samples of size indicated below:

1. 12"x12" sample of each specified finish.

E. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified ready-mix concrete manufacturer and testing agency .

B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

C. Material Test Reports: For each of the following:

1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Quality control to be maintained by a licensed installer of Craftsmen Specification Pneumatic Small Material Finish throughout duration of the project. As part of the bid submittal, the General Contractor shall provide qualifications for the site concrete contractor certified for Craftsman Specification Pneumatic Small

Material Finish installation. Provide a listing of five (5) projects of installed Craftsmen Pneumatic Small Material Finish architectural finish totally a minimum of 50,000 square feet. Include address of installation and contact information for project's design or owner representative. Provide two (2) images of each installation listed above representing the installation. First photo shall show approximate size of the installation. Second photo shall be taken two to three feet from finish surface of paving. This information shall provide evidence to indicate successful experience in providing concrete work similar to that specified herein. Failure to provide this information or the submittal of incomplete or inaccurate information shall give cause to reject the entire bid as non-responsive and incomplete.

B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

C. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests must be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP or an equivalent certification program.

D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. Refer to 014339 ‘Mockups’.

1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than 48 inches by 48 inches .
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
5. Refer to section 014339 ‘Mockups’ and ‘321316 Craftsmen Specification Exposed Aggregate Finish’ for respective mockup requirements.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures. Testing

personnel must meet ASTM E329 requirements.

1.8 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms , steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or

less. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 60 percent.

B. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from as-drawn steel wire into flat sheets.

C. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

D. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A, plain steel.

E. Reinforcing Bars: ASTM A615/A615M, Grade 60; deformed.

F. Galvanized Reinforcing Bars: ASTM A767/A767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A615/A615M, Grade 60 deformed bars.

G. Epoxy-Coated Reinforcing Bars: ASTM A775/A775M or ASTM A934/A934M; with ASTM A615/A615M, Grade 60 deformed bars.

H. Steel Bar Mats: ASTM A184/A184M; with ASTM A615/A615M, Grade 60 deformed bars; assembled with clips.

I. Plain-Steel Wire: ASTM A1064/A1064M, as drawn .

J. Deformed-Steel Wire: ASTM A1064/A1064M.

K. Epoxy-Coated-Steel Wire: ASTM A884/A884M, Class A; coated, deformed .

L. Joint Dowel Bars: ASTM A615/A615M, 5/8 inchglass fiber reinforced polymer dowel bar. . Cut bars true to length with ends square and free of burrs.

M. Tie Bars: ASTM A615/A615M, Grade 60; deformed.

N. Hook Bolts: ASTM A307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

O. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater

compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

P. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

Q. Zinc Repair Material: ASTM A780/A780M.

2.4 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.

B. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.

1. Fly Ash or Pozzolan: 25 percent. Only use fly ash when seeding reactive aggregates such as glass or seashells.
2. Slag Cement: 50 percent.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content, 1-1/2-inch Nominal Maximum Aggregate Size: 4-1/2 percent plus or minus 1-1/2 percent.
2. Air Content, 1-inch Nominal Maximum Aggregate Size: 6 percent plus or minus 1-1/2 percent.
3. Air Content, 3/4-inch Nominal Maximum Aggregate Size: 6 percent plus or minus 1-1/2 percent.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture in concrete as required for placement and workability.
2. Use water-reducing and retarding admixture when required by high

temperatures, low humidity, or other adverse placement conditions.

F. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1/2 lb per cubic yard mix. Stealth or Microfiber .

G. Concrete Mixtures: Normal-weight concrete.

1. Compressive Strength (28 Days): 3500 psi .
2. Maximum W/C Ratio at Point of Placement: 0.50 .
3. Slump Limit: 4 inches , plus or minus 1 inch.

2.5 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M and ASTM C1116/C1116M . Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For concrete batches larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

C. Aggregates

1. Craftsman Specification Pneumatic Small Material Finish matching sample numbers SS#25-168, SS#20-231, SS#24-037, SS#22-010.
2. Use same Craftsmen Specification Pneumatic Small Material Finish surface seeded aggregate from same source for each paving type specified throughout entire project.
3. Thoroughly blend screen, and wash aggregates prior to seeding into concrete matrix.

D. Craftsmen Specification Products

1. Craftsmen Specification Conditioner
2. Craftsmen Specification Etch-Retarder
3. Craftsmen Specification Cure

4. Craftsmen Specification Hydrolyzed Lithium Quartz Sealer
5. Craftsmen Specification Seal

E. Sealer

1. Acid clean entire surface after initial cure (3 day minimum) and seal surface of paving using hydrolyzed alkali-silica solution when reactive materials are used.
2. Follow sealer directions when applying this product. Improper use or other sealers may not prevent ASR and will lead to delamination.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction . Limit vehicle speed to 3 mph.
2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 312000 "Earth Moving."

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 INSTALLATION OF STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963/D3963M.

G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Provide tie bars at sides of paving strips where indicated.
3. Butt Joints: Use epoxy-bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.

5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows , to match jointing of existing adjacent concrete paving :

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.
b. Do not exceed 3/16" in width. Sawcut joints in a straight line with no overcutting. Use a hand tool to sawcut up to vertical edges such as walls, steps, curbs and columns. No cutting into vertical surfaces will be allowed.

2. Doweled Contraction Joints: Construct speed dowel construction joints at modules no larger than 20'x20'. Wire dowel baskets may be used in lieu of construction joints to facilitate larger pour areas. Dowel schedule to match rebar schedule with a minimum spacing of 18" oc. Utilize 5/8 inch fiber reinforced polymer dowel bars. Encase 50 percent of each dowel in a speed dowel plastic sleeve to allow parallel lateral movement of each dowel. Double check fiberglass dowel to speed dowel tolerance to ensure a snug fit.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation , steel reinforcement, and items to be embedded or cast-in.

B. If applicable, remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are

at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies , reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.

2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.
3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.
4. Refer to section 321316 craftsmen specification exposed aggregate finish for respective finish texture requirements.

3.8 CRAFTSMEN SPECIFICATION PNEUMATIC SMALL MATERIAL FINISH INSTALLATION

A. Installation:

1. Prepare subgrade to desired grade elevation.
2. Pump or place concrete mix over subgrade.
3. Screed concrete mix to a desired FS elevation.
4. Float the top surface of the screened concrete mix, erasing all float lines.
5. Pneumatically spray and embed carbide, mirror, mica, or other small materials with a mechanical vibrating device or embed by hand using floats to fully implant surface applied aggregates.
6. Trowel surface applied material into cement/fines concrete paste, hand trowel edges and machine power trowel field panels until finish is flat and tight.
7. Apply Craftsmen Specification Cure and cure concrete for 7 days.
8. After appropriate cure time, acid wash to expose aggregate and remove free lime and salts and allow drying. Contain acid wash wastewaster and pump into containers and haul to hazardous waste facility for disposal.
9. Seal paving per manufacturer's recommendation.

3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure concrete by curing compound as follows:

1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.10 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-feet- long; unleveled straightedge not to exceed 1/2 inch.
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch.
6. Vertical Alignment of Dowels: 1/4 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M will be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231/C231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at seven days and two specimens at 28 days.

a. A compressive-strength test to be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results to be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests to contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency will make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.12 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign

material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 321316

CRAFTSMEN SPECIFICATION EXPOSED AGGREGATE FINISH

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

A. Requirements of "General Conditions of the Contract" and of Division 1, "General Requirements," apply to work in this Section with same force and effect as though repeated in full herein.

1.2 SCOPE OF WORK

A. Furnish materials, labor, transportation, services, and equipment necessary to furnish and install Craftsmen Specification Finish architectural concrete paving as indicated on drawings and as specified herein.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

A. Federal, State, and local laws and regulations governing this Work are hereby incorporated into and made part of this Section. When this Section calls for certain materials, workmanship, or a level of construction that exceeds the level of Federal, State, or local requirements, provisions of this Section take precedence.

B. No procedures, materials or products referenced in this specification may be substituted or replaced with a proposed alternative or equivalent product without the written consent of the Owner.

1.4 APPLICABLE STANDARDS

A. Specifications and recommended practices of American Concrete Institute (ACI), American Society for Testing and Materials (ASTM), and The Uniform Building Code are to be considered part of this Specification.

B. Design and Control of Concrete Mixtures – Thirteenth Edition; Portland Cement Association.

1.5 QUALITY CONTROL

A. Paving Subcontractor Qualifications: provide evidence to indicate successful

experience in providing decorative concrete finishes similar to that specified herein and demonstrate successful experience.

B. As part of the bid submittal the General Contractor shall submit background information and/or qualifications on his Architectural Cast-in-place Contractor certified for Craftsmen Specification Exposed Aggregate Finish installation. This information shall provide evidence to indicate successful experience in providing concrete work identical to that specified herein. A listing of projects shall be provided and shall be reviewed and approved as comparable projects to the specified work by the Owner or Architect prior to award of bid. Failure to provide this information or the submittal of incomplete or inaccurate information shall give cause to reject the entire bid as nonresponsive and incomplete. The submittal shall provide the Owner and Architect with evidence of successful experience in Craftsmen Specification Exposed Aggregate Finish similar to that specified herein and can demonstrate successful experience through past project documentation and references.

C. Demonstration of experience: provide a minimum of five (5) projects of installed Craftsmen Specification Exposed Aggregate Finish cast-in-place concrete totaling at least 50,000 square feet with a reference list of each containing address of installation, contact person and phone number of project's architect and or landscape architect or owner's representation. Minimum size of each individual installation shall be 10,000 square feet. Provide two (2) color photos, 8" x 10" size, of each installation listed above representing the installation. Photo #1 shall show the approximate size of the installation. Photo #2 shall be taken approximately 2 to 3 feet from the paving surface. See submittals portion of this section for additional information.

D. Supervision: On-site superintendent must have a minimum of 10 years of experience.

1.6 SITE INSPECTION

A. Verify conditions at site that affect work of this Section.

B. Take field measurements as required.

C. Report major discrepancies between Drawings and field dimensions to Owner's Authorized Representative prior to commencing work.

1.7 SUBMITTALS

A. Product Data: Submit no later than 10 days after contract award a typed list of products specified in this Section.

B. Shop Drawings:

1. Submit shop drawings for reinforcing steel and accessories in accordance with ACI standards.

2. Paving Jointing and Pour Sequence Plan - submit indicating the following:

   a. Proposed layout of construction, dowel basket, and sawcut joints. Clearly delineate the three different joint types.
   b. Layout of paving types as indicated on Drawing Paving Schedule. Give overall dimensions of each paving type.

C. Statement of Mix Design: Submit one (1) copy of Statement of Mix Design prepared by batch plant servicing Project for each load delivered to Project. Statement of Mix Design to contain following information:

1. Name, address, and telephone number of batch plant preparing statement of mix design.
2. Date of mix design.
3. Project location.
4. Contractor requesting load delivery.
5. Mix design number.
6. Integral color used.
7. Gradations for sand and aggregate.
8. Material weights, specific gravity, and absolute volumes.
9. Basis of testing, i.e. UBC 2605 D4 and Title 24 2604 D4.
10. Water/cement ratio.
11. PSI rating.
12. Signature of testing laboratory manager.
13. Signed stamp from registered Project structural engineer or architect.

D. Samples: Three 12-inch by 12-inch samples representative of each paving finish approved by the Landscape Architect.

1.8 SUBSTITUTIONS

A. None allowed unless approved in writing by Owner’s Authorized Representative.

1.9 TESTING

A. A testing agency may be designated by Owner or Owner's Authorized Representative. Testing personnel must meet ASTM E329 requirements.

1.10 MOCK-UPS:

A. Refer to 014339 ‘Mockup’ for requirements.

B. Prior to construction, provide (1) 12-foot x 12-foot x 4-inch mock-up of each architectural paving finish type specified on drawings.

C. Locate mock-ups in a conveniently accessible and protected place. Approved mock-ups will be standard for future Craftsmen Specification Exposed Aggregate

Finish installation review.

D. Mock-ups to be tested with 3000 PSI pressure washer to simulate typical maintenance procedures.

E. Remove mock-ups from site upon completion of Work and approval by Owner's Authorized Representative.

1.11 PROJECT CONDITIONS

A. Keep work area clean, and in a safe and workmanlike condition so that rubbish, waste and debris do not interfere with work of other trades.

1.12 PRODUCT HANDLING

A. Store materials in a dry and protected location. Protect reinforcing steel and dowels from rusting, deformation, staining, and moisture damage.

1.13 COORDINATION

A. Notify Owner's Authorized Representative and contractors performing work related to installation of Contractor's Work in ample time, to allow sufficient time for them to perform their portion of work.

PART 2 - PRODUCTS

2.1 PORTLAND CEMENT

A. Type I, IA, IL, II, IIA, III, IIIA, IV, and V cements, to conform to ASTM C150.

B. Use same brand of cement from single source throughout entire project.

C. Refer to specifications for cement type herein.

2.2 WASHED CONCRETE SAND

A. Clean, hard, and durable washed concrete sand, conforming to ASTM C33.

B. Use same sand from single source throughout entire project.

2.3 COARSE AGGREGATE

A. Clean, hard, and durable coarse aggregate, conforming to ASTM C33.

B. Use same aggregate from single source throughout entire project.

2.4 WATER

A. Free from deleterious materials such as oils, acids, and organic matter.

2.5 ADMIXTURES

A. Integral Concrete Coloring Admixture: Refer to drawings for color type and manufacturer.

1. Acceptable Manufacturers:

a. L.M. Scofield: (800) 800-9900
b. Colorfull by Admixtures, Inc.: (626) 357-3263
c. QC: (800) 453-8213
d. Davis Color: (323) 269-7311
e. Solomon Colors: (800) 624-0261
f. Increte Systems: (800) 752-4626
g. MasterColor by BASF: (800) 526-1072
h. Sika Corporation: (201) 933-8800

B. Air Entrainment Admixtures: Conforming to ASTM C260.

1. Acceptable Manufacturers:

a. Grace Construction Products; Daravair® , (800) 433-0020 or www.graceconstruction.com/concrete/air_entraining.html#daravair.
b. Master Builders, Inc.; Micro-Air® , (800) 628-9990 or www.masterbuilders.com/MB/pub/Product.asp?TypeCat=2&ParentID=78&ProductID=22.

C. Water Reducing Admixtures: Conforming to ASTM C494, Type A.

1. Acceptable Manufacturers:

a. Grace Construction Products; WRDA® (800) 433-0020 www.graceconstruction.com/concrete/water_reducers.html#wrda.
b. Master Builders, Inc.; Micro-Air® (800) 628-9990 or www.masterbuilders.com.

D. Waterproofing Admixtures

1. Use waterproofing admixture when Craftsmen Specification Finish is to be poured within 5’-0” of pool water, splash pads, etc.
2. Acceptable Manufacturers:

a. Hycrete; Hycrete w1000 (866) 492 or http://www.hycrete.com/products/waterproofing/hycrete-w1000/

b. Xypex; Admix c1000 (800)961-4477 or www.xypex.com
c. Kryton; Krystol Internal Membrane (800)267 https://www.kryton.com/products/krystol-internal-membrane-kim/

2.6 READY MIXED CONCRETE

A. Batched mixed and transported in accordance with ASTM C94 - "Specifications for Ready Mixed Concrete."

2.7 GEOTEXTILE FABRIC

A. Install Mirafi 500X woven geotextile fabric under base course of all concrete paving except in the City right-of-way conditions per manufacturer's directions.

2.8 REINFORCING

A. Reinforcing Steel: Conforming to ASTM A615, clean and free of rust, dirt, grease or oils.

B. Tie Wire: 16-gauge plain cold-drawn steel conforming to ASTM A82, clean, and free of rust, dirt, grease or oils.

C. Supports for Reinforcement:

1. Provide support for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars in place.

D. Polypropylene Fiber Reinforcement: 100% virgin multifilament polypropylene fibers, complying with ASTM C 1116 - Type III.

1. Acceptable Manufacturers:

a. Fibermesh; Fibermix Stealth□ – 1/4" long (423) 892-8080 or www.fibermesh.com/family/stealth.htm.
b. Grace Construction Products; MicroFiberTM (800) 433-0020 or www.graceconstruction.com/concrete/fibers.html

2. Application Rate: 1/2 lb/CY of mix.

2.9 ISOLATION JOINT MATERIALS

A. Refer to Section 07900 – Joint Sealers for isolation joint construction.

2.10 CONSTRUCTION JOINT DOWELS

A. Construct Speed Dowel Construction Joints (CJ) at modules no larger than 20’-0” x 20’-0”. Wire dowel baskets (DB) may be used in lieu of CJs to facilitate larger pour areas.

B. Dowel schedule to match rebar schedule with a minimum spacing of 18” o.c.

C. 5/8” Glass fiber reinforced polymer dowel bar. Contact Aslan FRP at (402) 643-2991 or Owens Corning at (800) GET-PINK.

D. Encase 50 percent of each dowel in a Speed DowelTM plastic sleeve to allow parallel lateral movement of each dowel. Double check fiberglass dowel to Speed dowel tolerance to ensure snug fit. Contact Greenstreak at (800) 325-9504 or www.greenstreak.com/speeddowelhome.htm or contact local suppliers such as White Cap.

2.11 FLY ASH

A. ASTM C618 - Type F.

2.12 SURFACE RETARDER

A. Acceptable Products

1. Architectural Concrete Chemicals; Optimus – (301) 336-9300
2. Craftsmen Specification; Etch Retarder – (949) 642-0660

2.13 CURING COMPOUND

A. Acceptable Products

1. Admixtures Inc.; Colorfull Clear Curing Compound – (626) 357-3263
2. W.R. Meadows; CURE-TREAT RTU – (800)342-5976
3. W.R. Meadows; MED-CURE – (800)342-5976
4. Sinak Corporation; LithiumCure 1000 – (619) 231-1771

2.14 SEALER

A. Acceptable Products

1. Craftsmen Specification.; Seal – (949) 642-0660
2. Craftsmen Specification; Hydrolyzed Lithium Quartz Sealer – (949) 642-0660
3. Sinak Corporation; HLQ-125 – (619) 231-1771

PART 3 - EXECUTION

3.1 SUBGRADE

A. Subgrade to meet requirements of project's soils report.

B. Recommend that a minimum 2-inch layer of graded washed concrete sand compacted to 95 percent relative compaction is placed over subgrade prior to placing concrete.

C. Include an add alternate for Stego 15 ml. sealed sheeting over subgrade under Mirafi 500x soil stabilizer fabric under 6" miscellaneous base.

D. General Contractor to include waterproofing and drainage board when pouring on structure.

E. Ensure that utilities, including irrigation lines are buried and compacted.

3.2 FORMING

A. Be responsible for design and engineering of form work as well as its construction.

B. Ensure that work conforms to recommended practice for concrete form work (ACI 347), latest edition.

C. Do not exceed 20'-0" by 20'-0" in a formed construction area unless speed dowels and dowel baskets are used.

D. Ensure that form lumber is new #2 or better grade wood. Do not use used form lumber.

E. Perform form layout with a digital electronic transit for line layout accuracy.

F. Allow forms to remain in place long enough to allow concrete to set properly. Remove forms when appropriate.

3.3 DESIGN OF MIXES AND PROPORTIONING

A. Proportion and mix of cement, aggregate, admixture and water to attain required plasticity and strength in accordance with current edition of ACI Manual of Concrete Practice and PCA "Design and Control of Concrete Mixtures."

B. Concrete mixtures to be designed by an approved commercial testing laboratory, using approved materials to obtain specified minimum compressive strength.

C. Concrete Mix Criteria (parameters only, actual mix may vary):

1. Slump: 4-inch, with a 1-inch slump differential between successive batches. Obtain approval from Owner's Authorized Representative if slump

is outside these parameters.

2. Minimum PSI rating at 28 days: 3,500.
3. Cement quantity per yard of mix:

    a. Minimum: 6 sacks.
    b. Maximum: 7 sacks.

4. Water/cement ratio: 0.5-.57.
5. Sand: 60% of total mix.
6. Pea gravel: 40% of total mix.
7. Admixtures:

    a. Air entrainment: not recommended. Use waterproofing admixture in place of for freeze thaw conditions.
    b. Shrinkage Reducing: Do not exceed 2% by weight of cement.

8. Fly ash: Use only when seeding reactive Craftsmen Specification aggregates such as glass and seashells.
9. Non-Chloride Accelerators: Do not use corrosive accelerators such as calcium chloride.
10. Concrete Delivery: Use of concrete loads exceeding 90 minutes from time of batch plant must be approved by Owner's Authorized Representative.
11. Ensure that batch plant guarantees single source supply for cement, sand, and aggregate for the entire project.

3.4 CRAFTSMEN SPECIFICATION EXPOSED AGGREGATE FINISH INSTALLATION

A. Contact Shaw & Sons at (949) 642-0660 for installation.

B. Craftsmen Specification Exposed Aggregate Finish matching samples #20-210, #20-231, #20-217, and #25-168.

C. Craftsmen Specification Exposed Aggregate Finish process may incorporate the use of following products:

1. Craftsmen Specification Conditioner
2. Craftsmen Specification Etch Retarder
3. Craftsmen Specification Hydrolyzed Lithium Quartz Sealer
4. Craftsmen Specification Pneumatic spray process – U.S. Patent #7,670,081 B2 and #8,246,269
5. Craftsmen Specification LQS Process – U.S. Patent #7,322,722 B2, #7,607,859 B2, and #8,936,411 B1

D. Installation procedures:

1. Prepare subgrade to a desired grade elevation;
2. Protect all adjacent areas that are not to receive retarder finish prior to concrete placement and retarder application.
3. Pump or place a concrete mix over subgrade;
4. Screed concrete mix to a desired FS elevation;

5. Float the top surface of the screened concrete mix, erasing all float lines;
6. Hand trowel edges and machine power trowel field panels until surface is flat and tight;
7. Apply surface retarder.
8. Wash surface retarder same day with water using stiff brooms or high pressure washing equipment.
9. Apply curing compound per manufacturer's recommendations and cure concrete for 7-28 days;
10. After appropriate cure time, acid wash concrete surface to remove free lime and salts and allow drying. Contain acid wash wastewater and pump into containers and haul to a hazardous waste facility for disposal.
11. Seal paving per manufacturer's recommendation.

3.5 JOINTING

A. Refer to ACI 302 "Guide for Concrete Floor and Slab Construction" for work under this section.

B. Construction and Contraction Joints:

1. Sawcut construction and contraction joints in locations indicated on drawings.
2. Perform jointing with a new diamond tip circular saw.
3. Joint Width: Per Drawings. Do not exceed 3/16-inch in width.
4. Depth of sawcuts: 1/4 depth of slab.
5. Decorative Sawcut Joints: Per Drawings.
6. Sawcut joints in a straight line with no overcutting (alignment variance shall not deviate more than 1/8" in 10'-0").
7. Use a hand tool to sawcut up to vertical edges such as walls, steps, curbs and columns. No cutting into vertical surfaces will be allowed.

C. Isolation Joint Caulking:

1. Install isolation joint caulking to be installed under Section 07900 – Joint Sealers.

3.6 CURING

A. After Craftsmen Specification Exposed Aggregate Finish exposure, cure concrete for seven (7) days without foot traffic and twenty-eight (28) days without vehicular traffic. If a curing compound is required, refer to Section 2.13 of this specification for acceptable curing compounds for use with Craftsmen Specification Exposed Aggregate Finish.

3.7 SEALING

A. Acid clean entire surface after initial cure (3-day minimum) and seal surface of paving using hydrolyzed alkali-silica solution.

B. Follow sealer directions when applying this product (sealer must be applied in 3 to 6 coats).

C. Utilize Craftsmen Specification Seal if further stain repellence is desired.

3.8 MAINTENANCE

A. Follow Craftsmen Specification Exposed Aggregate Finish Paving Cleaning and sealing care procedures.

B. Surfaces exposed to salts, chlorine, and chemicals should be washed daily with potable water.

C. Pressure wash at the first sign of calcification or salt build up and reseal with hydrolyzed lithium quartz sealer and a water proofing sealer.

END OF SECTION

SECTION 32 14 13

INTERLOCKING CONCRETE PAVEMENT ON AN AGGREGATE BASE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Interlocking Concrete Paver Units (manually installed).
   2. Bedding and Joint Sand.
   3. Edge Restraints.
   4. Cleaner, Sealers, and Joint sand stabilizers

B. Related Sections:
   1. Section: 32 11 23 Aggregate Base.
   2. Section: 32 13 13-Pavements and Concrete.
   3. Section: 31 32 19.23 Geotextiles.

Note: Pavements subject to vehicles should be designed in consultation with a qualified civil engineer, in accordance with ASCE/T&DI/ICPI 58-16 Structural Design of Interlocking Concrete Pavement for Municipal Streets and Roadways*, ICPI Structural Design software, and in accordance with ICPI Tech Spec technical bulletins. See ICPI Tech Specs 11 and 15 for guidance on specifying machine installed bedding materials and concrete pavers.*

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. C33 Standard Specification for Concrete Aggregates.
   2. C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
   3. C140 Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
   4. C144 Standard Specification for Aggregate for Masonry Mortar.
   5. C936 Standard Specification for Solid Concrete Interlocking Paving Units.
   6. C979 Standard Specification for Pigments for Integrally Colored Concrete.
   7. C1549 Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.
   8. C1645 Standard Test Method for Freeze-thaw and De-icing Salt Durability of Solid Concrete Interlocking Paving Units.
   9. D698 Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,000 ft-lbf/ft^3 (600 kN-m/m^3)).
   10. D1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
   11. D2940 Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports.
   12. E1980 Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

B. Interlocking Concrete Pavement Institute (ICPI) Technical Bulletins:
   1. Tech Spec 3 Edge Restraints for Interlocking Concrete Pavements.

2. Tech Spec 5 Cleaning, Sealing and Joint Sand Stabilization of Interlocking Concrete Pavement.
3. Tech Spec 16 Achieving LEED Credits with Segmental Concrete Pavement.
4. Tech Spec 17 Bedding Sand Selection for Interlocking Concrete Pavements in Vehicular Applications.

C. U.S. Green Building Council (USGBC) Leadership in Energy and Environmental Design for New Construction (LEED®-NC) v4.1.

1.03 SUBMITTALS

A. In accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
B. Manufacturer's drawings and details: Indicate perimeter conditions, relationship to adjoining materials and assemblies, expansion and control joints, concrete paver layout, patterns, color arrangement, installation and setting details.
C. Sieve analysis per ASTM C136 for grading of bedding and joint sand.
D. Concrete pavers:
1. Four representative full-size samples of each paver type, thickness, color, finish that indicate the range of color variation and texture expected in the finished installation. Color(s) selected by Engineer from manufacturer's available colors.
2. Accepted samples become the standard of acceptance for the work.
3. Test results from an independent testing laboratory for compliance of concrete pavers with ASTM C1782.
4. Manufacturer's catalog product data, installation instructions, and material safety data sheets for the safe handling of the specified materials and products.
5. Current certificates from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program for job foremen on the project.
6. Provide documentation complying with LEED-NC v4.1 Sustainable Sites (SS) and/or Materials & Resources (MR) Credits as follows:
a. SS Credit: Heat Island Effect, Nonroof – Test results according to ASTM C1549 indicating a minimum a three-year aged solar reflectance (SR) value of at least 0.28. If three-year aged value information is not available, use materials with a minimum initial SR of at least 0.33 at installation.
b. SS Credit: Heat Island Effect, Roof – Test results according to ASTM E1980 indicating a minimum initial solar reflectance index (SRI) according of 82 or and a 3-year aged minimum SRI of 64 for paving units on low-sloped roofs ≤ 2:12 (≤ 15%). For steep-sloped roofs >2:12 (15%) the initial minimum SRI shall be 39 and the 3-year aged minimum SRI shall be 32.

c. MR Building Product Disclosure and Optimization—Environmental Product Declarations Credit: Product-specific Type III EPD internally or externally reviewed.

d. MR Building Product Disclosure and Optimization—Sourcing of Raw Materials Credit: Document products extracted, manufactured and purchased within 100 miles (160 km) of the project site; recycled content, i.e., post-consumer recycled content and pre-consumer recycled content based on weight; salvaged, refurbished, or reused materials; and/or whose manufacturers participate in an extended producer responsibility program.

e. MR Building Product Disclosure and Optimization—Material Ingredients Credit: Provide documentation for any of the following: material ingredient screening and optimization action plan; health product declaration (HPD); Red List free; Cradle-to-Cradle Certified v3 product with Material Health category score of Bronze, or a certified Material Health Certificate Bronze level; Material Ingredient Optimization using a manufacturer chemical inventory or HPD: a chemical inventory to at least 0.01% by weight (100 ppm) with at least 95% by weight of product assessed using the GreenScreen Benchmark assessment.

E. Paver Installation Subcontractor:
   1. A copy of Subcontractor’s current certificate from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program.
   2. Job references from projects of a similar size and complexity. Provide Owner/Client/General Contractor names, postal address, phone, fax, and email address.

1.04 QUALITY ASSURANCE

A. Paving Subcontractor Qualifications:
   1. Utilize an installer having successfully completed concrete paver installation similar in design, material, and extent indicated on this project.
   2. Utilize an installer holding a current certificate from the Interlocking Concrete Pavement Institute Concrete Paver Installer Certification program.

B. Regulatory Requirements and Approvals: [Specify applicable licensing, bonding or other requirements of regulatory agencies.].

C. Mock-Ups

Note: A site visit and approval by the owner's representative during the first day of paving may substitute for a mock-up.

1. Install a 7 x 7 ft (2 x 2) m paver area.
2. Use this area to determine surcharge of the bedding sand layer, joint sizes, lines, laying pattern(s), color(s) and texture of the job.
3. This area will be used as the standard by which the work will be judged.
4. Subject to acceptance by owner, mock-up may be retained as part of finished work.
5. If mock-up is not retained, remove and properly dispose of mock-up.

1.05 DELIVERY, STORAGE & HANDLING

A. General: Comply with Division 1 Product Requirement Section.

B. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers packaging with identification labels intact.
   1. Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving.
   2. Deliver concrete pavers to the site in steel banded, plastic banded or plastic wrapped packaging capable of transfer by forklift or clamp lift.
   3. Unload pavers at job site in such a manner that no damage occurs to the product.

D. Storage and Protection: Store materials protected such that they are kept free from mud, dirt, and other foreign materials. Store concrete paver cleaners and sealers per manufacturer's instructions.
   1. Cover bedding sand and joint sand with waterproof covering if needed to prevent exposure to rainfall or removal by wind. Secure the covering in place.

1.06 PROJECT/SITE CONDITIONS

A. Environmental Requirements:
   1. Do not install sand or pavers during heavy rain or snowfall.
   2. Do not install sand and pavers over frozen base materials.
   3. Do not install frozen sand or saturated sand.
   4. Do not install concrete pavers on frozen or saturated sand.

1.07 MAINTENANCE

A. Extra Materials: Provide [Specify area] [Specify percentage.] additional material for use by owner for maintenance and repair.

B. Pavers shall be from the same production run as installed materials.

PART 2 - PRODUCTS

2.01 INTERLOCKING CONCRETE PAVERS

Note: In addition to ASTM standards conformance, ICPI recommends a maximum 3:1 aspect ratio (length ÷ thickness) and a minimum 3 1/8 in. (80 mm) thickness for vehicular applications.

Residential driveways and pedestrian applications can use a minimum 2 3/8 in. (60 mm) thick units with a maximum 4:1 aspect ratio.

A. Manufacturer: ORCO Block and Hardscape.
   1. Contact: Abdol Bahrami.
B. Interlocking Concrete Pavers:
   1. Paver Type: ORCO 4x12
      a. Material Standard: Comply with material standards set forth in ASTM C 1782 Standard Specification for Segmental Concrete Paving Slabs
      b. Color and finish: ORCO Solar Tan and Coffee, Shot Blasted Finish, Per Engineer's Approval. See drawings.
      c. Color Pigment Material Standard: Comply with ASTM C979.
      d. Size: 4 inches x 12 inches 80mm thick.
      e. Average Modulus of Rupture: 725 psi (5.0 MPa) with no individual unit under 650 psi (4.5 MPa) per ASTM C 140.
      f. Chamfer: Micro Chamfer

2.02 PRODUCT SUBSTITUTIONS
A. Interlocking concrete pavers: as specified or approved equal.

2.03 BEDDING AND JOINT SAND
A. Provide bedding and joint sand as follows:
   1. Washed, clean, non-plastic, free from deleterious or foreign matter, symmetrically shaped, natural or manufactured from crushed rock.
   2. Do not use limestone screenings, stone dust, or sand for the bedding sand material that does not conform to conform to the grading requirements of ASTM C33.
   3. Do not use mason sand or sand conforming to ASTM C144 for the bedding sand.
   4. Where concrete pavers are subject to vehicular traffic, utilize sands that are as hard as practically available.
   5. Sieve according to ASTM C136.
   6. Bedding Sand Material Requirements: Conform to the grading requirements of ASTM C33 with modifications as shown in Table 1 below.

Table 1
Grading Requirements for Bedding Sand
ASTM C33

Sieve Size	Percent Passing
3/8 in.(9.5 mm)	100
No. 4 (4.75 mm)	95 to 100
No. 8 (2.36 mm)	85 to 100
No. 16 (1.18 mm)	50 to 85
No. 30 (0.600 mm)	25 to 60
No. 50 (0.300 mm)	10 to 30
No. 100 (0.150 mm)	2 to 10
No. 200 (0.075 mm)	0 to 1

Note: Bedding sands should conform to ASTM C33 gradations for concrete sand. CMHA recommends the additional limitations on the No. 200 (0.075 mm) sieve as shown.

7. Joint Sand Material Requirements:
    a. ORCO Apex Polymeric Sand by ORCO Block & Hardscape
    b. Or, conform to the grading requirements of ASTM C 144 as shown with modifications in Table 2 below:

Table 2
Grading Requirements for Joint Sand

Sieve Size	ASTM C 144 Natural Sand Percent Passing	ASTM C 144 Manufactured Sand Percent Passing
No. 4 (4.75 mm)	100	100
No. 8 (2.36 mm)	95 to 100	95 to 100
No. 16 (1.18 mm)	70 to 100	70 to 100
No. 30 (0.600 mm)	40 to 75	40 to 100
No. 50 (0.300 mm)	10 to 35	20 to 40
No. 100 (0.150 mm)	2 to 15	10 to 25
No. 200 (0.075 mm)	0 to 5	0 to 5

Note; ASTM C144 allows up to 10% passing the No. 200 (0.075 mm) sieve for manufactured sand. ICPI recommends reducing this to no more than 5% as a means to maintain interlock since material passing the No. 200 sieve can lubricate larger sand particles and thereby reduce interlock among paving units.

2.04 EDGE RESTRAINTS

Note: Specify specific components of a system, manufactured unit or type of equipment. See ICPI Tech Spec 3, Edge Restraints for Interlocking Concrete Pavements *for guidance on selection and design of edge restraints.*

A. Provide edge restraints installed around the perimeter of all interlocking concrete paving unit areas as follows:
    1. Manufacturer: As noted on the drawings.
    2. Material: Concrete
    3. Material As noted on the drawings.

2.05 ACCESSORIES

A. Provide accessory materials as follows:

1. Geotextile:
    a. Material Type and Description: Mirafi 160N non-woven geotextile.
    b. Material Standard: AASHTO M288, Class 2.
    c. Manufacturer: TenCate/Solmax.

2. Cleaners

a. Material Type and Description: NMD 80 Cleaner
b. Material Standard: Water based cleaner complies with SCAQMD
c. Manufacturer: EaCo Chem.

PART 3 EXECUTION

3.01 ACCEPTABLE INSTALLERS
A. Installers must have CMHA Paver Installer Certification.

3.02 EXAMINATION

Note: Compaction of the soil subgrade is recommended to at least 98% standard Proctor density per ASTM D698 for pedestrian areas and residential driveways. Compaction to at least 98% modified Proctor density per ASTM D1557 is recommended for areas subject to heavy vehicular traffic. Stabilization of the subgrade and/or base material may be necessary with weak or saturated subgrade soils.

Note: Local aggregate base materials typical to those used for highway flexible pavements are recommended, or those conforming to ASTM D2940. Compaction of aggregate is recommended to not less than 98% Proctor density in accordance with ASTM D698 is recommended for pedestrian areas and residential driveways. 98% modified Proctor density according to ASTM D1557 is recommended for vehicular areas. Mechanical tampers are recommended for compaction of soil subgrade and aggregate base in areas not accessible to large compaction equipment. Such areas can include that around lamp standards, utility structures, building edges, curbs, tree wells and other protrusions.

Note: Prior to screeding the bedding sand, the recommended base surface tolerance should be ±3/8 in. (±10 mm) over a 10 ft. (3 m) straight edge. See ICPI Tech Spec 2, Construction of Interlocking Concrete Pavements *for further guidance on construction practices.*

Note: The elevations and surface tolerance of the base determine the final surface elevations of concrete pavers. The paver installation contractor cannot correct deficiencies in the base surface with additional bedding sand or by other means. Therefore, the surface elevations of the base should be checked and accepted by the General Contractor or designated party, with written certification to the paving subcontractor, prior to placing bedding sand and concrete pavers.

A. Acceptance of Site Verification of Conditions:
1. General Contractor shall inspect, accept and certify in writing to the paver installation subcontractor that site conditions meet specifications for the following items prior to installation of interlocking concrete pavers.
a. Verify that subgrade preparation, compacted density and elevations conform to specified requirements.
b. Verify that geotextiles, if applicable, have been placed according to drawings and specifications.
c. Verify that Aggregate base materials, thickness, compaction to 98%, or as directed by the geotechnical report. Proctor density,

surface tolerances and elevations shall conform to specified requirements.

d. Provide written density test results for soil subgrade, aggregate base materials to the Owner, General Contractor and paver installation subcontractor.

e. Verify location, type, and elevations of edge restraints, concrete collars around utility structures, and drainage inlets.

2. Do not proceed with installation of bedding sand and interlocking concrete pavers until subgrade soil and base conditions are corrected by the General Contractor or designated subcontractor.

3.03 PREPARATION

A. Verify base is dry, certified by General Contractor as meeting material, installation and grade specifications.

B. Verify that base and geotextile is ready to support sand, edge restraints, paving, pavers and imposed loads.

C. Edge Restraint Preparation:

1. Install edge restraints per the drawings and manufacturer's recommendations at the indicated elevations.

Note: Retain the following two subparagraphs if specifying edge restraints that are staked into the base with spikes.

2. If applicable, mount directly to finished base. Do not install on bedding sand.

3. If applicable, the minimum distance from the outside edge of the base to the spikes shall be equal to the thickness of the base.

3.04 INSTALLATION

A. Spread bedding sand evenly over the base course and screed to a nominal 1 in. (25 mm) thickness, not exceeding 1½ in. (40 mm) thickness. Spread bedding sand evenly over the base course and screed rails, using the rails and/or edge restraints to produce a nominal 1 in. (25 mm) thickness, allowing for specified variation in the base surface.

1. Do not disturb screeded sand.

2. Screeded area shall not substantially exceed that which is covered by pavers in one day.

3. Do not use bedding sand to fill depressions in the base surface.

Note: When initially placed on the bedding sand, manually installed pavers often touch each other, or their spacer bars if present. Joint widths and lines (bond lines) are straightened and aligned to specifications with rubber hammers and pry bars as paving proceeds.

B. Lay pavers in pattern(s) shown on drawings. Place units hand tight without using hammers. Make horizontal adjustments to placement of laid pavers with rubber hammers and pry bars as required.

Note: Contact manufacturer of interlocking concrete paver units for recommended joint widths.

C. Provide consistent joints widths between [1/16 in. and 3/16 in. (2 and 5 mm)]. No more than 5% of the joints shall exceed [1/4 in. (6 mm)] wide to achieve straight bond lines.
D. Joint (bond) lines shall not deviate more than ±1/2 in. (±15 mm) over 50 ft. (15 m) from string lines.
E. Fill gaps at the edges of the paved area with cut pavers or edge units.
F. Cut pavers to be placed along the edge with a [double blade paver splitter or] masonry saw.

Note. Specify requirements for edge treatment in paragraph below.

G. Adjust bond pattern at pavement edges such that cutting of edge pavers is minimized. All cut pavers exposed to vehicular tires shall be no smaller than one-third of a whole paver.
H. Keep skid steer and forklift equipment off newly laid pavers that have not received initial compaction and joint sand.
I. Use a low-amplitude plate compactor capable of at least minimum of 4,000 lbf (18 kN) at a frequency of 75 to 100 Hz to vibrate the pavers into the sand. Remove any cracked or damaged pavers and replace with new units.
J. Simultaneously spread, sweep and compact dry joint sand into joints continuously until full. This will require at least 4 to 6 passes with a plate compactor. Do not compact within 6 ft (2 m) of unrestrained edges of paving units.
K. All work within 6 ft. (2 m) of the laying face must shall be left fully compacted with sand-filled joints at the end of each day or compacted upon acceptance of the work. Cover the laying face or any incomplete areas with plastic sheets overnight if not closed with cut and compacted pavers with joint sand to prevent exposed bedding sand from becoming saturated from rainfall.
L. Remove excess sand from surface when installation is complete.

Note: Excess joint sand can remain on surface of pavers to aid in protecting their surface especially when additional construction occurs after their installation. If this is the case, delete the article above and use the article below. Designate person responsible for directing timing of removal of excess joint sand.

M. Allow excess joint sand to remain on surface to protect pavers from damage from other trades. Remove excess sand per manufacturer’s recommendations and when directed by Engineer.
N. Surface shall be broom clean after removal of excess joint sand.

3.05 FIELD QUALITY CONTROL

A. The final surface tolerance from grade elevations shall not deviate more than ±3/8 in. (±10 mm) under a 10 ft (3 m) straightedge.
B. Check final surface elevations for conformance to drawings.

Note: For installations on a compacted aggregate base and soil subgrade, the top surface of the pavers may be 1/8 to 1/4 in. (3 to 6 mm) above the final elevations after compaction. This helps compensate for possible minor settling normal to pavements. For pedestrian access routes maximum elevation should not exceed ¼ in. (6 mm) above final elevations.

C. The surface elevation of pavers shall be 1/8 in. to 1/4 in. (3 to 6 mm) above adjacent drainage inlets, concrete collars or channels.

D. Lippage: No greater than 1/8 in. (3 mm) difference in height between adjacent pavers.

Note: Cleaning and sealing may be required for some applications. See ICPI Tech Spec 5 Cleaning, Sealing and Joint Sand Stabilization of Interlocking Concrete Pavement *for guidance on when to clean and seal the paver surface, and when to stabilize joint sand. Delete article below if cleaners, sealers, and or joint sand stabilizers are not applied.*

3.06 CLEANING, SEALING, JOINT SAND STABILIZATION

A. Clean, Seal, Apply joint sand stabilization materials between concrete pavers in accordance with the manufacturer's written recommendations.

3.07 PROTECTION

A. After work in this section is complete, the General Contractor shall be responsible for protecting work from damage due to subsequent construction activity on the site.

END OF SECTION

SECTION 321540

STABILIZED CRUSHED AGGREGATE PAVING

PART 1 - GENERAL

1.1 Related documents

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 Section Includes

A. Section Includes: Supply and installation of stabilized crushed aggregate paving as indicated in the Contract documents, including:

1. Base Course
2. Crushed Aggregate Paving
3. Organic Binder for Crushed Aggregate

1.3 Related Sections

A. Section 31 20 00 – Earth Moving - Refer to the project Geotechnical Investigation Report, dated 9-17-2024.

B. Section 31 23 13 – Subgrade Preparation - Refer to the project Geotechnical Investigation Report, dated 9-17-2024.

C. Section 32 11 23 – Aggregate Base Courses - Refer to the project Geotechnical Investigation Report, dated 9-17-2024.

1.4 References

A. ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.

B. ASTM D2419 – Sand Equivalent Value of Soils and Fine Aggregates.

1.5 Submittals

A. Submit in accordance with Section 01 33 00 - Submittal Procedures:

1. Manufacturer’s product data sheet.
2. 8 quarts sample of base course, unless Engineer states otherwise.

3. Base Course gradation indicating that the product meets specifications.
4. 8 quarts sample of stabilized crushed aggregate paving, unless Engineer states otherwise.
5. Stabilized crushed aggregate gradation indicating that the product meets specifications.

1.6 Mock-Up

A. Install 20 square feet minimum of stabilized crushed aggregate paving including base course, at location approved by Engineer.

B. Allow Engineer to view mock-up before proceeding with rest of stabilized crushed aggregate paving.

C. Remove mock-up after acceptance of work specified in this Section.

1.7 1.6 Delivery, Storage and Handling

A. Protect stabilized crushed aggregate mix from contamination. Store under cover.

1.8 1.7 Sequencing

A. Do not install work specified in this Section prior to acceptance of earth moving.

B. Coordinate work specified in this Section with work specified in other Sections to minimize cutting of and operation of heavy equipment over installed stabilized crushed aggregate paving.

C. Do not install stabilized crushed aggregate surfacing when subbase is wet at saturated field capacity.

PART 2 - PRODUCTS

2.1 Materials

A. Base Course Materials:

B. Comply with MTO OPSS 1010 – “Material Specification for Aggregates – Granular A, B, M and Select Subgrade Material” specification for Granular A material.

C. Crushed Aggregate Materials:

1. Crushed Aggregate Material shall consist of sound, angular, durable particles.
2. Gradation, in accordance with ASTM C136:

D. Aggregate color shall be selected from a pre-approved material pallet from Gail Materials 951-667-6106, wwwgailmaterials.net.

E. Organic Binder:

1. Organic-Lock™ self-healing organic binder by Gail Materials, Corona, CA; phone 951-667-6106; fax 951-667-6102; www.gailmaterials.net.
2. Requests for substitutions will be considered in accordance with provisions of section 01 25 00 Substitution Procedures.
3. Substitutions: Not permitted.
4. Mix Crushed Aggregate Material with Organic-Lock™ binder using a pug mill that includes a weigh-belt feeder.
5. Mix rate of Organic-Lock depends on the selected material as well as the application and shall be determined by Gail Materials.

F. Accessories:

1. Water: Free from contaminants that would discolour or be deleterious to stabilized aggregate paving.

PART 3 - EXECUTION

3.1 Examination

A. Examine grading and subsoil conditions. Do not proceed until conditions are acceptable.

3.2 Preparation of Subgrade

A. Excavate to depth required so that finish grade can be established as noted on plans.

B. Remove excavated soil from site. Spread excavated surface as specified in Section 31 10 00

C. Compact subgrade to 95% Modified Proctor Density.

D. Excavate soft and unstable areas of subgrade that cannot be compacted to standard noted, fill and compact with approved granular material.

3.3 Base Course

A. Place base course material over subgrade to depths and dimensions shown on drawings in maximum (6”) lifts compacted to 95% Modified Proctor Density.

3.4 Pre-BLENDED ORGANIC Lock™ Aggregate Surfacing

A. For typical pathways or trails install Organic Lock™ Aggregate Paving to a compacted depth of 4 inches. For areas of vehicular use or equal install Organic Lock™ Aggregate Paving to a compacted depth of 6 inches.

B. Prewetted Organic Lock Aggregate Paving can be installed in one lift for pathway, trails or equal application. For areas of vehicular use of compacted depths of 6 inches or greater shall be installed at 3-inch compacted lifts. Estimated compacted max density is +/- 129 lbs/cu. ft. The moisture percentage in the prewetted Organic Lock Aggregate Paving will be determined by Gail Materials and will depend on selected aggregate.

C. For applications that are not prewetted by Gail Materials the Organic Lock Aggregate Paving will be delivered dry. Gail Materials will calculate the required gallons of water to be added per ton of selected material in order to reach the ideal moisture percentage for installation. In order to ensure that water is being applied correctly the Organic Lock Aggregate Paving shall be bucket blended or equal prior to spreading. Gail Materials does not recommend installing Organic Lock Aggregate Paving in place and then watering in either lifts or from the surface down.

D. Depending on weather conditions, the time required to allow the material to set-up before it can be compacted varies. Generally, this time period is between 6 and 48 hours. The top layer should be firm and not sticky. Compaction can begin when you can walk on the material without significantly sinking in and material does not feel muddy. If material sticks to the roller during compaction, allow the material to further dry. Do not allow the material to completely dry out.

E. Make 4 passes using a 1 ton double or single static drum roller, or equivalent. Do not use a vibratory compactor or vibratory setting on the compactor. The contractor shall select the proper size roller for the appropriate application.

F. After final compaction, the surface shall be true to elevation and shall not vary by more than (1/4”) tested with a straight edge at any location on the surfaces. Surfaces can either be crowed at a minimum of 2% and/or installed with a cross slope of minimum 1%.

G. Compaction testing shall not be conducted until the Organic Lock Aggregate Paving has be allowed to thoroughly dry and cure.

3.5 Adjust and Clean

A. All paved areas or adjacent surface shall be brushed clean and excess materials shall be removed from the work site and disposed of in an approved dump location.

3.6 Protection

A. Do not allow traffic on stabilized crushed aggregate paving after placement or until compacted stabilized crushed aggregate paving has fully cured. This time may vary depending on weather conditions.

B. Protect stabilized crushed aggregate paving surface from damage until Project completion. Repair damaged areas to match specified requirements.

3.7 Maintenance & Repairs

A. Loose aggregate will appear on the surface over time and is a natural occurrence. If excess material becomes loose, redistribute the material over the surface, water thoroughly and re-compact with a minimum 1-ton drum roller.

B. To repair, excavate damaged area and scarify exposed stabilized crushed aggregate paving. Pre-blend replacement crushed aggregate material with Organic-Lock™ Aggregate Paving at the specified rate. Apply material to the excavated area and compact. Thoroughly water the material and allow the material to cure, but not completely dry out. Re-compact the material, ensuring that the final grade and crown are maintained. Do not use a vibratory compactor.

END OF SECTION

SECTION 323300

SITE FURNISHINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Benches
2. Trash Receptacles
3. Blade Panel Fence and Gate
4. Seat Wall with Signage Letters
5. Standard Bollards
6. Removable Bollards
7. Bistro Lights
8. Cantilevered Disc Shade Structure
9. Shade Structure
10. Stage Canopy
11. Mockettes
12. Pebble Seating
13. Tree Well and Frame
14. Concrete Planter with Integral Seat
15. Umbrella Sleeves
16. Metal Panel
17. Fabrication

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 BENCHES

A. Provide benches as indicated in Construction Legend and on the drawings.

2.2 TRASH RECEPTACLES

A. Provide trash receptacles as indicated in the Construction Legend and on the drawings.

2.3 BLADE PANEL FENCE AND GATE

A. Provide blade panel fence and gate as indicated in Construction Legend and on the drawings.

2.4 SEAT WALL WITH SIGNAGE LETTERS

A. Provide seat wall with signage letters as indicated in Construction Legend and on the drawings.

2.5 STANDARD BOLLARDS

A. Provide standard bollards as indicated in Construction Legend and on the drawings.

2.6 REMOVABLE BOLLARDS

A. Provide removable bollards as indicated in the Construction Legend and on the drawings.

2.7 BISTRO LIGHTS

A. Provide bistro lights as indicated in the Construction Legend and on the drawings.

2.8 CANTILEVERED DISC SHADE STRUCTURE

A. Provide cantilevered disc shade structure as indicated in the Construction Legend and on the drawings.

2.9 SHADE STRUCTURE

A. Provide shade structure as indicated in the Construction Legend and on the drawings.

2.10 STAGE CANOPY

A. Provide stage canopy as indicated in the Construction Legend and on the drawings.

2.11 MOCKETTES

A. Provide mockettes as indicated in the Construction Legend and on the drawings.

2.12 PEBBLE SEATING

A. Provide pebble seating as indicated in the Construction Legend and on the drawings.

2.13 TREE WELLS WITH FRAMES

A. Provide tree wells with frames as indicated in the Construction Legend and on the drawings.

2.14 CONCRETE PLANTER WITH INTEGRAL SEAT

A. Provide concrete planter with integral seat as indicated in the Construction Legend and on the drawings.

2.15 UMBRELLA SLEEVES

A. Provide umbrella sleeves as indicated in the Construction Legend and on the drawings.

2.16 METAL PANEL

A. Provide metal panel as indicated in the Construction Legend and on the drawings.

2.17 FABRICATION

A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.

B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended, so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.

C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

D. Preservative-Treated Wood Components: Complete fabrication of treated items before treatment if possible. If cut after treatment, apply field treatment complying with AWPA M4 to cut surfaces.

E. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.

F. Factory Assembly: Factory assemble components to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written installation instructions and provided details unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.

D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

E. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete to depth recommended in writing by manufacturer of site furnishings and 3/4 inch larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with material recommended by manufacturer, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

F. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with material recommended by manufacturer, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

END OF SECTION

SECTION 328400

PLANTING IRRIGATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Manual valves.
3. Pressure-reducing valves.
4. Automatic control valves.
5. Transition fittings.
6. Dielectric fittings.
7. Miscellaneous piping specialties.
8. Sprinklers.
9. Quick couplers.
10. Drip irrigation specialties.
11. Controllers.
12. Boxes for automatic control valves.

B. Related Requirements:

1. Section 220500 "Common Work Results for Plumbing" for water metering requirements.
2. Section 230923.14 "Flow Instruments" for water metering equipment.

1.2 DEFINITIONS

A. Circuit Piping: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.

B. Drain Piping: Downstream from circuit-piping drain valves. Piping is not under pressure.

C. ET Controllers: EvapoTranspiration Controllers. Irrigation controllers, which use some method of weather-based adjustment of irrigation. These adjusting methods include use of historical monthly averages of ET, broadcasting of ET measurements, or use of on-site sensors to track ET.

D. Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.

E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.3 ACTION SUBMITTALS

A. Product Data: For each product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated Design Submittals: For irrigation systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Sustainable Design Submittals:

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Irrigation systems, drawn to scale, on which components are indicated and coordinated with each other, using input from Installers of the items involved. Also include adjustments necessary to avoid plantings and obstructions, such as signs and light standards.

B. Zoning Chart: Indicate each irrigation zone and its control valve.

C. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.

D. Field quality control reports.

E. Qualification Statements: For Installer.

F. Delegated design engineer qualifications.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sprinklers controllers and automatic control valves to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Spray Sprinklers: Equal to 5 percent of amount installed for each type and size indicated, but no fewer than 5 units.
2. Bubblers: Equal to 5 percent of amount installed for each type indicated, but no fewer than 5 units.
3. Drip-Tube System Tubing: Equal to 5 percent of total length installed for

each type and size indicated, but not less than 500 ft..

4. Quick Coupler Keys: 2 minimum

B. Schedule of maintenance material items.

1.7 QUALITY ASSURANCE

A. Qualifications:

1. Installers: Entity that employs a Certified Irrigation Designer - Landscape qualified by the Irrigation Association Professional Class member of the American Society of Irrigation Consultants Professional Technical Class member of the American Society of Irrigation Consultants.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and entrance of dirt, debris, and moisture.

B. Store plastic piping protected from direct sunlight. Support piping to prevent sagging and bending.

1.9 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without Construction Manager's Owner's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Irrigation Zone Control: Automatic operation with controller and automatic control valves.

B. Location of Sprinklers and Specialties: Design location is approximate. Make

minor adjustments necessary to avoid plantings and obstructions, such as signs

and light standards. Maintain 100 percent irrigation coverage of areas indicated.

C. Delegated Design: Design 100 percent coverage irrigation system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

D. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:

1. Irrigation Main Piping: 200 psig.
2. Circuit Piping: 150 psig.

2.2 PIPES, TUBES, AND FITTINGS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

B. Hard Copper Tube: ASTM B88, Type L, water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

C. PE Pipe with Controlled ID: ASTM D2239, PE 3408 compound; SIDR 11.5 and SIDR 15.

1. Insert Fittings for PE Pipe: ASTM D2609, nylon or propylene plastic with barbed ends. Include bands or other fasteners.

D. PVC Pipe: ASTM D1785, PVC 1120 compound, Schedules 40 and 80.

1. PVC Socket Fittings: ASTM D2466, Schedule 80.
2. PVC Threaded Fittings: ASTM D2464, Schedule 80.
3. PVC Socket Unions: Construction similar to that of MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.

E. PVC Pipe, Pressure Rated: ASTM D2241, PVC 1120 compound, SDR 21 and SDR 26.

1. PVC Socket Fittings: ASTM D2467, Schedule 80.
2. PVC Socket Unions: Construction similar to that of MSS SP-107, except both headpiece and tailpiece shall be PVC with socket or threaded ends.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick unless otherwise indicated; full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

D. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux in accordance with ASTM B813.

E. Solvent Cements for Joining PVC Piping: ASTM D2564. Include primer in accordance with ASTM F656.

F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.4 MANUAL VALVES

A. Iron Gate Valve Casings:

1. Standard: AWWA M44 for cast-iron valve casings.
2. Top Section: Adjustable extension of length required for depth of burial of valve.
3. Barrel: Approximately 5-inch diameter.
4. Plug: With lettering "WATER."
5. Bottom Section: With base of size to fit over valve.
6. Base Support: Concrete collar or wood frame.

B. Operating Wrenches for Iron Gate Valve Casings: Furnish two steel, tee-handle operating wrench(es) with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut for Project.

2.5 TRANSITION FITTINGS

A. General Requirements: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

2.7 MISCELLANEOUS PIPING SPECIALTIES

A. Water Hammer Arresters: ASSE 1010 or PDI WH 201, with bellows or piston-type pressurized cushioning chamber and in sizes complying with PDI WH 201, Sizes A to F.

B. Pressure Gauges: ASME B40.1. Include 4-1/2-inch- diameter dial, dial range of two times system operating pressure, and bottom outlet.

2.8 SPRINKLERS

A. General Requirements: Designed for uniform coverage over entire spray area indicated at available water pressure.

2.9 BOXES FOR AUTOMATIC CONTROL VALVES

A. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3/4 inch minimum to 3 inches maximum.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

B. Install warning tape directly above pressure piping, 12 inches below finished grades, except 6 inches below subgrade under pavement and slabs.

C. Drain Pockets: Excavate to sizes indicated. Backfill with cleaned gravel or crushed stone, graded from 3/4 to 3 inches, to 12 inches below grade. Cover gravel or crushed stone with sheet of asphalt-saturated felt and backfill remainder with excavated material.

D. Provide minimum cover over top of underground piping according to the following:

1. Irrigation Main Piping: Minimum depth of 24" below finished grade, or not less than 18 inches below average local frost depth, whichever is deeper.
2. Circuit Piping: 12 inches.
3. Drain Piping: 12 inches.
4. Sleeves: 24 inches.

3.2 PREPARATION

A. Set stakes to identify locations of proposed irrigation system. Obtain Architect's approval before excavation.

3.3 INSTALLATION OF PIPING

A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.

B. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.

C. Install piping free of sags and bends.

D. Install groups of pipes parallel to each other, spaced to permit valve servicing.

E. Install fittings for changes in direction and branch connections.

F. Install unions adjacent to valves and to final connections to other components with NPS 2 or smaller pipe connection.

G. Install expansion loops in control-valve boxes for plastic piping.

H. Lay piping on solid subbase, uniformly sloped without humps or depressions.

I. Install PVC piping in dry weather when temperature is above 40 deg F. Allow joints to cure at least 24 hours at temperatures above 40 deg F before testing.

J. Install water regulators with shutoff valve and strainer on inlet and pressure gauge on outlet. Install shutoff valve on outlet. Install aboveground or in control-valve boxes.

K. Water Hammer Arresters: Install between connection to building main and circuit valves aboveground or in control-valve boxes.

L. Install piping in sleeves under parking lots, roadways, and sidewalks.

M. Install sleeves made of Schedule 40, PVC pipe and socket fittings, and solvent-cemented joints.

N. Install transition fittings for plastic-to-metal pipe connections according to the following:

1. Underground Piping:

    a. NPS 1-1/2 (DN 40) and Smaller: Plastic-to-metal transition fittings.
    b. NPS 2 (DN 50) and Larger: AWWA transition couplings.

O. Install dielectric fittings for dissimilar-metal pipe connections according to the following:

1. Underground Piping:

    a. NPS 2 (DN 50) and Smaller: Dielectric coupling or dielectric nipple.
    b. NPS 2-1/2 (DN 65) and Larger: Prohibited except in control-valve box.

2. Aboveground Piping:

    a. NPS 2 (DN 50) and Smaller: Dielectric union.
    b. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Dielectric flange.
    c. NPS 5 (DN 125) and Larger: Dielectric flange kit.

3. Piping in Control-Valve Boxes:

    a. NPS 2 (DN 50) and Smaller: Dielectric union.
    b. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Dielectric flange.
    c. NPS 5 (DN 125) and Larger: Dielectric flange kit.

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Flanged Joints: Select rubber gasket material of size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

E. Ductile-Iron Piping Gasketed Joints: Comply with AWWA C600 and AWWA M41.

F. Copper-Tubing Brazed Joints: Construct joints in accordance with CDA's "Copper Tube Handbook," using copper-phosphorus brazing filler metal.

G. Copper-Tubing Soldered Joints: Apply ASTM B813 water-flushable flux to tube end unless otherwise indicated. Construct joints in accordance with ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B32.

H. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Pressure Piping: Join schedule number, ASTM D1785, PVC pipe and PVC socket fittings in accordance with ASTM D2672. Join other-than-

schedule-number PVC pipe and socket fittings in accordance with ASTM D2855.

3. PVC Nonpressure Piping: Join in accordance with ASTM D2855.

3.5 INSTALLATION OF VALVES

A. Underground Iron Gate Valves, Resilient Seat: Comply with AWWA C600 and AWWA M44. Install in valve casing with top flush with grade.

1. Install valves and PVC pipe with restrained, gasketed joints.

B. Aboveground Valves: Install as components of connected piping system.

C. Pressure-Reducing Valves: Install in boxes for automatic control valves or aboveground between shutoff valves. Install full-size valved bypass.

D. Throttling Valves: Install in underground piping in boxes for automatic control valves.

3.6 INSTALLATION OF SPRINKLERS

A. Install sprinklers after hydrostatic test is completed.

B. Install sprinklers at manufacturer's recommended heights.

C. Locate part-circle sprinklers to maintain a minimum distance of 24 inches from walls and 24 inches from other boundaries unless otherwise indicated.

3.7 INSTALLATION OF DRIP IRRIGATION SPECIALTIES

A. Install application pressure regulators and filter units in piping near device being protected, and in control-valve boxes.

B. Install air relief valves and in piping, and in control-valve boxes.

3.8 INSTALLATION OF AUTOMATIC IRRIGATION CONTROL SYSTEM

A. Equipment Mounting, Interior: Install controllers on interior concrete bases.

1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Equipment Mounting, Exterior: Install exterior freestanding controllers on precast concrete bases.

1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Install control cable in same trench as irrigation piping and at least 2 inches below or beside piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

3.9 CONNECTIONS

A. Comply with requirements for piping specified in Section 331415 "Site Water Distribution Piping" for water supply from exterior water service piping, water meters, protective enclosures, and backflow preventers. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.

C. Connect wiring between controllers and automatic control valves.

3.10 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller.

1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

C. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tapes over underground piping during backfilling of trenches. See Section 312000 "Earth Moving" for warning tapes.

3.11 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service with Test Assistance: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Irrigation system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.12 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.
2. Verify that controllers are installed and connected in accordance with the Contract Documents.
3. Verify that electrical wiring installation complies with manufacturer's submittal.

3.13 ADJUSTING

A. Adjust settings of controllers.

B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.

C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than 1/2 inch above, finish grade.

3.14 CLEANING

A. Flush dirt and debris from piping before installing sprinklers and other devices.

3.15 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic control valves and controllers.

3.16 PIPING SCHEDULE

A. Install components having pressure rating equal to or greater than system operating pressure.

B. Piping in control-valve boxes and aboveground may be joined with flanges or unions instead of joints indicated.

C. Aboveground Irrigation Main Piping:

1. NPS 4 (DN 100) and Smaller:

a. Type L Type M hard copper tube, wrought- or cast-copper fittings, and soldered joints.
b. Schedule 40, PVC pipe; socket-type PVC fittings; and solvent-cemented joints.
c. Schedule 80, PVC pipe; Schedule 80, threaded PVC fittings; and threaded joints.

D. Underground Irrigation Main Piping:

1. NPS 4 (DN 100) and Smaller:

a. Schedule 40, PVC pipe and socket fittings, and solvent-cemented joints.
b. Schedule 80, PVC pipe; Schedule 80, threaded PVC fittings; and threaded joints.
c. SDR 21, PVC, pressure-rated pipe; Schedule 80, PVC socket fittings; and solvent-cemented joints.

E. Circuit Piping:

1. NPS 2 (DN 50) and Smaller:

a. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.
b. SDR 26, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.

F. Underground Branches and Offsets at Sprinklers and Devices: Schedule 80, PVC pipe; threaded PVC fittings; and threaded joints.

1. Option: Plastic swing-joint assemblies, with offsets for flexible joints, manufactured for this application.

G. Risers to Aboveground Sprinklers and Specialties:

1. Schedule 80, PVC pipe and socket fittings; and solvent-cemented joints.

H. Drain piping shall be one of the following:

1. SIDR 9, 11.5, or 15; PE, controlled ID pipe; insert fittings for PE pipe; and

banded or fastener joints.
2. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.
3. SDR 21, 26, or 32.5; PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.

3.17 VALVE SCHEDULE

A. Underground, Shutoff-Duty Valves: Use the following:

1. NPS 2 (DN 50) and Smaller: Curb valve, curb-valve casing, and shutoff rod.
2. NPS 3 (DN 80) and Larger: Iron gate valve, resilient seated; iron gate valve casing; and operating wrench(es).

B. Aboveground, Shutoff-Duty Valves:

1. NPS 2 (DN 50) and Smaller:

a. Brass Plastic ball valve.
b. Bronze gate valve.

END OF SECTION

SECTION 329113

SOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes planting soils and layered soil assemblies specified by composition of the mixes.

B. Related Requirements:

1. Section 323300 "Site Furnishings" for placing planting soil in exterior unit planters.
2. Section 329200 "Turf and Grasses" for placing planting soil for turf and grasses.
3. Section 329300 "Plants" for placing planting soil for plantings.
4. Section 329600 "Transplanting" for placing planting soil in tree planting pits.

1.2 ALLOWANCES

A. Preconstruction and field quality-control testing are part of testing and inspecting allowance.

1.3 UNIT PRICES

A. Work of this Section is affected by Square Foot.

1.4 DEFINITIONS

A. AAPFCO: Association of American Plant Food Control Officials.

B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.

C. CEC: Cation exchange capacity.

D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.

F. Imported Soil: Soil that is transported to Project site for use.

G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.

H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.

M. SSSA: Soil Science Society of America.

N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

Q. USCC: U.S. Composting Council.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for application and use.
2. Include test data substantiating that products comply with requirements.
3. Include sieve analyses for aggregate materials.
4. Material Certificates: For each type of soil amendment and fertilizer before delivery to the site, according to the following:

a. Manufacturer's qualified testing agency's certified analysis of standard products.
b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.
c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

B. Sustainable Design Submittals:

1. Third-Party Certifications: For each product.
2. Third-Party Certified Life Cycle Assessment: For each product.

C. Samples: For each bulk-supplied material, 1-quart volume of each in sealed containers labeled with content, source, and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For each testing agency.

B. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.

C. Field quality-control reports.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1. Laboratories: Subject to compliance with requirements, provide testing by the following:

a. Wallace Laboratories - 365 Coral Cir, El Segundo, CA 90245, or approved equal.

2. Multiple Laboratories: At Contractor's option, work may be divided among qualified testing laboratories specializing in physical testing, chemical testing, and fertility testing.

1.9 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil.

1. Notify Engineer seven days in advance of the dates and times when laboratory samples will be taken.

B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.

1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.10 SOIL-SAMPLING REQUIREMENTS

A. General: Extract soil samples according to requirements in this article.

B. Sample Collection and Labeling: Have samples taken and labeled by state-certified, -licensed, or -registered soil scientist under the direction of the testing agency.

1. Number and Location of Samples: Minimum of three representative soil samples where directed by Architect for each soil to be used or amended for landscaping purposes.
2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."
3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.
4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.11 TESTING REQUIREMENTS

A. General: Perform tests on soil samples according to requirements in this article.

B. Physical Testing:

1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":

a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
b. Hydrometer Method: Report percentages of sand, silt, and clay.

2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."

3. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1- Physical and Mineralogical Methods."
4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D698 (Standard Proctor).

C. Chemical Testing:

1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1- Physical and Mineralogical Methods."
3. Metals Hazardous to Human Health: Test for presence and quantities of RCRA metals including aluminum, arsenic, barium, copper, cadmium, chromium, cobalt, lead, lithium, and vanadium. If RCRA metals are present, include recommendations for corrective action.
4. Phytotoxicity: Test for plant-available concentrations of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt, copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.

D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAPT NCR-13, including the following:

1. Percentage of organic matter.
2. CEC, calcium percent of CEC, and magnesium percent of CEC.
3. Soil reaction (acidity/alkalinity pH value).
4. Buffered acidity or alkalinity.
5. Nitrogen ppm.
6. Phosphorous ppm.
7. Potassium ppm.
8. Manganese ppm.
9. Manganese-availability ppm.
10. Zinc ppm.
11. Zinc availability ppm.
12. Copper ppm.
13. Sodium ppm and sodium absorption ratio.
14. Soluble-salts ppm.
15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
16. Other deleterious materials, including their characteristics and content of each.

E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."

F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum,

recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.

1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. for 6-inchdepth of soil.
2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. for 6-inchdepth of soil.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 MATERIALS
2.2 PLANTING SOILS SPECIFIED BY COMPOSITION

A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.

B. Planting-Soil Type _: Existing, on-site surface soil, with the duff layer, if any, retained; and stockpiled on-site; modified to produce viable planting soil. Blend existing, on-site surface soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:

1. Ratio of Loose Compost to Soil: per soil test recommendations by volume.
2. Ratio of Loose Wood Derivatives Soil: per soil test recommendations by volume.
3. Weight of Lime: Per Soil Test Recommendations per 1000 sq. ft. per 6 inches of soil depth.
4. Weight of Sulfur and Iron Sulfate: Per Soil Test Recommendations per 1000 sq. ft. per 6 inches of soil depth.
5. Weight of Agricultural Gypsum: Per Soil Test Recommendations per 1000

sq. ft. per 6 inches of soil depth.

6. Weight of Superphosphate: Per Soil Test Recommendations per 1000 sq. ft. per 6 inches of soil depth.
7. Weight of Commercial Fertilizer: Per Soil Test Recommendations per 1000 sq. ft. per 6 inches of soil depth.
8. Weight of Slow-Release Fertilizer: Per Soil Test Recommendations per 1000 sq. ft. per 6 inches of soil depth.

C. Planting-Soil Type Per Soil Test Recommendations: Imported, naturally formed soil from off-site sources and consisting of sandy loam soil Per Soil Test Recommendations according to USDA textures; and modified to produce viable planting soil.

1. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches deep, not from agricultural land,bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass.
2. Additional Properties of Imported Soil before Amending: Soil reaction of Per Soil Test Recommendations and minimum of Per Soil Test Recommendations percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
3. Unacceptable Properties: Clean soil of the following:

    a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
    b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 8 percent by dry weight of the imported soil.
    c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 2 inches in any dimension.

4. Amended Soil Composition: Blend imported, unamended soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:

    a. Ratio of Loose Compost to Soil: Per Soil Test Recommendations by volume.
    b. Ratio of Loose Wood Derivatives to Soil: Per Soil Test Recommendations by volume.
    c. Weight of Lime: Weight Per Soil Test Recommendations per Per Soil Test Recommendations per Per Soil Test Recommendations of soil depth.
    d. Weight of Sulfur and Iron Sulfate: Per Soil Test Recommendations per Per Soil Test Recommendations per Per Soil Test Recommendations of soil depth.
    e. Weight of Agricultural Gypsum: Per Soil Test Recommendations per

Per Soil Test Recommendations per Per Soil Test Recommendations of soil depth.

f. Weight of Superphosphate: Per Soil Test Recommendations per Per Soil Test Recommendations per Per Soil Test Recommendations of soil depth.
g. Weight of Commercial Fertilizer: Per Soil Test Recommendations per Per Soil Test Recommendations per Per Soil Test Recommendations of soil depth.
h. Weight of Slow-Release Fertilizer: Per Soil Test Recommendations per Per soils testing recommendations per Per Soil Test Recommendations of soil depth.

D. Planting-Soil Type Per Soil Test Recommendations-1: Manufactured soil consisting of manufacturer's basic Per Soil Test Recommendations blended in a manufacturing facility with sand, stabilized organic soil amendments, and other materials to produce viable planting soil.

1. Additional Properties of Manufacturer's Basic Soil before Amending: Soil reaction of Per soils testing recommendations and minimum of per soils testing recommendations percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
2. Unacceptable Properties-1: Manufactured soil shall not contain the following:

    a. Unacceptable Materials-1: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
    b. Unsuitable Materials-1: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of per soils testing agency percent by dry weight of the manufactured soil.
    c. Large Materials-1: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 2 inches in any dimension.

3. Blend manufacturer's basic soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:

    a. Ratio of Loose Compost to Soil: Per Soil Test Recommendations by volume.
    b. Ratio of Loose Wood Derivatives Soil: Per Soil Test Recommendations by volume.
    c. Volume of Sand: Per Soil Test Recommendations per Per Soil Test Recommendations.
    d. Volume of Perlite: Per Soil Test Recommendations per Per Soil Test Recommendations.
    e. Weight of Lime: Per Soil Test Recommendations per Per Soil Test Recommendations.
    f. Weight of Sulfur and Iron Sulfate: Per Soil Test Recommendations per Per Soil Test Recommendations.
    g. Weight of Agricultural Gypsum: Per Soil Test Recommendations per Per Soil Test Recommendations.

h. Weight of Superphosphate: Per Soil Test Recommendations per Per Soil Test Recommendations.
i. Weight of Commercial Fertilizer: Per Soil Test Recommendations per Insert Per Soil Test Recommendations.
j. Weight of Slow-Release Fertilizer: Per Soil Test Recommendations per Per Soil Test Recommendations.

2.3 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through a No. 8 sieve and a minimum of 75 percent passing through a No. 60 sieve.
2. Class-1: O, with a minimum of 95 percent passing through a No. 8 sieve and a minimum of 55 percent passing through a No. 60 sieve.
3. Form: Provide lime in form of ground .

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Perlite: Horticultural perlite, soil amendment grade.

E. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 sieve.

F. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C33/C33M.

2.4 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:

1. Feedstock: per testing agency.
2. Reaction: per testing agency.
3. Soluble-Salt Concentration: Less than per testing agency dS/m.
4. Moisture Content: per testing agency percent by weight.
5. Organic-Matter Content: per testing agency percent of dry weight.
6. Particle Size: Minimum of 98 percent passing through a sieve per soils testing agency.

B. Wood Derivatives: Shredded and composted, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or

toxic materials.

1. Partially Decomposed Wood Derivatives: In lieu of shredded and composted wood derivatives, mix shredded and partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft. of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. of loose sawdust or ground bark.

2.5 FERTILIZERS

A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of per soils testing agency20 percent available phosphoric acid .

B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition-1: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition-1: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

D. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

PART 3 - EXECUTION

3.1 GENERAL

A. Place planting soil and fertilizers according to requirements in other Specification Sections.

B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

A. Excavation: Excavate soil from designated area(s) to a depth of 6 inches and stockpile until amended.

B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

C. Unsuitable Materials: Clean soil to contain a maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.

D. Screening: Pass unamended soil through a 2-inch sieve to remove large materials.

3.3 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth of 6 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top per soils agency 4 inches of subgrade. Spread remainder of planting soil.

C. Mixing: Spread unamended soil to total depth of 6 inches, but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Amendments: Apply soil amendments, except compost, and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.

a. Mix lime and sulfur with dry soil before mixing fertilizer.
b. Mix fertilizer with planting soil no more than seven days before planting.

2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

D. Compaction: Compact each blended lift of planting soil to percent of maximum

Standard Proctor density according to ASTM D698 and tested in-place.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 PLACING MANUFACTURED PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply manufactured soil on-site in its final, blended condition. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth of 6 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply approximately half the thickness of planting soil over prepared, loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.

C. Application: Spread planting soil to total depth of 4 inches, but not less than required to meet finish grades after natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Lifts: Apply planting soil in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 4 inches6 inches in loose depth for material compacted by hand-operated tampers.

D. Compaction: Compact each lift of planting soil to per soils testing agency percent of maximum Standard Proctor density according to ASTM D698 except where a different compaction value is indicated on Drawings.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.5 BLENDING PLANTING SOIL IN PLACE

A. General: Mix amendments with in-place, unamended soil to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Preparation: Till unamended, existing soil in planting areas to a minimum depth of of 6 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

C. Mixing: Apply soil amendments, except compost, and fertilizer, if required, evenly on surface, and thoroughly blend them into full depth of unamended, in-place soil

to produce planting soil.

1. Mix lime and sulfur with dry soil before mixing fertilizer.
2. Mix fertilizer with planting soil no more than seven days before planting.

D. Compaction: Compact blended planting soil to per soils testing agency percent of maximum Standard Proctor density according to ASTM D698 except where a different compaction value is indicated on Drawings.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.6 APPLYING COMPOST TO SURFACE OF PLANTING SOIL

A. Application: Apply 6 inches of compost to surface of in-place planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Finish Grading: Grade surface to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.7 LAYERED SOIL ASSEMBLIES

A. Layered Soil Assembly per soils testing agency:

1. Top Layer: Planting-soil type per soils testing agency.
2. per soils testing agency: Planting-soil type per soils testing agency.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D698. Space tests at no less than one for each 1000 sq. ft. of in-place soil or part thereof.
2. Wallace Laboratories: 365 Coral Cir, El Segundo, CA 90245, or approved equal.

C. Soil will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.9 PROTECTION

A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."

B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Vehicle traffic.
4. Foot traffic.
5. Erection of sheds or structures.
6. Impoundment of water.
7. Excavation or other digging unless otherwise indicated.

C. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Architect and replace contaminated planting soil with new planting soil.

3.10 CLEANING

A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION

SECTION 329200

TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sodding.

B. Related Requirements:

1. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.

1.2 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" and drawing designations for planting soils.

E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer.

B. Product Certificates: For fertilizers, from manufacturer.

C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf and meadows during a calendar year. Submit before expiration of required maintenance periods.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf and meadow establishment.

1. Professional Membership: Installer shall be a member in good standing of either the National Association of Landscape Professionals or AmericanHort.
2. Experience: Three years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in all of the following categories from the National Association of Landscape Professionals:

    a. Landscape Industry Certified Technician - Exterior.
    b. Landscape Industry Certified Lawn Care Manager.
    c. Landscape Industry Certified Lawn Care Technician.

5. Pesticide Applicator: State licensed, commercial.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.8 FIELD CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: End of February, Beginning of March.
2. Fall Planting: Insert dates to Late September.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 TURFGRASS SOD

A. Turfgrass Sod: Certified, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.

B. Turfgrass Species, Cool-Season Grass: Sod of grass species as follows, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:

1. Full Sun: Kentucky bluegrass (Poa pratensis), a minimum of cultivars per Sodded Turf Distributor.
2. Sun and Partial Shade: Proportioned by weight per Sodded Turf Distributor:

2.2 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition:

a. 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
b. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition:

a. 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
b. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.3 MULCHES

A. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

B. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

2.4 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Engineer and replace with new planting soil.

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation."

B. Placing Planting Soil: Blend planting soil in place.

1. Reduce elevation of planting soil to allow for soil thickness of sod.

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Before planting, obtain Engineer's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across slopes exceeding 1:3.
2. Anchor sod on slopes exceeding 1:6 with or steel staples spaced as recommended by sod manufacturer but not less than two anchors per sod strip to

prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.5 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. If applicable, mow bermudagrass to a height of 1/2 to 1 inch.
2. Mow annual ryegrass to a height of 1-1/2 to 2 inches and per Sodded Turf Distributor’s recommendations.

D. Turf Postfertilization: Apply slow-release fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.6 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by the City.

1. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.7 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.8 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

3.9 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

1. Sodded Turf: As recommended by Sodded Turf Distributor the number of days from date of Substantial Completion.

END OF SECTION 329200

SECTION 329300

PLANTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Contractor shall provide all labor, materials, and equipment for the installation of plant material as indicated on the drawings and as specified herein.

1.2 COORDINATION

A. Contractor shall coordinate planting with other site improvements. Unless otherwise specified, structural improvements shall be constructed prior to planting operations.

B. Contractor shall be responsible for locating and staking existing sewer, water and utility lines above or below grade that might be damaged as a result of planting operation. Contractor shall assume sole responsibility for any cost incurred due to damage and for replacement of aforementioned utilities.

C. All work on the irrigation system, including hydrostatic and coverage tests, operational tests, and the backfilling and compaction of trenches shall be performed prior to planting operations.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 SUBMITTALS

A. Contractor shall furnish the Engineer with a delivery receipt and Certificate of Compliance stating that the material substantially meets the specifications.

B. Contractor shall provide a representative color photo of each type of plant material to be installed on the project to the Engineer for review at least four (4) weeks prior to incorporation into the work. Tree and Shrub photos shall include a readable measuring stick and person for scale next to the plant material. Stock photos will not be accepted. Provide width and height dimensions on plant material photos.

1.5 REPAIR and REPLACEMENT

A. Costs incurred due to repair or replacement of defective or damaged work, rejected materials, workmanship and damage to utilities or sparse turf areas shall

be the responsibility of the Contractor.

B. Replacement plant material shall be of the same species, variety, size and condition as shown on the drawings and specified herein, and shall be guaranteed for one (1) full year from the date of planting

1.6 QUALITY ASSURANCE

A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

1. Pesticide Applicator: State licensed, commercial.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

B. Handle planting stock by root ball.

C. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1.8 POST INSTALLATION MAINTENANCE PERIOD

A. Provide post installation maintenance as prescribed herein.

1. Contractor shall provide all labor, materials, equipment and incidentals to perform work during the Post-Installation Maintenance Period, as specified herein, including but not limited to; litter removal, drain cleaning, hardscape sweeping, adequate watering of plant materials, mowing, fertilizing, replacing unsuitable plant material and controlling weeds, rodents and other pests.
2. Shall commence on the first day after the completion of planting.
3. Maintenance during Plant Establishment shall include eradicating weeds, eradicating insects and diseases, and protecting areas from traffic, watering, and erosion.
4. Contractor shall maintain the project on a continuous basis for ninety (90) calendar days. Areas shall be so cared for as to present a neat and clean condition at all times.
5. Working days when the Contractor fails to adequately perform

maintenance operations as specified herein will not be credited as time of Post-Installation Maintenance Period.

6. Post-Installation Maintenance Period may be extended by the Engineer if the Project is improperly maintained, appreciable replacement is required, or other corrective work becomes necessary.
7. Contractor shall schedule a monthly walkthrough inspection five (5) calendar days prior to the first thirty (30) calendar days. This notification and inspection time should continue for the duration of the maintenance period until acceptance of the work. Contractor shall correct deficiencies before the next monthly walkthrough or maintenance period shall be extended accordingly.
8. At the end of the Post-Installation Maintenance Period, all areas shall be in a weed-free condition.

B. Specialty Type Operations

1. Notification shall be given to the Agency seventy-two (72) hours prior to the Contractor performing “specialty-type” operations, including but not limited to; fertilization, chemical weed abatement and turf aerification, de-thatching and fungicide applications.
2. Contractor shall apply spray chemicals when air currents are still; preventing drifting onto adjoining property and preventing toxic exposure to persons whether or not they are in, or near, the project.

C. Protection

1. Contractor shall be responsible for fencing and maintaining adequate protection of the site. Costs incurred due to damage or replacement shall be the responsibility of the Contractor.

D. Public Interface

1. Contractor shall be responsible for fencing and maintaining adequate protection of the site. Costs incurred due to damage or replacement shall be the responsibility of the Contractor.

E. Repair and Replacement

1. Dead or dying container plant material shall be immediately replaced with material of the same species and size and guaranteed as described in these specifications.
2. Costs incurred due to repair or replacement of irrigation equipment shall be the responsibility of the Contractor. Replacement parts shall be identical to the material specified herein and on the drawings.

PART 2 - PRODUCTS

2.1 CONTAINER GROWN PLANT MATERIAL QUALITY

A. Plant material shall be in accordance with the California State Department of

Agriculture's regulations for nursery inspections, rules and grading. All plants shall be of No. 1 Grade and have a normal habit of growth, and shall be sound, healthy, vigorous and free of insect infestations, plant diseases, sun scalds, fresh bark abrasions or other objectionable disfigurements. All plants shall have a normal, well-developed branch system and vigorous and fibrous root system which are not pot bound and are free of kinked or girdling roots.

2.2 CONTAINER GROWN PLANT MATERIAL

A. Nursery grown stock shall be selected from high quality, well-shaped stock, grown under climatic conditions similar to those in the project locale. Minimum acceptable size of plants specified shall correspond with that normally expected for the species and variety of commercially available nursery stock.

B. Caliper shall be the diameter of the trunk one foot (1') above the ground surface and shall be the determining measurement for trees when specified.

C. Oversize plants may be used if not root bound, but shall not increase the Contract price. Up to ten percent (10%) of undersize plants in any one (1) variety and grade may be used; provided they are larger than the average size of the next smaller grade.

D. Scientific and common names conform to customary nursery usage, Hortus Third, or the Checklist of Woody Ornamental Plants of California, Oregon, and Washington.

E. Types, sizes and quantities of plant materials shall be as indicated on the drawings. The plant list shown on the drawings shall be used as a guide only; Contractor shall verify quantities by Contractor's own plan check.

F. The Engineer reserves the right to refuse or reject any unsuitable plant material. Unsuitable plants shall be removed from the project site and replaced at the Contractor's expense. New plants shall be the same species, variety, size and condition as specified.

G. Pruning of plant materials shall not be done prior to delivery. After planting, as directed by the Engineer, pruning shall be limited to that which is necessary to remove injured twigs and branches, deadwood, and suckers.

H. Plant material specified is subject to substitution based upon availability. Substituted material shall be approved in advance by the Engineer and shall conform to the requirements of those originally specified and shall be supplied by the Contractor.

2.3 WOOD MULCH

A. Wood mulch shall be a ground or processed wood product derived from fir or cedar, or from the bark of fir or pine, free of stones, sticks, and toxic substances harmful to plants and stabilized with nitrogen. Depth of mulch shall be as

specified in the drawings.

2.4 WEED-CONTROL BARRIERS

A. Nonwoven Geotextile Filter Fabric, if required: Polypropylene or polyester fabric, 4 oz./sq. yd.START_SIEND_SI minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.

2.5 PESTICIDES

A. General: Pesticide registered and approved by the Environmental Protection Agency (EPA), acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

2.6 POST INSTALLATION MAINTENANCE

A. Fertilizer: Provide fertilizer as specified in Fertilizer Article.

PART 3 - EXECUTION

3.1 MATERIAL DELIVERY AND INSPECTION

A. Plant material shall be delivered with legible identification labels, handled and stored adequately to maintain a healthy condition. They shall be protected from drying out, windburn or any other injury. Container plant material shall not be picked up by stems or trunks.

B. Inspection of plant materials required by State or Federal authorities shall be the responsibility of the Contractor. Secure any permits or certificates, if required by the jurisdiction having authority, prior to delivery of plants to project site.

C. Plants shall be inspected and approved by the Engineer, at the Contractor’s source prior to delivery to the project site and until acceptance of the work, for size, variety, condition, latent defects and injuries. Engineer to provide acceptance letter to the Agency after delivery of the plant material to the project site.

3.2 FINISH GRADING

A. Finish grading shall be completed prior to weed abatement operations. The Agency, at its own expense, may conduct a soils test at the completion of grading operations. See Engineer’s specification sections for additional grading

requirements.

3.3 WEED ABATEMENT OPERATIONS

A. The irrigation system, soil preparation operations, and finish grade shall be approved by the Engineer prior to weed abatement operations.

B. Contractor shall operate the irrigation system to keep planting areas uniformly moist for a period of two (2) weeks (14 calendar days). At the end of the two (2) week period, Contractor shall spray all visible weeds with an approved non-selective, post emergent herbicide. Application rate and method shall be recommended by the manufacturer. After spraying, planting areas shall remain unwatered for a minimum of forty-eight (48) hours.

C. After seven (7) calendar days from the chemical application, weeds and debris shall be disposed of off-site.

D. Contractor shall apply spray chemicals when air currents are still; preventing drifting onto adjoining property and preventing any toxic exposure to persons whether or not they are in or near the project.

E. After weed abatement operations, and as determined by the Engineer, planting areas shall be scarified to a depth not to exceed one inch (1”). The Engineer shall approve weed abatement operations prior to sodding, if applicable.

F. Weeds and debris shall be disposed of off-site.

3.4 INSTALLATION OF CONTAINER GROWN PLANT MATERIAL

A. Plant trees, shrubs, and ground cover as indicated on the drawings and specified herein as soon as the site and weather conditions are suitable.

B. Planting operations shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture or other unsatisfactory conditions prevail, the work shall be suspended. When special conditions warrant a variance to the planting operations proposed planting times shall be submitted to and approved by the Engineer.

C. Install trees before turf is installed, if applicable.

D. Stake plant locations and secure approval from the Engineer before excavating pits, making necessary adjustments as requested by the Engineer.

E. Excavated pits shall have vertical, roughened sides, and uncompacted bottoms. Glazed surfaces created by using an auger shall be scarified. Dust sides of pits with gypsum before backfilling.

F. Plants shall be set plumb and held into position until sufficient soil/backfill has been firmly placed around roots or ball. Container-grown material shall be installed such that the collars of the plants are slightly higher than immediate

adjacent grades.

G. Containers shall be opened and removed in such a manner that the plant root ball is not injured. Non-biodegradable containers of platforms shall be removed without damage to the plant or root system. Biodegradable containers shall be split.

H. Test for percolation shall be done to determine positive drainage of plant pits. The Engineer shall be notified of all soil and drainage conditions detrimental to growth of plant material. Contractor shall submit proposal for correcting the condition.

I. Trees shall be staked at time of planting as indicated on the drawings.

J. Unsuitable soil encountered in excavation shall be disposed of off-site and acceptable soil shall be provided.

K. Water all planting areas thoroughly after installation of plant materials. Additional backfill shall be added to fill voids caused by water settlement.

L. Inspection of all planting shall be made at the end of the construction to establish the time for the beginning of the Post-Installation Maintenance Period.

M. Except in turf areas, plants shall be set in a temporary watering basin as indicated on the drawings.

N. Areas around the plants shall be regraded to indicated finish grade.

3.5 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Mulch in Planting Areas: Apply thickness as indicated on drawings of mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 6 inches of trunks or stems.

3.6 POST INSTALLATION MAINTENANCE PERIOD

A. Weed Control.

1. Before weeds exceed two inches (2”) in height, they shall be removed and disposed of off-site. Serious weed pests (i.e. blackberry, nut sedge or bind weed) shall be sprayed with an approved non-selective, post-emergent herbicide and left in place for seven (7) calendar days. Application rate and method shall be as recommended by the manufacturer. As determined by the Engineer, a second application shall be made seven (7) days after the first application. With both applications, areas sprayed shall remain unwatered for a minimum of forty-eight (48) hours. Dead weeds shall be removed seven (7) calendar days after second application and disposed of off-site.

2. If the Engineer notifies the Contractor of failure to control weeds as specified herein, the Contractor shall kill all weeds within ten (10) calendar days of such notification. The Post-Installation Maintenance Period will be extended for every day after ten (10) calendar days until such weeds have been killed.

B. Irrigation System.

1. Contractor shall operate the irrigation system automatically and shall properly and completely maintain all parts of the irrigation system during both the Post-Installation Maintenance Period.
2. Contractor shall adjust irrigation system to deliver water in sufficient quantities to maintain plant material in a healthy condition and adjust water application to compensate for seasonal conditions.
3. Irrigation system is designed for watering five (5) days a week, 11 p.m. to 4 a.m. with even distribution.

C. Trees and Shrubs.

1. Installed plants shall be maintained in a healthy growing condition. Maintenance operations shall begin immediately after each plant is installed and shall continue until the post-installation maintenance period commences. This maintenance shall include, but not be limited to: watering, pruning, wound dressing, straightening, and other industry-related, customary and necessary procedure for healthy and vigorous growth. Plant beds and earth saucers shall be kept free of weeds, grass, and other undesirable vegetation. Plants shall be checked for settlement and shall be reset at proper grade as necessary. Run-off, puddling, and wilting shall be prevented.
2. Fifteen (15) calendar days after the beginning of the Post-Installation Maintenance Period, container plant material as part of the Contract shall be fed with a commercial fertilizer at rates recommended by the manufacturer. No fertilizer shall be applied directly at the crown and/or during the months of September through February.
3. Dead or dying plant material shall be immediately replaced with material of the same species and size and guaranteed as described in these specifications.
4. Trees planted as part of the Contract shall be pruned or headed back, as requested by the Engineer, to eliminate diseased or damaged growth, reduce the risk of toppling or wind damage, maintain growth within space limitations, maintain natural appearance, and to balance the crown with the root structure.
5. Staking of trees shall be checked frequently for damage, and to prevent chafing and girdling. Costs incurred due to damage or replacement of staking materials shall be the responsibility of the Contractor.
6. Contractor shall provide a clearance of not less than seven feet (7’) in height over walks, slabs and active play areas, and not less than fourteen feet (14’) in height over roadways.
7. As approved by the Engineer, all wounds over one and one-half inch (1 ½”) in diameter may be sealed with a tree seal.

3.7 GUARANTEE

A. Contractor shall guarantee new trees through one (1) full year after the date of acceptance of the work.

END OF SECTION

SECTION 329310

NON-VEGETATIVE SITE MATERIALS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Contractor shall provide all labor, materials, tools, equipment, and incidentals for establishing subgrade, ensuring flow lines are maintained, performing weed abatement operations and furnishing, loading, hauling, and placing non-vegetative surface or subbase materials as indicated on the drawings and specified herein.

1.2 MATERIAL SAMPLES

A. Contractor shall submit samples of materials to the Engineer for review and approval prior to purchase and installation.

1.3 QUALITY MEASUREMENT

A. Quantities of non-vegetative surface materials will be as measured in place and compensated for at the Contract unit prices bid.

B. Quantities of non-vegetative subsurface materials shall be as indicated in the unit price bid for the various item of work.

1.4 PROTECTION

A. Contractor shall provide all necessary protection to prevent injury to humans, animals, or adjacent plant life and property occasioned by application of weed abatement materials or soil sterilent for crushed rock mulch.

B. Contractor will be held responsible for all personal injury or property damage caused by application or storage of such materials.

PART 2 - PRODUCTS

2.1 CRUSHED ROCK MULCH

A. Crushed rock mulch, if applicable, shall be the product of crushing rock or gravel; clean, hard, sound durable, uniform in quality, and free of any detrimental quantity of soft, friable, or laminated pieces, disintegrated material, organic matter, oil or other deleterious material.

B. Crushed rock mulch color, if applicable, shall be as indicated on the drawings. Contractor shall submit a sample to Engineer for review and approval prior to purchase and installation of material.

C. Mulch- refer to 329300 SF PLANTS for information pertaining to Mulch.

D. Soil sterilent for crushed rock areas shall be Lacco-Bor by Los Angeles Chemical Company, Spike 8OW by Elanco Products, Poly-Bor-Chlorate by United States Borox and Chemical Corporation, or an approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Contractor shall furnish and place crushed rock mulch on compacted and sterilized subgrade in areas as indicated on the drawings and according to the details.

B. Prior to placing the crushed rock mulch, the subgrade shall be cleaned of all foreign substances. Ruts or soft, yielding spots that may appear in subgrade, areas having inadequate compaction, and deviations of the surface from requirements set forth therein shall be corrected by loosening, removing, and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements and as approved by the Engineer.

C. Soil sterilent shall be applied per manufacturer’s recommendation and applied by or under the direct supervision of someone holding a State of California Qualified Application Certificate.

D. Material shall be level to a uniform thickness so that the layer, will not be less than the indicated thickness.

E. Adjustments shall be made in placing, spreading, or finishing procedures as may be directed by the Engineer to obtain a uniform layer thickness and true grades, to minimize segregation and degradation where pertinent, and to insure a satisfactory course.

F. Materials found unsatisfactory shall be replaced or reworked at the Contractor’s expense to produce satisfactory material.

3.2 GUARANTEE

A. Contractor shall guarantee crushed rock mulch through one (1) full year after the date of acceptance of the work.

END OF SECTION

SECTION 334100

STORM DRAINS

PART 1 – GENERAL

1.1 SUMMARY

A. Provide storm drains, complete as indicated, specified, and required.

B. Work In This Section: Principal items include:

1 Storm drain pipe and fittings.
2. Extensions of storm drains through curbs, or to existing storm drain lines, as applicable.
3. Trenching, backfilling and compaction for storm drain system.

C. Related Work Not in This Section:

1. Earth Moving
2. Asphalt Paving
3. Concrete Paving
4. Excavation Support & Protection

1.2 SUBMITTALS

A. Submittal: List of material proposed to use accompanied by manufacturer's latest printed literature with technical data.

B. Certificates: Manufacturers' certification that materials meet specified requirements.

1.3 RECORD DRAWINGS

A. Provide complete record drawings showing dimensioned locations and depths of all piping, and exact locations off all accessories.

1.4 INSPECTION AND TESTING

A. Refer to Division 1 for procedures.

B. Inspection: Soils Engineer will inspect and test the backfilling work of this section. Notify Soils Engineer prior to commencement of work.

C. Testing: Soils Engineer will make tests to determine degree of compaction in accordance with the following ASTM test methods:

1. Maximum Density and Optimum Moisture Content: ASTM D1557, 5 layers.
2. Density of soil in place: ASTM D1556.

D. Report: Soils Engineer will submit a written report that trenches were backfilled with acceptable material, and that compaction meets the requirements of these specifications.

PART 2 - PRODUCTS

2.1 PIPE MATERIALS

A. Cast iron pipe shall be used where indicated and where storm drain lines are within 5 feet of walls and where lines have less than 12 inches of cover.

B. Cast Iron Pipe: Service weight, hubless, coated, cast iron soil pipe and fittings conforming to ASTM A74, latest revision.

C. Plastic Pipe: Plastic pipe shall contain ultraviolet inhibitor to provide protection from exposure to direct sunlight.

PART 1 - Polyvinyl Chloride (PVC) Pipe shall conform to ASTM F 758, Type PS 46, ASTM D 3034, or ASTM F 949 with a minimum pipe stiffness of 46 psi, shall be SDR-35 and with ends suitable for elastomeric gasket joints or solvent cement joints. Joints shall conform to ASTM D3212. Gaskets shall conform to ASTM F477. Solvent cement shall conform to ASTM D 2564.

PART 2 - High Density Polyethylene (HDPE) Pipe shall conform to ASTM F 405, ASTM F 667, ASTM D 2321 and ASTM D 3350. Joints shall conform to ASTM F 477 and ASTM D 3212.

D. Frame and grates: Conform to the drawings and to the requirements of ASTM A48, Class 30.

2.2 DRAINAGE STRUCTURES

A. Construct catch basins other drainage structures at locations, and to the design and dimensions indicated. Exposed concrete work shall have a smooth troweled finish with rounded corners and edges finished plumb and true. Provide grates, frames and covers for catch basins as detailed and indicated.

B. Concrete for catch basins and other drainage structures shall be 3,000 psi concrete at 28 days.

C. Forms for concrete drainage structures shall be rigid and substantial. Plywood or tongue and grooved lumber shall be used for forming the exposed faces of all concrete drainage structures. The top surfaces of the concrete shall be finished by bringing mortar to the surface by tamping, troweling smooth and tooling the edges.

D. Forms shall be kept in place not less than five days after placing, unless otherwise directed or approved. Concrete work shall be cured by keeping it continuously wet for not less than seven days after placing.

2.3 IDENTIFICATION

A. Metallic-Lined Plastic Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches wide by 4 mils thick, solid green in color with continuously printed caption in black letters "CAUTION - STORM DRAIN LINE BURIED BELOW."

PART 3 - EXECUTION

3.1 TRENCHING

A. Excavate trenches per requirements stated in paragraph below. Accurately shape and thoroughly compact trench bottom to grade. Excavate joint space when bells are used, so that the lowest 1/3 of all pipe has firm bearing for its entire length. Lay pipe to lines and grades indicated with sections close jointed to form a smooth flow line. Keep trenches clean until installed work has been approved.

B. Bedding material shall be clean sand extending from 6 inches thick beneath pipe to 12 inches above top of pipe. Place sand simultaneously on each side of the pipe, and thoroughly compact to provide lateral support for the line. Place remaining backfill in 6 inch layers above top of bedding material, moisten as required and compact with hand or pneumatic tampers. Compacting by flooding is prohibited.

C. Compaction shall be performed and comply with the related requirements of Section 02200.

3.2 LAYING PIPE AND JOINTS

A. Lay bell, hub or groove ends up-grade; accurately center the following spigots in them.

B. Polyvinyl Chloride Pipe: Join and install PVC pipe using solvent cement joint pipe and fittings, joining with solvent cement in accordance with ASTM D 2855 and ASTM F 402. Pipe with gasketed fittings shall be joined with elastomeric seals in accordance with ASTM D 3212

C. Unless otherwise indicated, lateral connections to main lines and angles in lines shall be made with the use of 45 degree wyes.

3.3 SPECIFIC ITEMS

A. Installation of Identification: Install continuous metallic underground warning tape during back-filling of trench for underground plastic piping. Locate 6 to 8 inches below finished grade, directly over piping.

B. Protection: Comply with requirements of Division 1, and as follows:

1. Provide adequate cribbing, sheathing and shoring as necessary to retain the earth sides of all excavations and trenches from caving and other damage resulting from excavating, together with suitable forms of protection against property damage and bodily injury to personnel employed on the work and the general public. The design, installation and maintenance of required cribbing and shoring shall be the

responsibility of the Contractor and shall conform to requirements of the State Division of Industrial Safety and the local governing agencies.

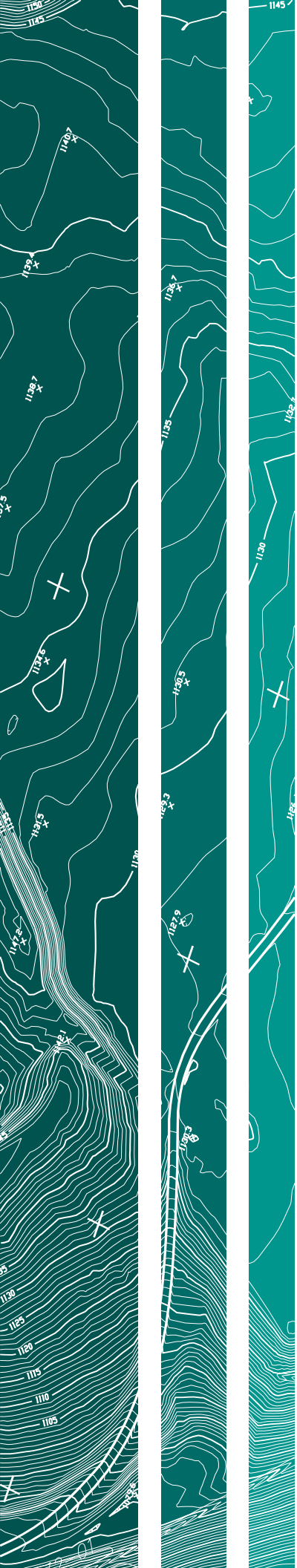
2. Furnish and maintain all temporary barricades, warning lights, and other types of protection and prevent accidental injury to the general public and all personnel employed on the project.
3. Drain lines, including trenches, shall be protected from damage during the construction period. Contractor shall replace or rework any damaged portion of the work at no additional cost to the Owner until time of final acceptance of project.

C. Clean-Up. Upon completion of the work, all storm drain systems shall be left free from silt, debris and obstructions.

END OF SECTION 334100

APPENDIX A

GEOTECHNICAL INVESTIGATION BY GEOCON
Report #1: 09.17.24



GEOCON

GEOTECHNICAL INVESTIGATION

LAKEWOOD CIVIC PARK
4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

SEPTEMBER 17, 2024
PROJECT NO. W1974-06-01

PREPARED FOR:
Dahlin Group, Inc.
Pleasanton, California

GEOCON
WEST, INC.
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

Project No. W1974-06-01
September 17, 2024

Dahlin Group, Inc.
5865 Owens Drive
Pleasanton, CA 94588

Subject: GEOTECHNICAL INVESTIGATION
LAKEWOOD CIVIC PARK
4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

Ladies and Gentlemen:

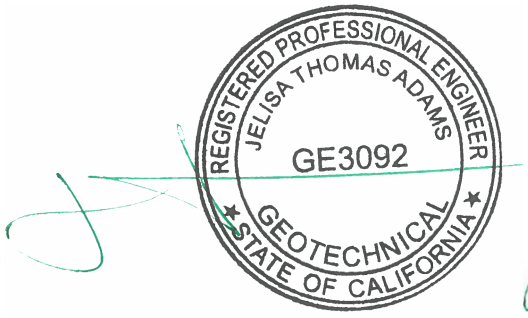
In accordance with your authorization of our proposal dated July 22, 2023, we have performed a geotechnical investigation for proposed Lakewood Civic Park planned for 4900 Clark Avenue in the City of Lakewood, California. The accompanying report presents the findings of our study and our conclusions and recommendations pertaining to the geotechnical aspects of the proposed design and construction. Based on the results of our investigation, it is our opinion that the site can be developed as proposed, provided the recommendations in this report are followed and implemented during design and construction.

If you have any questions regarding this report, or if we may be of further service, please contact the undersigned.

Very truly yours,

GEOCON WEST, INC.







Andrew Sover,
PE 92879

Jelisa Adams
GE 3092

Lisa Battiato
CEG 2316

(email) Addressee

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GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report presents the results of a geotechnical investigation for the proposed Lakewood Civic Park planned for 4900 Clark Avenue in the City of Lakewood, California (see Vicinity Map, Figure1). The purpose of the investigation was to evaluate subsurface soil and geologic conditions underlying the site and, based on conditions encountered, to provide conclusions and recommendations pertaining to the geotechnical aspects of proposed design and construction.

The scope of this investigation included a site reconnaissance, field exploration, laboratory testing, engineering analysis, and the preparation of this report. The site was explored on August 2, 2024, by excavating five 8-inch-diameter borings using a truck-mounted hollow-stem auger drilling machine to depths between 5½ and 63½ feet beneath the ground surface. Additionally, percolation testing was performed in four of the borings (B-1 through B-4) to determine the infiltration rate of site soils. The approximate locations of the exploratory borings are depicted on the Site Plan (see Figure 2). A detailed discussion of the field investigation, including boring logs, is presented in Appendix A.

Laboratory tests were performed on selected soil samples obtained during the investigation to determine pertinent physical and chemical soil properties. Appendix B presents a summary of the laboratory test results.

The recommendations presented herein are based on analysis of the data obtained during the investigation and our experience with similar soil and geologic conditions. References reviewed to prepare this report are provided in the *List of References* section.

If project details vary significantly from those described herein, Geocon should be contacted to determine the necessity for review and possible revision of this report.

2. SITE AND PROJECT DESCRIPTION

The subject site is located at 4900 Clark Avenue in the City of Lakewood, California. The northern half of the site is an asphalt parking lot and the southern half of the site is a vacant lot. The site is bounded a drive aisle and a public library to the north, by an asphalt parking lot and Civic Center Way to the east, by Del Amo Boulevard to the south, and by Clark Avenue to the west. The site is relatively level and surface water drainage at the site appears to flow southeast to the city streets.

Based on the information provided by the Client, it is our understanding that two conceptual plans are being considered for the proposed park. Option 1 includes flatwork and landscape improvements, a restroom and storage building, play area, artistic wall, and trash enclosure. Option 2 depicts two large shade structures over synthetic turf, two stages, a restroom, paved dining area and food truck parking/serving zone. The northeastern parking lot will be preserved to serve either park option. Based on the current site grades with respect to the surrounding roadways, we expect the improvements will be constructed near current site elevations. Plans depicting the proposed improvements are provided on the Site Plan (see Figure 2).

Based on the preliminary nature of the design at this time, wall and column loads were not available. It is anticipated that column loads for the proposed structures will be up to 25 kips, and wall loads will be up to 2 kips per linear foot.

Once the design phase and foundation loading configuration proceeds to a more finalized plan, the recommendations within this report should be reviewed and revised, if necessary. Any changes in the design, location or elevation of any structure, as outlined in this report, should be reviewed by this office. Geocon should be contacted to determine the necessity for review and possible revision of this report.

3. GEOLOGIC SETTING

The site is located in the Los Angeles Basin. The Los Angeles Basin is a coastal plain between the Santa Monica Mountains to the north, the Elysian Hills and Repetto Hills to the northeast, the Puente Hills and Whittier Fault to the east, the Palos Verdes Peninsula and Pacific Ocean on the west and south, and the Santa Ana Mountains and San Joaquin Hills on the southeast. Regionally, the site is located within the Peninsular Ranges geomorphic province, characterized by northwest-trending physiographic and geologic structures such as the nearby Whittier Fault and Newport-Inglewood Fault Zone.

4. SOIL AND GEOLOGIC CONDITIONS

Based on published geologic maps of the area, the site is underlain by younger alluvium and Terrace Deposits/Palos Verdes Sand at depth (Johns, et.al, 1954) most recently referred to as Older Alluvium. The terrace deposits were not encountered in our borings. Artificial fill is present across the site from the previous development. The younger alluvium consists of sandy silt, clay, silt and poorly graded sand. Detailed stratigraphic profiles of the materials encountered at the site are provided on the boring logs in Appendix A.

4.1 Artificial Fill

Artificial fill was encountered in our explorations to a maximum depth of 3 feet below existing ground surface. The artificial fill generally consists of brown sandy silt and can be characterized as slightly moist and soft. The fill is likely the result of past grading or construction activities at the site. Deeper fill may exist between excavations and in other portions of the site that were not directly explored.

4.2 Younger Alluvium

Holocene-age alluvium was encountered beneath the fill in each boring to the maximum depth explored of 63½ feet below existing ground surface. The alluvium generally consists of brown to grey brown interbedded silt, clay, silty sand and poorly graded sand. The alluvial soils are characterized as moist to wet and soft to hard or medium dense to dense.

5. GROUNDWATER

Review of the Seismic Hazard Zone Report for the Long Beach Quadrangle (California Division of Mines and Geology [CDMG], 1998) indicates the historically highest groundwater level in the area is approximately 20 feet beneath the ground surface. Groundwater information presented in this document is generated from data collected in the early 1900's to the late 1990s. Based on current groundwater basin management practices, it is unlikely that groundwater levels will ever exceed the historic high levels.

Groundwater was encountered at a depth of 31 feet below the ground surface during site exploration. The groundwater measurements were performed in a manner that is typical of geotechnical exploration and should not be interpreted as representing a fully equalized water level; the depth to water at the time of construction may be higher or lower than what was observed in the boreholes

Based on the depth of groundwater encountered in our borings and the depth of proposed construction, static groundwater is neither expected to be encountered during construction, nor have a detrimental effect on the project. However, it is not uncommon for groundwater levels to vary seasonally or for groundwater seepage conditions to develop where none previously existed (especially in impermeable fine-grained soils which are heavily irrigated or after seasonal rainfall), groundwater seepage levels encountered during construction may be actually higher than those encountered during our investigation. In addition, recent requirements for stormwater infiltration could result in shallower seepage conditions in the region. Proper surface drainage of irrigation and precipitation will be critical for future performance of the project. Recommendations for drainage are provided in the Surface Drainage section of this report (see Section 7.16).

6. GEOLOGIC HAZARDS

6.1 Surface Fault Rupture

The numerous faults in Southern California include Holocene-active, pre-Holocene, and inactive faults. The criteria for these major groups are based on criteria developed by the California Geological Survey (CGS, formerly known as CDMG) for the Alquist-Priolo Earthquake Fault Zone Program (CGS, 2018). By definition, a Holocene-active fault is one that has had surface displacement within Holocene time (about the last 11,700 years). A pre-Holocene fault has demonstrated surface displacement during Quaternary time (approximately the last 1.6 million years) but has had no known Holocene movement. Faults that have not moved in the last 1.6 million years are considered inactive.

The site is not within a state-designated Alquist-Priolo Earthquake Fault Zone (CGS, 1986) for surface fault rupture hazards. However, the Los Alamos Fault terminates immediately southeast of the site. No Holocene-active or pre-Holocene faults with the potential for surface fault rupture are known to pass directly beneath the site. Therefore, the potential for surface rupture due to faulting occurring beneath the site during the design life of the proposed development is considered low. However, the site is located in the seismically active Southern California region and could be subjected to moderate to strong ground shaking in the event of an earthquake on one of the many active Southern California faults. The faults in the vicinity of the site are shown in Figure 3, Regional Fault Map.

The closest surface trace of an active fault to the site is the Los Alamitos Fault located approximately 50 feet southeast of the site (Jennings & Bryant, 2010). Other nearby active faults are the Newport-Inglewood Fault, the Palos Verdes Fault, the Whittier Fault, and the Hollywood Fault, located approximately 3.5 miles southwest, 11 miles northeast, 11.5 miles to the southwest, and 20 miles to the northwest of the site, respectively (USGS, 2006; Ziony and Jones, 1989). The active San Andreas Fault Zone is located approximately 45 miles northeast of the site (USGS, 2006; Ziony and Jones, 1989).

Several buried thrust faults, commonly referred to as blind thrusts, underlie the Southern California area at depth. These faults are not exposed at the ground surface and are typically identified at depths greater than 3.0 kilometers. The October 1, 1987 M_w 5.9 Whittier Narrows earthquake and the January 17, 1994 M_w 6.7 Northridge earthquake were a result of movement on the Puente Hills Blind Thrust and the Northridge Thrust, respectively. The Puente Hills Blind Thrust underlies the site at depth. These thrust faults and others in the Los Angeles area are not exposed at the surface and do not present a potential surface fault rupture hazard at the site; however, these deep thrust faults are considered active features capable of generating future earthquakes that could result in moderate to significant ground shaking at the site.

6.2 Seismicity

As with all of Southern California, the site has experienced historic earthquakes from various regional faults. The seismicity of the region surrounding the site was formulated based on research of an electronic database of earthquake data. The epicenters of recorded earthquakes with magnitudes equal to or greater than 5.0 in the site vicinity are depicted on Figure 4, Regional Seismicity Map. A partial list of moderate to major magnitude earthquakes that have occurred in the Southern California area within the last 100 years is included in the following table.

LIST OF HISTORIC EARTHQUAKES

Earthquake (Oldest to Youngest)	Date of Earthquake	Magnitude	Distance to Epicenter (Miles)	Direction to Epicenter
Long Beach	March 10, 1933	6.4	19	SE
Tehachapi	July 21, 1952	7.5	94	NW
San Fernando	February 9, 1971	6.6	42	NNW
Whittier Narrows	October 1, 1987	5.9	15	NNE
Sierra Madre	June 28, 1991	5.8	30	NNE
Landers	June 28, 1992	7.3	100	ENE
Big Bear	June 28, 1992	6.4	79	ENE
Northridge	January 17, 1994	6.7	34	NW
Hector Mine	October 16, 1999	7.1	118	ENE
Ridgecrest China Lake Fault	July 5, 2019	7.1	136	NNE

The site could be subjected to strong ground shaking in the event of an earthquake. However, this hazard is common in Southern California and the effects of ground shaking can be minimized if the proposed structures are designed and constructed in conformance with current building codes and engineering practices.

6.3 Seismic Design Criteria

The following table summarizes the site-specific design criteria obtained from the 2022 California Building Code (CBC; Based on the 2021 International Building Code [IBC] and ASCE 7-16), Chapter 16 Structural Design, Section 1613 Earthquake Loads. The data was calculated using the online application U.S. Seismic Design Maps, provided by the Structural Engineers Association of California (SEAOC). The short spectral response uses a period of 0.2 second. We evaluated the Site Class based on the discussion in Section 1613.2.2 of the 2022 CBC and Table 20.3-1 of ASCE 7-16. The values presented on the following page are for the risk-targeted maximum considered earthquake (MCE_R).

2022 CBC SEISMIC DESIGN PARAMETERS

Parameter	Value	2022 CBC Reference
Site Class	D	Section 1613.2.2
MCE_R Ground Motion Spectral Response Acceleration – Class B (short), S_S	1.565g	Figure 1613.2.1(1)
MCE_R Ground Motion Spectral Response Acceleration – Class B (1 sec), S_1	0.559g	Figure 1613.2.1(2)
Site Coefficient, F_A	1	Table 1613.2.3(1)
Site Coefficient, F_V	1.741*	Table 1613.2.3(2)
Site Class Modified MCE_R Spectral Response Acceleration (short), S_{MS}	1.565g	Section 1613.2.3 (Eqn 16-20)
Site Class Modified MCE_R Spectral Response Acceleration – (1 sec), S_{M1}	0.973g*	Section 1613.2.3 (Eqn 16-21)
5% Damped Design Spectral Response Acceleration (short), S_{DS}	1.043g	Section 1613.2.4 (Eqn 16-22)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.649*	Section 1613.2.4 (Eqn 16-23)

*Per Supplement 3 of ASCE 7-16, a ground motion hazard analysis (GMHA) shall be performed for projects on Site Class "D" sites with 1-second spectral acceleration (S1) greater than or equal to 0.2g, which is true for this site. However, Supplement 3 of ASCE 7-16 provides an exception stating that that the GMHA may be waived provided that the parameter SM1 is increased by 50% for all applications of SM1. The values for parameters SM1 and SD1 presented above have **not** been increased in accordance with Supplement 3 of ASCE 7-16.

The table below presents the mapped maximum considered geometric mean (MCE_G) seismic design parameters for projects located in Seismic Design Categories of D through F in accordance with ASCE 7-16.

ASCE 7-16 PEAK GROUND ACCELERATION

Parameter	Value	ASCE 7-16 Reference
Mapped MCE_G Peak Ground Acceleration, PGA	0.671g	Figure 22-9
Site Coefficient, F_{PGA}	1.1	Table 11.8-1
Site Class Modified MCE_G Peak Ground Acceleration, PGA_M	0.738g	Section 11.8.3 (Eqn 11.8-1)

Deaggregation of the MCE peak ground acceleration was performed using the USGS online Unified Hazard Tool, 2014 Conterminous U.S. Dynamic edition (v4.2.0). The result of the deaggregation analysis indicates that the predominant earthquake contributing to the MCE peak ground acceleration is characterized as a 7.3 magnitude event occurring at a hypocentral distance of 10.67 kilometers from the site.

Conformance to the criteria in the above tables for seismic design does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur if a large earthquake occurs. The primary goal of seismic design is to protect life, not to avoid all damage, since such design may be economically prohibitive.

6.4 Liquefaction Potential

Liquefaction is a phenomenon in which loose, saturated, relatively cohesionless soil deposits lose shear strength during strong ground motions. Primary factors controlling liquefaction include intensity and duration of ground motion, gradation characteristics of the subsurface soils, in-situ stress conditions, and the depth to groundwater. Liquefaction is typified by a loss of shear strength in the liquefied layers due to rapid increases in pore water pressure generated by earthquake accelerations.

The current standard of practice, as outlined in the "Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California" and "Special Publication 117A, Guidelines for Evaluating and Mitigating Seismic Hazards in California" requires liquefaction analysis to a depth of 50 feet below the lowest portion of the proposed structure. Liquefaction typically occurs in areas where the soils below the water table are composed of poorly consolidated, fine- to medium-grained, primarily sandy soil. In addition to the requisite soil conditions, the ground acceleration and duration of the earthquake must also be of a sufficient level to induce liquefaction.

The State of California Seismic Hazard Zone Map for the Long Beach Quadrangle (CDMG, 1999) indicates that the site is located in an area designated as having a potential for liquefaction.

The historic high groundwater level in the site vicinity is at a depth of 20 feet beneath the ground surface. Groundwater was encountered in boring B5 at an approximate depth of 31 feet beneath the ground surface.

Liquefaction analysis of the soils underlying the site was performed using the 1996 NCEER method of analysis with the updates by Youd et al. (2001). This semi-empirical method is based on a correlation between values of Standard Penetration Test (SPT) resistance and field performance data.

Screening criteria developed by Bray and Sancio (2006) characterize fine-grained soils which are not susceptible to liquefaction as soils with a plasticity index (PI) that is greater than 18 or with a saturated moisture content that is less than 80 percent of the liquid limit. In order to apply the screening criteria, laboratory testing was performed to evaluate the Atterberg Limits of select soil samples. Laboratory test results used for the screening criteria are presented as Figure B5.

The liquefaction analysis was performed for the Maximum Considered Earthquake level by using a groundwater table of 20 feet below the ground surface, a magnitude 7.3 earthquake, and a peak horizontal acceleration of 0.738g (PGA_M). The enclosed liquefaction analysis, included herein for boring B5, indicates that the alluvium below the historic high groundwater level could be susceptible to approximately 1.6 inches of liquefaction settlement during Maximum Considered Earthquake ground motion (see enclosed calculation sheets, Figures 5 and 6).

6.5 Seismically-Induced Settlement

Dynamic compaction of dry and loose sands may occur during a major earthquake. Typically, settlements occur in thick beds of such soils. The seismically-induced settlement calculations were performed in accordance with the American Society of Civil Engineers, Technical Engineering and Design Guides as adapted from the US Army Corps of Engineers, No. 9.

The calculations provided herein for boring B1 indicates that the soil above the historic high groundwater level of 20 feet could be susceptible to approximately 0.35 inches of settlement as a result of the Maximum Considered Earthquake peak ground acceleration (PGA_M). Calculation of the anticipated seismically-induced settlements is provided as Figure 7.

6.6 Slope Stability

The topography at the site is relatively level and the topography in the immediate site vicinity slopes very gently to the south-southwest. The Seismic Hazards Zones Map of the Long Beach Quadrangle (CGS, 1999). Additionally, the site is not within an area identified as having a potential for seismic slope instability (CGS 1999). There are no known landslides near the site, nor is the site in the path of any known or potential landslides. Therefore, the potential for slope stability hazards to adversely affect the proposed development is considered low.

6.7 Earthquake-Induced Flooding

Earthquake-induced flooding is inundation caused by failure of dams or other water-retaining structures due to earthquakes. Based on a review of the California Department of Water Resources Dam Breach Inundation Map Web Publisher, the site is not located within a potential inundation area for an earthquake-induced dam failure. Therefore, the probability of earthquake-induced flooding is considered very low.

6.8 Tsunamis, Seiches, and Flooding

The site is not located within a coastal area. Therefore, tsunamis are not considered a significant hazard at the site.

Seiches are large waves generated in enclosed bodies of water in response to ground shaking. No major water-retaining structures are located immediately up gradient from the project site. Therefore, flooding resulting from a seismically induced seiche is considered unlikely.

The site is within an area of reduced flood risk due to levee (Zone X) as defined by the Federal Emergency Management Agency (FEMA, 2008).

6.9 Oil Fields & Methane Potential

Based on a review of the California Geologic Energy Management Division (CalGEM) Well Finder Website, the site is not located within an oil field and oil or gas wells are not documented within ½-mile of the site (CalGEM, 2024). However, due to the voluntary nature of record reporting by the oil well drilling companies, wells may be improperly located or not shown on the location map and undocumented wells could be encountered during construction. Any wells encountered during construction will need to be properly abandoned in accordance with the current requirements of CalGEM.

Since the site is not located within the boundaries of a known oil field, the potential for the presence of methane or other volatile gases at the site is considered low. However, should it be determined that a methane study is required for the proposed development it is recommended that a qualified methane consultant be retained to perform the study and provide mitigation measures as necessary.

6.10 Subsidence

Subsidence occurs when a large portion of land is displaced vertically, usually due to the withdrawal of groundwater, oil, or natural gas. Soils that are particularly subject to subsidence include those with high silt or clay content. The site is located within an area of known ground subsidence due to groundwater pumping (USGS, 2024). Ground subsidence typically over a region and may not necessarily result in differential settlement within relatively small areas such as the subject site.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 General

7.1.1 It is our opinion that neither soil nor geologic conditions were encountered during the investigation that would preclude the construction of the proposed development provided the recommendations presented herein are followed and implemented during design and construction.

7.1.2 Up to 3 feet of existing artificial fill was encountered during the site investigation. The existing fill encountered is believed to be the result of past grading and construction activities at the site. Deeper fill may exist in other areas of the site that were not directly explored. It is our opinion that the existing fill, in its present condition, is not suitable for direct support of proposed foundations or slabs. The existing fill and site soils are suitable for re-use as engineered fill provided the recommendations in the *Grading* section of this report are followed (see Section 7.4).

7.1.3 The enclosed seismically-induced settlement analyses indicate that the site soils could be susceptible to up to approximately 2 inches of total settlement as a result of the Maximum Considered Earthquake peak ground acceleration (PGA_M). The resulting differential settlement at the ground surface is anticipated to be less than 1 inch over a distance of 30 feet. The grading and foundation design recommendations presented herein are intended to reduce the effects of settlement on proposed improvements.

7.1.4 Based on these considerations, is recommended that proposed habitable structures be supported on a conventional foundation system deriving support in a blanket of newly placed engineered fill. All foundation excavations must be observed and approved in writing by the Geotechnical Engineer prior to placement of steel or concrete. Recommendations for the *Foundation Design* are provided in Sections 7.5 and 7.6.

7.1.4 As a minimum, it is recommended that the upper 3 feet of existing earth materials within proposed habitable structure footprint areas be excavated and properly compacted for foundation and slab support. Deeper excavations should be conducted as needed to remove any deeper fill or soft soils as necessary at the direction of the Geotechnical Engineer (a representative of Geocon). The excavation should extend laterally a minimum distance of 3 feet beyond the building footprint areas, including building appurtenances, or a distance equal to the depth of fill below the foundation, whichever is greater. The limits of existing fill and/or soft soil removal will be verified by the Geocon representative during site grading activities. Recommendations for earthwork are provided in the Grading section of this report (see Section 6.4).7.1.6 All excavations must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon) prior to the placement of bedding materials, fill, gravel, steel, or concrete.

7.1.5 The upper alluvial soils at the site are currently very moist and the grading contractor should be aware that the existing soils are currently near or slightly above optimum moisture content. Conditions could change seasonally. If the soils are in excess of 3 percent above optimum moisture content at the time of construction the soils will likely require some spreading and drying activities in order to achieve proper compaction. Additionally, stabilization of the excavation bottom may be required prior to the placement and compaction of engineered fill.

7.1.6 It is anticipated that stable excavations for the recommended grading associated with the proposed structures can be achieved with sloping measures. However, if excavations in close proximity to an adjacent property line and/or structure are required, special excavation measures may be necessary in order to maintain lateral support of offsite improvements. Excavation recommendations are provided in the *Temporary Excavations* section of this report (Section 7.13).

7.1.7 It should be noted that implementation of the recommendations presented herein is not intended to completely prevent damage to the structure during the occurrence of strong ground shaking as a result of nearby earthquakes. It is intended that the structure be designed in such a way that the amount of damage incurred as a result of strong ground shaking be minimized.

7.1.8 It is recommended that flexible utility connections be considered for all rigid utilities to minimize or prevent damage to utilities from minor differential movements.

7.1.9 Foundations for small outlying structures, such as block walls up to 6 feet high, planter walls or trash enclosures, which will not be tied-in to the proposed structure, may be supported on conventional foundations bearing on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and proper compaction cannot be performed, foundations may derive support directly in the undisturbed alluvial soils at or below a depth of 2½ feet and should be deepened as necessary to maintain a minimum of 12-inch embedment into recommended bearing materials. If the soils exposed in the excavation bottom are soft or loose, compaction of the soft soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved in writing by a Geocon representative.

7.1.9 Cast-in-place friction piles may be utilized for support of proposed lighting improvements, as well as proposed shade structures, provided foundations derive support in the competent alluvium found at or below a depth of 3 feet. Recommendations for friction pile design are provided in Section 6.7 of this report.

7.1.10 Where new paving is to be placed, it is recommended that all existing fill soils and soft alluvial soils be excavated and properly compacted for paving support. The client should be aware that excavation and compaction of all existing fill in the area of new paving is not required; however, paving constructed over existing uncertified fill or unsuitable soils may experience increased settlement and/or cracking, and may therefore have a shorter design life and increased maintenance costs. As a minimum, the upper 12 inches of soil should be scarified and properly compacted for paving support. Paving recommendations are provided in the *Preliminary Pavement Recommendations* section of this report (see Section 7.12).

7.1.11 Based on the results of the percolation testing, stormwater infiltration is not considered feasible for this project. It is recommended that stormwater be retained, filtered, and discharged in accordance with the requirements of the local governing agency. Discussion on the percolation test results are provided in Section 7.15.

7.1.12 Once the design and foundation loading configuration for the proposed structures proceeds to a more finalized plan, the recommendations within this report should be reviewed and revised, if necessary. Based on the final foundation loading configurations, the potential for settlement should be re-evaluated by this office.

7.1.13 Any changes in the design, location or elevation, as outlined in this report, should be reviewed by this office. Geocon should be contacted to determine the necessity for review and possible revision of this report.

7.1.14 The most recent ASTM standards apply to this project and must be utilized, even if older ASTM standards are indicated in this report.

7.2 Soil and Excavation Characteristics

7.2.1 The in-situ soils can be excavated with moderate effort using conventional excavation equipment. Some caving should be anticipated in unshored excavations, especially where granular soils are encountered.

7.2.2 It is the responsibility of the contractor to ensure that all excavations and trenches are properly shored and maintained in accordance with applicable OSHA rules and regulations to maintain safety and maintain the stability of existing adjacent improvements.

7.2.3 All onsite excavations must be conducted in such a manner that potential surcharges from existing structures, construction equipment, and vehicle loads are resisted. The surcharge area may be defined by a 1:1 projection down and away from the bottom of an existing foundation or vehicle load. Penetrations below this 1:1 projection will require special excavation measures such as sloping or shoring. Excavation recommendations are provided in the *Temporary Excavations* section of this report (see Section 7.13).

7.2.4 The upper five feet of existing site soils encountered during the investigation are considered to have a “low” expansive potential (EI = 27) and are classified as “expansive” in accordance with the 2022 California Building Code (CBC) Section 1803.5.3. The recommendations presented herein assume that foundations and slabs as well as new paving and hardscape will derive support in these materials.

7.3 Minimum Resistivity, pH, and Water-Soluble Sulfate

7.3.1 Potential of Hydrogen (pH) and resistivity testing as well as chloride content testing were performed on representative samples of soil to generally evaluate the corrosion potential to surface utilities. The tests were performed in accordance with California Test Method Nos. 643 and 422 and indicate that the soils are considered “severely corrosive” with respect to corrosion of buried ferrous metals on site. The results are presented in Appendix B (Figure B9) and should be considered for design of underground structures. Due to the corrosive potential of the soils, it is recommended that PVC, ABS or other approved plastic piping be utilized in lieu of cast-iron when in direct contact with the site soils.

7.3.2 Laboratory tests were performed on representative samples of the on-site soil to measure the percentage of water-soluble sulfate content. Results from the laboratory water-soluble sulfate tests are presented in Appendix B (Figure B9) and indicate that the on-site soil possess a sulfate exposure class of "S0" to concrete structures as defined by 2022 CBC Section 1904 and ACI 318-19 Chapter 19.

7.3.3 Geocon West, Inc. does not practice in the field of corrosion engineering and mitigation. If corrosion sensitive improvements are planned, it is recommended that a corrosion engineer be retained to evaluate corrosion test results and incorporate the necessary precautions to avoid premature corrosion of buried metal pipes and concrete structures in direct contact with the soils.

7.4 Grading

7.4.1 Grading is anticipated to include preparation of building pads, excavation of site soils for the foundations and utility trenches, placement of backfill for trenches, and preparation of paving and hardscape subgrade.

7.4.2 A preconstruction conference should be held at the site prior to the beginning of excavation operations with the owner, contractor, civil engineer, geotechnical engineer, and building official in attendance. Special soil handling requirements can be discussed at that time.

7.4.3 Earthwork should be observed, and compacted fill tested by representatives of Geocon West, Inc. The existing fill and alluvial soil encountered during exploration are suitable for re-use as an engineered fill, provided any encountered oversize material (greater than 6 inches) and any encountered deleterious debris are removed.

7.4.4 Grading should commence with the removal of all existing vegetation and existing improvements from the area to be graded. Deleterious debris such as wood and root structures should be exported from the site and should not be mixed with the fill soils. Asphalt and concrete should not be mixed with the fill soils unless approved by the Geotechnical Engineer. All existing underground improvements planned for removal should be completely excavated and the resulting depressions properly backfilled in accordance with the procedures described herein. Once a clean excavation bottom has been established it must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.).

7.1.4 As a minimum, it is recommended that the upper 3 feet of existing earth materials within proposed habitable structure footprint areas be excavated and properly compacted for foundation and slab support. Deeper excavations should be conducted as needed to remove any deeper fill or soft soils as necessary at the direction of the Geotechnical Engineer (a representative of Geocon). The excavation should extend laterally a minimum distance of 3 feet beyond the building footprint areas, including building appurtenances, or a distance equal to the depth of fill below the foundation, whichever is greater. The limits of existing fill and/or soft soil removal will be verified by the Geocon representative during site grading activities. All excavations must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon).

7.4.5 Based on the conditions encountered during site exploration, areas of soft and overly moist soils may be encountered during grading operations. These conditions may change seasonally. If the soils are more than 3 percent above the optimum moisture content at the time of construction the soils will likely require some spreading and drying activities in order to achieve proper compaction.

7.4.6 Prior to placing fill, a stable excavation bottom must be established. In areas where the subgrade is saturated or soft, proper compaction will likely not be possible or achieved in a timely manner without introducing stabilization measures. If subgrade stabilization is required at the excavation bottom, rubber tire equipment should not be allowed in the excavation bottom until it is stabilized or extensive soil disturbance could result. It is suggested that excavation and grading be performed during the summer season to promote moisture control of the soils. In addition, the use of track equipment should be used to minimize disturbance to the soils at the excavation bottom.

7.4.7 Bottom stabilization, if necessary, may be achieved placing a thin lift of 3- to 6-inch-diameter crushed angular rock into the soft excavation bottom. The use of crushed concrete will also be acceptable. The crushed rock should be spread thinly across the excavation bottom and pressed into the soils by track rolling or wheel rolling with heavy equipment. It is very important that voids between the rock fragments are not created so the rock must be thoroughly pressed or blended into the soils. All subgrade soils must be properly compacted and proof-rolled in the presence of the Geotechnical Engineer (a representative of Geocon West, Inc.).

7.4.8 An additional method of subgrade stabilization would be to place a minimum 12 inches thick layer of aggregate base over Tensar InterAx NX850 geogrid or equivalent extruded (nonwoven) geotextile. The Tensar geogrids should be installed taught and should overlap in accordance with the manufacturer's recommendations. Prior to placing the geogrid, excessively soft or wet materials should be removed and the resulting excavation bottom should be free of loose material. Non-vibratory compaction methods should be used for compaction of the base material. The aggregate base should be compacted to a dry density of at least 95 percent of the laboratory maximum density near the optimum moisture. If pumping of the subgrade continues, a thicker layer of aggregate base may be placed. It is very important that subgrade stabilization be performed uniformly across the entire excavation bottom.

7.4.9 Stable excavations for the recommended grading can be achieved with sloping measures. However, if excavations in close proximity to an adjacent property line and/or structure are required, special excavation measures such as slot cutting may be necessary in order to maintain lateral support of the existing offsite improvements. Excavation recommendations are provided in the Temporary Excavations section of this report (Section 7.13).

7.4.10 All fill and backfill soils should be placed in horizontal loose layers approximately 6 to 8 inches thick, moisture conditioned to near to slightly above optimum moisture content, and properly compacted to a minimum 90 percent of the maximum dry density in accordance with ASTM D 1557 (latest edition).

7.4.11 Although not anticipated for this project, all imported fill shall be observed, tested, and approved by Geocon West, Inc. prior to bringing soil to the site. Import fill should consist of the characteristics presented in the table below.

SUMMARY OF IMPORT FILL RECOMMENDATIONS

Soil Characteristic	Values
Expansion Potential	"Low" (Expansion Index of 50 or less)
Particle Size	Maximum Dimension Less Than 6 Inches
	Free of Debris
Corrosivity	Less Detrimental Than Existing Onsite Soils

7.4.12. Where new paving is to be placed, it is recommended that all existing fill and soft alluvium be excavated and properly compacted for paving support. As a minimum, the upper 12 inches of soil should be scarified, moisture conditioned to near to slightly above optimum moisture content, and compacted to at least 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition). Paving recommendations are provided in *Preliminary Pavement Recommendations* section of this report (see Section 7.12).

7.4.13 Foundations for small outlying structures, such as block walls up to 6 feet high, planter walls or trash enclosures, which will not be tied to the proposed building, may be supported on conventional foundations deriving support on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and proper compaction cannot be performed, foundations may derive support directly in the undisturbed alluvial soils at and below a depth of 2½ feet below the existing ground surface and should be deepened as necessary to maintain a minimum 12-inch embedment into the recommended bearing materials. If the soils exposed in the excavation bottom are soft or loose, compaction of the soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved by a Geocon representative.

7.4.14 Utility trenches should be properly backfilled in accordance with the following requirements. The pipe should be bedded with clean sands (Sand Equivalent greater than 30) to a depth of at least 1 foot over the pipe, and the bedding material must be inspected and approved in writing by the Geotechnical Engineer (a representative of Geocon). The use of gravel is not acceptable unless used in conjunction with filter fabric to prevent the gravel from having direct contact with soil. The remainder of the trench backfill may be derived from onsite soil or approved import soil, compacted as necessary, until the required compaction is obtained. The use of minimum 2-sack slurry as backfill is also acceptable. Prior to placing any bedding materials or pipes, the excavation bottom must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon).

7.4.15 All trench and foundation excavation bottoms must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon), prior to placing bedding materials, fill, steel, gravel, or concrete.

7.5 Shrinkage

7.5.1 Shrinkage results when a volume of material removed at one density is compacted to a higher density. A shrinkage factor of between 10 and 18 percent should be anticipated when excavating and compacting the upper few feet of existing earth materials on the site to an average relative compaction of 92 percent.

7.4.2 If import soils will be utilized in the building pad, the soils must be placed uniformly and at equal thickness at the direction of the Geotechnical Engineer (a representative of Geocon West, Inc.). Soils can be borrowed from non-building pad areas and later replaced with imported soils.

7.6 Conventional Foundation Design

7.6.1 Once the foundation loading configuration for the proposed structures proceeds to a more finalized plan, the recommendations within this report should be reviewed and revised, if necessary.

7.6.2 A conventional shallow spread foundation system may be utilized for support of the proposed structures provided foundations derive support in a blanket of newly placed engineered fill. All foundation excavations must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon), prior to placing steel or concrete.

7.6.3 Conventional shallow spread foundations for proposed structures should consist of continuous strip footings and/or isolated spread footings and should be designed using the parameters in the table on the following page.

SUMMARY OF FOUNDATION RECOMMENDATIONS

Parameter	Value
Minimum Continuous Foundation Width	12 Inches
Minimum Isolated Foundation Width	24 Inches
Minimum Foundation Depth	18 Inches Below Lowest Adjacent Grade & 12 Inches into Recommended Bearing Material
Minimum Steel Reinforcement	4 No. 4 Bars, 2 Top and 2 Bottom
Allowable Bearing Capacity – Continuous Foundation	2,000 psf
Allowable Bearing Capacity – Isolated Foundation	2,500 psf
Bearing Capacity Increase	250 psf per Foot of Width
	600 psf per Foot of Depth
Maximum Allowable Bearing Capacity	3,500 psf
Estimated Total Settlement	½ Inch
Estimated Differential Settlement	¼ Inch over 20 Feet

7.6.4 The above foundation dimensions and minimum reinforcement recommendations are based on soil conditions and building code requirements only and are not intended to be used in lieu of those required for structural purposes.

7.6.5 The allowable bearing pressure may be increased by up to one-third for transient loads due to wind or seismic forces.

7.6.6 The enclosed liquefaction analyses indicate that the site soils could be susceptible to up to approximately 2 inches of total settlement as a result of the MCE peak ground acceleration (PGA_M). The resulting differential settlement at the ground surface is anticipated to be less than 1 inch over a distance of 30 feet. These settlements are in addition to the static settlements indicated in the table above and must be considered in the structural design.

7.6.7 Once the design and foundation loading configurations for the proposed structures proceeds to a more finalized plan, the estimated settlements presented in this report should be reviewed and revised, if necessary. If the final foundation loading configurations are greater than the assumed loading conditions, the potential for settlement should be reevaluated by this office.

7.6.8 No special subgrade presaturation is required prior to placement of concrete. However, the moisture in the foundation subgrade should be sprinkled as necessary to maintain a moist condition at the time of concrete placement.

7.6.9 Foundation excavations should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to the placement of reinforcing steel and concrete to verify that the excavations and exposed soil conditions are consistent with those anticipated. If unanticipated soil conditions are encountered, foundation modifications may be required.

7.6.10 This office should be provided with a copy of the final construction plans so that the excavation recommendations presented herein could be properly reviewed and revised if necessary.

7.7 Miscellaneous Foundations

7.7.1 Foundations for small outlying structures, such as block walls up to 6 feet in height, planter walls or trash enclosures, which will not be tied to the proposed structure, may be supported on conventional foundations deriving support on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and compaction cannot be performed, foundations may derive support directly in the competent undisturbed alluvial soils at and below a depth of 2½ feet and should be deepened as necessary to maintain a minimum 12-inch embedment into the recommended bearing materials.

7.7.2 If the soils exposed in the excavation bottom are soft, compaction of the soft soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved by a Geocon representative. Miscellaneous foundations may be designed for a bearing value of 1,500 psf and should be a minimum of 12 inches in width, 18 inches in depth below the lowest adjacent grade and 12 inches into the recommended bearing material. The allowable bearing pressure may be increased by up to one-third for transient loads due to wind or seismic forces.

7.7.3 Foundation excavations should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to the placement of reinforcing steel and concrete to verify that the excavations and exposed soil conditions are consistent with those anticipated.

7.8 Lateral Design

7.8.1 Resistance to lateral loading may be provided by friction acting at the base of foundations, slabs and by passive earth pressure. An allowable coefficient of friction of 0.35 may be used with the dead load forces in the newly placed engineered fill or alluvial soils.

7.8.2 Passive earth pressure for the sides of foundations and slabs poured against newly placed engineered fill or undisturbed alluvial soils may be computed as an equivalent fluid having a density of 230 pounds per cubic foot (pcf) with a maximum earth pressure of 2,300 psf. When combining passive and friction for lateral resistance, the passive component should be reduced by one-third. A one-third increase in the passive value may be used for wind or seismic loads.

7.9 Friction Pile Foundations – Light Standards

7.9.1 Typical light standards are between 10 and 15 feet in height and are supported on pile foundations. Cast-in-place friction piles may be utilized for support of the proposed lighting poles as well as proposed shade structures provided foundations derive support in or the competent alluvium found at and below a depth of 3 feet.

7.9.2 Friction piles should be a minimum of 18 inches in diameter and should be embedded a minimum of 6 feet into the recommended bearing materials (undisturbed alluvium). Where not protected by pavement, the upper two feet of soil should be ignored when calculating axial and lateral capacity.

7.9.3 Friction piles may be designed based on a skin friction capacity of 100 pounds per square foot and do not require the complete removal of all loose earth materials from the bottom of the excavation since the end-bearing capacity is not being considered for design. However, a cleanout of the excavation bottom will be required. Piles may be assumed fixed at an embedment depth of 5 feet below the ground surface. Single pile uplift capacity can be taken as 60 percent of the allowable downward capacity. The allowable downward capacity and allowable uplift capacity may be increased by one-third when considering transient wind or seismic loads.

7.9.4 For design purposes, an allowable passive value for the soils may be assumed to be 230 psf per foot with a maximum earth pressure of 2,300 psf. To develop the full lateral value, provisions should be implemented to assure firm contact between the piles and the engineered fill and underlying alluvium. A one-third increase in the passive value may be used for wind or seismic loads. The allowable capacity may be doubled for isolated piles spaced more than three times the diameter on-center.

7.9.5 All drilled pile excavations should be continuously observed by personnel of this firm to verify adequate penetration into the recommended bearing materials. The capacity presented is based on the strength of the soils. The compressive and tensile strength of the pile sections should be checked to verify the structural capacity of the piles.

7.10 Pile Installation

7.10.1 Caving may occur in granular soils and the contractor should have casing available prior to commencement of pile excavation. When casing is used, extreme care should be employed so that the pile is not pulled apart as the casing is withdrawn. At no time should the distance between the surface of the concrete and the bottom of the casing be less than 5 feet. Continuous observation of the drilling and pouring of the piles by the Geotechnical Engineer (a representative of Geocon West, Inc.), is required.

7.10.2 Groundwater was encountered during exploration at a depth of 31 feet beneath the ground surface. Groundwater is not expected to be encountered during construction. However, should groundwater or seepage be encountered during pile installation, the contractor should be prepared. Piles placed below the water level require the use of a tremie to place the concrete into the bottom of the hole. A tremie should consist of a rigid, water-tight tube having a diameter of not less than 6 inches with a hopper at the top. The tube should be equipped with a device that will close the discharge end and prevent water from entering the tube while it is being charged with concrete. The tremie should be supported so as to permit free movement of the discharge end over the entire top surface of the work and to permit rapid lowering when necessary to retard or stop the flow of concrete. The discharge end should be closed at the start of the work to prevent water entering the tube and should be entirely sealed at all times, except when the concrete is being placed. The tremie tube should be kept full of concrete. The flow should be continuous until the work is completed and the resulting concrete seal should be monolithic and homogeneous. The tip of the tremie tube should always be kept about 5 feet below the surface of the concrete and definite steps and safeguards should be taken to insure that the tip of the tremie tube is never raised above the surface of the concrete.

7.10.3 A special concrete mix should be used for concrete to be placed below water. The design should provide for concrete with an unconfined compressive strength psi of 1,000 pounds per square inch (psi) over the initial job specification. An admixture that reduces the problem of segregation of paste/aggregates and dilution of paste should be included. The slump should be commensurate to any research report for the admixture, provided that it should also be the minimum for a reasonable consistency for placing when water is present.

7.10.4 Closely spaced piles should be drilled and filled alternately, with the concrete permitted to set at least eight hours before drilling an adjacent hole. Unless the holes are fully cased from top to bottom, it is not recommended that holes be left open overnight.

7.11 Concrete Slabs-on-Grade

7.11.1 Concrete slabs-on-grade subject to vehicle loading should be designed in accordance with the recommendations in the Preliminary Pavement Recommendations section of this report (Section 7.12).

7.11.2 Subsequent to the recommended grading, concrete slabs-on-grade for structures, not subject to vehicle loading, should be a minimum of 4 inches thick and minimum slab reinforcement should consist of No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions. Steel reinforcing should be positioned vertically near the slab midpoint.

7.11.3 Slabs-on-grade at the ground surface that may receive moisture-sensitive floor coverings or may be used to store moisture-sensitive materials should be underlain by a vapor retarder placed directly beneath the slab. The vapor retarder and acceptable permeance should be specified by the project architect or developer based on the type of floor covering that will be installed. The vapor retarder selection and design should be consistent with the guidelines presented in Section 9.3 of the American Concrete Institute's (ACI) Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials (ACI 302.2R-06) as well as ASTM E1745 and should be installed in general conformance with ASTM E 1643 (latest edition) and the manufacturer's recommendations. A minimum thickness of 15 mils extruded polyolefin plastic is recommended; vapor retarders which contain recycled content or woven materials are not recommended. The vapor retarder should have a permeance of less than 0.01 perms demonstrated by testing before and after mandatory conditioning is recommended. The vapor retarder should be installed in direct contact with the concrete slab with proper perimeter seal. If the California Green Building Code requirements apply to this project, the vapor retarder should be underlain by 4 inches of clean aggregate. It is important that the vapor retarder be puncture resistant since it will be in direct contact with angular gravel. As an alternative to the clean aggregate suggested in the Green Building Code, it is our opinion that the concrete slab-on-grade may be underlain by a vapor retarder over 4-inches of clean sand (sand equivalent greater than 30), since the sand will serve a capillary break and will minimize the potential for punctures and damage to the vapor barrier.

7.11.4 For seismic design purposes, a coefficient of friction of 0.35 may be utilized between concrete slabs and subgrade soils without a moisture barrier, and 0.15 for slabs underlain by a moisture barrier.

7.11.5 Exterior slabs for walkways and flatwork, not subject to traffic loads, should be at least 4 inches thick and reinforced with No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions, positioned near the slab midpoint. Prior to construction of slabs, the upper 12 inches of subgrade should be moistened to near to slightly above optimum moisture content and properly compacted to at least 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition). Crack control joints should be spaced at intervals not greater than 10 feet and should be constructed using saw-cuts or other methods as soon as practical following concrete placement. Crack control joints should extend a minimum depth of one-fourth the slab thickness. Construction joints should be designed by the project structural engineer.

7.11.6 The moisture content of the slab subgrade should be maintained and sprinkled as necessary to maintain a moist condition as would be expected in any concrete placement.

7.11.7 The recommendations of this report are intended to reduce the potential for cracking of slabs due to settlement. However, even with the incorporation of the recommendations presented herein, foundations, stucco walls, and slabs-on-grade may exhibit some cracking due to minor soil movement and/or concrete shrinkage. The occurrence of concrete shrinkage cracks is independent of the supporting soil characteristics. Their occurrence may be reduced and/or controlled by limiting the slump of the concrete, proper concrete placement and curing, and by the placement of crack control joints at periodic intervals, in particular, where re-entrant slab corners occur.

7.12 Preliminary Pavement Recommendations

7.12.1 Where new paving is to be placed, it is recommended that all existing fill and soft alluvium materials be excavated and properly compacted for paving support. The client should be aware that excavation and compaction of all existing artificial fill and soft alluvium in the area of new paving is not required; however, paving constructed over existing uncertified fill or unsuitable alluvium material may experience increased settlement and/or cracking, and may therefore have a shorter design life and increased maintenance costs. As a minimum, the upper 12 inches of paving subgrade should be scarified, moisture conditioned to near to slightly above optimum moisture content, and properly compacted to at least 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition).

7.12.2 The following pavement sections are based on a R-Value of 25. Once site grading activities are complete an R-Value should be obtained by laboratory testing to confirm the properties of the soils serving as paving subgrade, prior to placing pavement.

7.12.3 The Traffic Indices listed below are estimates. Geocon does not practice in the field of traffic engineering. The actual Traffic Index for each area should be determined by the project civil engineer. If pavement sections for Traffic Indices other than those listed below are required, Geocon should be contacted to provide additional recommendations. Pavement thicknesses were determined following procedures outlined in the *California Highway Design Manual* (Caltrans). It is anticipated that the majority of traffic will consist of automobile and large truck traffic.

PRELIMINARY PAVEMENT DESIGN SECTIONS

Location	Estimated Traffic Index (TI)	Asphalt Concrete (inches)	Class 2 Aggregate Base (inches)
Automobile Parking and Driveways	4.0	3.0	4.0
Trash Truck & Fire Lanes	7.0	4.0	12.0

7.12.4 Asphalt concrete should conform to Section 203-6 of the "*Standard Specifications for Public Works Construction"* (Green Book). Class 2 aggregate base materials should conform to Section 26-1.02A of the "*Standard Specifications of the State of California, Department of Transportation"* (Caltrans). The use of Crushed Miscellaneous Base (CMB) in lieu of Class 2 aggregate base is acceptable. Crushed Miscellaneous Base should conform to Section 200-2.4 of the "*Standard Specifications for Public Works Construction"* (Green Book).

7.12.5 Unless specifically designed and evaluated by the project structural engineer, where exterior concrete paving will be utilized for support of vehicles, it is recommended that the concrete be a minimum of 6 inches of concrete reinforced with No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions. Concrete paving supporting vehicular traffic should be underlain by a minimum of 4 inches of aggregate base and a properly compacted subgrade. The subgrade and base material should be compacted to 95 percent relative compaction as determined by ASTM Test Method D 1557 (latest edition).

7.12.6 The performance of pavements is highly dependent upon providing positive surface drainage away from the edge of pavements. Ponding of water on or adjacent to the pavement will likely result in saturation of the subgrade materials and subsequent cracking, subsidence and pavement distress. If planters are planned adjacent to paving, it is recommended that the perimeter curb be extended at least 12 inches below the bottom of the aggregate base to minimize the introduction of water beneath the paving.

7.13 Temporary Excavations

7.13.1 Excavations less than 5 feet in height are anticipated for grading and construction activities. The excavations are expected to expose artificial fill and alluvial soils, which may be subject to caving where granular soils are exposed. Temporary vertical excavations up to 5 feet in height may be attempted where loose soils or caving sands are not present, and where excavations are not surcharged by adjacent traffic or structures.

7.13.2 Vertical excavations greater than 5 feet or where surcharged by existing structures will require sloping or shoring measures in order to provide a stable excavation. Where sufficient space is available, temporary unsurcharged embankments could be sloped back at a uniform 1:1 slope gradient or flatter up to a maximum of 8 feet in height. A uniform slope does not have a vertical portion.

7.13.3 Where temporary construction slopes are utilized, the top of the slope should be barricaded to prevent vehicles and storage loads at the top of the slope within a horizontal distance equal to the height of the slope. If the temporary construction slopes are to be maintained during the rainy season, berms are suggested along the tops of the slopes where necessary to prevent runoff water from entering the excavation and eroding the slope faces. The soils exposed in the cut slopes should be inspected during excavation by our personnel and the contractor's competent person so that modifications of the slopes can be made if variations in the soil conditions occur. All excavations should be stabilized within 30 days of initial excavation.

7.14 Stormwater Infiltration

7.14.1 During the site exploration, borings B1, B2, B3 and B4 were used to perform percolation testing. The borings were excavated to depths of approximately 5 to 10 feet below ground surface, as indicated in the table below. Slotted casing was placed in the borings and the borings were then filled with water to pre-saturate the soils. The casing was refilled with water and percolation test readings were performed after repeated flooding of the cased excavation.

7.14.2 Based on the test results, the field-measured percolation rate and the design infiltration rate are provided in the following table. The Reduction Factor (Rf), to convert the field-measured percolation rate to an infiltration rate, is also shown in the table below. This value has been calculated in accordance with the Small Diameter Boring Infiltration Test Procedure in the County of Los Angeles Department of Public Works GMED *Guidelines for Design, Investigation, and Reporting Low Impact Development Stormwater Infiltration* (June 2021). Calculations of the percolation rate, reduction factor, and infiltration rate are provided on Figures 8 through 11.

Boring	Infiltration Depth (ft)	Field Measured Infiltration Rate (in/hour)	Reduction Factor (Rf)	Design Infiltration Rate (in / hour)
B1	5-10	0.11	3.0	0.04
B2	2-5	0.04	3.0	0.01
B3	2-5	0.06	3.0	0.02
B4	2-5	0.01	3.0	0.0

7.14.3 The results of the percolation testing indicated that the infiltration rate within the alluvial soils is less than the accepted minimum accepted infiltration rate of 0.3 inches per hour. Therefore, based on the results of percolation testing performed at the site, a stormwater infiltration system is not recommended for this project. It is recommended that stormwater be retained, filtered, and discharged in accordance with the requirements of the local governing agency.

7.15 Surface Drainage

7.15.1 Proper surface drainage is critical to the future performance of the project. Uncontrolled infiltration of irrigation excess and storm runoff into the soils can adversely affect the performance of the planned improvements. Saturation of a soil can cause it to lose internal shear strength and increase its compressibility, resulting in a change in the original designed engineering properties. Proper drainage should be maintained at all times.

7.15.2 All site drainage should be collected and controlled in non-erosive drainage devices. Drainage should not be allowed to pond anywhere on the site, and especially not against any foundation or retaining wall. The site should be graded and maintained such that surface drainage is directed away from structures in accordance with 2022 CBC 1804.4 or other applicable standards. In addition, drainage should not be allowed to flow uncontrolled over any descending slope. Discharge from downspouts, roof drains and scuppers are not recommended onto unprotected soils within 5 feet of the building perimeter. Planters which are located adjacent to foundations should be sealed to prevent moisture intrusion into the soils providing foundation support. Landscape irrigation is not recommended within 5 feet of the building perimeter footings except when enclosed in protected planters.

7.15.3 Positive site drainage should be provided away from structures, pavement, and the tops of slopes to swales or other controlled drainage structures.

7.15.4 Landscaping planters immediately adjacent to paved areas are not recommended due to the potential for surface or irrigation water to infiltrate the pavement's subgrade and base course. Either a subdrain, which collects excess irrigation water and transmits it to drainage structures, or impervious above-grade planter boxes should be used. In addition, where landscaping is planned adjacent to the pavement, it is recommended that consideration be given to providing a cutoff wall along the edge of the pavement that extends at least 12 inches below the base material.

7.16 Plan Review

7.16.1 Grading, foundation, and shoring plans should be reviewed by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to finalization to verify that the plans have been prepared in substantial conformance with the recommendations of this report and to provide additional analyses or recommendations.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The firm that performed the geotechnical investigation for the project should be retained to provide testing and observation services during construction to provide continuity of geotechnical interpretation and to check that the recommendations presented for geotechnical aspects of site development are incorporated during site grading, construction of improvements, and excavation of foundations. If another geotechnical firm is selected to perform the testing and observation services during construction operations, that firm should prepare a letter indicating their intent to assume the responsibilities of project geotechnical engineer of record. A copy of the letter should be provided to the regulatory agency for their records. In addition, that firm should provide revised recommendations concerning the geotechnical aspects of the proposed development, or a written acknowledgement of their concurrence with the recommendations presented in our report. They should also perform additional analyses deemed necessary to assume the role of Geotechnical Engineer of Record.

2. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon Incorporated should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon Incorporated.

3. This report is issued with the understanding that it is the responsibility of the owner or his representative to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

4. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.

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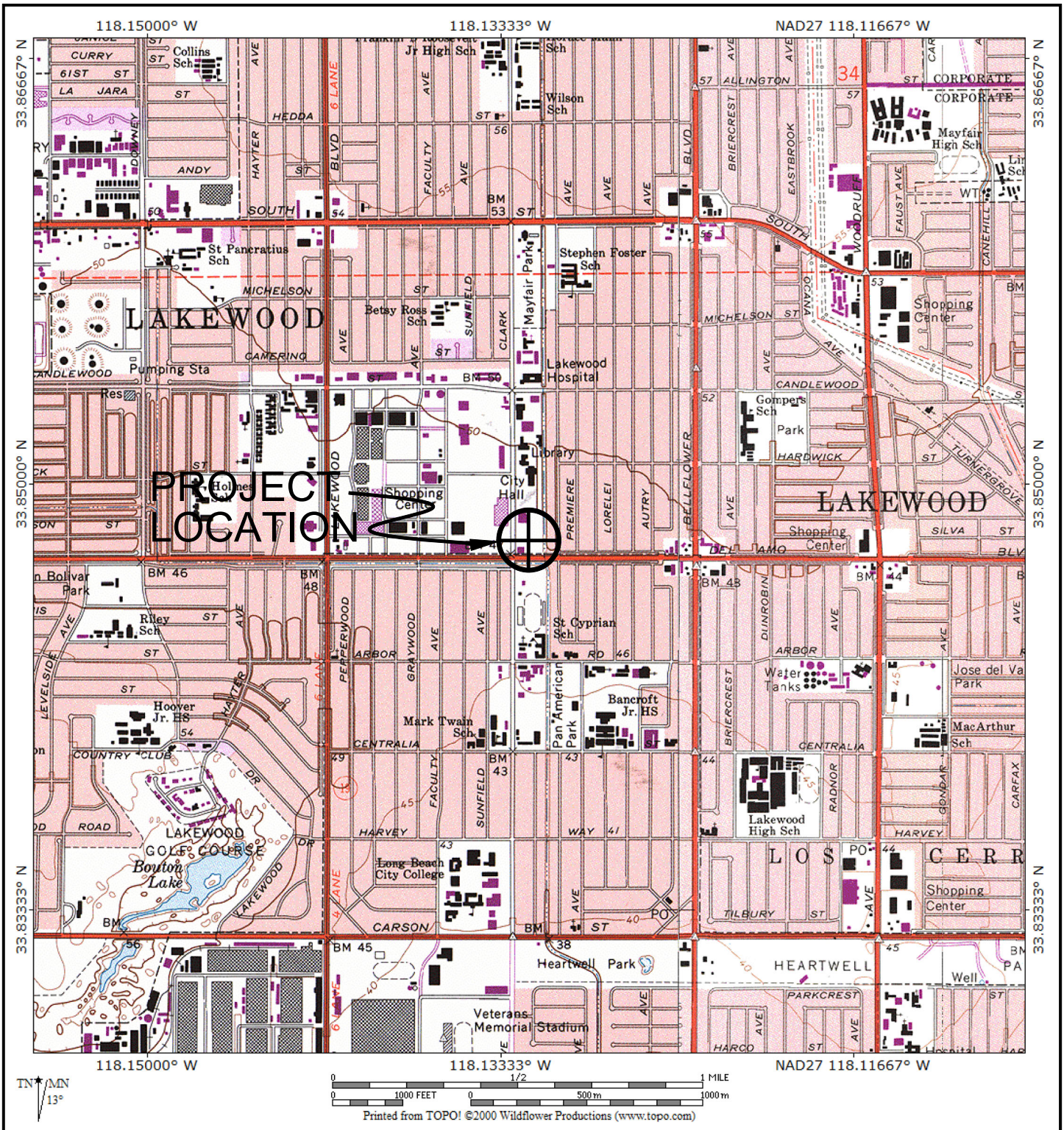
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GEOCON WEST, INC.

ENVIRONMENTAL GEOTECHNICAL MATERIALS
500 N. VICTORY BOULEVARD, BURBANK, CA 91052
PHONE (818) 841-8388 - FAX (818) 841-1704

VICINITY MAP

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

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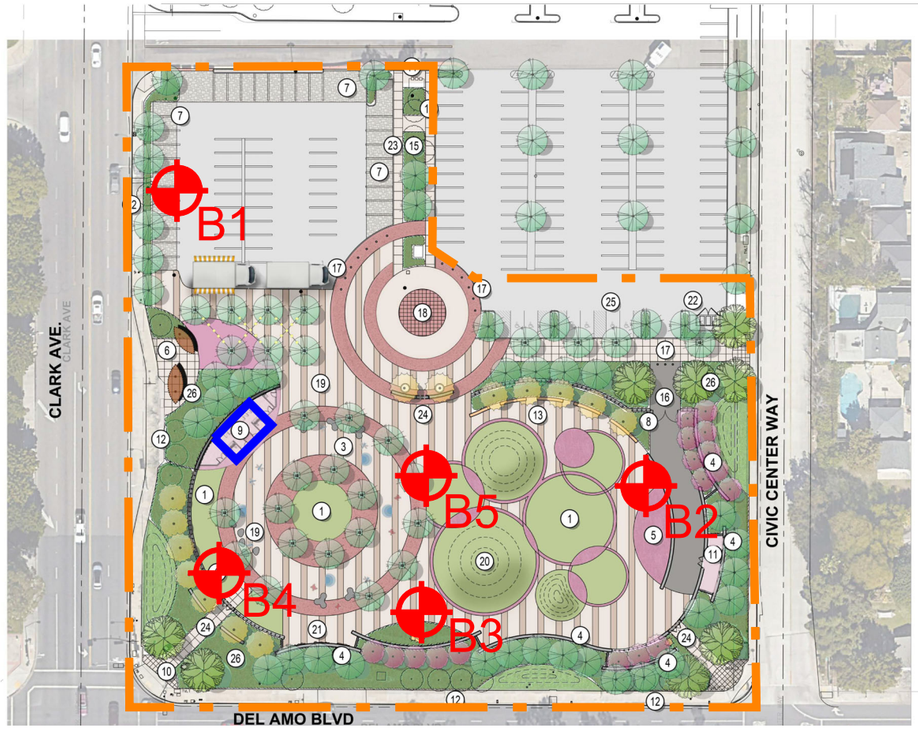
SEPT 2024	PROJECT NO. W1974-06-01	FIG. 1

LEGEND

B5 Approximate Boring Locations

Approximate Project Limits

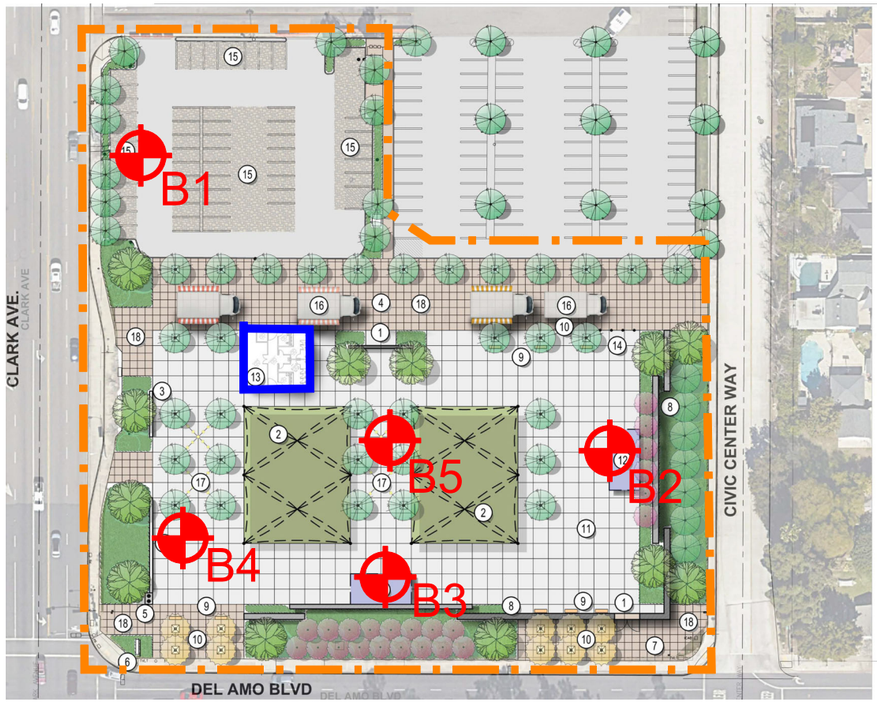
Proposed Restroom



Plan Option 1

LEGEND

1. FLAT SYNTHETIC TURF
2. CHRISTMAS TREE AREA
3. ACCENT PAVING
4. 10' HIGH SOUND WALL
5. MOBILE STAGE (14' X 36')
6. BUS SHELTER AND SHADE AREA
7. PERMEABLE PAVING
8. 6' HIGH WROUGHT IRON FENCE WITH MOW CURB
9. RESTROOM
10. PARK ENTRY SIGN
11. STORAGE ROOM
12. EXISTING STREET TREES
13. SEAT WALLS
14. EXISTING TRASH ENCLOSURE
15. EXISTING EUCALYPTUS TREES
16. SERVICE ACCESS WITH LOCKING GATE
17. BOLLARDS
18. REMOVABLE CHRISTMAS TREE
19. ARTISTIC PLAY FEATURE
20. MOUNDED SYNTHETIC TURF FOR STAGE SEATING AND PLAY
21. CHILDREN'S ARTISTIC WALL
22. PROPOSED TRASH ENCLOSURE
23. FORMAL ACCESS THROUGH EXISTING PARKING LOT
24. VERTICAL GATEWAY FEATURE
25. PROPOSED PARKING
26. LOW WATER TREES BUFFER AND PLANTING



Plan Option 2

LEGEND

1. GATEWAY ARCH
2. SHADE OVER SYNTHETIC TURF
3. LOW WALL
4. CHRISTMAS TREE AREA
5. FLAG LOCATION
6. PARK SIGN
7. OPEN TO STREET
8. SOUND WALL
9. CONCRETE BENCH (TYP.)
10. TREE WELL (TYP.)
11. 10'X10' PAVING JOINT GRID
12. STAGE LOCATION
13. RESTROOM
14. REMOVABLE BOLLARDS FOR TRUCK ACCESS
15. PERMEABLE PAVING
16. FOOD TRUCK PARKING
17. BISTRO LIGHTING OPTIONAL DINING AREA
18. 5'X5' PAVING JOINT GRID

NORTH

0 100' 200'

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500 N. VICTORY BOULEVARD, BURBANK, CA 91052
PHONE (818) 841-8388 - FAX (818) 841-1704

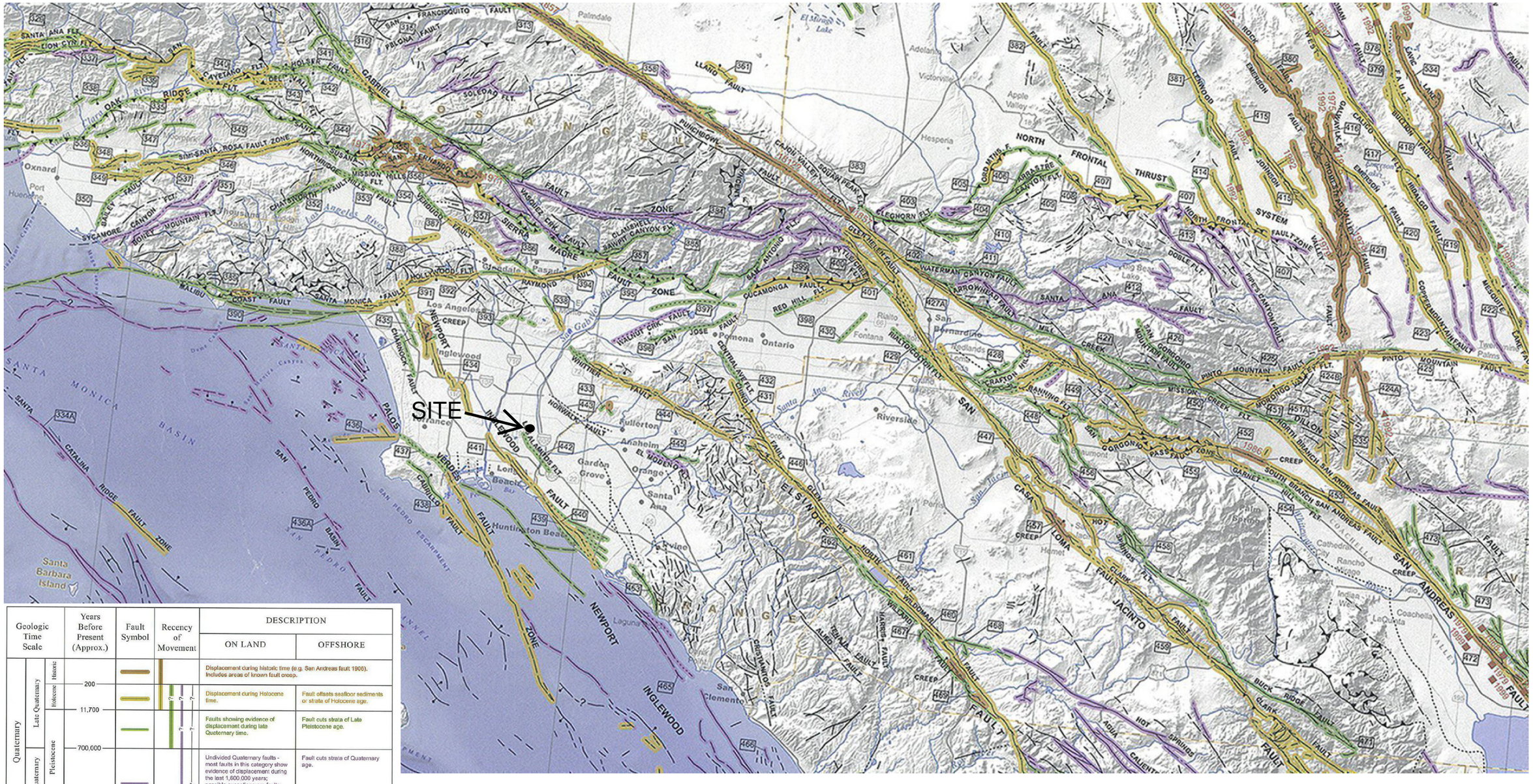
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SITE PLAN

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

SEPT 2024	PROJECT NO. W1974-06-01	FIG. 2

Reference: Jennings, C.W. and Bryant, W. A., 2010, Fault Activity Map of California, California Geological Survey Geologic Data Map No. 6.



Geologic Time Scale			Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION: ON LAND	DESCRIPTION: OFFSHORE
Quaternary	Late Quaternary	Historic				Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
		Holocene	200			Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
	Pleistocene		11,700			Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
	Early Quaternary		700,000			Undivided Quaternary faults - most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	Fault cuts strata of Quaternary age.
Pre-Quaternary			1,600,000*			Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.
			4.5 billion (Age of Earth)				

* Quaternary now recognized as extending to 2.6 Ma (Walker and Geissman, 2009). Quaternary faults in this map were established using the previous 1.6 Ma criterion.

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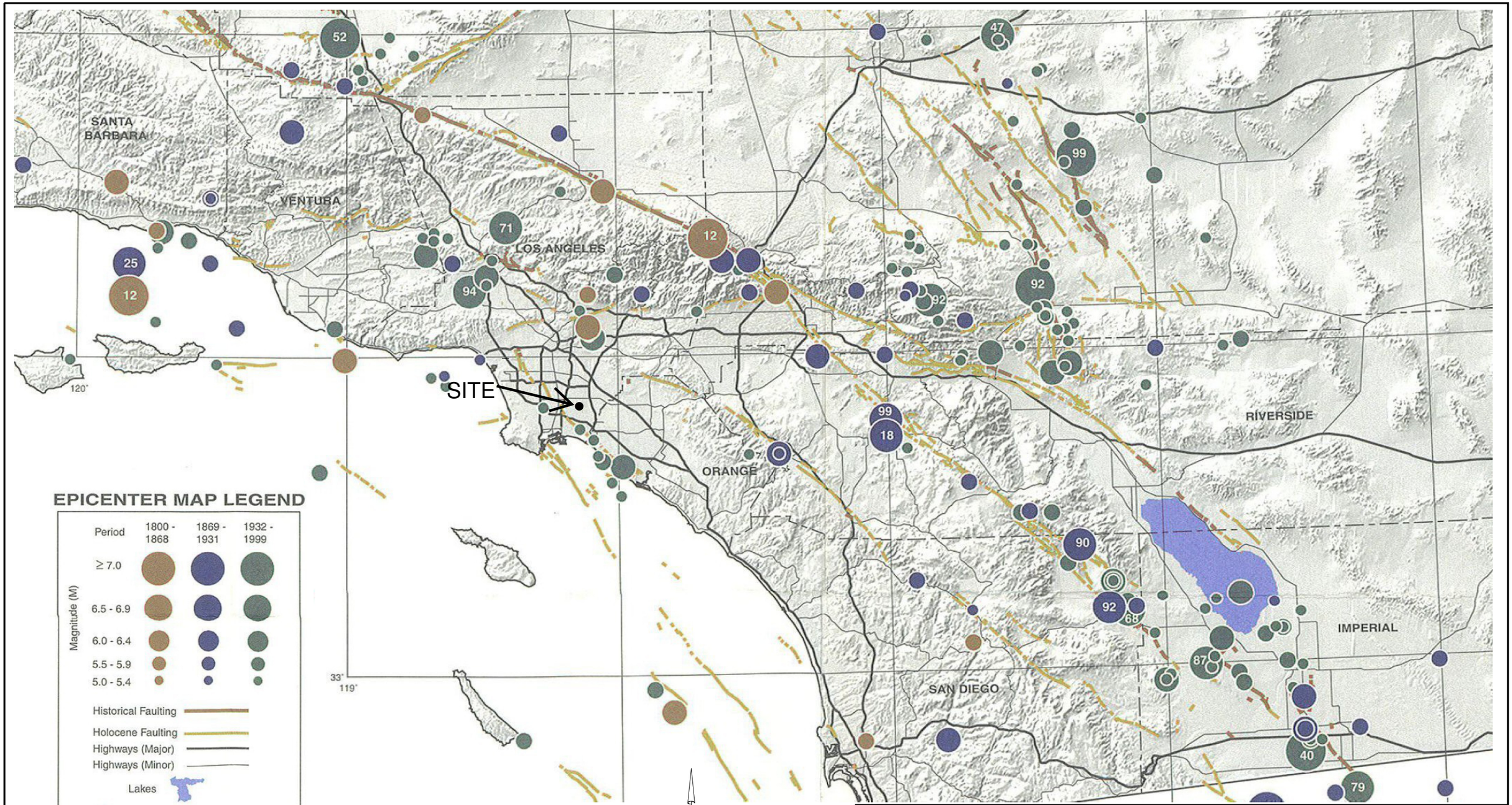
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500 N. VICTORY BOULEVARD, BURBANK, CA 91052
PHONE (818) 841-8388 - FAX (818) 841-1704

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REGIONAL FAULT MAP

4900 CLARK AVENUE!
LAKEWOOD, CALIFORNIA

SEPT 2024 | PROJECT NO. W1974-06-01 | FIG. 3



Reference: Toppozada, T., Branum, D., Petersen, M., Hallstrom, C., Cramer, C., and Reichle, M., 2000, Epicenters and Areas Damaged by M>5 California Earthquakes, 1800 - 1999, California Geological Survey, Map Sheet 49.

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ENVIRONMENTAL GEOTECHNICAL MATERIALS
500 N. VICTORY BOULEVARD, BURBANK, CA 91052
PHONE (818) 841-8388 - FAX (818) 841-1704

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REGIONAL SEISMICITY MAP

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

SEPT 2024 | PROJECT NO. W1974-06-01 | FIG.4

EMPIRICAL ESTIMATION OF LIQUEFACTION POTENTIAL
MAXIMUM CONSIDERED EARTHQUAKE

NCEER (1996) METHOD W 2001 UPDATES

EARTHQUAKE INFORMATION:

Earthquake Magnitude:	7.30
Peak Horiz. Acceleration PGA_M (g):	0.738
Magnitude Scaling Factor:	1.071
Historic High Groundwater:	20.0
Groundwater Depth During Exploratio	31.0

ENERGY & ROD CORRECTIONS:

Energy Correction (CE) for N60:	1.25
Rod Len.Corr.(CR) (0-no or 1-yes):	1
Bore Dia. Corr. (CB):	1.00
Sampler Corr. (CS):	1.20
Use Ksigma (0-no or 1-yes):	1

Boring ID: B5

LIQUEFACTION CALCULATIONS:

Unit Wt. Water (pcf): 62.4

Depth to Base (ft)	Total Unit Wt. (pcf)	Water (0 or 1)	Field SPT (N)	Depth of SPT (ft)	Liq.Sus. (0 or 1)	-200 (%)		Est. Dr (%)	CN Factor	Corrected (N1)60cs	Eff. Unit Wt. (psf)	Resist. CRR 7.5	rd Factor	Induced CSR	Liquefac. Safe.Fact.
1.0	125.0	0	6.0	1.0	1	50	*	59	1.700	18.8	125.0	0.201	1.000	0.480	--
2.0	125.0	0	6.0	2.0	1	50	*	58	1.700	18.8	125.0	0.201	0.998	0.479	--
3.0	125.0	0	6.0	3.0	1	50	*	56	1.700	18.8	125.0	0.201	0.996	0.478	--
4.0	125.0	0	6.0	4.0	1	50	*	55	1.700	18.8	125.0	0.201	0.994	0.477	--
5.0	125.0	0	6.0	5.0	1	50	*	53	1.700	18.8	125.0	0.201	0.991	0.476	--
6.0	125.0	0	6.0	6.0	1	50	*	52	1.700	18.8	125.0	0.201	0.989	0.474	--
7.0	125.0	0	6.0	7.0	1	50	*	51	1.603	18.0	125.0	0.192	0.987	0.473	--
8.0	125.0	0	6.0	8.0	1	50	*	50	1.492	17.1	125.0	0.182	0.985	0.472	--
9.0	125.0	0	6.0	9.0	1	50	*	49	1.402	16.4	125.0	0.174	0.982	0.471	--
10.0	125.0	0	8.0	12.5	1	50	*	53	1.326	19.3	125.0	0.207	0.980	0.470	--
11.0	125.0	0	8.0	12.5	1	50	*	53	1.261	18.6	125.0	0.199	0.978	0.469	--
12.5	125.0	0	8.0	12.5	1	50	*	53	1.192	17.9	125.0	0.190	0.975	0.468	--
13.0	125.0	0	8.0	12.5	1	50	*	53	1.168	17.6	125.0	0.187	0.973	0.467	--
14.0	125.0	0	8.0	12.5	1	50	*	53	1.112	17.0	125.0	0.181	0.972	0.466	--
15.0	125.0	0	8.0	12.5	1	50	*	53	1.073	16.6	125.0	0.176	0.970	0.465	--
16.0	125.0	0	10.0	17.5	0	88			1.038	21.0	125.0	~	0.967	0.464	~
17.0	125.0	0	10.0	17.5	0	88			1.006	20.5	125.0	~	0.965	0.463	~
18.0	125.0	0	10.0	17.5	0	88			0.977	20.0	125.0	~	0.963	0.462	~
19.0	125.0	0	10.0	17.5	0	88			0.950	19.6	125.0	~	0.961	0.461	~
20.0	125.0	0	10.0	17.5	0	88			0.926	19.3	125.0	~	0.958	0.460	~
21.0	125.0	1	10.0	17.5	0	88			0.903	18.9	62.6	~	0.956	0.464	~
22.5	125.0	1	10.0	17.5	0	88			0.876	18.5	62.6	~	0.952	0.476	~
23.0	125.0	1	14.0	22.5	0	55			0.866	25.3	62.6	~	0.949	0.480	~
24.0	125.0	1	14.0	22.5	0	55			0.843	24.7	62.6	~	0.947	0.491	~
25.0	125.0	1	14.0	22.5	0	55			0.826	24.3	62.6	~	0.944	0.498	~
26.0	125.0	1	14.0	22.5	0	55			0.809	23.9	62.6	~	0.940	0.505	~
27.5	125.0	1	14.0	22.5	0	55			0.790	23.5	62.6	~	0.935	0.513	~
28.0	125.0	1	18.0	27.5	1	52		66	0.783	29.8	62.6	0.457	0.931	0.515	0.81
29.0	125.0	1	18.0	27.5	1	52		66	0.766	29.3	62.6	0.425	0.928	0.523	0.73
30.0	125.0	1	18.0	27.5	1	52		66	0.752	28.9	62.6	0.404	0.923	0.528	0.68
31.0	125.0	1	23.0	32.5	1	22		73	0.743	32.0	62.6	Infin.	0.918	0.532	Non-Liq.
32.0	125.0	1	23.0	32.5	1	22		73	0.737	31.7	62.6	Infin.	0.912	0.535	Non-Liq.
33.0	125.0	1	23.0	32.5	1	22		73	0.731	31.5	62.6	Infin.	0.907	0.538	Non-Liq.
34.0	125.0	1	23.0	32.5	1	22		73	0.725	31.3	62.6	Infin.	0.900	0.541	Non-Liq.
35.0	125.0	1	23.0	32.5	1	22		73	0.720	31.1	62.6	Infin.	0.894	0.543	Non-Liq.
36.0	125.0	1	23.0	32.5	1	22		73	0.714	30.9	62.6	Infin.	0.887	0.544	Non-Liq.
37.5	125.0	1	23.0	32.5	1	22		73	0.707	30.6	62.6	Infin.	0.878	0.545	Non-Liq.
38.0	125.0	1	17.0	37.5	1	3		61	0.705	18.0	62.6	0.192	0.870	0.543	0.31
39.0	125.0	1	17.0	37.5	1	3		61	0.698	17.8	62.6	0.190	0.864	0.545	0.30
40.0	125.0	1	17.0	37.5	1	3		61	0.693	17.7	62.6	0.188	0.855	0.544	0.30
41.0	125.0	1	17.0	37.5	1	3		61	0.688	17.6	62.6	0.187	0.846	0.543	0.29
42.0	125.0	1	17.0	37.5	1	3		61	0.683	17.4	62.6	0.185	0.837	0.542	0.29
43.0	125.0	1	20.0	42.5	1	6		64	0.679	20.5	62.6	0.222	0.828	0.540	0.34
44.0	125.0	1	20.0	42.5	1	6		64	0.674	20.3	62.6	0.220	0.818	0.537	0.34
45.0	125.0	1	20.0	42.5	1	6		64	0.670	20.2	62.6	0.218	0.808	0.535	0.34
46.0	125.0	1	11.0	47.5	0	89			0.665	18.2	62.6	~	0.798	0.532	~
47.5	125.0	1	11.0	47.5	0	89			0.660	18.1	62.6	~	0.786	0.528	~
48.0	125.0	1	11.0	47.5	0	89			0.658	18.0	62.6	~	0.775	0.522	~
49.0	125.0	1	11.0	47.5	0	89			0.652	17.9	62.6	~	0.768	0.521	~
50.0	125.0	1	11.0	47.5	0	89			0.648	17.8	62.6	~	0.757	0.517	~
51.0	125.0	1	33.0	52.5	1	15	*	78	0.644	35.9	62.6	Infin.	0.747	0.513	Non-Liq.
52.5	125.0	1	33.0	52.5	1	15	*	78	0.639	35.7	62.6	Infin.	0.735	0.508	Non-Liq.
53.0	125.0	1	33.0	52.5	1	15	*	78	0.637	35.6	62.6	Infin.	0.725	0.502	Non-Liq.
54.0	125.0	1	33.0	52.5	1	15	*	78	0.632	35.3	62.6	Infin.	0.717	0.501	Non-Liq.
55.0	125.0	1	33.0	52.5	1	15	*	78	0.629	35.1	62.6	Infin.	0.708	0.496	Non-Liq.
56.0	125.0	1	33.0	52.5	1	15	*	78	0.625	34.9	62.6	Infin.	0.698	0.492	Non-Liq.
57.0	125.0	1	33.0	52.5	1	15	*	78	0.621	34.7	62.6	Infin.	0.689	0.488	Non-Liq.
58.0	125.0	1	33.0	52.5	1	15	*	78	0.618	34.5	62.6	Infin.	0.680	0.484	Non-Liq.
59.0	125.0	1	33.0	52.5	1	15	*	78	0.614	34.4	62.6	Infin.	0.671	0.480	Non-Liq.
60.0	125.0	1	33.0	52.5	1	15	*	78	0.611	34.2	62.6	Infin.	0.663	0.476	Non-Liq.
61.0	125.0	1	33.0	52.5	1	15	*	78	0.607	34.0	62.6	Infin.	0.655	0.472	Non-Liq.
62.0	125.0	1	33.0	52.5	1	15	*	78	0.604	33.8	62.6	Infin.	0.647	0.468	Non-Liq.
63.5	125.0	1	33.0	52.5	1	15	*	78	0.600	33.6	62.6	Infin.	0.638	0.463	Non-Liq.

* Indicates Assumed Value

GEOCON WEST, INC.

ENVIRONMENTAL GEOTECHNICAL MATERIALS
500 NORTH VICTORY BOULEVARD - BURBANK, CA 91502
PHONE: 818-841-8388 FAX: 818-841-1704

LIQUEFACTION POTENTIAL - MAXIMUM CONSIDERED EARTHQUAKE

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

DRAFTED BY: ACS	CHECKED BY: JTA	SEPT 2024	PROJECT NO. W1974-06-01	FIG. 5

LIQUEFACTION SETTLEMENT ANALYSIS
MAXIMUM CONSIDERED EARTHQUAKE

NCEER (1996) METHOD W 2001 UPDATES

Boring ID: B5

EARTHQUAKE INFORMATION:

Earthquake Magnitude:	7.30
PGA_M (g):	0.738
Magnitude Scaling Factor:	1.071
Historic High Groundwater:	20.0
Groundwater @ Exploration:	31.0

DEPTH TO BASE	BLOW COUNT N	WET DENSITY (PCF)	TOTAL STRESS O (TSF)	EFFECT STRESS O' (TSF)	REL. DEN. Dr (%)	ADJUST BLOWS (N1)60	Tav/σ'o	LIQUEFACTION SAFETY FACTOR	VOL. STRAIN [e_{15}] (%)	EQ. SETTLE. Pe (in.)
1.0	6	125.0	0.031	0.031	59	19	0.480	--	0.00	0.00
2.0	6	125.0	0.094	0.094	58	19	0.480	--	0.00	0.00
3.0	6	125.0	0.156	0.156	56	19	0.480	--	0.00	0.00
4.0	6	125.0	0.219	0.219	55	19	0.480	--	0.00	0.00
5.0	6	125.0	0.281	0.281	53	19	0.480	--	0.00	0.00
6.0	6	125.0	0.344	0.344	52	19	0.480	--	0.00	0.00
7.0	6	125.0	0.406	0.406	51	18	0.480	--	0.00	0.00
8.0	6	125.0	0.469	0.469	50	17	0.480	--	0.00	0.00
9.0	6	125.0	0.531	0.531	49	16	0.480	--	0.00	0.00
10.0	8	125.0	0.594	0.594	53	19	0.480	--	0.00	0.00
11.0	8	125.0	0.656	0.656	53	19	0.480	--	0.00	0.00
12.5	8	125.0	0.734	0.734	53	18	0.480	--	0.00	0.00
13.0	8	125.0	0.766	0.766	53	18	0.480	--	0.00	0.00
14.0	8	125.0	0.844	0.844	53	17	0.480	--	0.00	0.00
15.0	8	125.0	0.906	0.906	53	17	0.480	--	0.00	0.00
16.0	10	125.0	0.969	0.969		21	0.480	~	0.00	0.00
17.0	10	125.0	1.031	1.031		20	0.480	~	0.00	0.00
18.0	10	125.0	1.094	1.094		20	0.480	~	0.00	0.00
19.0	10	125.0	1.156	1.156		20	0.480	~	0.00	0.00
20.0	10	125.0	1.219	1.219		19	0.480	~	0.00	0.00
21.0	10	125.0	1.281	1.266		19	0.486	~	0.00	0.00
22.5	10	125.0	1.359	1.305		18	0.500	~	0.00	0.00
23.0	14	125.0	1.391	1.320		25	0.505	~	0.00	0.00
24.0	14	125.0	1.469	1.360		25	0.518	~	0.00	0.00
25.0	14	125.0	1.531	1.391		24	0.528	~	0.00	0.00
26.0	14	125.0	1.594	1.422		24	0.538	~	0.00	0.00
27.5	14	125.0	1.672	1.461		23	0.549	~	0.00	0.00
28.0	18	125.0	1.703	1.477	66	30	0.553	0.81	0.75	0.05
29.0	18	125.0	1.781	1.516	66	29	0.564	0.73	0.75	0.09
30.0	18	125.0	1.844	1.547	66	29	0.572	0.68	0.75	0.09
31.0	23	125.0	1.906	1.579	73	32	0.579	Non-Liq.	0.00	0.00
32.0	23	125.0	1.969	1.610	73	32	0.587	Non-Liq.	0.00	0.00
33.0	23	125.0	2.031	1.641	73	31	0.594	Non-Liq.	0.00	0.00
34.0	23	125.0	2.094	1.673	73	31	0.601	Non-Liq.	0.00	0.00
35.0	23	125.0	2.156	1.704	73	31	0.607	Non-Liq.	0.00	0.00
36.0	23	125.0	2.219	1.735	73	31	0.613	Non-Liq.	0.00	0.00
37.5	23	125.0	2.297	1.774	73	31	0.621	Non-Liq.	0.00	0.00
38.0	17	125.0	2.328	1.790	61	18	0.624	0.31	1.70	0.10
39.0	17	125.0	2.406	1.829	61	18	0.631	0.30	1.70	0.20
40.0	17	125.0	2.469	1.860	61	18	0.637	0.30	1.70	0.20
41.0	17	125.0	2.531	1.892	61	18	0.642	0.29	1.70	0.20
42.0	17	125.0	2.594	1.923	61	17	0.647	0.29	1.70	0.20
43.0	20	125.0	2.656	1.954	64	20	0.652	0.34	1.40	0.17
44.0	20	125.0	2.719	1.986	64	20	0.657	0.34	1.40	0.17
45.0	20	125.0	2.781	2.017	64	20	0.662	0.34	1.40	0.17
46.0	11	125.0	2.844	2.048		18	0.666	~	0.00	0.00
47.5	11	125.0	2.922	2.087		18	0.672	~	0.00	0.00
48.0	11	125.0	2.953	2.103		18	0.674	~	0.00	0.00
49.0	11	125.0	3.031	2.142		18	0.679	~	0.00	0.00
50.0	11	125.0	3.094	2.173		18	0.683	~	0.00	0.00
51.0	33	125.0	3.156	2.205	78	36	0.687	Non-Liq.	0.00	0.00
52.5	33	125.0	3.234	2.244	78	36	0.691	Non-Liq.	0.00	0.00
53.0	33	125.0	3.266	2.259	78	36	0.693	Non-Liq.	0.00	0.00
54.0	33	125.0	3.344	2.299	78	35	0.698	Non-Liq.	0.00	0.00
55.0	33	125.0	3.406	2.330	78	35	0.701	Non-Liq.	0.00	0.00
56.0	33	125.0	3.469	2.361	78	35	0.705	Non-Liq.	0.00	0.00
57.0	33	125.0	3.531	2.392	78	35	0.708	Non-Liq.	0.00	0.00
58.0	33	125.0	3.594	2.424	78	35	0.711	Non-Liq.	0.00	0.00
59.0	33	125.0	3.656	2.455	78	34	0.714	Non-Liq.	0.00	0.00
60.0	33	125.0	3.719	2.486	78	34	0.717	Non-Liq.	0.00	0.00
61.0	33	125.0	3.781	2.518	78	34	0.720	Non-Liq.	0.00	0.00
62.0	33	125.0	3.844	2.549	78	34	0.723	Non-Liq.	0.00	0.00
63.5	33	125.0	3.922	2.588	78	34	0.727	Non-Liq.	0.00	0.00

TOTAL SETTLEMENT = 1.6 inches

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LIQUEFACTION INDUCED SETTLEMENT - MAXIMUM CONSIDERED EARTHQUAKE

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

DRAFTED BY: ACS	CHECKED BY: JTA	SEPT 2024	PROJECT NO. W1974-06-01	FIG. 6

MCE EARTHQUAKE INFORMATION

Earthquake Magnitude	7.30
Peak Horiz. Acceleration (g)	0.738

Boring ID: B5

Depth of Base of Strate (ft)	Thickness of Layer (ft)	Depth of Mid-point of Layer (ft)	Soil Unit Weight (pcf)	Overburden Pressure at Mid-point (tsf)	Mean Effective Pressure at Mid-point (tsf)	Average Cyclic Shear Stress [Tav]	Field SPT [N]	Correction Factor [Cer]	Relative Density [Dr] (%)	Correction Factor [Cn]	Corrected [N1]60	rd Factor	Maximum Shear Mod. [Gmax] (tsf)	[yeff]*[Geff] [Gmax]	yeff Shear Strain	[yeff]*100%	Volumetric Strain M7.5 [E15] (%)	Number of Strain Cycles [Nc]	Corrected Vol. Strains [Ec]	Estimated Settlement [S] (inches)
1.0	1.0	0.5	125.0	0.03	0.02	0.015	6	1.25	59.3	1.7	18.8	1.0	171.9	8.63E-05	1.60E-04	0.016	1.73E-02	13.3	1.64E-02	0.00
2.0	1.0	1.5	125.0	0.09	0.06	0.045	6	1.25	57.6	1.7	18.8	1.0	297.7	1.47E-04	2.30E-04	0.023	2.48E-02	13.3	2.35E-02	0.01
3.0	1.0	2.5	125.0	0.16	0.10	0.075	6	1.25	56.0	1.7	18.8	1.0	384.4	1.86E-04	1.70E-04	0.017	1.83E-02	13.3	1.74E-02	0.00
4.0	1.0	3.5	125.0	0.22	0.15	0.105	6	1.25	54.5	1.7	18.8	1.0	454.8	2.15E-04	8.10E-04	0.081	8.74E-02	13.3	8.29E-02	0.02
5.0	1.0	4.5	125.0	0.28	0.19	0.135	6	1.25	53.2	1.7	18.8	1.0	515.7	2.40E-04	8.10E-04	0.081	8.74E-02	13.3	8.29E-02	0.02
6.0	1.0	5.5	125.0	0.34	0.23	0.164	6	1.25	51.9	1.7	18.8	1.0	570.1	2.60E-04	4.50E-04	0.045	4.86E-02	13.3	4.61E-02	0.01
7.0	1.0	6.5	125.0	0.41	0.27	0.194	6	1.25	50.8	1.6	18.0	1.0	611.0	2.81E-04	4.50E-04	0.045	5.11E-02	13.3	4.85E-02	0.01
8.0	1.0	7.5	125.0	0.47	0.31	0.224	6	1.25	49.7	1.5	17.1	1.0	645.2	3.02E-04	1.00E-03	0.100	1.21E-01	13.3	1.15E-01	0.03
9.0	1.0	8.5	125.0	0.53	0.36	0.253	6	1.25	48.7	1.4	16.4	1.0	676.9	3.20E-04	1.00E-03	0.100	1.27E-01	13.3	1.21E-01	0.03
10.0	1.0	9.5	125.0	0.59	0.40	0.282	8	1.25	52.8	1.3	19.3	1.0	756.5	3.14E-04	1.00E-03	0.100	1.04E-01	13.3	9.89E-02	0.02
11.0	1.0	10.5	125.0	0.66	0.44	0.311	8	1.25	52.8	1.3	18.6	1.0	785.6	3.28E-04	1.00E-03	0.100	1.09E-01	13.3	1.03E-01	0.02
12.5	1.5	11.8	125.0	0.73	0.49	0.347	8	1.25	52.8	1.2	17.9	1.0	819.9	3.44E-04	1.00E-03	0.100	1.14E-01	13.3	1.09E-01	0.04
13.0	0.5	12.8	125.0	0.80	0.53	0.376	8	1.25	52.8	1.2	17.6	1.0	849.8	3.54E-04	7.10E-04	0.071	8.27E-02	13.3	7.85E-02	0.01
14.0	1.0	13.5	125.0	0.84	0.57	0.398	8	1.25	52.8	1.1	17.0	1.0	864.4	3.63E-04	7.10E-04	0.071	8.62E-02	13.3	8.18E-02	0.02
15.0	1.0	14.5	125.0	0.91	0.61	0.426	8	1.25	52.8	1.1	16.6	1.0	888.4	3.73E-04	7.10E-04	0.071	8.88E-02	13.3	8.43E-02	0.02
16.0	1.0	15.5	125.0	0.97	0.65	0.454	10	1.25		1.0	21.0	1.0	993.3	3.51E-04	7.10E-04	0.071	6.70E-02	13.3	6.36E-02	0.02
17.0	1.0	16.5	125.0	1.03	0.69	0.482	10	1.25		1.0	20.5	1.0	1016.8	3.58E-04	7.10E-04	0.071	6.90E-02	13.3	6.54E-02	0.02
18.0	1.0	17.5	125.0	1.09	0.73	0.509	10	1.25		1.0	20.0	1.0	1039.4	3.66E-04	7.10E-04	0.071	7.08E-02	13.3	6.72E-02	0.02
19.0	1.0	18.5	125.0	1.16	0.77	0.536	10	1.25		1.0	19.6	1.0	1061.4	3.72E-04	7.10E-04	0.071	7.26E-02	13.3	6.89E-02	0.02
20.0	1.0	19.5	125.0	1.22	0.82	0.563	10	1.25		0.9	19.3	1.0	1082.6	3.78E-04	7.10E-04	0.071	7.43E-02	13.3	7.05E-02	0.02
21.0	1.0	20.5	125.0	1.28	0.86	0.590	10	1.25		0.9	18.9	1.0	1103.2	3.84E-04	7.10E-04	0.071	7.60E-02	13.3	7.21E-02	0.00
22.5	1.5	21.8	125.0	1.36	0.91	0.623	10	1.25		0.9	18.5	1.0	1128.1	3.90E-04	7.10E-04	0.071	7.80E-02	13.3	7.40E-02	0.00
23.0	0.5	22.8	125.0	1.42	0.95	0.649	14	1.25		0.9	25.3	0.9	1280.0	3.54E-04	7.10E-04	0.071	5.37E-02	13.3	5.09E-02	0.00
24.0	1.0	23.5	125.0	1.47	0.98	0.668	14	1.25		0.8	24.7	0.9	1291.5	3.58E-04	7.10E-04	0.071	5.51E-02	13.3	5.23E-02	0.00
25.0	1.0	24.5	125.0	1.53	1.03	0.693	14	1.25		0.8	24.3	0.9	1311.5	3.61E-04	5.20E-04	0.052	4.12E-02	13.3	3.90E-02	0.00
26.0	1.0	25.5	125.0	1.59	1.07	0.718	14	1.25		0.8	23.9	0.9	1330.9	3.65E-04	5.20E-04	0.052	4.19E-02	13.3	3.98E-02	0.00
27.5	1.5	26.8	125.0	1.67	1.12	0.748	14	1.25		0.8	23.5	0.9	1354.6	3.69E-04	5.20E-04	0.052	4.29E-02	13.3	4.07E-02	0.00
28.0	0.5	27.8	125.0	1.73	1.16	0.772	18	1.25	66.5	0.8	29.8	0.9	1494.5	3.41E-04	5.20E-04	0.052	3.22E-02	13.3	3.05E-02	0.00
29.0	1.0	28.5	125.0	1.78	1.19	0.790	18	1.25	66.5	0.8	29.3	0.9	1505.2	3.44E-04	5.20E-04	0.052	3.29E-02	13.3	3.12E-02	0.00
30.0	1.0	29.5	125.0	1.84	1.24	0.814	18	1.25	66.5	0.8	28.9	0.9	1524.1	3.46E-04	5.20E-04	0.052	3.35E-02	13.3	3.18E-02	0.00
31.0	1.0	30.5	125.0	1.91	1.28	0.837	23	1.25	72.5	0.7	32.0	0.9	1603.0	3.35E-04	5.20E-04	0.052	2.96E-02	13.3	2.81E-02	0.00
32.0	1.0	31.5	125.0	1.97	1.32	0.859	23	1.25	72.5	0.7	31.7	0.9	1625.2	3.36E-04	5.20E-04	0.052	2.99E-02	13.3	2.84E-02	0.00
33.0	1.0	32.5	125.0	2.03	1.36	0.881	23	1.25	72.5	0.7	31.5	0.9	1646.9	3.37E-04	5.20E-04	0.052	3.02E-02	13.3	2.86E-02	0.00
34.0	1.0	33.5	125.0	2.09	1.40	0.903	23	1.25	72.5	0.7	31.3	0.9	1668.1	3.38E-04	5.20E-04	0.052	3.04E-02	13.3	2.88E-02	0.00
35.0	1.0	34.5	125.0	2.16	1.44	0.924	23	1.25	72.5	0.7	31.1	0.9	1689.0	3.39E-04	5.20E-04	0.052	3.07E-02	13.3	2.91E-02	0.00
36.0	1.0	35.5	125.0	2.22	1.49	0.945	23	1.25	72.5	0.7	30.9	0.9	1709.5	3.39E-04	5.20E-04	0.052	3.09E-02	13.3	2.93E-02	0.00
37.5	1.5	36.8	125.0	2.30	1.54	0.971	23	1.25	72.5	0.7	30.6	0.9	1734.5	3.40E-04	5.20E-04	0.052	3.12E-02	13.3	2.96E-02	0.00
38.0	0.5	37.8	125.0	2.36	1.58	0.991	17	1.25	60.8	0.7	18.0	0.9	1472.1	4.05E-04	8.10E-04	0.081	9.21E-02	13.3	8.74E-02	0.00
39.0	1.0	38.5	125.0	2.41	1.61	1.005	17	1.25	60.8	0.7	17.8	0.9	1482.1	4.06E-04	8.10E-04	0.081	9.31E-02	13.3	8.83E-02	0.00
40.0	1.0	39.5	125.0	2.47	1.65	1.024	17	1.25	60.8	0.7	17.7	0.9	1497.6	4.06E-04	8.10E-04	0.081	9.39E-02	13.3	8.91E-02	0.00
41.0	1.0	40.5	125.0	2.53	1.70	1.043	17	1.25	60.8	0.7	17.6	0.8	1512.8	4.07E-04	8.10E-04	0.081	9.47E-02	13.3	8.99E-02	0.00
42.0	1.0	41.5	125.0	2.59	1.74	1.061	17	1.25	60.8	0.7	17.4	0.8	1527.8	4.07E-04	8.10E-04	0.081	9.55E-02	13.3	9.06E-02	0.00
43.0	1.0	42.5	125.0	2.66	1.78	1.079	20	1.25	64.0	0.7	20.5	0.8	1631.7	3.85E-04	5.20E-04	0.052	5.05E-02	13.3	4.79E-02	0.00
44.0	1.0	43.5	125.0	2.72	1.82	1.097	20	1.25	64.0	0.7	20.3	0.8	1647.0	3.85E-04	5.20E-04	0.052	5.09E-02	13.3	4.83E-02	0.00
45.0	1.0	44.5	125.0	2.78	1.86	1.114	20	1.25	64.0	0.7	20.2	0.8	1662.1	3.84E-04	5.20E-04	0.052	5.14E-02	13.3	4.87E-02	0.00
46.0	1.0	45.5	125.0	2.84	1.91	1.130	11	1.25		0.7	18.2	0.8	1622.1	3.97E-04	5.20E-04	0.052	5.84E-02	13.3	5.54E-02	0.00
47.5	1.5	46.8	125.0	2.92	1.96	1.150	11	1.25		0.7	18.1	0.8	1640.9	3.97E-04	5.20E-04	0.052	5.88E-02	13.3	5.57E-02	0.00
48.0	0.5	47.8	125.0	2.98	2.00	1.166	11	1.25		0.7	18.0	0.8	1657.1	3.96E-04	5.20E-04	0.052	5.89E-02	13.3	5.59E-02	0.00
49.0	1.0	48.5	125.0	3.03	2.03	1.177	11	1.25		0.7	17.9	0.8	1666.8	3.96E-04	1.00E-02	1.000	1.14E+00	13.3	1.08E+00	0.00
50.0	1.0	49.5	125.0	3.09	2.07	1.192	11	1.25		0.6	17.8	0.8	1681.4	3.95E-04	1.00E-02	1.000	1.15E+00	13.3	1.09E+00	0.00
51.0	1.0	50.5	125.0	3.16	2.11	1.206	33	1.25	78.4	0.6	35.9	0.7	2144.6	3.12E-04	1.00E-02	1.000	4.95E-01	13.3	4.70E-01	0.00
52.5	1.5	51.8	125.0	3.23	2.17	1.224	33	1.25	78.4	0.6	35.7	0.7	2165.8	3.11E-04	1.00E-02	1.000	5.00E-01	13.3	4.74E-01	0.00
53.0	0.5	52.8	125.0	3.30	2.21	1.237	33	1.25	78.4	0.6	35.6	0.7	2184.6	3.10E-04	1.00E-02	1.000	5.01E-01	13.3	4.76E-01	0.00
54.0	1.0	53.5	125.0	3.34	2.24	1.247	33	1.25	78.4	0.6	35.3	0.7	2194.9	3.10E-04	1.00E-02	1.000	5.06E-01	13.3	4.80E-01	0.00
55.0	1.0	54.5	125.0	3.41	2.28	1.260	33	1.25	78.4	0.6	35.1	0.7	2211.2	3.10E-04	1.00E-02	1.000	5.09E-01	13.3	4.83E-01	0.00
56.0	1.0	55.5	125.0	3.47	2.32	1.272	33	1.25	78.4	0.6	34.9	0.7	2227.4	3.09E-04	1.00E-02	1.000	5.12E-01	13.3	4.86E-01	0.00
57.0	1.0	56.5	125.0	3.53	2.37	1.284	33	1.25	78.4	0.6	34.7	0.7	2243.3	3.08E-04	1.00E-02	1.000	5.16E-01	13.3	4.89E-01	0.00
58.0	1.0	57.5	125.0	3.59	2.41	1.296	33	1.25	78.4	0.6	34.5	0.7	2259.0	3.08E-04	1.00E-02	1.000	5.19E-01	13.3	4.92E-01	0.00
59.0	1.0	58.5	125.0	3.66	2.45	1.307	33	1.25	78.4	0.6	34.4	0.7	2274.6	3.07E-04	1.00E-02	1.000	5.22E-01	13.3	4.95E-01	0.00
60.0	1.0	59.5	125.0	3.72	2.49	1.317	33	1.25	78.4	0.6	34.2	0.7	2290.0	3.06E-04	1.00E-02	1.000	5.26E-01	13.3	4.99E-01	0.00
61.0	1.0	60.5	125.0	3.78	2.53	1.328	33	1.25	78.4	0.6	34.0	0.7	2305.2	3.05E-04	1.00E-02	1.000	5.29E-01	13.3	5.02E-01	0.00
62.0	1.0	61.5	125.0	3.84	2.58	1.338	33	1.25	78.4	0.6	33.8	0.6	2320.2	3.05E-04	1.00E-02	1.000	5.32E-01	13.3	5.05E-01	0.00
63.5	1.5	62.8	125.0	3.92	2.63	1.350	33	1.25	78.4	0.6	33.6	0.6	2338.8	3.04E-04	1.00E-02	1.000	5.36E-01	13.3	5.09E-01	0.00

REFERENCE: TECHNICAL ENGINEERING AND DESIGN GUIDES AS ADAPTED FROM THE US ARMY CORPS OF ENGINEERS, NO. 9

TOTAL SETTLEMENT (inches) = 0.35

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ENVIRONMENTAL GEOTECHNICAL MATERIALS
500 NORTH VICTORY BOULEVARD - BURBANK, CA 91502
PHONE: 818-841-8388 FAX: 818-841-1704

DRAFTED BY: ACS | CHECKED BY: JTA

EVALUATION OF EARTHQUAKE-INDUCED SETTLEMENTS IN DRY SANDY SOILS

MAXIMUM CONSIDERED EARTHQUAKE

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

SEPT 2024 | PROJECT NO. W1974-06-01 | FIG. 7

BORING PERCOLATION TEST FIELD LOG

Date:	Friday, August 2, 2024		**Boring/Test Number:**	Boring B1	
Project Number:	W1974-06-01		**Diameter of Boring:**	8	inches
Project Location:	4900 Clark Avenue		**Diameter of Casing:**	2	inches
Earth Description:	ML-CL		**Depth of Boring:**	10	feet
Tested By:	RA		**Depth to Invert of BMP:**	5	feet
Liquid Description:	Water		**Depth to Water Table:**	32	feet
Measurement Method:	Sounder		**Depth to Initial Water Depth (d_1)**	45	inches

Start Time for Pre-Soak:	7:00 AM	**Water Remaining in Boring (Y/N):**	Yes
Start Time for Standard:	8:00 AM	**Standard Time Interval Between Readings:**	30 min

Reading Number	Start Time (hh:mm)	Time End (hh:mm)	Elasped Time Δtime (min)	Water Drop During Standard Time Interval, Δd (in)	Soil Despcription Notes Comments
1	8:27 AM	8:57 AM	30	3.6	
2	8:58 AM	9:28 AM	30	3.2	
3	9:23 AM	9:53 AM	30	2.2	
4	10:04 AM	10:34 AM	30	2.2	
5	10:35 AM	11:05 AM	30	2.2	
6	11:06 AM	11:36 AM	30	2.2	Stabilized Readings
7	11:37 AM	12:07 PM	30	2.2	Achieved with Readings
8	12:08 PM	12:38 PM	30	2.3	6, 7, and 8

MEASURED PERCOLATION RATE AND DESIGN INFILTRATION RATE CALCULATIONS*

* Calculations Below Based on Stabilized Readings Only

Boring Radius, r: **4** inches
Test Section Height, h: **75** inches

$$Test\ Section\ Surface\ Area, A = 2\pi rh + \pi r^2$$

A= **1935** in^2

$$Discharged\ Water\ Volume, V = \pi r^2 \Delta d$$

Reading 6	V= **109**	in^3
Reading 7	V= **109**	in^3
Reading 8	V= **115**	in^3

$$Percolation\ Rate = \left(\frac{V/A}{\Delta T}\right)$$

Percolation Rate =	0.11	inches/hour
Percolation Rate =	0.11	inches/hour
Percolation Rate =	0.12	inches/hour

Measured Percolation Rate = **0.11** inches/hour

Reduction Factors

Small Diameter Boring, RF_t =	1
Site Variability, RF_v =	1
Long Term Siltation, RF_s =	1

$$Total\ Reduction\ Factor, RF = RF_t + RF_v + RF_s$$

Total Reduction Factor = 3

Design Infiltration Rate

Design Infiltration Rate = **0.04** inches/hour

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500 NORTH VICTORY BOULEVARD - BURBANK, CA 91502
PHONE: 818-841-8388 FAX: 818-841-1704

PERCOLATION TEST RESULTS AND CALCULATIONS

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

DRAFTED BY: ACS	CHECKED BY: JTA	SEPT 2024	PROJECT NO. W1974-06-01	FIG. 8

BORING PERCOLATION TEST FIELD LOG

Date:	Friday, August 2, 2024		**Boring/Test Number:**	Boring B2	
Project Number:	W1974-06-01		**Diameter of Boring:**	8	inches
Project Location:	4900 Clark Avenue		**Diameter of Casing:**	2	inches
Earth Description:	ML-CL		**Depth of Boring:**	5	feet
Tested By:	RA		**Depth to Invert of BMP:**	2	feet
Liquid Description:	Water		**Depth to Water Table:**	32	feet
Measurement Method:	Sounder		**Depth to Initial Water Depth (d_1)**	17.76	inches

Start Time for Pre-Soak:	7:15 AM	**Water Remaining in Boring (Y/N):**	Yes
Start Time for Standard:	8:15 AM	**Standard Time Interval Between Readings:**	30 min

Reading Number	Start Time (hh:mm)	Time End (hh:mm)	Elasped Time Δtime (min)	Water Drop During Standard Time Interval, Δd (in)	Soil Despcription Notes Comments
1	8:32 AM	9:02 AM	30	0.0	
2	9:02 AM	9:32 AM	30	0.5	
3	9:34 AM	10:04 AM	30	0.8	
4	10:06 AM	10:36 AM	30	0.5	
5	10:40 AM	11:10 AM	30	0.4	
6	11:10 AM	11:40 AM	30	0.5	Stabilized Readings
7	11:40 AM	12:10 PM	30	0.5	Achieved with Readings
8	12:10 PM	12:40 PM	30	0.5	6, 7, and 8

MEASURED PERCOLATION RATE AND DESIGN INFILTRATION RATE CALCULATIONS*

* Calculations Below Based on Stabilized Readings Only

Boring Radius, r: **4** inches
Test Section Height, h: **42.24** inches

$$Test\ Section\ Surface\ Area, A = 2\pi rh + \pi r^2$$

A= **1112** in^2

$$Discharged\ Water\ Volume, V = \pi r^2 \Delta d$$

$$Percolation\ Rate = \left(\frac{V/A}{\Delta T}\right)$$

Reading 6	V= **24** in^3	Percolation Rate =	0.04 inches/hour
Reading 7	V= **24** in^3	Percolation Rate =	0.04 inches/hour
Reading 8	V= **24** in^3	Percolation Rate =	0.04 inches/hour

Measured Percolation Rate = **0.04** inches/hour

Reduction Factors

Small Diameter Boring, RF_t = 1
Site Variability, RF_v = 1
Long Term Siltation, RF_s = 1

$$Total\ Reduction\ Factor, RF = RF_t + RF_v + RF_s$$

Total Reduction Factor = 3

Design Infiltration Rate

Design Infiltration Rate = **0.01** inches/hour

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ENVIRONMENTAL GEOTECHNICAL MATERIALS
500 NORTH VICTORY BOULEVARD - BURBANK, CA 91502
PHONE: 818-841-8388 FAX: 818-841-1704

PERCOLATION TEST RESULTS AND CALCULATIONS

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

DRAFTED BY: ACS	CHECKED BY: JTA	SEPT 2024	PROJECT NO. W1974-06-01	FIG. 9

BORING PERCOLATION TEST FIELD LOG

Date:	Friday, August 2, 2024		**Boring/Test Number:**	Boring B3	
Project Number:	W1974-06-01		**Diameter of Boring:**	8	inches
Project Location:	4900 Clark Avenue		**Diameter of Casing:**	2	inches
Earth Description:	ML-CL		**Depth of Boring:**	5	feet
Tested By:	RA		**Depth to Invert of BMP:**	2	feet
Liquid Description:	Water		**Depth to Water Table:**	32	feet
Measurement Method:	Sounder		**Depth to Initial Water Depth (d_1)**	18.6	inches

Start Time for Pre-Soak:	7:30 AM	**Water Remaining in Boring (Y/N):**	Yes
Start Time for Standard:	8:30 AM	**Standard Time Interval Between Readings:**	30 min

Reading Number	Start Time (hh:mm)	Time End (hh:mm)	Elasped Time Δtime (min)	Water Drop During Standard Time Interval, Δd (in)	Soil Despcription Notes Comments
1	8:48 AM	9:18 AM	30	0.6	
2	9:18 AM	9:48 AM	30	1.3	
3	9:48 AM	10:18 AM	30	1.2	
4	10:18 AM	10:48 AM	30	0.7	
5	10:48 AM	11:18 AM	30	0.8	
6	11:18 AM	11:48 AM	30	0.6	Stabilized Readings
7	11:48 AM	12:18 PM	30	0.6	Achieved with Readings
8	12:18 PM	12:48 PM	30	0.7	6, 7, and 8

MEASURED PERCOLATION RATE AND DESIGN INFILTRATION RATE CALCULATIONS*

* Calculations Below Based on Stabilized Readings Only

Boring Radius, r: **4** inches
Test Section Height, h: **41.4** inches

$$Test\ Section\ Surface\ Area, A = 2\pi rh + \pi r^2$$

A= **1091** in^2

$$Discharged\ Water\ Volume, V = \pi r^2 \Delta d$$

Reading 6	V= **30**	in^3
Reading 7	V= **30**	in^3
Reading 8	V= **36**	in^3

$$Percolation\ Rate = \left(\frac{V/A}{\Delta T}\right)$$

Percolation Rate =	0.06	inches/hour
Percolation Rate =	0.06	inches/hour
Percolation Rate =	0.07	inches/hour

Measured Percolation Rate = **0.06** inches/hour

Reduction Factors

Small Diameter Boring, RF_t =	1
Site Variability, RF_v =	1
Long Term Siltation, RF_s =	1

$$Total\ Reduction\ Factor, RF = RF_t + RF_v + RF_s$$

Total Reduction Factor = 3

Design Infiltration Rate

Design Infiltration Rate = **0.02** inches/hour

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ENVIRONMENTAL GEOTECHNICAL MATERIALS
500 NORTH VICTORY BOULEVARD - BURBANK, CA 91502
PHONE: 818-841-8388 FAX: 818-841-1704

PERCOLATION TEST RESULTS AND CALCULATIONS

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

DRAFTED BY: ACS	CHECKED BY: JTA	SEPT 2024	PROJECT NO. W1974-06-01	FIG. 10

BORING PERCOLATION TEST FIELD LOG

Date:	Friday, August 2, 2024		**Boring/Test Number:**	Boring B4	
Project Number:	W1974-06-01		**Diameter of Boring:**	8	inches
Project Location:	4900 Clark Avenue		**Diameter of Casing:**	2	inches
Earth Description:	ML-CL		**Depth of Boring:**	5	feet
Tested By:	RA		**Depth to Invert of BMP:**	2	feet
Liquid Description:	Water		**Depth to Water Table:**	32	feet
Measurement Method:	Sounder		**Depth to Initial Water Depth (d_1)**	9.6	inches

Start Time for Pre-Soak:	8:00 AM	**Water Remaining in Boring (Y/N):**	Yes
Start Time for Standard:	9:00 AM	**Standard Time Interval Between Readings:**	30 min

Reading Number	Start Time (hh:mm)	Time End (hh:mm)	Elasped Time Δtime (min)	Water Drop During Standard Time Interval, Δd (in)	Soil Despcription Notes Comments
1	9:15 AM	9:45 AM	30	0.6	
2	9:45 AM	10:15 AM	30	0.6	
3	10:15 AM	10:45 AM	30	0.2	
4	10:45 AM	11:15 AM	30	0.4	
5	11:15 AM	11:45 AM	30	0.5	
6	11:45 AM	12:15 PM	30	0.1	Stabilized Readings
7	12:15 PM	12:45 PM	30	0.1	Achieved with Readings
8	12:45 PM	1:15 PM	30	0.0	6, 7, and 8

MEASURED PERCOLATION RATE AND DESIGN INFILTRATION RATE CALCULATIONS*

* Calculations Below Based on Stabilized Readings Only

Boring Radius, r: **4** inches
Test Section Height, h: **50.4** inches

$$Test\ Section\ Surface\ Area, A = 2\pi rh + \pi r^2$$

A= **1317** in^2

$$Discharged\ Water\ Volume, V = \pi r^2 \Delta d$$

$$Percolation\ Rate = \left(\frac{V/A}{\Delta T}\right)$$

Reading 6	V= **6** in^3	Percolation Rate =	0.01 inches/hour
Reading 7	V= **6** in^3	Percolation Rate =	0.01 inches/hour
Reading 8	V= **0** in^3	Percolation Rate =	0.00 inches/hour

Measured Percolation Rate = **0.01** inches/hour

Reduction Factors

Small Diameter Boring, RF_t = 1
Site Variability, RF_v = 1
Long Term Siltation, RF_s = 1

$$Total\ Reduction\ Factor, RF = RF_t + RF_v + RF_s$$

Total Reduction Factor = 3

Design Infiltration Rate

Design Infiltration Rate = **0.00** inches/hour

GEOCON WEST, INC.
ENVIRONMENTAL GEOTECHNICAL MATERIALS
500 NORTH VICTORY BOULEVARD - BURBANK, CA 91502
PHONE: 818-841-8388 FAX: 818-841-1704

PERCOLATION TEST RESULTS AND CALCULATIONS

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

DRAFTED BY: ACS	CHECKED BY: JTA	SEPT 2024	PROJECT NO. W1974-06-01	FIG. 11

APPENDIX A

APPENDIX A
FIELD INVESTIGATION

The site was explored on August 2, 2024, by excavating five 8-inch-diameter borings using a truck-mounted hollow-stem auger drilling machine to depths between 5½ and 63½ feet beneath the ground surface. Representative and relatively undisturbed samples were obtained by driving a 3-inch, O. D., California Modified Sampler into the "undisturbed" soil mass with blows from a 140-pound auto-hammer falling 30 inches. The California Modified Sampler was equipped with 1-inch by $2\frac{3}{8}$-inch diameter brass sampler rings to facilitate soil removal and testing. Bulk samples were also obtained.

The soil conditions encountered in the borings were visually examined, classified and logged in general accordance with the Unified Soil Classification System (USCS). The logs of the borings are presented on Figures A1 through A5. The logs depict the soil and geologic conditions encountered and the depth at which samples were obtained. The logs also include our interpretation of the conditions between sampling intervals. Therefore, the logs contain both observed and interpreted data. We determined the lines designating the interface between soil materials on the logs using visual observations, penetration rates, excavation characteristics and other factors. The transition between materials may be abrupt or gradual. Where applicable, the logs were revised based on subsequent laboratory testing. The approximate locations of the borings are shown on Figure 2.

PROJECT NO. W1974-06-01

BORING 1

ELEV. (MSL.) -- DATE COMPLETED **08/02/2024**

EQUIPMENT **HOLLOW STEM AUGER** BY: **ACS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-5'				**ASPHALT: 4" BASE: 5.5"** **ARTIFICIAL FILL** Sandy Silt, soft, slightly moist, brown, fine-grained, trace clay.			
2	B1@2.5'					7	89.3	26.3
4					**YOUNGER ALLUVIUM** Sandy Silt, firm, slightly moist, brown, fine-grained, some clay.			
6	B1@5'			ML		15	90.0	28.6
8	B1@7.5'				- soft, light brown	10	87.3	33.5
10	B1@10'				- stiff	23	97.1	27.0

Total depth of boring: 10.5 feet
Fill to 3 feet.
No groundwater encountered.
Percolation testing performed.
Backfilled with soil cuttings and tamped.
Patched with asphalt.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

W1974-06-01 BORING LOGS.GPJ

Figure A1,
Log of Boring 1, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

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PROJECT NO. W1974-06-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**BORING 2** ELEV. (MSL.) -- DATE COMPLETED **08/02/2024** EQUIPMENT **HOLLOW STEM AUGER** BY: **ACS**	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0					**ARTIFICIAL FILL** Sandy Silt, stiff, slightly moist, brown, fine-grained, trace clay.			
2	B2@2.5'					22	99.7	18.8
4				ML	**YOUNGER ALLUVIUM** Sandy Silt, stiff, slightly moist, brown, fine-grained, trace clay.			
	B2@5'					25	100.6	17.0
					Total depth of boring: 5.5 feet Fill to 3 feet. No groundwater encountered. Percolation testing performed. Backfilled with soil cuttings and tamped. *Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

W1974-06-01 BORING LOGS.GPJ

Figure A2,
Log of Boring 2, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

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PROJECT NO. W1974-06-01

BORING 3

ELEV. (MSL.) -- DATE COMPLETED **08/02/2024**

EQUIPMENT **HOLLOW STEM AUGER** BY: **ACS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ARTIFICIAL FILL** Sandy Silt, firm, slightly moist, brown, fine-grained, trace clay.			
2	B3@2.5'					17	91.5	25.4
4				ML	**YOUNGER ALLUVIUM** Sandy Silt, slightly moist, brown, fine-grained, trace clay.			
	B3@5'					16	96.0	23.5
					Total depth of boring: 5.5 feet Fill to 3 feet. No groundwater encountered. Percolation testing performed. Backfilled with soil cuttings and tamped. *Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

W1974-06-01 BORING LOGS.GPJ

Figure A3,
Log of Boring 3, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

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PROJECT NO. W1974-06-01

BORING 4

ELEV. (MSL.) -- DATE COMPLETED **08/02/2024**

EQUIPMENT **HOLLOW STEM AUGER** BY: **ACS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-5'				**ARTIFICIAL FILL** Sandy Silt, firm, slightly moist, brown, fine-grained, trace clay.			
2	B4@2.5'				- asphalt	49	118.7	8.0
4				ML	**YOUNGER ALLUVIUM** Sandy Silt, stiff, slightly moist, brown, fine-grained, trace clay.			
	B4@5'					22	92.3	30.1

Total depth of boring: 5.5 feet
Fill to 3 feet.
No groundwater encountered.
Percolation testing performed.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

W1974-06-01 BORING LOGS.GPJ

Figure A4,
Log of Boring 4, Page 1 of 1

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL ◧ ... STANDARD PENETRATION TEST ■ ... DRIVE SAMPLE (UNDISTURBED)
⊠ ... DISTURBED OR BAG SAMPLE ◥ ... CHUNK SAMPLE ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

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PROJECT NO. W1974-06-01

BORING 5

ELEV. (MSL.) -- DATE COMPLETED **08/02/2024**

EQUIPMENT **HOLLOW STEM AUGER** BY: **ACS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-5'				**ARTIFICIAL FILL** Sandy Silt, soft, slightly moist, brown, fine-grained, trace clay.			
2	B5@2.5'				**YOUNGER ALLUVIUM** Sandy Silt, soft, slightly moist, brown, fine-grained, trace clay.	6		21.3
4	B5@5'				- firm	17	99.9	17.1
6	B5@7.5'			ML	- soft, increase in fine-grained	8		17.6
8	B5@10'				- firm	26	90.7	28.1
10	B5@12.5'				- soft, dark brown, increase in clay	8		28.7
12	B5@15'				Silty Clay, firm, slightly moist, dark brown, trace fine-grained sand.	19	93.2	27.4
14	B5@17.5'			CL	- soft, gray to brown	10		20.1
16	B5@20'				- stiff, gray	31	114.1	18.5
18	B5@22.5'				Sandy Clay, firm, slighlty moist, grayish brown, fine-grained, trace clay.	14		17.8
20	B5@25'			CL	- stiff, light brown	32	105.1	23.0
22	B5@27.5'				Sandy Silt, firm, slightly moist, grayish brown, fine-grained.	18		19.9
24				ML				
26								
28								

W1974-06-01 BORING LOGS.GPJ

Figure A5,
Log of Boring 5, Page 1 of 3

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

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PROJECT NO. W1974-06-01

BORING 5

ELEV. (MSL.) -- DATE COMPLETED **08/02/2024**

EQUIPMENT **HOLLOW STEM AUGER** BY: **ACS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B5@30'		▼		Silty Sand, medium dense, moist, grayish brown, fine-grained.	36	117.2	17.2
					- groundwater encountered			
32	B5@32.5'			SM		23		23.2
34								
36	B5@35'				- dense, decrease in silt	64	108.2	19.9
38	B5@37.5'				Sand, poorly graded, medium dense, wet, grayish brown, fine- to medium-grained.	17		19.7
40	B5@40'			SP	- no recovery	11		
42	B5@42.5'					20		20.3
44								
46	B5@45'				Clay, soft, wet, brown.	50	109.7	17.2
48	B5@47.5'			CL		11		34.2
50	B5@50'				Silty Sand, dense, wet, brown, fine-grained.	43	116.3	19.1
52	B5@52.5'					33		16.9
54				SM				
56								
58	B5@57.5'				- fine- to medium-grained	41		19.9

W1974-06-01 BORING LOGS.GPJ

Figure A5,
Log of Boring 5, Page 2 of 3

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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PROJECT NO. W1974-06-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**BORING 5** ELEV. (MSL.) -- DATE COMPLETED **08/02/2024** EQUIPMENT **HOLLOW STEM AUGER** BY: **ACS**	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
60								
62	B5@62.5'			SM	- very dense	72		20.1
					Total depth of boring: 63.5 feet Fill to 2 feet. Groundwater encountered at 31 feet. Percolation testing performed. Backfilled with soil cuttings and tamped. *Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

W1974-06-01 BORING LOGS.GPJ

Figure A5,
Log of Boring 5, Page 3 of 3

SAMPLE SYMBOLS

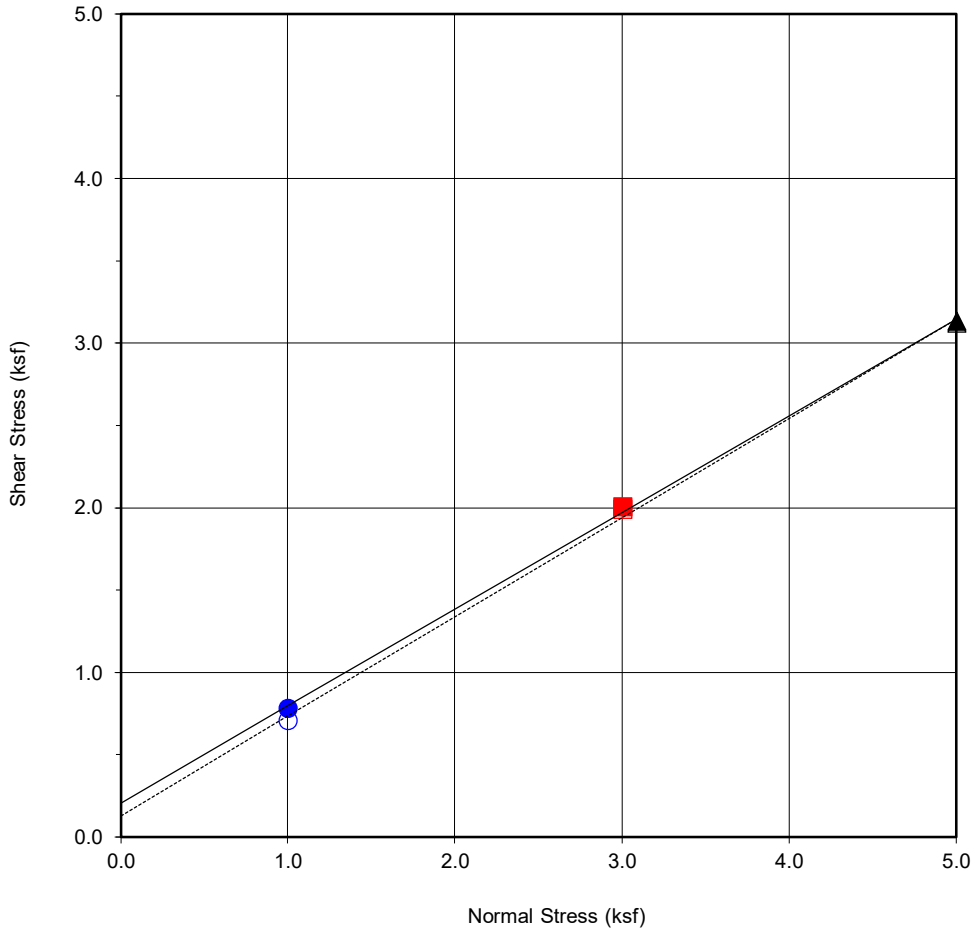
- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

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APPENDIX B

APPENDIX B
LABORATORY TESTING

We performed laboratory tests in accordance with generally accepted test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. We tested selected soil samples for in-place dry density/moisture content, expansion index, water-soluble sulfate, pH, resistivity, water-soluble chloride ion content, consolidation, and direct shear strength. The in-place dry density and moisture content of the samples tested are presented on the boring logs, Appendix A.



Boring No.	**B5**
Sample No.	**B5@5'**
Depth (ft)	**5'**
Sample Type:	RING

Soil Identification:		
Sandy Silt (ML)		
Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	208	30
Ultimate	131	31

Normal Stress (kip/ft²)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.78	■ 2.00	▲ 3.13
Shear Stress @ End of Test (ksf)	○ 0.71	□ 1.99	△ 3.12
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	28.5	27.5	26.3
Initial Dry Density (pcf)	97.1	96.4	92.9
Initial Degree of Saturation (%)	104.4	99.3	87.2
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	30.2	28.4	27.7

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DIRECT SHEAR TEST RESULTS

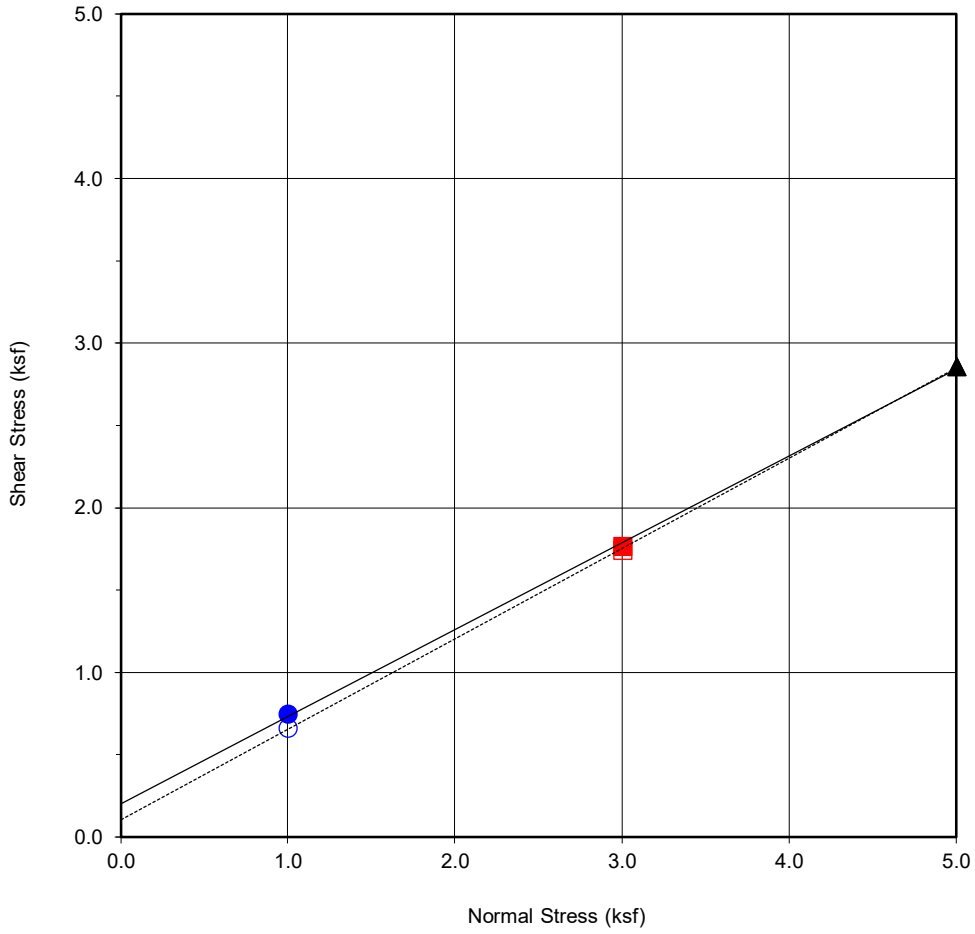
Consolidated Drained ASTM D-3080

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Project No.: W1974-06-01

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September 2024 Figure B1



Boring No.	**B5**
Sample No.	**B5@10'**
Depth (ft)	**10'**
Sample Type:	RING

Soil Identification:		
Sandy Silt (ML)		
Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	204	28
Ultimate	105	29

Normal Stress (kip/ft²)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.74	■ 1.76	▲ 2.86
Shear Stress @ End of Test (ksf)	○ 0.66	□ 1.74	△ 2.86
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	28.7	27.1	36.2
Initial Dry Density (pcf)	93.3	90.9	89.2
Initial Degree of Saturation (%)	96.2	85.6	109.8
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	33.6	33.7	31.5

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DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

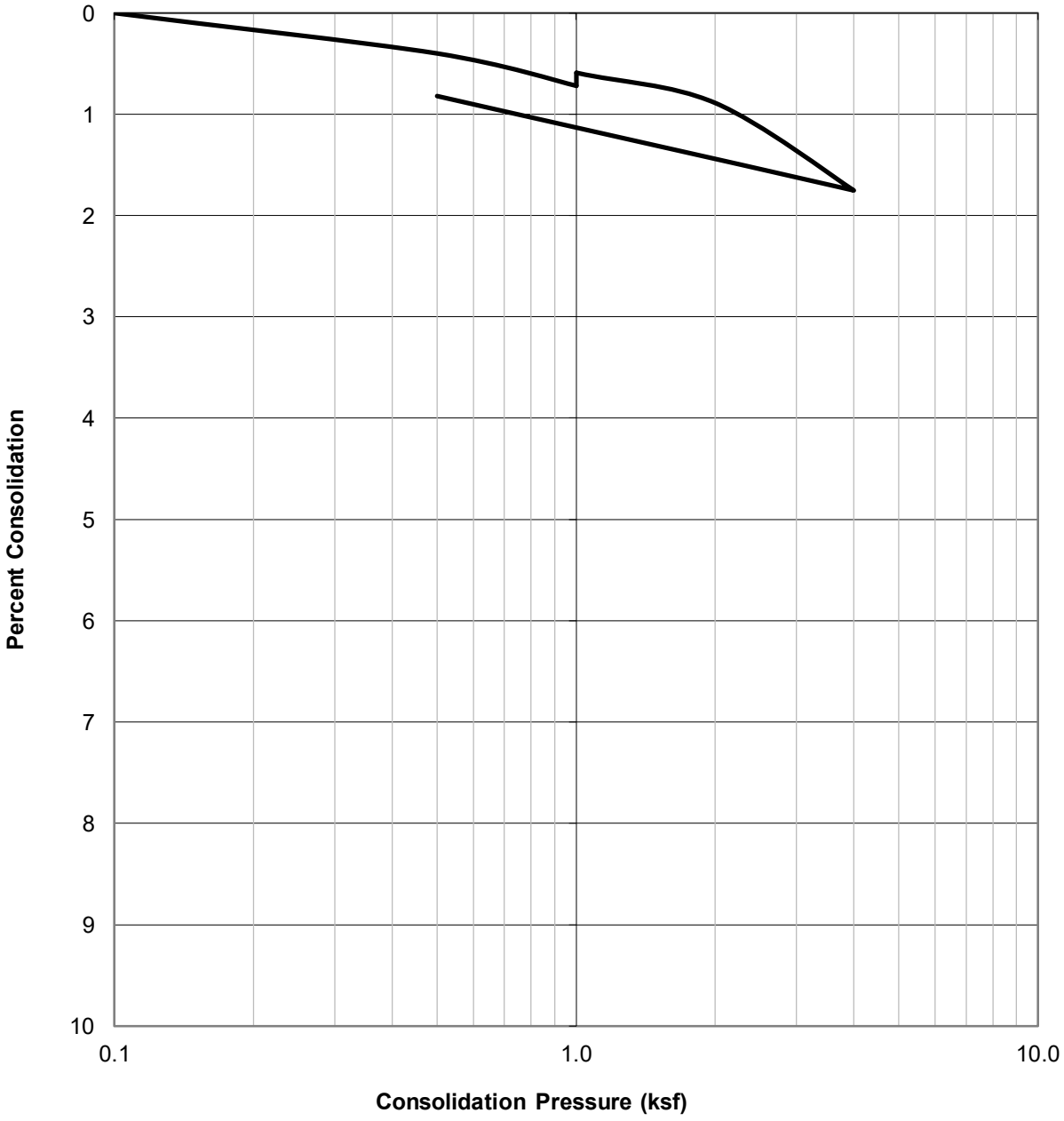
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4900 CLARK AVENUE
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September 2024 Figure B2

WATER ADDED AT 1.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B5@5'	Sandy Silt (ML)	100.7	20.9	25.1

GEOCON

CONSOLIDATION TEST RESULTS

ASTM D-2435

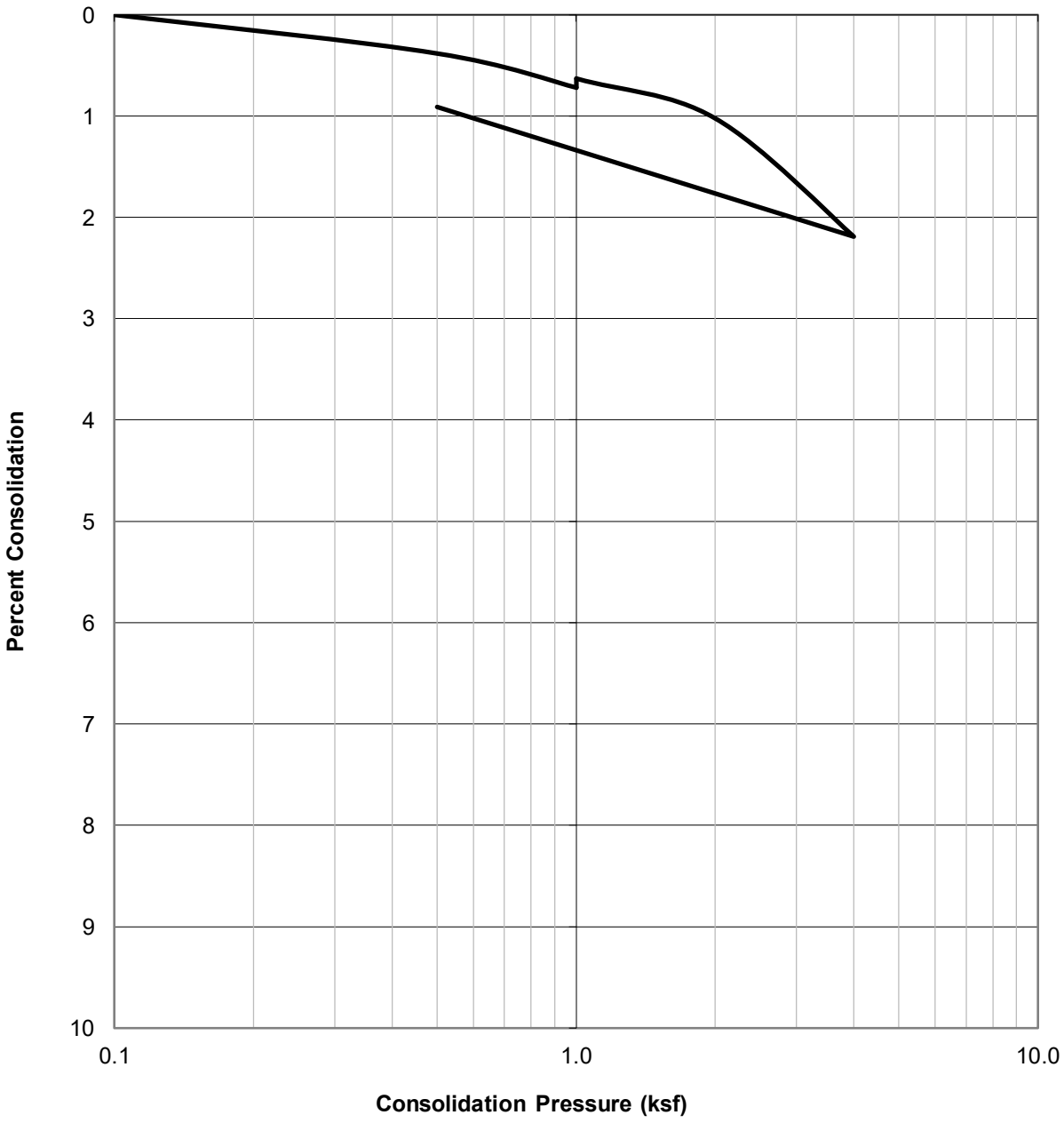
Checked by: ACS

Project No.: W1974-06-01

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

September 2024 Figure B3

WATER ADDED AT 1.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B5@10'	Sandy Silt (ML)	90.0	31.7	33.3

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CONSOLIDATION TEST RESULTS

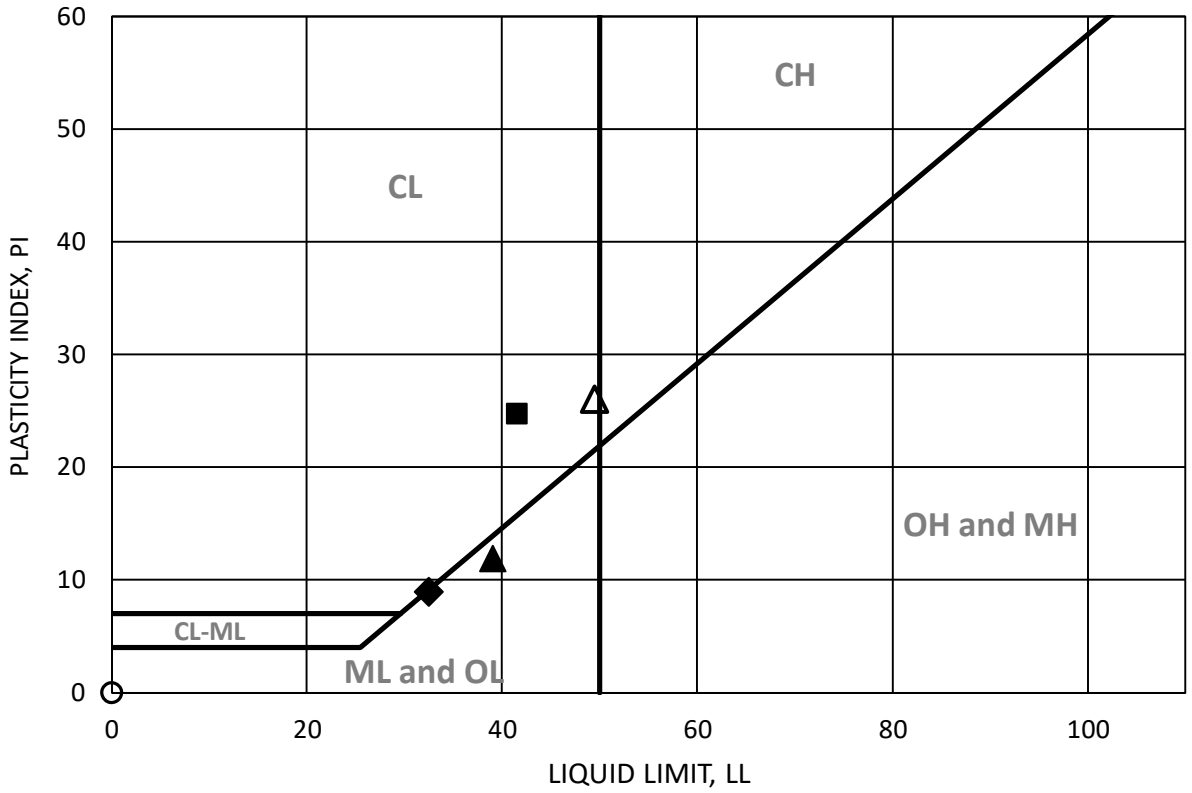
ASTM D-2435

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4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

September 2024 Figure B4



SYMBOL	BORING	DEPTH (ft)	LL	PL	PI	MOISTURE CONTENT AT SATURATION	SOIL BEHAVIOR
■	B5	17.5'	41.5	17	25		CL
◆	B5	22.5'	33	24	9	23	CL
▲	B5	27.5'	39	27	12		ML
●	B5	32.5'	N/P	N/P	N/P		N/P
□	B5	37.5'	N/P	N/P	N/P		N/P
◇	B5	42.5'	N/P	N/P	N/P		N/P
△	B5	47.5'	50	23	26		CH
○							

N/P = Non-Plastic

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ATTERBERG LIMITS

ASTM D-4318

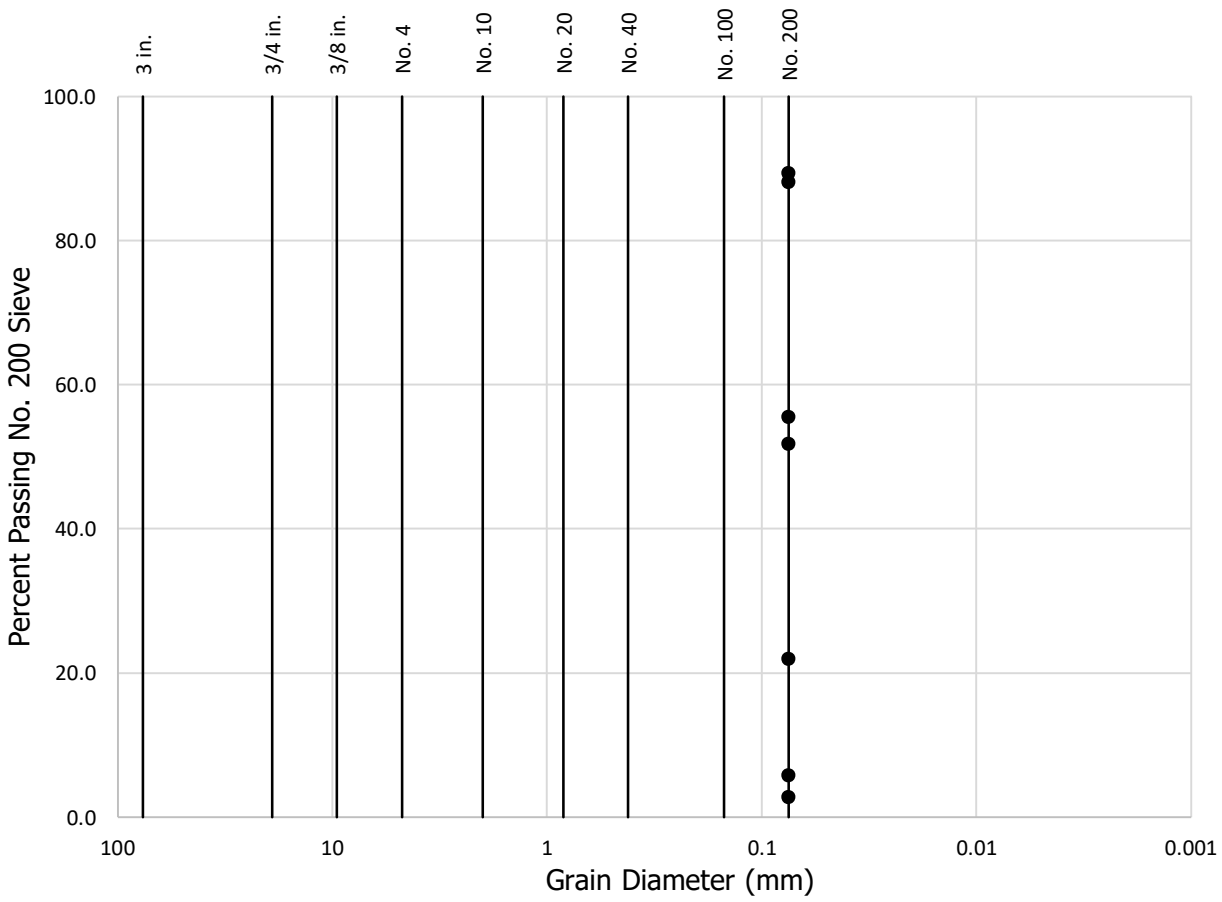
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4900 CLARK AVENUE
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September 2024 Figure B5

GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



Sample No.	Percent Passing No. 200 Sieve
B5 @ 17.5'	88.1
B5 @ 22.5'	55.5
B5 @ 27.5'	51.8
B5 @ 32.5'	21.9
B5 @ 37.5'	2.8
B5 @ 42.5'	5.8
B5 @ 47.5'	89.3

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GRAIN SIZE ANALYSIS

ASTM D-1140

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4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

September 2024 Figure B6

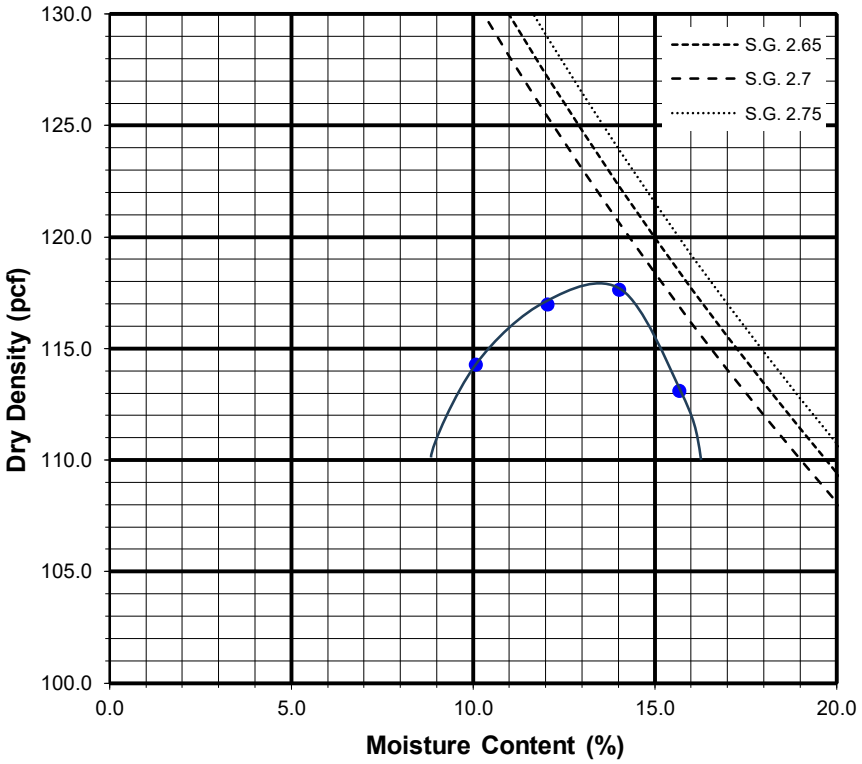
Sample No:

B1+B5 MIX	Sandy Silt (ML)

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6308	6258	6262	6182		
Weight of Mold	(g)	4282	4282	4282	4282		
Net Weight of Soil	(g)	2026	1976	1980	1900		
Wet Weight of Soil + Cont.	(g)	2393.4	2389.3	2357.8	2291.0		
Dry Weight of Soil + Cont.	(g)	2145.4	2120.9	2144.7	2116.0		
Weight of Container	(g)	378.0	408.5	377.3	378.7		
Moisture Content	(%)	14.0	15.7	12.1	10.1		
Wet Density	(pcf)	134.1	130.8	131.1	125.8		
Dry Density	(pcf)	117.6	113.1	117.0	114.3		

Maximum Dry Density (pcf)	**118.0**
Bulk Specific Gravity (dry)	**2.50**
Corrected Maximum Dry Density (pcf)	**120.0**

Optimum Moisture Content (%)	**13.0**
Oversized Fraction (%)	**7.0**
Corrected Moisture Content (%)	**12.1**



Preparation Method: A

GEOCON

COMPACTION CHARACTERISTICS USING MODIFIED EFFORT TEST RESULTS

ASTM D-1557

Checked by: ACS

Project No.: W1974-06-01

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

Sep 24

Figure B7

B1+B5 MIX

MOLDED SPECIMEN		BEFORE TEST	AFTER TEST
Specimen Diameter	(in.)	4.0	4.0
Specimen Height	(in.)	1.0	1.0
Wt. Comp. Soil + Mold	(gm)	585.0	611.6
Wt. of Mold	(gm)	195.2	195.2
Specific Gravity	(Assumed)	2.7	2.7
Wet Wt. of Soil + Cont.	(gm)	306.8	611.6
Dry Wt. of Soil + Cont.	(gm)	276.6	350.5
Wt. of Container	(gm)	6.8	195.2
Moisture Content	(%)	11.2	18.8
Wet Density	(pcf)	117.6	125.4
Dry Density	(pcf)	105.7	105.6
Void Ratio		0.6	0.6
Total Porosity		0.4	0.4
Pore Volume	(cc)	77.2	82.8
Degree of Saturation	(%) [S_{meas}]	51.3	79.5

Date	Time	Pressure (psi)	Elapsed Time (min)	Dial Readings (in.)
8/8/2024	10:00	1.0	0	0.3824
8/8/2024	10:10	1.0	10	0.3821
Add Distilled Water to the Specimen				
8/9/2024	10:00	1.0	1430	0.4094
8/9/2024	11:00	1.0	1490	0.4094

Expansion Index (EI meas) =	27.3
Expansion Index (Report) =	**27**

Expansion Index, EI_{50}	CBC CLASSIFICATION *	UBC CLASSIFICATION **
0-20	Non-Expansive	Very Low
21-50	Expansive	Low
51-90	Expansive	Medium
91-130	Expansive	High
>130	Expansive	Very High

* Reference: 2022 California Building Code, Section 1803.5.3
** Reference: 1997 Uniform Building Code, Table 18-I-B.

GEOCON

EXPANSION INDEX TEST RESULTS
ASTM D-4829

Checked by: ACS

Project No.: W1974-06-01

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

September 2024 Figure B8

SUMMARY OF LABORATORY
POTENTIAL OF HYDROGEN (pH) AND RESISTIVITY TEST RESULTS
AASHTO T289 ASTM D4972 and AASHTO T288 ASTM G187

Sample No.	pH	Resistivity (ohm centimeters)
B1+B5 MIX	8.1	480 (Severely Corrosive)

SUMMARY OF LABORATORY CHLORIDE CONTENT TEST RESULTS
AASHTO T291 ASTM C1218

Sample No.	Chloride Ion Content (%)
B1+B5 MIX	0.017

SUMMARY OF LABORATORY WATER SOLUBLE SULFATE TEST RESULTS
AASHTO T290 ASTM C1580

Sample No.	Water Soluble Sulfate (% SO_4)	Sulfate Exposure
B1+B5 MIX	0.060	S0

GEOCON

CORROSIVITY TEST RESULTS

Checked by: ACS

Project No.: W1974-06-01

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

September 2024 Figure B9

SUMMARY OF LABORATORY R-VALUE TEST RESULTS

Sample No.	Soil Description	R-Value
B1 + B5 MIX	Sandy Silt (ML)	25

GEOCON

R-VALUE TEST RESULTS

ASTM D-2844

Checked by: ACS

Project No.: W1974-06-01

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

September 2024 Figure B10

APPENDIX B

SWPPP Bid Documents Contractor Responsibility

Wording for SWPPP Bid Documents

The City of Lakewood will provide the Storm Water Pollution Prevention Plan (SWPPP) & Erosion Control Plan only for the City of Lakewood Town Square Project prepared by a certified QSD. Bidder is responsible for the QSP and provide the weekly/quarterly/yearly inspections and reporting for the project by a certified QSP. Bidder is also responsible for preparing the Annual Reports submitted to SMARTS by September of each year through the duration of the projects, and submission of the NOT (Notice of Termination) submitted to SMARTS.

The SWPPP will address the implementation and monitoring of a Storm Water Pollution Prevention Plan (SWPPP) & Water Pollution Control Drawings (Erosion Control Plan) for the purpose of preventing the discharge of pollutants from the construction site into the receiving waters per the new adopted (September 8, 2022) Statewide Construction General Permit (CGP) Order No. 2009-0009-DWQ, as amended by 2010-0014-DWQ (CGP) and Order No. 2022-0057-DWG (2022 CGP) and an effective date of September 1, 2023, NPDES No. CAS000002 and this document and all attachments within the CGP & SWPPP for this project.

It is the sole responsibility of the Contractor awarded the Project to comply with all aspects of the New Statewide Construction General Permit (CGP). The Contractor is responsible for providing and installing the implementation, maintenance, inspection, reporting, and monitoring the SWPPP for Lakewood Town Square Project, for the purpose of preventing and eliminating the discharge of pollutants from the construction site throughout the duration of this project work. Implementation and maintenance of SWPPP to include all materials/equipment identified in the SWPPP binder and drawings. They must comply with any issues/concerns on the site per the weekly inspections and reports by the Awardee's certified QSP assigned to the project. The QSP must have a certified QSP # that will be supplied to the City.

It is highly recommended that the Contractor read and be knowledgeable of the Construction General Permit (CGP) to understand their contractual responsibility and familiar with the updated CASQA Construction BMPs.

The Awardee will have a certified QSP assigned to this project to be responsible for the daily, weekly and quarterly inspections and reporting, Annual Report, and NOT per the CGP. Any COI (Change of Information) will be prepared by the QSD who prepared the SWPPP for this project. The contractor/superintendent on site for this project will adhere to any issues/concerns brought up by the QSP per their weekly inspections so that the City is not in violations with the State Water Resource Control Board Construction General Permit.

The Contractor shall have a Qualified Storm Water Manager to oversee implementation of the BMPs and the overall construction of the project required and comply with the CGP and SWPPP. Any changes to the assigned BMPs in the SWPPP binder needs approval of the QSD.

The Contractor is responsible for maintaining the project site per the CGP until final completion/acceptance of the NOT by the SWCRB.

APPENDIX D

LID REPORT
July 2026

CEQA Final Initial Study & Mitigated Negative Declaration
Mitigated Monitoring and Reporting Plan
August 2026

Table 5-1. Lakewood Civic Center Corner Lot Development Project Mitigation Monitoring and Reporting Plan					
Mitigation Measure	**Monitoring Activity/ Timing/ Frequency**	**Implementation Responsibility/ Verification**	**Responsibility for Oversight of Compliance/ Verification**	**Outside Agency Coordination**	**Comments**
Biological Resources Mitigation Measures					
BIO-1: Pre-Construction Nesting Bird Survey. If ground disturbing Project activities, tree trimming, or tree removal are scheduled to occur during the nesting bird season (February 1–August 31), a qualified biologist shall conduct a pre-construction nesting bird survey to ensure that active bird nests will not be disturbed or destroyed. The survey shall be completed no more than 3 working days prior to initial ground disturbance. The nesting bird survey shall include the Project Site and adjacent areas where Project activities have the potential to affect active nests, either directly or indirectly due to construction activity, noise, or vibrations. If an active nest is identified, a qualified biologist shall establish an appropriate disturbance limit buffer around the nest using flagging or staking. Construction	**Activity:** Pre-construction nesting bird survey. **Timing:** Within three days prior to the start of construction, if construction initiates during the nesting bird season. **Frequency:** One time.	**Qualified Biologist** Initials Date	**City of Lakewood** Initials Date	CDFW	

Table 5-1. Lakewood Civic Center Corner Lot Development Project Mitigation Monitoring and Reporting Plan					
Mitigation Measure	**Monitoring Activity/ Timing/ Frequency**	**Implementation Responsibility/ Verification**	**Responsibility for Oversight of Compliance/ Verification**	**Outside Agency Coordination**	**Comments**
activities shall not occur within any disturbance limit buffer zones until the nest is deemed inactive by the qualified biologist.					
Cultural Resources Mitigation Measures					
CUL-1: Contractor Awareness Training Program. The lead agency shall ensure that a Contractor Awareness Training Program is delivered to train equipment operators about cultural resources. The program shall be designed to inform construction personnel about: federal and state regulations pertaining to cultural resources and tribal cultural resources; the subsurface indicators of resources that shall require a work stoppage; procedures for notifying the lead agency of any occurrences; Project-specific requirements and mitigation measures; and enforcement of	**Activity:** Contractor Awareness Training Program. **Timing:** Prior to construction. **Frequency:** As necessary during construction.	**Qualified Archaeologist** _____ Initials _____ Date	**City of Lakewood** _____ Initials _____ Date	None.	

Table 5-1. Lakewood Civic Center Corner Lot Development Project Mitigation Monitoring and Reporting Plan					
Mitigation Measure	**Monitoring Activity/ Timing/ Frequency**	**Implementation Responsibility/ Verification**	**Responsibility for Oversight of Compliance/ Verification**	**Outside Agency Coordination**	**Comments**
penalties and repercussions for non-compliance with the program. The training shall be prepared by a qualified professional archaeologist and may be provided either through a brochure, video, or in-person tailgate meeting, as determined appropriate by the archaeologist. The training shall be provided to all construction supervisors, forepersons, and operators of ground-disturbing equipment. All personnel shall be required to sign a training roster. The construction manager is responsible for ensuring that all required personnel receive the training. The Construction Manager shall provide a copy of the signed training roster to the lead agency as proof of compliance.					

Table 5-1. Lakewood Civic Center Corner Lot Development Project Mitigation Monitoring and Reporting Plan					
Mitigation Measure	**Monitoring Activity/ Timing/ Frequency**	**Implementation Responsibility/ Verification**	**Responsibility for Oversight of Compliance/ Verification**	**Outside Agency Coordination**	**Comments**
CUL-2: Unanticipated Discoveries. If subsurface deposits believed to be cultural or human in origin are discovered during construction, all work must halt within a 100-foot radius of the discovery. A qualified professional archaeologist, meeting the Secretary of the Interior's Professional Qualification Standards for prehistoric and historic archaeology, shall be retained to evaluate the significance of the find, and shall have the authority to modify the no-work radius as appropriate, using professional judgment. The following notifications shall apply, depending on the nature of the find: ▪ If the professional archaeologist determines that the find does not represent a cultural resource, work may resume immediately and no agency notifications are required.	**Activity:** Archaeological evaluation of potential cultural resources. **Timing:** During construction. **Frequency:** As necessary during construction.	**Qualified Archaeologist** Initials Date	**City of Lakewood** Initials Date	Orange County Coroner Native American Heritage Commission Native American Most Likely Descendant (MLD)	

Table 5-1. Lakewood Civic Center Corner Lot Development Project Mitigation Monitoring and Reporting Plan					
Mitigation Measure	**Monitoring Activity/ Timing/ Frequency**	**Implementation Responsibility/ Verification**	**Responsibility for Oversight of Compliance/ Verification**	**Outside Agency Coordination**	**Comments**
▪ If the professional archaeologist determines that the find does represent a cultural resource from any time period or cultural affiliation, the archaeologist shall immediately notify the lead agencies. The agencies shall consult on a finding of eligibility and implement appropriate treatment measures, if the find is determined to be a Historical Resource under the California Environmental Quality Act (CEQA), as defined by CEQA or a historic property under Section 106 National Historic Preservation Act, if applicable. Work may not resume within the no-work radius until the lead agencies, through consultation as appropriate, determine that the site either: 1) is not a Historical Resource under CEQA or a Historic Property under Section 106; or 2) that the treatment measures have been completed to their satisfaction. ▪ If the find represents a Native American or potentially Native American resource					

Table 5-1. Lakewood Civic Center Corner Lot Development Project Mitigation Monitoring and Reporting Plan					
Mitigation Measure	**Monitoring Activity/ Timing/ Frequency**	**Implementation Responsibility/ Verification**	**Responsibility for Oversight of Compliance/ Verification**	**Outside Agency Coordination**	**Comments**
that does not include human remains, then he or she shall further notify the appropriate tribe. The agencies shall consult with the tribes on a finding of eligibility and implement appropriate treatment measures, if the find is determined to be a Historical Resource under CEQA, as defined in Section 15064.5(a) of the CEQA Guidelines. Preservation in place is the preferred treatment, if feasible. Work may not resume within the no-work radius until the lead agencies, through consultation as appropriate, determine that the site either: 1) is not a Historical Resource under CEQA, as defined in Section 15064.5(a) of the CEQA Guidelines; or 2) that the treatment measures have been completed to their satisfaction. ■ If the find includes human remains, or remains that are potentially human, they shall ensure reasonable protection measures are taken to protect the discovery from disturbance (Assembly					

Table 5-1. Lakewood Civic Center Corner Lot Development Project Mitigation Monitoring and Reporting Plan					
Mitigation Measure	**Monitoring Activity/ Timing/ Frequency**	**Implementation Responsibility/ Verification**	**Responsibility for Oversight of Compliance/ Verification**	**Outside Agency Coordination**	**Comments**
Bill [AB] 2641). The archaeologist shall notify the Los Angeles County Coroner (per § 7050.5 of the Health and Safety Code). The provisions of § 7050.5 of the California Health and Safety Code, § 5097.98 of the California Public Resources Code (PRC), and AB 2641 will be implemented. If the coroner determines the remains are Native American and not the result of a crime scene, the coroner will notify the Native American Heritage Commission (NAHC), which then will designate a Native American Most Likely Descendant (MLD) for the Project (§ 5097.98 of the PRC). The designated MLD will have 48 hours from the time access to the property is granted to make recommendations concerning treatment of the remains. If the landowner does not agree with the recommendations of the MLD, the NAHC can mediate (§ 5097.94 of the PRC). If no agreement is reached, the					

Table 5-1. Lakewood Civic Center Corner Lot Development Project Mitigation Monitoring and Reporting Plan					
Mitigation Measure	**Monitoring Activity/ Timing/ Frequency**	**Implementation Responsibility/ Verification**	**Responsibility for Oversight of Compliance/ Verification**	**Outside Agency Coordination**	**Comments**
landowner must rebury the remains where they will not be further disturbed (§ 5097.98 of the PRC). This will also include either recording the site with the NAHC or the appropriate Information Center; using an open space or conservation zoning designation or easement; or recording a reinternment document with the county in which the property is located (AB 2641). Work may not resume within the no-work radius until the lead agencies, through consultation as appropriate, determine that the treatment measures have been completed to their satisfaction.					
Geology and Soils Mitigation Measures					
GEO-1: Unanticipated Discovery of Paleontological Resources. If paleontological resources are discovered during construction, all work must halt within a 100-foot radius of the discovery and a qualified	**Activity:** Evaluation of potential paleontological resources by a qualified paleontologist.	**Qualified Paleontologist/ Construction Contractor**	**City of Lakewood**	None.	

Table 5-1. Lakewood Civic Center Corner Lot Development Project Mitigation Monitoring and Reporting Plan					
Mitigation Measure	**Monitoring Activity/ Timing/ Frequency**	**Implementation Responsibility/ Verification**	**Responsibility for Oversight of Compliance/ Verification**	**Outside Agency Coordination**	**Comments**
paleontologist will be retained to evaluate the find. The paleontologist shall notify the lead agency if the find is significant. The paleontologist shall evaluate the significance of the find and shall have the authority to modify the no-work radius as appropriate, using professional judgment. The qualified paleontologist will evaluate the significance of the find and recommend appropriate measures for the disposition of the find (e.g., fossil recovery, curation, data recovery, and/or monitoring). Construction activities may continue on other parts of the construction site while evaluation and treatment of the paleontological resource takes place.	**Timing:** During excavation activities as part of construction. **Frequency:** As necessary during construction.	Initials Date	Initials Date		

Table 5-1. Lakewood Civic Center Corner Lot Development Project Mitigation Monitoring and Reporting Plan					
Mitigation Measure	**Monitoring Activity/ Timing/ Frequency**	**Implementation Responsibility/ Verification**	**Responsibility for Oversight of Compliance/ Verification**	**Outside Agency Coordination**	**Comments**
Transportation Mitigation Measures					
TRANS-1: Special Event Traffic Management Plan. The City of Lakewood shall prepare and implement a Traffic Management Plan (TMP) for special events, which will identify the primary routes of travel to ensure efficient vehicle traffic movement and control between adjacent roadways and the Proposed Project. The plan will designate the routes for entry and exit, signage placement along these routes, temporary street closures and other special traffic management procedures, such as use of traffic control personnel to direct traffic at key intersections. The staffing levels and locations of law enforcement officers, including security, traffic, and parking personnel will also be identified to assist with the control of the roadways. Each TMP shall be	**Activity:** Implementation of traffic management plan. **Timing:** During special events. **Frequency:** As necessary during special events.	**City of Lakewood** Initials Date	**City of Lakewood** Initials Date	None.	

Table 5-1. Lakewood Civic Center Corner Lot Development Project Mitigation Monitoring and Reporting Plan					
Mitigation Measure	**Monitoring Activity/ Timing/ Frequency**	**Implementation Responsibility/ Verification**	**Responsibility for Oversight of Compliance/ Verification**	**Outside Agency Coordination**	**Comments**
tailored to the specific special event(s) and approved prior to the start of the event. The TMP will also identify potential off-site parking locations and ways to bring event-goers from there to the civic plaza.					
Tribal Cultural Resources Mitigation Measures					
TCR-1: Tribal Monitoring. Prior to the issuance of a Grading Permit or ground disturbing activities, the Project applicant/lead agency shall engage the Gabrieleno Band of Mission Indians – Kizh Nation in discussions to provide one (1) paid Native American Monitor to observe "ground-disturbing activity" for the Project. The scope of "ground-disturbing activity" that shall be subject to monitoring shall be limited to activities where ground disturbance exceeds a depth of 3-feet below the existing surface ground elevation.	**Activity:** Retain a Tribal monitor representing the Gabrieleño Band of Mission Indians – Kizh Nation. **Timing:** Prior to commencement of all ground-disturbing activity where ground disturbance	**Construction Contractor** _____ Initials _____ Date	**City of Lakewood** _____ Initials _____ Date	Native American Tribe entering into agreement with the City	

Table 5-1. Lakewood Civic Center Corner Lot Development Project Mitigation Monitoring and Reporting Plan					
Mitigation Measure	**Monitoring Activity/ Timing/ Frequency**	**Implementation Responsibility/ Verification**	**Responsibility for Oversight of Compliance/ Verification**	**Outside Agency Coordination**	**Comments**
Monitoring shall not occur for at- or above-surface work. Should the Gabrieleno Band of Mission Indians – Kizh Nation not enter into an agreement for monitoring, the lead agency shall identify and retain a suitable replacement, which may include a monitor from another culturally affiliated tribe or a professional archaeologist to monitor on their behalf. The Native American Monitor shall be invited to the Project pre-construction meeting for general construction and schedule information and shall be provided with at least 24-hours' notice prior to the initiation of any/all ground-disturbing activities that exceed 3-feet depth of ground disturbance. All notifications shall be documented by the lead agency and if the Native American Monitor is not present at the scheduled time of work, said work shall be allowed to continue	exceeds a depth of 3-feet below the existing surface ground elevation. **Frequency:** As needed.				

Table 5-1. Lakewood Civic Center Corner Lot Development Project Mitigation Monitoring and Reporting Plan					
Mitigation Measure	**Monitoring Activity/ Timing/ Frequency**	**Implementation Responsibility/ Verification**	**Responsibility for Oversight of Compliance/ Verification**	**Outside Agency Coordination**	**Comments**
without the Native American Monitor present. Any/All work with associated ground disturbance that does not exceed 3-feet depth shall be allowed without the presence of a Native American Monitor.					
TCR-2: Unanticipated Discovery of Tribal Cultural Resources. In the event of a discovery of a potential tribal cultural resource at the Project Site, upon notification of the discovery, the lead agency shall temporarily cease construction within a 50-foot radius of the discovery to immediately consult with the Native American Monitor and a qualified archaeologist, to be retained by the lead agency. The Native American Monitor shall work with the lead agency and its qualified archaeologist to assess the significance of the discovery and determine the corresponding treatment for the finding(s). Work shall not be allowed	**Activity:** Evaluation of potential tribal cultural resources. **Timing:** During construction. **Frequency:** As necessary during construction.	**Qualified Archaeologist, Native American Monitor** Initials Date	**City of Lakewood** Initials Date	Orange County Coroner Native American Heritage Commission Culturally Affiliated Tribe	

Table 5-1. Lakewood Civic Center Corner Lot Development Project Mitigation Monitoring and Reporting Plan					
Mitigation Measure	**Monitoring Activity/ Timing/ Frequency**	**Implementation Responsibility/ Verification**	**Responsibility for Oversight of Compliance/ Verification**	**Outside Agency Coordination**	**Comments**
to resume at the potential discovery location until authorized by the lead agency.					
TCR-3: Unanticipated Discovery of Human Remains. In the event that there is a discovery of human remains, or remains that are potentially human, the Contractor shall ensure reasonable protection measures are taken to protect the discovery from disturbance (AB 2641). The Lead Agency, or Native American Monitor shall notify the County Medical Examiner (as per § 7050.5 of the Health and Safety Code). The provisions of § 7050.5 of the California Health and Safety Code, § 5097.98 of the California PRC, and AB 2641 will be implemented. If the Medical Examiner determines the remains are Native American and not the result of a crime scene, the Medical Examiner will notify the NAHC, who then will designate a Native American	**Activity:** Evaluation of potential tribal cultural resources. **Timing:** During construction. **Frequency:** As necessary during construction.	**Qualified Archaeologist, Native American Monitor** Initials Date	**City of Lakewood** Initials Date	Orange County Coroner Native American Heritage Commission Most Likely Descendant	

Table 5-1. Lakewood Civic Center Corner Lot Development Project Mitigation Monitoring and Reporting Plan					
Mitigation Measure	**Monitoring Activity/ Timing/ Frequency**	**Implementation Responsibility/ Verification**	**Responsibility for Oversight of Compliance/ Verification**	**Outside Agency Coordination**	**Comments**
MLD for the Project (§ 5097.98 of the PRC). The designated MLD will have 48 hours from the time access to the property is granted to make recommendations concerning treatment of the remains. If the landowner does not agree with the recommendations of the MLD, the NAHC may mediate (§ 5097.94 of the PRC). If no agreement is reached, the landowner must rebury the remains where they will not be further disturbed (§ 5097.98 of the PRC). This will also include either recording the site with the NAHC or the appropriate information center; using an open space or conservation zoning designation or easement; or recording a reinternment document with the county in which the property is located (AB 2641). Work may not resume within the no-work radius until the City of Lakewood, through consultation as appropriate, determines that the					

Table 5-1. Lakewood Civic Center Corner Lot Development Project Mitigation Monitoring and Reporting Plan					
Mitigation Measure	**Monitoring Activity/ Timing/ Frequency**	**Implementation Responsibility/ Verification**	**Responsibility for Oversight of Compliance/ Verification**	**Outside Agency Coordination**	**Comments**
treatment measures have been completed to its satisfaction.					

APPENDIX D

LID REPORT

July 2026

FINAL LOW IMPACT DEVELOPMENT AND DRAINAGE STUDY FOR LAKEWOOD CORNER LOT PROJECT

PROJECT ADDRESS: 4900 CLARK AVENUE
APN: 7172-002-905 & 7172-002-906

CITY OF LAKEWOOD
CALIFORNIA

PREPARED FOR:

DAVID EVANS & ASSOCIATES
17542 17TH STREET, SUITE 150
TUSTIN, CA 92780
(714) 665.4549
ATTN: LINDA SANDUSKY

PREPARED BY:

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552
FAX 951.304.3568
CONTACT JOSEPH CASTANEDA
joe@jlcengineering.com

Stormwater Clearance
These plans have been reviewed and approved pursuant to the City's Stormwater regulations and policies. It is the applicant's responsibility to ensure that the BMP's herein are properly constructed and maintained and that runoff will not pollute soil, surface or subsurface waters
By _____ Date Jul 17 2026

OCTOBER 13, 2025
REVISE: APRIL 22, 2026, JUNE 25, 2026, JULY 13,2026

This report has been prepared by or under the direction of the following registered civil engineer who attests to the technical information contained herein. The registered civil engineer has also judged the qualifications of any technical specialists providing engineering data upon which recommendations, conclusions, and decisions are based.



	07/13/2026	
Joseph L. Castaneda RCE 59835 Registered Civil Engineer	Date	Seal

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I. INTRODUCTION & DRAIANGE NARRATIVE

The proposed development, defined as the Lakewood Corner Lot Project, will occur on APN 7172-002-905 & 7172-002-906 and is located at the northwest corner of the intersection of Del Amo Blvd and Clark Ave in the City of Lakewood, see Vicinity Map, Figure 1. The project site is approximately 3.7 acres. The existing project site consists of graded and compacted undeveloped area in the southern half and parking lot areas used by the City of Lakewood in the northern half. There are existing storm drain systems adjacent to the project site, described as follows:

- Within Del Amo Blvd there are two existing catch basins and a 24" storm drain system. These are maintained by the City of Lakewood.
- Within Del Amo Blvd there is an existing 34'x11.5' rectangular concrete channel along the south side of Del Amo Blvd. This is maintained by LACPW.
- Within Civic Center Way there is an existing 23'x11.5' reinforced concrete box along Civic Center Way. This is maintained by LACPW.
- Within Clark Avenue there is an existing parkway drain.

An existing condition map is included as Figure 2.

The City of Lakewood has planned for the undeveloped lot defined as APN 7172-002-905 & 7172-002-906 to be developed as a community park. The southern half of the project area will be developed as a community park area and the northern half of the project will consist of pavement rehabilitation. The pavement rehabilitation will be implemented for the existing parking lot areas in the northern half of the project. The proposed park will incorporate Low Impact Development (LID) Bioretention planters. The site development layout map is included as Figure 3.

In the existing condition, runoff from the project site discharges into the adjacent streets and is tributary to the existing catch basin in Del Amo Blvd. The proposed condition will perpetuate the existing condition drainage pattern. Runoff collected onsite will be conveyed to the existing catch basin in Del Amo Blvd. Runoff which is not collected onsite will enter the adjacent streets, similar to the existing condition.

The purpose of this study is to determine the necessary drainage improvements required for the development of APN 7172-002-905 & 7172-002-906. The project is proposing LID improvements that will mitigate stormwater runoff to be in compliance with the LID policies for all improvements within the limits of disturbance.

The scope of the study includes the following:

1. Determination of points of flow concentration and watershed subareas for onsite tributary areas in the pre-project condition and post-project condition.
2. Determination of 2-year, 10-year, 25-year, and 50-year storm event flow rates for the project area utilizing the Modified Rational Method as outlined in the Los

Angeles County Department of Public Works (LACDPW) Hydrology Manual for the pre-project and post-project conditions.

3. Determination of the LID flow rates and volumes using the 85th percentile rainfall value using the hydrograph generated by the Hydrocalc Program developed by LACDPW.
4. Demonstrate that the proposed design will comply with current LID requirements and reduce flooding into adjacent streets.
5. Validate the size of the proposed bioretention basin planters.
6. Preparation of a low impact development and drainage study, which consists of hydrological and analytical results and exhibits.

II. HYDROLOGY

Hydrology Parameters

The LACDPW Hydrology Manual (Reference 1), was used to develop the hydrological parameters for the hydrology analyses. The modified rational method was used for the analyses and the computations were performed using the HydroCalc 3.1 software developed by LACDPW.

The rainfall and soil parameters for the project were obtained from the LACDPW Hydrology Manual, see Figure 4 and Figure 5. The hydrology parameters for the modified rational method calculations are as follows:

- 50-Year, 25-Hour Rainfall: 5.4", see Figure 4
- Soil Classification: 6, see Figure 4
- 85th Percentile Rainfall Value: 0.9", see Figure 5
- Storm Desing Frequencies: 2-Year, 10-Year, 25-Year, 50-Year, and LID Flow Rate
- In the existing condition, an impervious area ratio of 0.95 was utilized for the northern parking lot areas and an impervious area ratio of 0 was utilized for the southern undeveloped area.
- For the proposed condition, a land cover and impervious areas map is included as Exhibit D.
- Note that the HydroCalc program does not allow an impervious ratio of 0 to be entered, so a value of 0.01 was used for the calculations.

Pre-Project Hydrology Discussion and Results

The pre-project hydrology map is included as Exhibit A. The pre-project hydrology calculations are included in Appendix A.

The following is a discussion of the areas in the pre-project condition:

- Drainage Area 1A consists of 0.58 acres of existing parking lot area in the northwest corner of the project site. This area discharges into Clark Ave.
- Drainage Area 2A (0.56 acres), Drainage Area 3A (0.44 acres), and Drainage Area 5A (1.26 acres) consist of graded and compacted undeveloped area in the southern portion of the project site. These areas discharge into Del Amo Blvd.
- Drainage Area 4A consists of 0.70 acres of existing parking lot area in the northeast corner of the project site. This area discharges into Civic Center Way.
- Drainage Area 6A consists of 0.16 acres of undeveloped area long the eastern edge of the project site. This area discharges into Civic Center Way.

The results of the rational method analysis are as follows:

Table 1 – Pre-Project Flow Rates

Subarea	Area (ac)	50-Year Flow Rate (ft^3/s)	25-Year Flow Rate (ft^3/s)	10-Year Flow Rate (ft^3/s)	2-Year Flow Rate (ft^3/s)
1A	0.58	1.68	1.47	1.09	0.48
2A	0.56	1.36	1.05	0.74	0.20
3A	0.44	1.19	0.91	0.63	0.18
4A	0.70	2.02	1.63	1.23	0.56
5A	1.26	3.06	2.37	1.67	0.42
6A	0.16	0.31	0.24	0.17	0.03

Post-Project Hydrology Discussion and Results

The post-project hydrology map is included as Exhibit B. The post-project hydrology calculations are included in Appendix B. The post-project condition impervious areas map is included as Exhibit D.

The following is a discussion of the areas in the post-project condition:

- Drainage Area 1A consists of 0.56 acres of parking lot area in the northwest corner of the project site. This area discharges into a bioretention planter. Any runoff not collected by the onsite storm drain system will enter Clark Avenue. Runoff from the parking lot area flows west into a gravel area which is sloped toward the bioretention basin, as shown on Exhibit C. A normal depth calculation for the surface flow through the gravel area is provided in Appendix G. The normal depth calculation uses the 50-year flow rate and results in a velocity of 0.9 ft/s. This velocity can be considered non-erosive for the slopes of the bioretention basin.
- Drainage Area 2A consists of 0.35 acres of park area in the southwest corner of the project site. This area discharges into a bioretention planter. Any runoff not collected by the onsite storm drain system will enter Del Amo Blvd.

- Drainage Area 3A consists of 0.74 acres of park area in the southwest corner of the project site. This area discharges into a bioretention planter. Any runoff not collected by the onsite storm drain system will enter Del Amo Blvd.
- Drainage Area 4A consists 0.74 acres of parking lot area in the northeast corner of the project site. This area discharges into Civic Center Way, matching the drainage pattern of the existing condition. This area consists of pavement rehabilitation. The pavement surfaces will hold identical lines and grades per the existing topography. This area is considered part of ongoing maintenance and operation. Treatment is not required for this area. Please note that Drainage Area 4A includes a small amount of new impervious area that is difficult to treat. The project is treating Drainage Area 1A when it's not required to, which is a much larger area and offsets the impacts from the untreated area within Drainage Area 4A.
- Drainage Area 5A consists of 0.89 acres of park area in the southeast corner of the project site. This area discharges into a bioretention planter. Any runoff not collected by the onsite storm drain system will enter Del Amo Blvd. Runoff from the park area flows south into a gravel area which is sloped toward the bioretention basin, as shown on Exhibit C.
- Drainage Area 6A consists of 0.38 acres of park area in the southeast corner of the project site. This area discharges into a bioretention planter. Any runoff not collect by the onsite storm drain system will enter Del Amo Blvd.
- Drainage Area 7A consists of 0.05 acres of area in the northeast corner of the project site. This area discharges into Civic Center Way, matching the drainage patten of the existing condition. This area is part of the northeast corner existing parking lot in which the project in implementing pavement rehabilitation and does not contain new impervious area. Treatment is not required for this area.

Drainage Area 3A and Area 5A include walls to the north of the bio-retention basins. The walls are designed with opening spaced every 6' and sized to be 1' wide and 0.5' high. These openings will allow runoff to be conveyed towards the bioretention basins. A capacity calculation for the openings is included in Appendix I.

The results of the rational method analysis are as follows:

Table 2 – Post-Project Flow Rates

Subarea	Area (ac)	50-Year Flow Rate (ft^3/s)	25-Year Flow Rate (ft^3/s)	10-Year Flow Rate (ft^3/s)	2-Year Flow Rate (ft^3/s)
1A	0.56	1.61	1.40	1.13	0.51
2A	0.35	0.99	0.86	0.63	0.26
3A	0.74	2.12	1.85	1.49	0.63
4A	0.74	2.14	1.87	1.39	0.65
5A	0.89	2.52	2.19	1.60	0.63
6A	0.38	1.05	0.90	0.64	0.21
7A	0.05	0.14	0.10	0.07	0.03

LID Hydrology Discussion and Results

The LID hydrology calculations were performed for areas which drain to bioretention planters for treatment. These calculations are based on the 85th percentile storm event. These areas are Drainage Area 1A, Drainage Area 2A, Drainage Area 3A, Drainage Area 5A, and Drainage Area 6A.

The post-project drainage area boundaries are shown on Exhibit B. The LID hydrology calculations are included in Appendix C.

The results of the LID analysis are as follows:

Table 3 – LID Flow Rates and Volumes

Subarea	Area (ac)	LID Flow Rate / SUSMP Flow Rate (ft^3/s)	LID Volume/ SUSMP Volume (ft^3)*
1A	0.56	0.15	1,393
2A	0.35	0.06	728
3A	0.74	0.18	1,839
5A	0.89	0.16	1,848
6A	0.38	0.03	431

Significant Ecological Area (SEA)

The project site is not located in, directly adjacent to, or discharging directly into a Significant Ecological Area (SEA). An LA County Map of SEA areas is included as Figure 6 with the location of the project site noted.

Receiving Waters/Hydromodifications

A Figure showing the downstream receiving waters for the project site is included as Figure 7. Onsite BMPs collect runoff and onsite storm drain conveys runoff into the existing storm drain in Del Amo Boulevard. Runoff the flows through the following systems:

1. Storm drain system in Del Amo Boulevard (Shown on Figure 2 in detail)
2. A 34'x11.5' Rectangular Concrete Channel located to the south of Del Amo Boulevard (show on Figure 2 in detail)
3. Clark Channel (Shown on Figure 2 in detail).
4. Spring Street Channel
5. Los Cerritos Channel
6. Los Cerritos Estuary
7. Alamitos Bay
8. Pacific Ocean

The downstream systems from the project site are engineered systems which are not susceptible to hydromodifications. Therefore, the project site is exempt from hydromodification mitigation requirements.

Harvest and Use

Harvest and Use BMPs are desirable for project areas that can store and use the collected runoff for different purposes such as irrigation or other water uses that can be sent to a sewer system. However, due to landscaping practices that implement water conservation, low drip irrigation and drought tolerant plant species the benefits of harvest and use are greatly reduced. The proposed project is not utilizing turf or plant areas that require high water uses that make harvest and use BMP beneficial. Due to the limited landscaping needs and the landscape water conservation practices it has been determined that harvest and use BMPs are not viable.

III. HYDRAULICS

Drainage Overview

A Drainage Facilities Map is included as Exhibit C. The proposed drainage facilities consist of a five bioretention planters and a 12" pipe system. The bioretention planters are discussed in detail in the following section. The 12" pipe system collects runoff from the bioretention planters and conveys it to the existing catch basin and storm drain system in Del Amo Blvd. The pipe system is designed to ensure the SUSMP flow rates are conveyed.

In the existing condition, runoff from the project site flows into the adjacent streets and into the catch basin located in Del Amo Blvd. The proposed condition perpetuates the existing condition flow pattern. Runoff is collected and conveyed to the existing catch basin in Del Amo Blvd or flows into adjacent streets. In the proposed condition, runoff will drain as follows:

- Runoff from the northeast corner will discharge into Civic Center Way, in the same pattern as in the existing condition. This area will implement pavement rehabilitation and is not new impervious area. The pavement surfaces will hold identical lines and grades per the existing topography. This area is considered part of ongoing maintenance and operation.
- Runoff will be collected from the southern area and northwest corner and conveyed to bioretention planters. Runoff will be conveyed through onsite storm drain and discharge into the existing catch basin in Del Amo Blvd. Runoff in excess of the capacity of the proposed storm drain system will discharge into the adjacent streets, similar to the existing condition.

Trench Drains

The project proposes two trench drains, one in area 2A and one in area 3A. The location of the trench drains is shown on the Drainage Facilities Map, Exhibit C. Capacity calculations for each trench drain were prepared using the FlowMaster Program. The calculations are included in Appendix H.

Equalizer Pipe

Bioretention Basin 3A, 5A, and 6A are connected by two 6” pipes to equalize the design capture volume between the three basins. The inverts of the equalizer pipe are designed to be within the ponding elevation of the basin and above the top of the soil media.

Pipe Capacity

The proposed storm drain system consists of 12” PVC pipes and 6” PVC pipes. The pipes were assessed using the FlowMaster Program to determine the full flow capacity of each system. The calculations are included in Appendix E.

The main 12” pipe system has a slope of 0.41% and a flow rate capacity of 2.28 ft^3/s. This system has the capacity to convey the SUSMP flow rates. This system has the capacity to convey the 2-year flow rates and a portion of the flows from the larger storm events.

Project Outflows

The proposed pipe system has the capacity to convey the 2-year flow rates. Runoff in excess of this value will be overtop the basin and leave the project site. In order to assess this situation, cross-sections were taken from the existing condition along the edge of the project adjacent to Bio-Retention Basins 1A, 2A, 3A, 5A, and 6A. The low end of each cross-section assumes a 6" vertical edge, which is a conservative approach. The location of these cross-sections is shown on the Drainage Facilities Map, Exhibit C. An average slope for the existing ground downstream of the project site was used. Normal depth calculations were performed for the 10-year, 25-year, and 50-year flow rates. The flow rates used for the calculations were by subtracting the 2-year flow rates from the calculated 10-year, 25-year, and 50-year flow rates. The normal depth calculations were performed using the FlowMaster program. The calculations are included in Appendix J.

IV. BIORETENTION BASIN SIZING

The project site area is greater than 1 acre and is creating more than 10,000 ft^2 of developed area. Therefore, the project is required to retain and treat the LID volume emanating from the areas being developed as part of the project.

Post-project Drainage Area 4A and 7A do not consist of any new impervious areas. Drainage Area 4A will implement pavement rehabilitation that resurfaces the parking lot area. The pavement surfaces will hold identical lines and grades per the existing topography. This area is considered part of ongoing maintenance and operation. Treatment is not required for this area. Drainage Area 7A will implement resurfacing the area with draught tolerant landscaping. Please note that Drainage Area 4A includes a small amount of new impervious area that is difficult to treat. The project is treating Drainage Area 1A when it's not required to, which is a much larger area and offsets the impacts from the untreated area within Drainage Area 4A.

Post-project Drainage Area 1A is a pavement rehabilitation area for the existing parking lot. Treatment is not required for this area. However, the project is proposing to treat the runoff through the use of a bioretention basin planter.

The project has poor percolation rates. The Geotechnical Report is included in Appendix F. The project is implementing the use of five bioretention planters. The locations of these systems are shown on Exhibit C.

The Bio-Retention Basins were sized based on the City of Lakewood LID Manual. The calculations for the required bioretention basin bottom areas are included in Appendix D. Step 1 of the process calculates the Design Capture Volume. Two calculation

methods were used and the higher resulting value was used as the volume for the rest of the calculations. The two methods are described as follows:

1. Using the equation established in the City of Lakewood LID Manual. However, a storm event value of 0.9" (0.075') was used instead of 0.75" (0.0625'). This 0.9" value is based on the MS4 permit.
2. Using the volumes calculated by the HydroCalc Program, multiplied by a facor of 1.5.

The following table summarizes the minimum required bottom area and the proposed design bottom area:

Table 4 – Bioretention Basin Sizing Table

Subarea	**Area (ac)**	**Design Capture Volume (ft^3)**	**Minimum Required Bottom Area (ft^2)**		**Design Bottom Area (ft^2)**	
1A	0.56	2,125	1,308		1,313	
2A	0.35	1,097	676		688	
3A	0.74	2,768	1,704	3,821 See note	849	3,842 See note
5A	0.89	2,783	1,713		849	
6A	0.38	656	404		2,144	

Note: Runoff will equalize between Bio-Retention Basin 3A, 5A, and 6A

The following table compares the Bio-Filtration BMP Design Criteria per the City of Lakewood LID Manual.

Table 5 – BMP Design Compliance Documentation

Design Parameter (unit)	**Criteria for Bioretention with Underdrain**	**Proposed for Project**
Design Capture Volume, $V_{capture}$ (cf)	1.5 x 0.0625 ft * Catchment Area (sq. ft.) where Catchment Area	$V_{capture}$ is calculated with the noted equation. However, 0.075' is used instead of 0.0625'.
Design Drawdown Time (hours)	48 (surface); 96 (total)	Varies, less than 48 hours
Factor of Safety	2	2
Soil Media Infiltration Rate (in/hr)	5 (max)	5
Max Ponding/Flow Depth (inches)	18	12
Soil Depth (ft)	2 (3 preferred) Topped with 3" of mulch	2' soil media 3" mulch
Underdrain	Slopped PVC pipe embedded in 12"	Slopped PVC pipe

	gravel section and 1" from bottom of facility	embedded in 12" or more gravel layer, at least 1" from bottom of gravel
Inlet Erosion Control	Energy dissipater to reduce velocity	Provided
Overflow device	Required if system is on-line and does not have an upstream bypass structure. Shall be designed to handle the peak storm flow.	Provided

Cross-sections of each Bio-Retention basin are provided on Exhibit C.

V. CONCLUSION

The study evaluated the proposed development to determine the necessary drainage improvements required to treat LID volumes and to perpetuate the flow patterns in a similar manner as the existing condition. It has been concluded that:

1. The post-project drainage pattern perpetuates the pre-project drainage pattern.
2. The proposed 12" pipe will function to fully convey the SUSMP flow rates and the 2-Year storm event flow rates for areas 1A, 2A, 3A, 5A, and 6A. Moreover, the pipe will be able to covey a total flow rate of 2.3 ft^3/s. This will allow the 12" system to convey a portion of the runoff from larger storm events to the existing catch basin. Therefore, the project will reduce the level of flooding within Del Amo Boulevard and Clark Avenue by 2.3 ft^3/s.
3. The proposed storm drain will reduce the amount of runoff entering the adjacent streets. This will reduce the flooding in Del Amo Boulevard and Clark Avenue.
4. Five bioretention planters are proposed to treat runoff to be in compliance with the City of Lakewood LID Manual.
5. The bioretention basins have been sized to adequately treat the design capture volumes per the Low Impact Development Standard.
6. The project is implementing pavement rehabilitation in the existing northeast parking lot area and is not required to provide treatment to this area.
7. The downstream receiving waters will benefit from the project with the bioretention basin planter treating Drainage Area A1 which does not require treatment. The area does not require treatment since this is considered pavement rehabilitation and is part of maintenance and operations. However, a proposed bioretention planter will provide treatment for this area and implement a LID BMP that implements current standards.

VI. REFERENCES

1. Los Angeles County Department of Public Works Manual, January 2006.
2. Los Angeles County Flood Control Design Manual, March 1982

FIGURES

FIGURE 1: VICINITY MAP



VICINITY MAP

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

FIGURE 1

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Last Opened: Oct 13, 2025 - 7:44pm by stanner

FIGURE 2: EXISTING CONDITION FOR APN 7172-002-905 & 7172-002-906



EXISTING CONDITION MAP

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

FIGURE 2

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Last Opened: Oct 16, 2025 - 11:49am by stanner

FIGURE 3: PROPOSED CONDITION FOR APN 7172-002-905 & 7172-002-906

LEGEND

1. RESTROOM PER ARCHITECT
2. LARGE SHADE STRUCTURE, TYPICAL
3. TOWN CENTER DECORATED FOR SEASONAL EVENTS
4. 7' H. SOUND WALL
5. DIGITAL MARQUEE SIGN
6. PORTABLE STAGE AREA
7. OPEN PLAZA SEATING AND PASSIVE PLAY AREA
8. MONUMENT SIGN
9. DECOMPOSED GRANITE DINING AREA
10. NATURAL TURF CONCERT SEATING
11. BIO-RETENTION PLANTER
12. UMBRELLA POST SLEEVES
13. FUTURE SHADE STRUCTURE
14. 4' HIGH METAL SLOT FENCE AND GATE: ALLOW FOR PEDESTRIAN ACCESS
15. DOUBLE SWING VEHICLE GATE TO MATCH FENCE
16. PARKING LOT TO BE RE-PAVED
17. LARGE ENTRY POTS
18. BOOMERANG BENCH PLANTER WITH UMBRELLA
19. BOLLARD, TYPICAL
20. BENCH/TRASH CAN, TYPICAL
21. POLE LIGHT, TYPICAL
22. REMOVABLE BOLLARD, TYPICAL
23. BISTRO DINING TABLE AND CHAIRS
24. BISTRO LIGHTING
25. LAKEWOOD LETTERS (INTERACTIVE) LOCATION TBD
26. BUS SHELTER TO BE PROTECTED
27. MOCKETTES-4' HIGH
28. FOOD TRUCK AREA
29. CONCRETE ETCHING-PLAY ELEMENT
30. PEBBLE SEATING- PLAY ELEMENT



FIGURE 3

SCHEMATIC LANDSCAPE DESIGN

LAKEWOOD CORNER LOT DEVELOPMENT
4970 CLARK AVE.
LAKEWOOD, CA, 90712

CITY OF LAKEWOOD CALIFORNIA

PROJECT NORTH

SCALE: 1" = 20'-0"

JOB NO. 24.058
DATE 07/22/25

NUVIS LANDSCAPE ARCHITECTURE
DAHLIN
505 Technology Drive, Suite 200
Irvine, California 92618
949-250-4680

L1

FIGURE 4: LACPWS RAINFALL & SOILS MAP

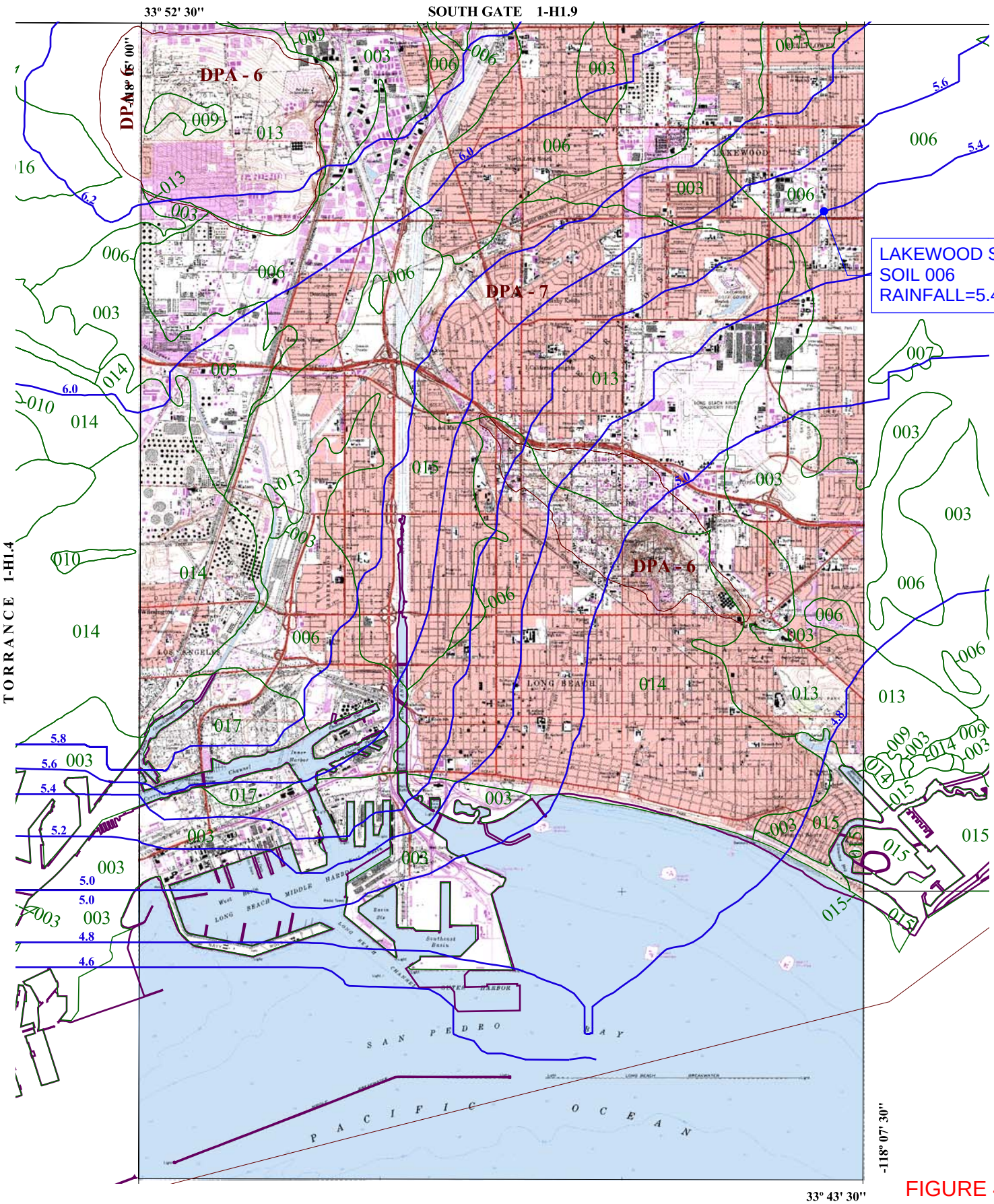


FIGURE 4

016 SOIL CLASSIFICATION AREA

7.2 INCHES OF RAINFALL

DPA - 6 DEBRIS POTENTIAL AREA

1 0 1 2 Miles

25-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.878
10-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.714

LONG BEACH
50-YEAR 24-HOUR ISOHYET

1-H1.5

LOS ANGELES COUNTY PUBLIC WORKS Public Service That Works

FIGURE 5: LACPWD 85TH PERCENTILE RAINFALL

85th Percentile 24-hr Rainfall Isohyetal Map

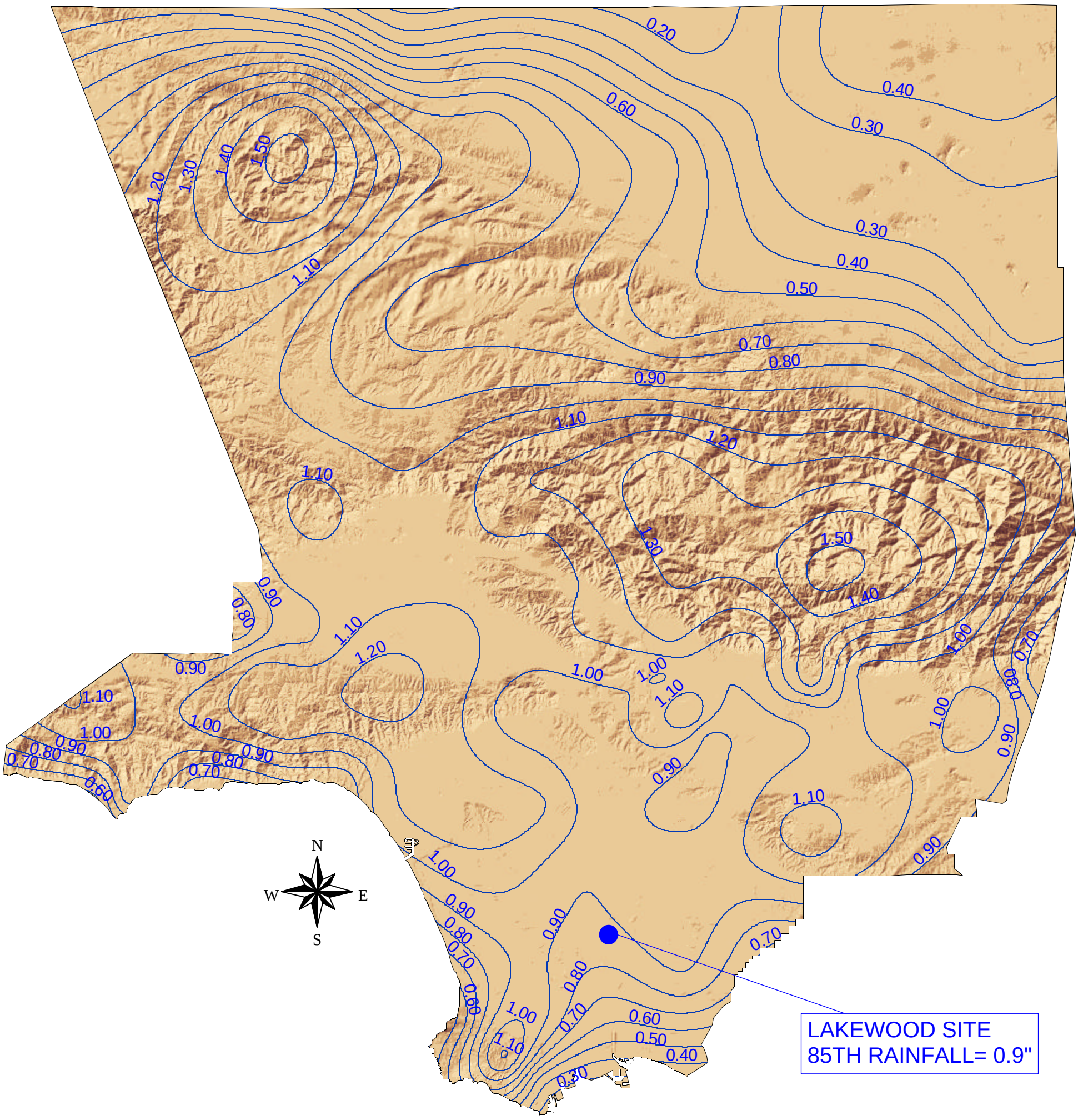


FIGURE 5

FIGURE 6: LA COUNTY SEA MAP

COUNTY OF LOS ANGELES

SIGNIFICANT ECOLOGICAL AREAS PROGRAM

Significant Ecological Areas (SEA) and Coastal Resource Areas

January 2022

LEGEND:

- Significant Ecological Areas
- Significant Ecological Areas (Incorporated City)*
- Coastal Resource Areas **
- Coastal Resource Areas (Incorporated City / Ocean)*

Base Features

- Unincorporated Area
- City Boundary
- National Forest
- Perennial Water Body
- Intermittent Water Body
- Dry Water Body

SIGNIFICANT ECOLOGICAL AREA:

Altadena Foothills and Arroyos
Antelope Valley
Cruzan Mesa Vernal Pools
East San Gabriel Valley
Griffith Park
Harbor Lake Regional Park
Joshua Tree Woodlands
Madrona Marsh Preserve
(Portions of the) Palos Verdes Peninsula and Coastline
Puente Hills
Rio Hondo College Wildlife Sanctuary
San Andreas
San Dimas Canyon / San Antonio Wash
San Gabriel Canyon
Santa Clara River
Santa Felicia
(Portions of the) Santa Monica Mountains

SIGNIFICANT ECOLOGICAL AREA:

Santa Susana Mountains / Simi Hills
Tujunga Valley / Hansen Dam
Valley Oaks Savannah
Verdugo Mountains

COASTAL RESOURCE AREA:

Alamitos Bay
Ballona Wetlands
El Segundo Dunes
Malibu Coastline
(Portions of the) Palos Verdes Peninsula and Coastline
Point Dume
(Portions of the) Santa Monica Mountains
Santa Catalina Island
Terminal Island (Pier 400)

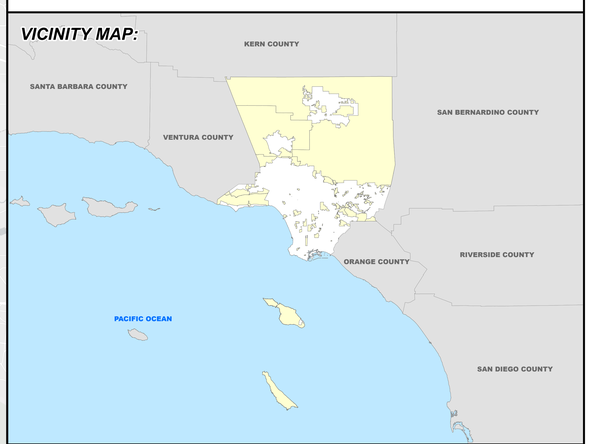
* SEAs WITHIN CITIES:

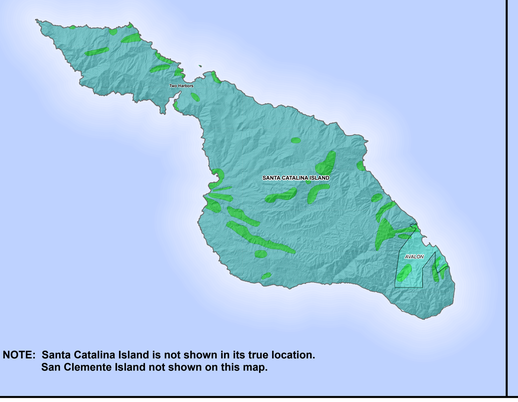
Emphasis is given for the Significant Ecological Areas in the unincorporated areas. Therefore, any SEA within an incorporated city will have a more muted green color.

** COASTAL ZONE REGULATORY INFORMATION:

The County considers the biological resources in the Santa Catalina Island and Santa Monica Mountains Coastal Zones to be of significance. The management and review of biological resources in the Coastal Zones differs from the countywide Significant Ecological Area regulatory program. Biological resource management and regulation in the Santa Catalina Island Coastal Zone is implemented through the Santa Catalina Island Local Coastal Program. Biological resource management in the Santa Monica Mountains Coastal Zone is currently implemented through the Santa Monica Mountains Local Coastal Program (LCP).

VICINITY MAP:





NOTE: Santa Catalina Island is not shown in its true location.
San Clemente Island not shown on this map.

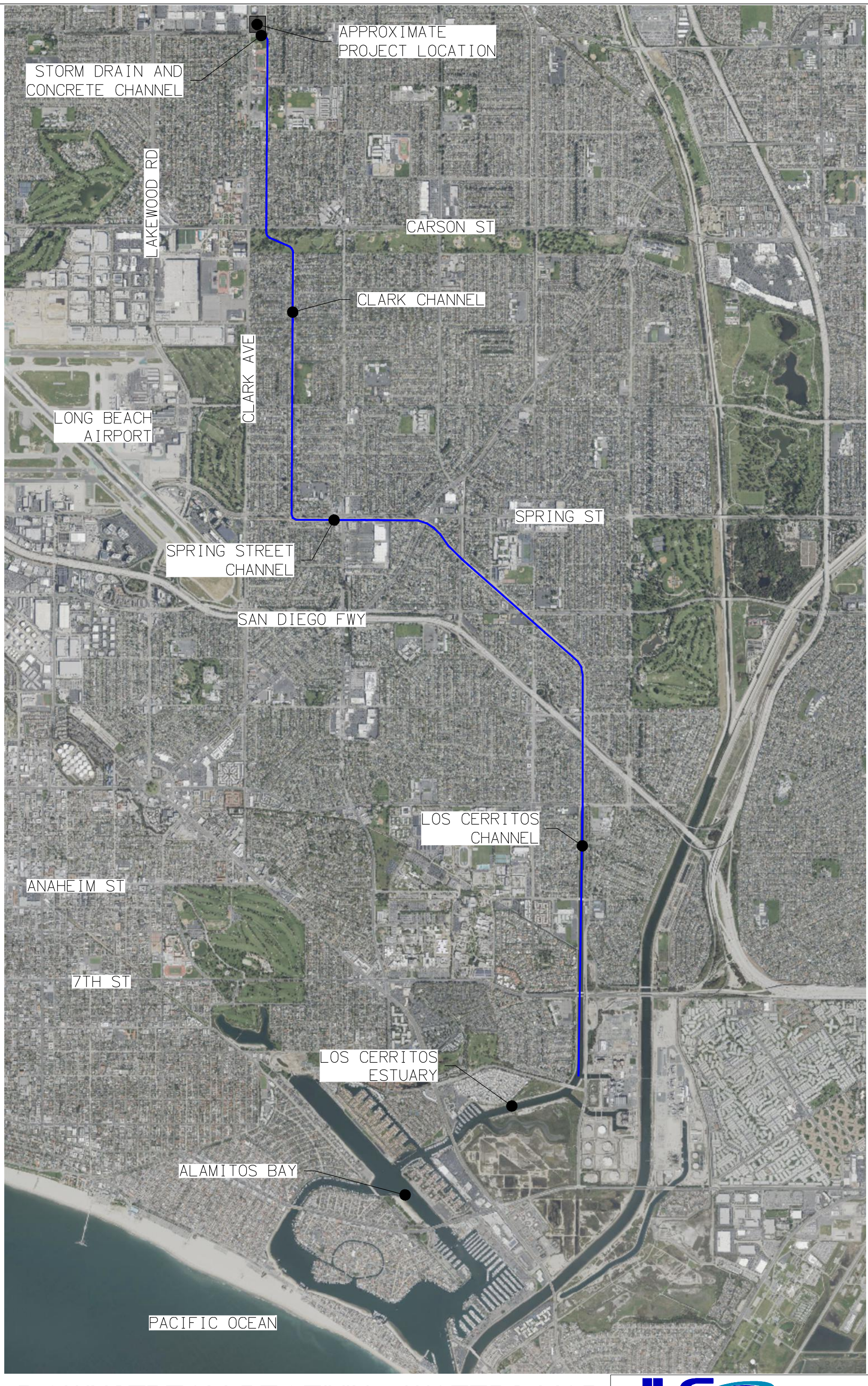
Date Updated: 3/1/2022

LOS ANGELES COUNTY
Department of Regional Planning
320 W. Temple St.
Los Angeles, CA 90012

Miles
0 1 2 4 6 8

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FIGURE 7: DOWNSTREAM RECEIVING WATERS MAP



DOWNSTREAM RECEIVING WATERS MAP

2500 1250 0 2500 5000 7500

SCALE: 1"=2500'

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

FIGURE 7

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Last Opened: Jun 23, 2026 - 11:05am by stanner

APPENDICES

APPENDIX A: PRE-PROJECT HYDROLOGY CALCULATIONS

APPENDIX A.1: PRE-PROJECT AREA 1A RATIONAL METHOD CALCULATIONS

Peak Flow Hydrologic Analysis

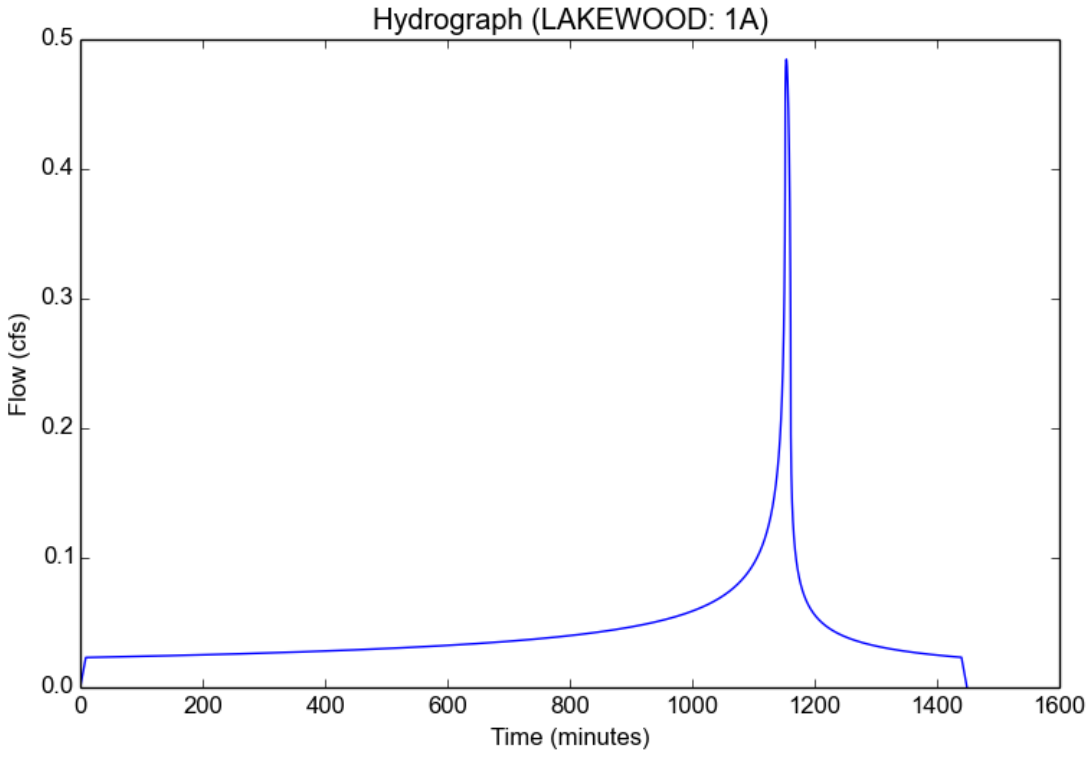
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/PRE_PROJECT/LAKEWOOD - 1A-2YR.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	1A
Area (ac)	0.58
Flow Path Length (ft)	245.0
Flow Path Slope (vft/hft)	0.0121
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.95
Soil Type	6
Design Storm Frequency	2-yr
Fire Factor	0
LID	False

Output Results

Modeled (2-yr) Rainfall Depth (in)	2.0898
Peak Intensity (in/hr)	0.9459
Undeveloped Runoff Coefficient (Cu)	0.5667
Developed Runoff Coefficient (Cd)	0.8833
Time of Concentration (min)	9.0
Clear Peak Flow Rate (cfs)	0.4846
Burned Peak Flow Rate (cfs)	0.4846
24-Hr Clear Runoff Volume (ac-ft)	0.0863
24-Hr Clear Runoff Volume (cu-ft)	3759.8886



Peak Flow Hydrologic Analysis

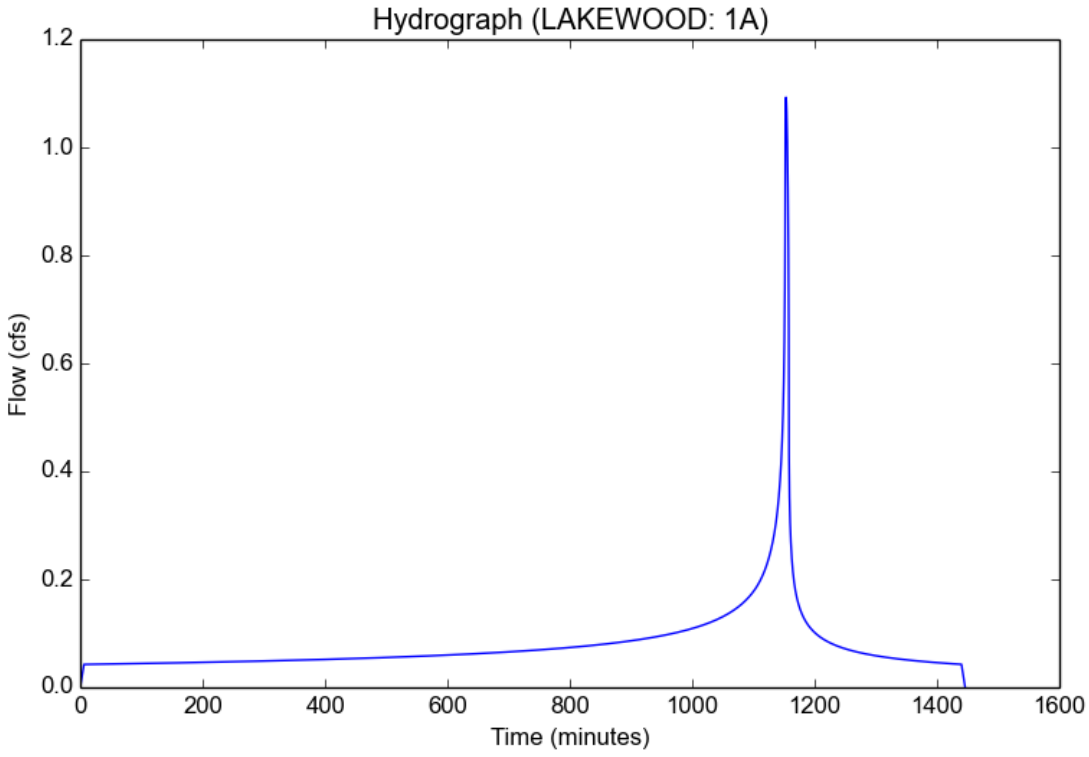
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/PRE_PROJECT/LAKEWOOD - 1A-10YR.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	1A
Area (ac)	0.58
Flow Path Length (ft)	245.0
Flow Path Slope (vft/hft)	0.0121
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.95
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	3.8556
Peak Intensity (in/hr)	2.1114
Undeveloped Runoff Coefficient (Cu)	0.7445
Developed Runoff Coefficient (Cd)	0.8922
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	1.0927
Burned Peak Flow Rate (cfs)	1.0927
24-Hr Clear Runoff Volume (ac-ft)	0.1596
24-Hr Clear Runoff Volume (cu-ft)	6951.3154



Peak Flow Hydrologic Analysis

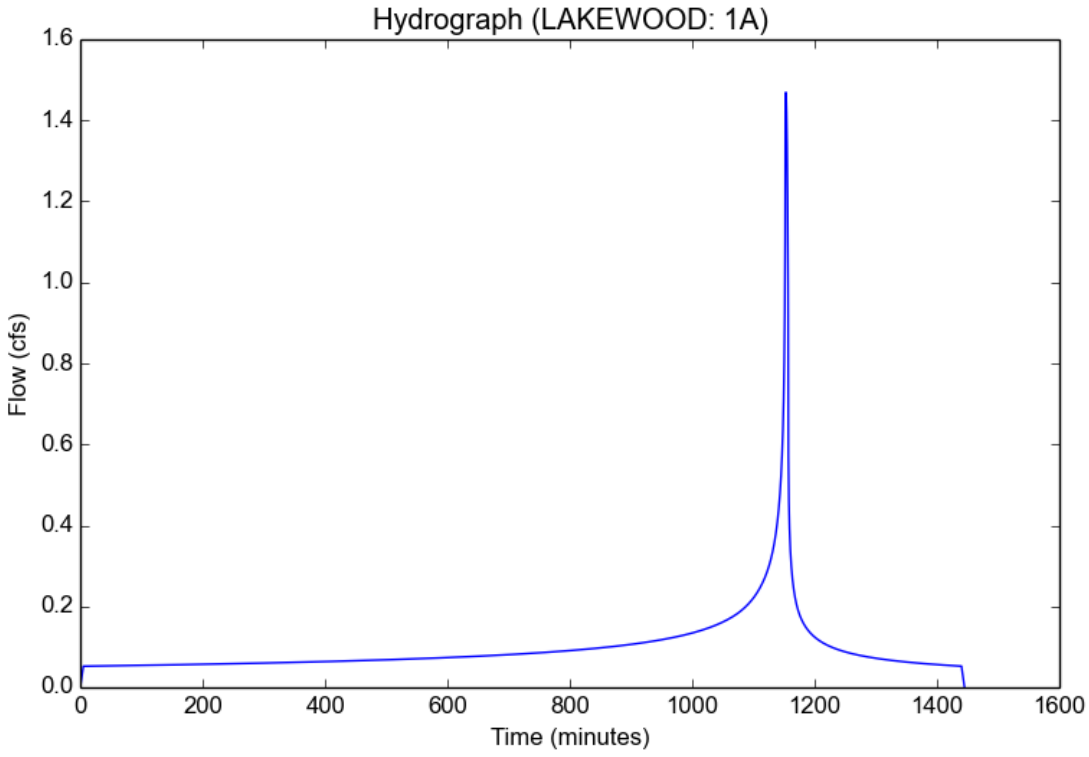
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/PRE_PROJECT/LAKEWOOD - 1A-25YR.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	1A
Area (ac)	0.58
Flow Path Length (ft)	245.0
Flow Path Slope (vft/hft)	0.0121
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.95
Soil Type	6
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.8287
Undeveloped Runoff Coefficient (Cu)	0.8103
Developed Runoff Coefficient (Cd)	0.8955
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.4692
Burned Peak Flow Rate (cfs)	1.4692
24-Hr Clear Runoff Volume (ac-ft)	0.1965
24-Hr Clear Runoff Volume (cu-ft)	8557.5953



Peak Flow Hydrologic Analysis

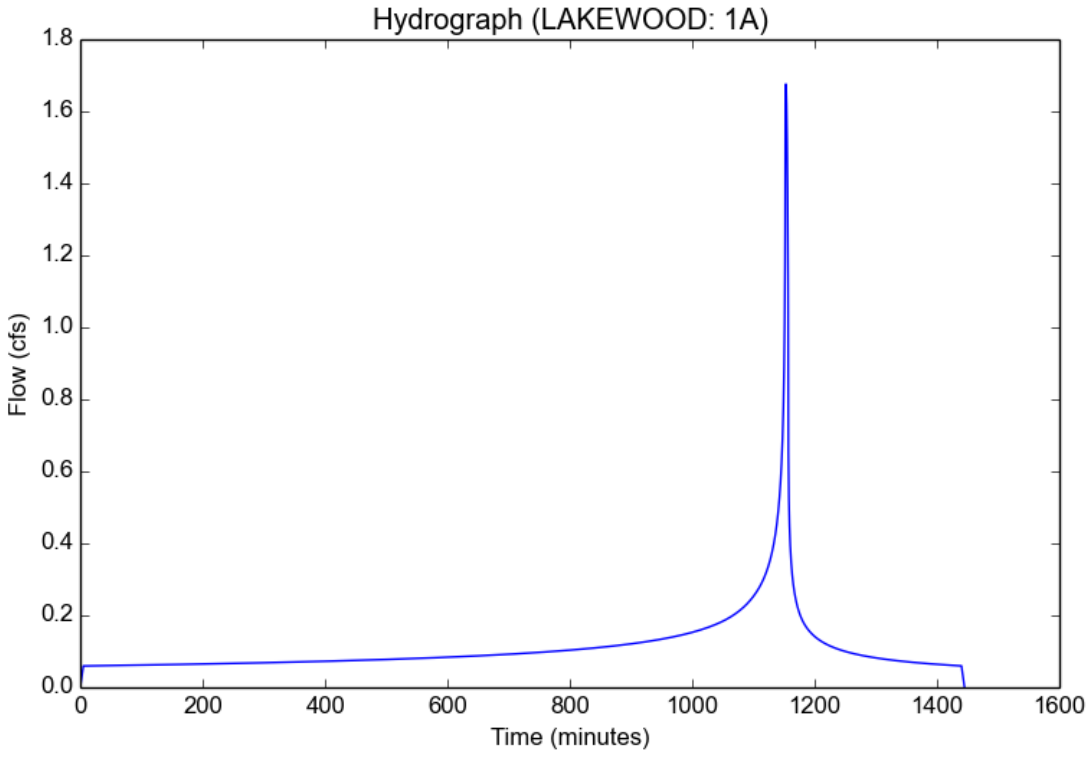
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Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	1A
Area (ac)	0.58
Flow Path Length (ft)	245.0
Flow Path Slope (vft/hft)	0.0121
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.95
Soil Type	6
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.8379
Developed Runoff Coefficient (Cd)	0.8969
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.676
Burned Peak Flow Rate (cfs)	1.676
24-Hr Clear Runoff Volume (ac-ft)	0.2239
24-Hr Clear Runoff Volume (cu-ft)	9754.8539



APPENDIX A.2: PRE-PROJECT AREA 2A RATIONAL METHOD CALCULATIONS

Peak Flow Hydrologic Analysis

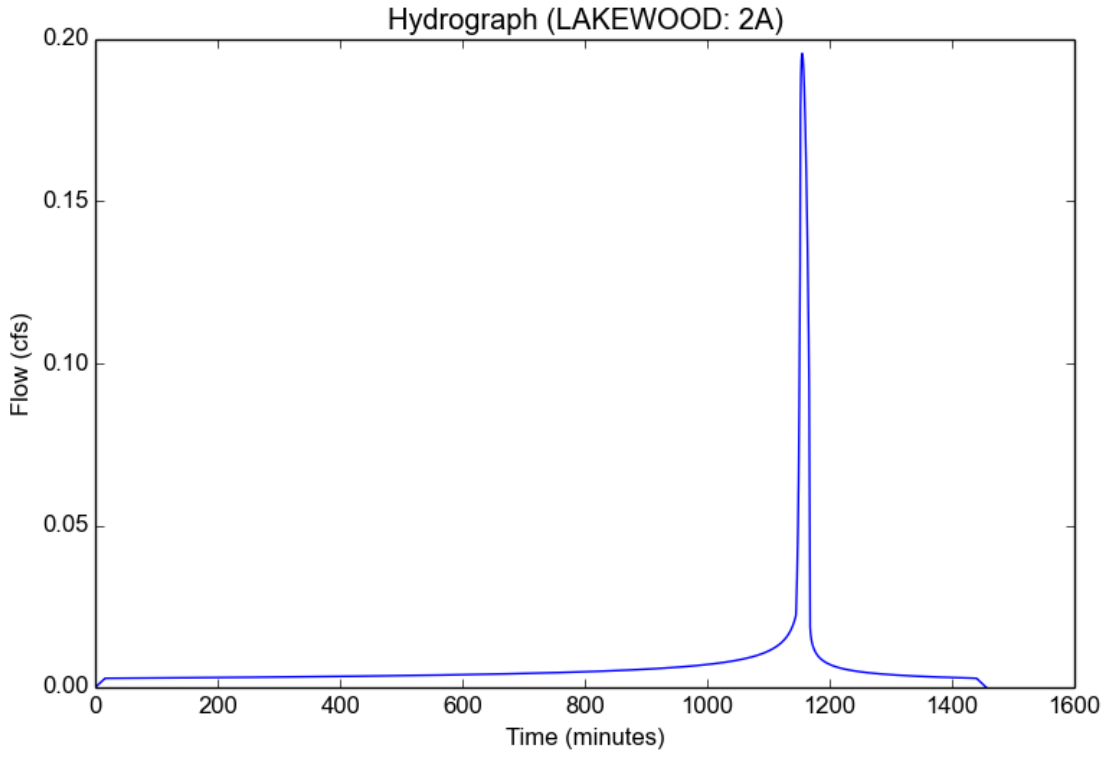
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/PRE_PROJECT/LAKEWOOD - 2A-2YR.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	2A
Area (ac)	0.56
Flow Path Length (ft)	301.0
Flow Path Slope (vft/hft)	0.0088
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	6
Design Storm Frequency	2-yr
Fire Factor	0
LID	False

Output Results

Modeled (2-yr) Rainfall Depth (in)	2.0898
Peak Intensity (in/hr)	0.7218
Undeveloped Runoff Coefficient (Cu)	0.48
Developed Runoff Coefficient (Cd)	0.4842
Time of Concentration (min)	16.0
Clear Peak Flow Rate (cfs)	0.1957
Burned Peak Flow Rate (cfs)	0.1957
24-Hr Clear Runoff Volume (ac-ft)	0.0134
24-Hr Clear Runoff Volume (cu-ft)	582.9969



Peak Flow Hydrologic Analysis

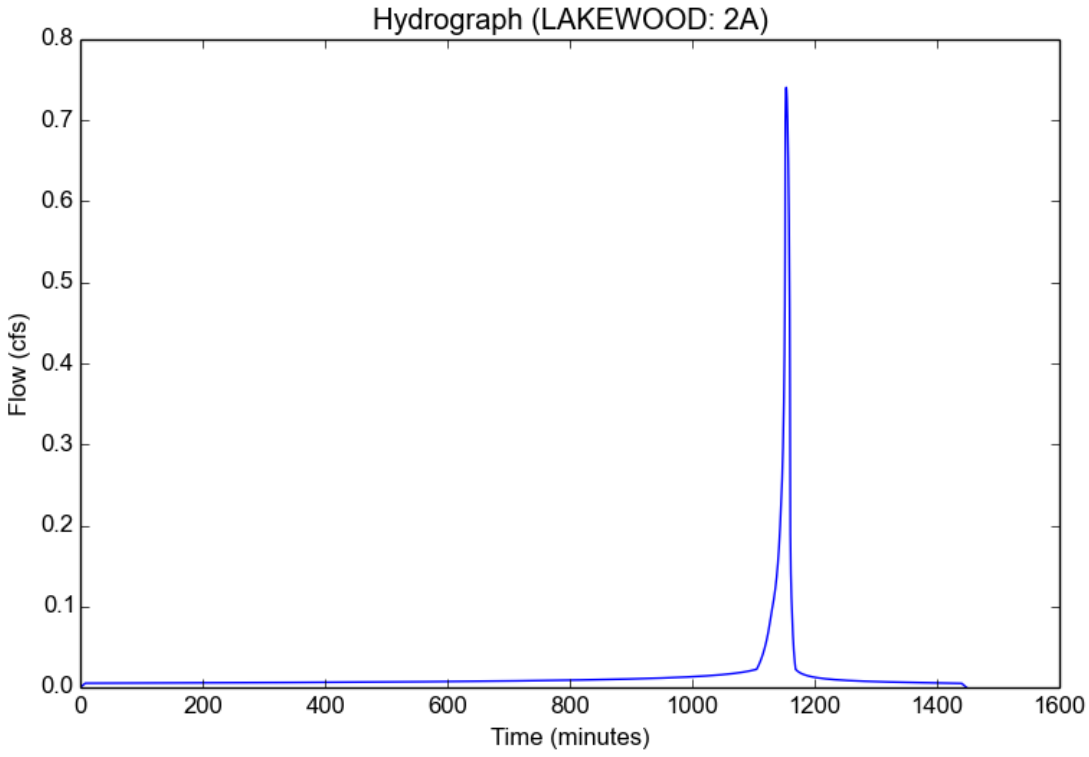
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/PRE_PROJECT/LAKEWOOD - 2A-10YR.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	2A
Area (ac)	0.56
Flow Path Length (ft)	301.0
Flow Path Slope (vft/hft)	0.0088
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	3.8556
Peak Intensity (in/hr)	1.8444
Undeveloped Runoff Coefficient (Cu)	0.7152
Developed Runoff Coefficient (Cd)	0.7171
Time of Concentration (min)	8.0
Clear Peak Flow Rate (cfs)	0.7406
Burned Peak Flow Rate (cfs)	0.7406
24-Hr Clear Runoff Volume (ac-ft)	0.0314
24-Hr Clear Runoff Volume (cu-ft)	1369.5797



Peak Flow Hydrologic Analysis

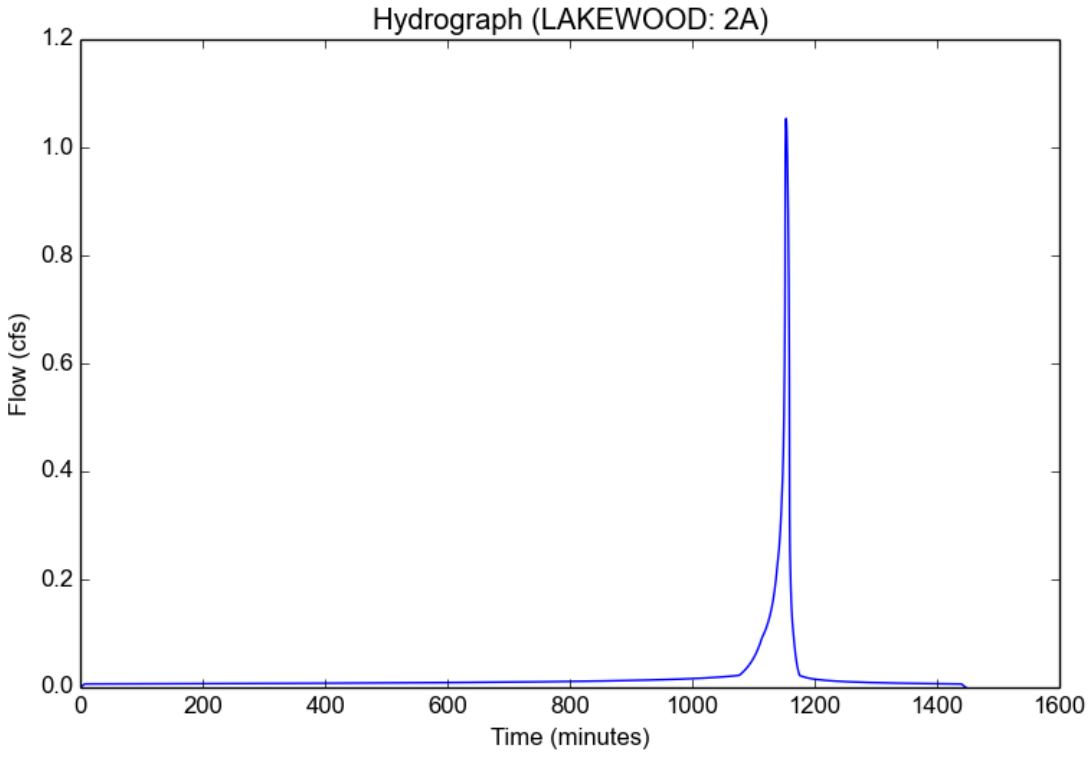
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Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	2A
Area (ac)	0.56
Flow Path Length (ft)	301.0
Flow Path Slope (vft/hft)	0.0088
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	6
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.415
Undeveloped Runoff Coefficient (Cu)	0.7778
Developed Runoff Coefficient (Cd)	0.7791
Time of Concentration (min)	7.0
Clear Peak Flow Rate (cfs)	1.0536
Burned Peak Flow Rate (cfs)	1.0536
24-Hr Clear Runoff Volume (ac-ft)	0.0428
24-Hr Clear Runoff Volume (cu-ft)	1866.0771



Peak Flow Hydrologic Analysis

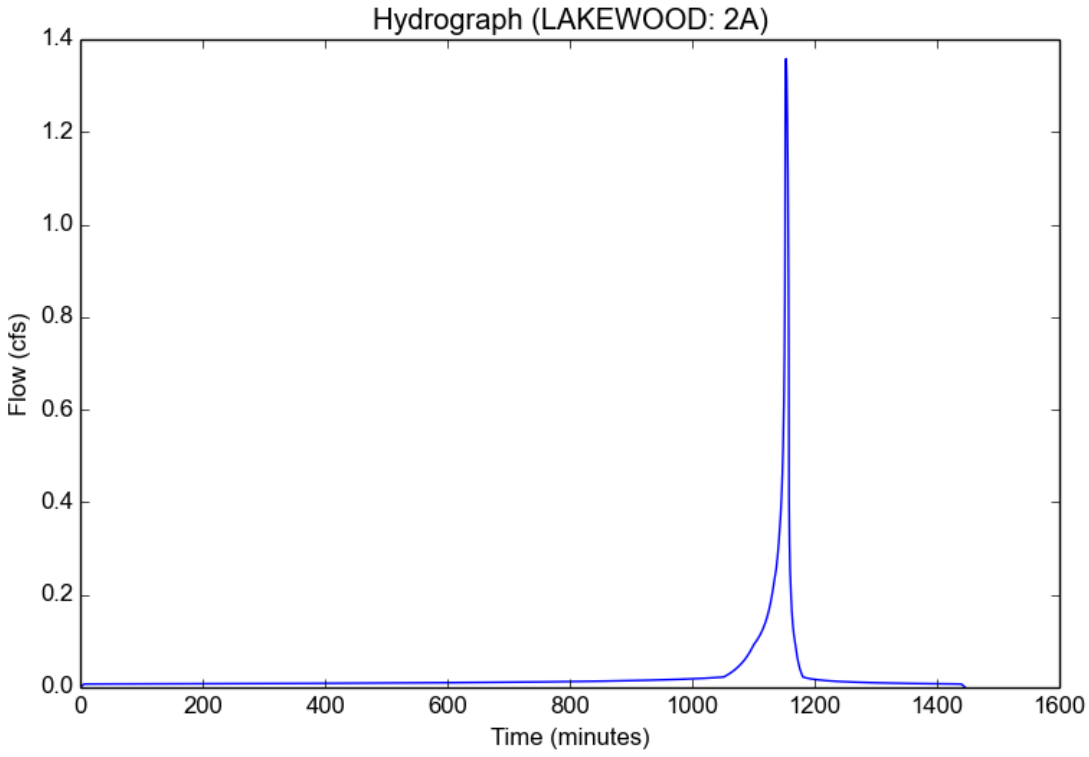
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/PRE_PROJECT/LAKEWOOD - 2A-50YR.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	2A
Area (ac)	0.56
Flow Path Length (ft)	301.0
Flow Path Slope (vft/hft)	0.0088
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	6
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	2.9572
Undeveloped Runoff Coefficient (Cu)	0.8193
Developed Runoff Coefficient (Cd)	0.8201
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	1.3581
Burned Peak Flow Rate (cfs)	1.3581
24-Hr Clear Runoff Volume (ac-ft)	0.0524
24-Hr Clear Runoff Volume (cu-ft)	2284.6404



APPENDIX A.3: PRE-PROJECT AREA 3A RATIONAL METHOD CALCULATIONS

Peak Flow Hydrologic Analysis

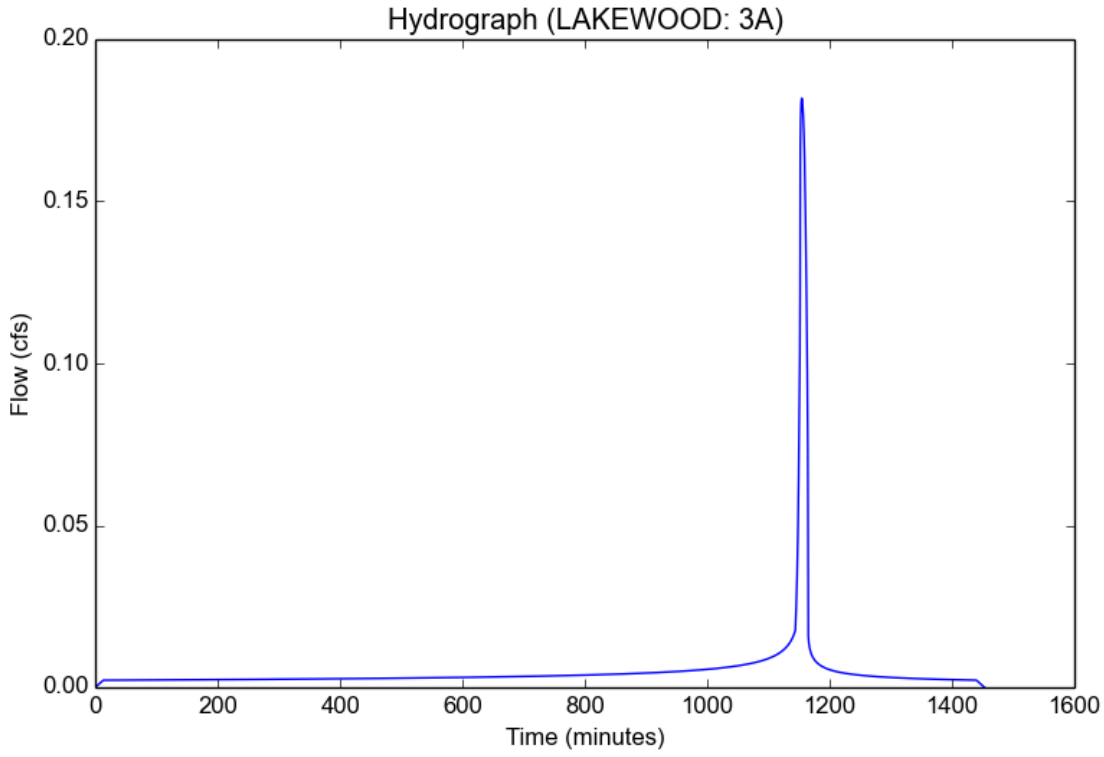
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/PRE_PROJECT/LAKEWOOD - 3A-2YR.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	3A
Area (ac)	0.44
Flow Path Length (ft)	264.0
Flow Path Slope (vft/hft)	0.0121
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	6
Design Storm Frequency	2-yr
Fire Factor	0
LID	False

Output Results

Modeled (2-yr) Rainfall Depth (in)	2.0898
Peak Intensity (in/hr)	0.7957
Undeveloped Runoff Coefficient (Cu)	0.5155
Developed Runoff Coefficient (Cd)	0.5194
Time of Concentration (min)	13.0
Clear Peak Flow Rate (cfs)	0.1818
Burned Peak Flow Rate (cfs)	0.1818
24-Hr Clear Runoff Volume (ac-ft)	0.0106
24-Hr Clear Runoff Volume (cu-ft)	463.1542



Peak Flow Hydrologic Analysis

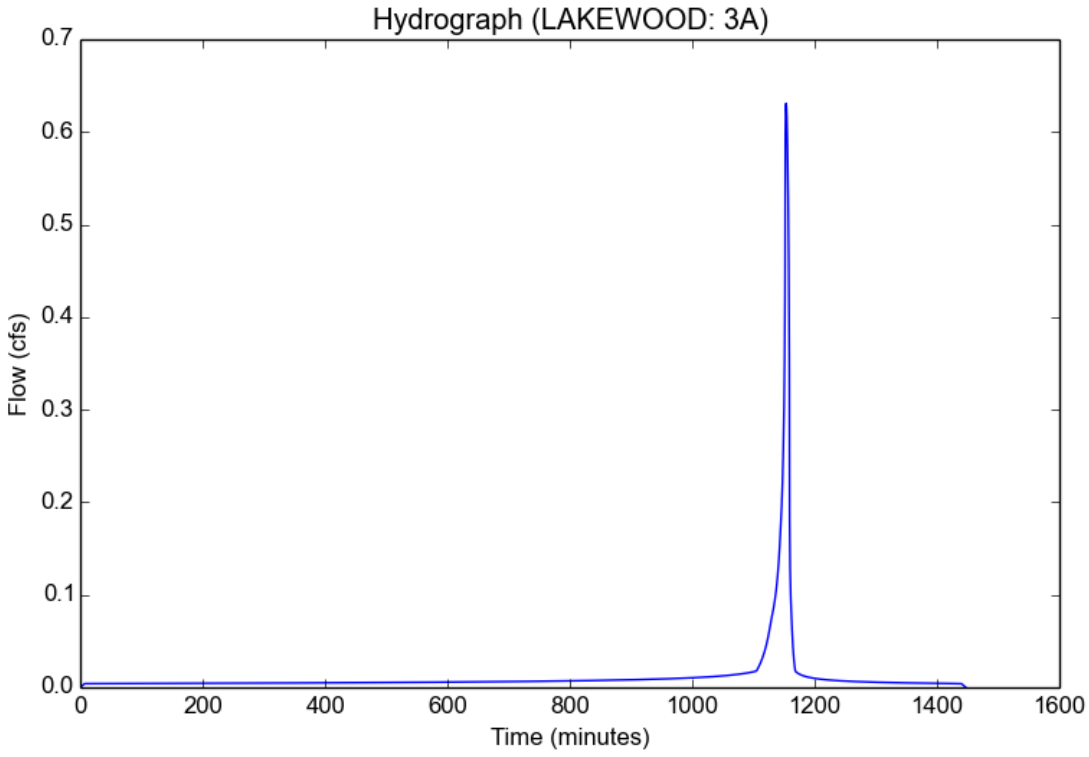
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Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	3A
Area (ac)	0.44
Flow Path Length (ft)	264.0
Flow Path Slope (vft/hft)	0.0121
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	3.8556
Peak Intensity (in/hr)	1.9639
Undeveloped Runoff Coefficient (Cu)	0.7283
Developed Runoff Coefficient (Cd)	0.73
Time of Concentration (min)	7.0
Clear Peak Flow Rate (cfs)	0.6308
Burned Peak Flow Rate (cfs)	0.6308
24-Hr Clear Runoff Volume (ac-ft)	0.0247
24-Hr Clear Runoff Volume (cu-ft)	1077.096



Peak Flow Hydrologic Analysis

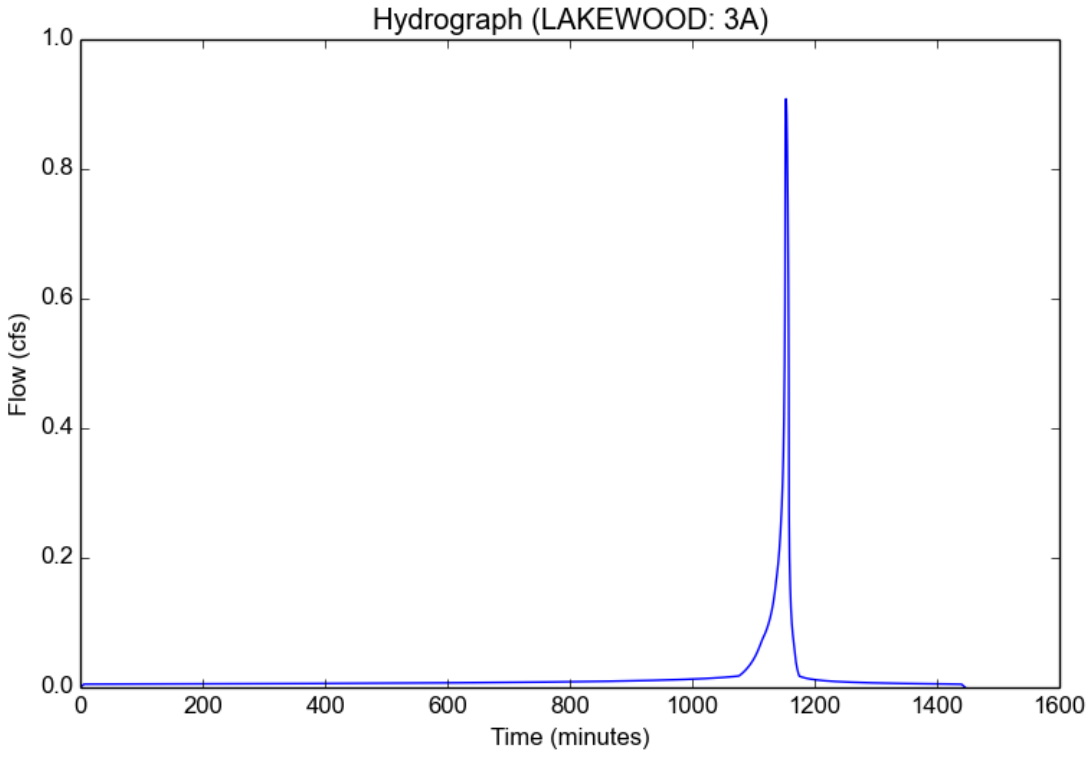
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Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	3A
Area (ac)	0.44
Flow Path Length (ft)	264.0
Flow Path Slope (vft/hft)	0.0121
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	6
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.5964
Undeveloped Runoff Coefficient (Cu)	0.7939
Developed Runoff Coefficient (Cd)	0.795
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	0.9082
Burned Peak Flow Rate (cfs)	0.9082
24-Hr Clear Runoff Volume (ac-ft)	0.0337
24-Hr Clear Runoff Volume (cu-ft)	1468.7217



Peak Flow Hydrologic Analysis

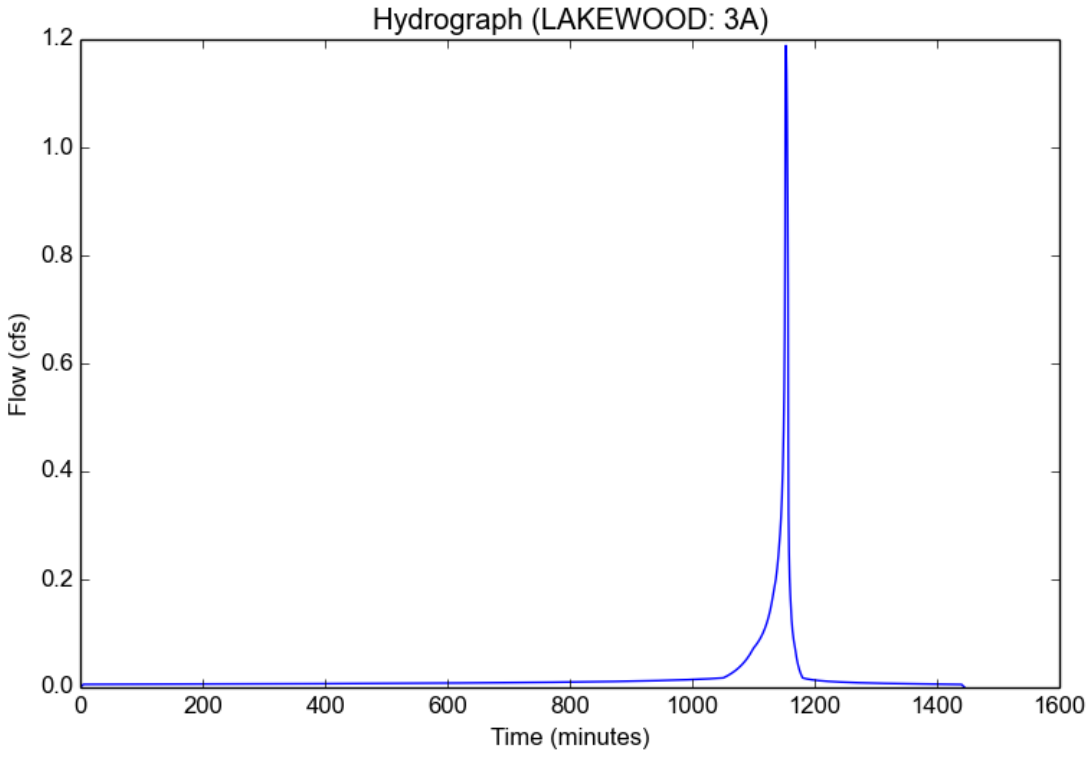
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Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	3A
Area (ac)	0.44
Flow Path Length (ft)	264.0
Flow Path Slope (vft/hft)	0.0121
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	6
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.8379
Developed Runoff Coefficient (Cd)	0.8385
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.1886
Burned Peak Flow Rate (cfs)	1.1886
24-Hr Clear Runoff Volume (ac-ft)	0.0413
24-Hr Clear Runoff Volume (cu-ft)	1797.6762



APPENDIX A.4: PRE-PROJECT AREA 4A RATIONAL METHOD CALCULATIONS

Peak Flow Hydrologic Analysis

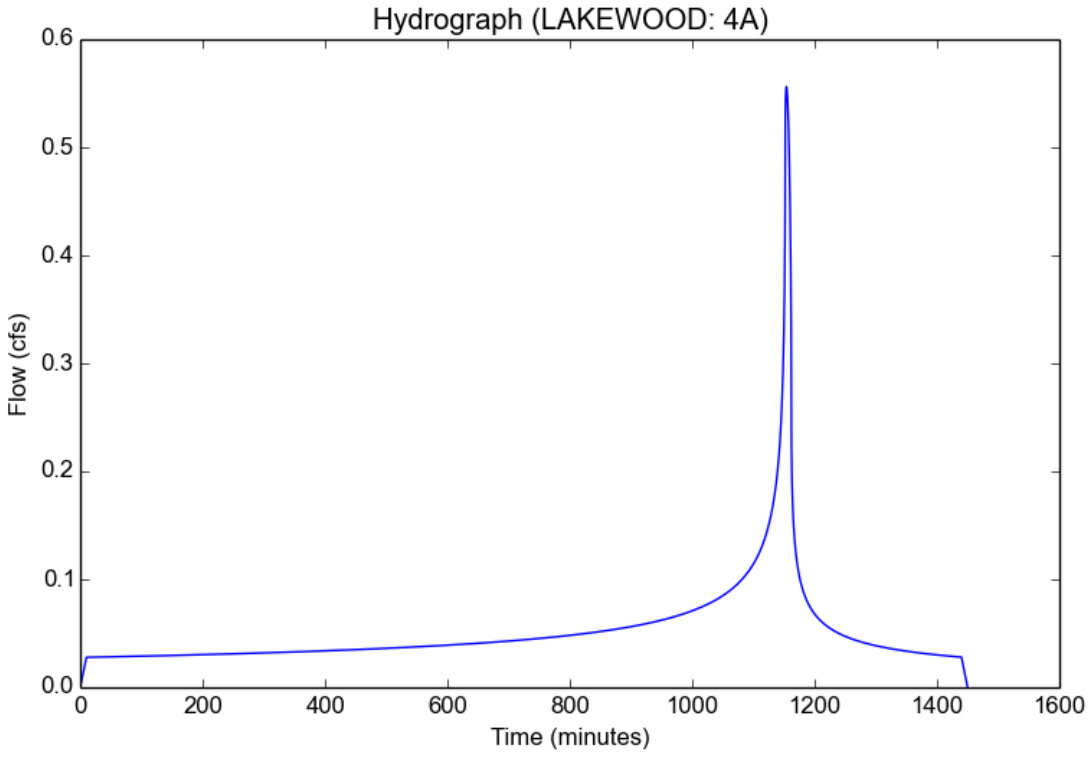
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/PRE_PROJECT/LAKEWOOD - 4A-2YR.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	4A
Area (ac)	0.7
Flow Path Length (ft)	228.0
Flow Path Slope (vft/hft)	0.004
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.95
Soil Type	6
Design Storm Frequency	2-yr
Fire Factor	0
LID	False

Output Results

Modeled (2-yr) Rainfall Depth (in)	2.0898
Peak Intensity (in/hr)	0.9002
Undeveloped Runoff Coefficient (Cu)	0.5511
Developed Runoff Coefficient (Cd)	0.8826
Time of Concentration (min)	10.0
Clear Peak Flow Rate (cfs)	0.5561
Burned Peak Flow Rate (cfs)	0.5561
24-Hr Clear Runoff Volume (ac-ft)	0.1042
24-Hr Clear Runoff Volume (cu-ft)	4537.7265



Peak Flow Hydrologic Analysis

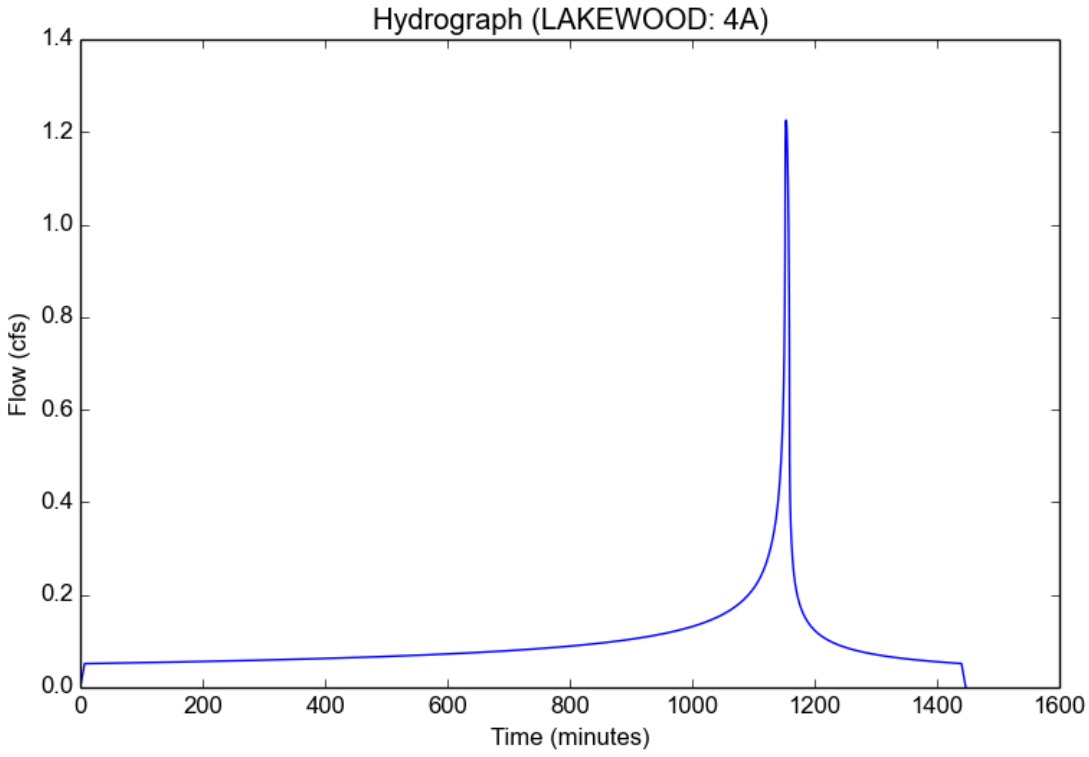
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/PRE_PROJECT/LAKEWOOD - 4A-10YR.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	4A
Area (ac)	0.7
Flow Path Length (ft)	228.0
Flow Path Slope (vft/hft)	0.004
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.95
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	3.8556
Peak Intensity (in/hr)	1.9639
Undeveloped Runoff Coefficient (Cu)	0.7283
Developed Runoff Coefficient (Cd)	0.8914
Time of Concentration (min)	7.0
Clear Peak Flow Rate (cfs)	1.2254
Burned Peak Flow Rate (cfs)	1.2254
24-Hr Clear Runoff Volume (ac-ft)	0.1926
24-Hr Clear Runoff Volume (cu-ft)	8389.408



Peak Flow Hydrologic Analysis

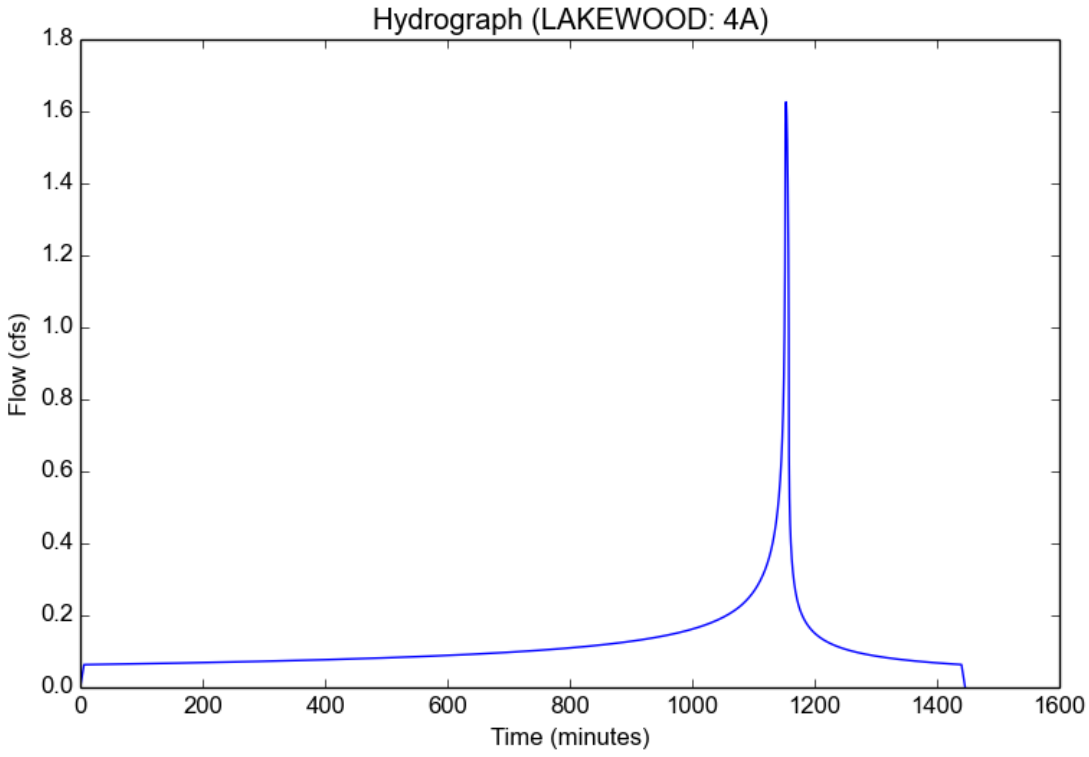
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/PRE_PROJECT/LAKEWOOD - 4A-25YR.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	4A
Area (ac)	0.7
Flow Path Length (ft)	228.0
Flow Path Slope (vft/hft)	0.004
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.95
Soil Type	6
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.5964
Undeveloped Runoff Coefficient (Cu)	0.7939
Developed Runoff Coefficient (Cd)	0.8947
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	1.6261
Burned Peak Flow Rate (cfs)	1.6261
24-Hr Clear Runoff Volume (ac-ft)	0.2371
24-Hr Clear Runoff Volume (cu-ft)	10327.9735



Peak Flow Hydrologic Analysis

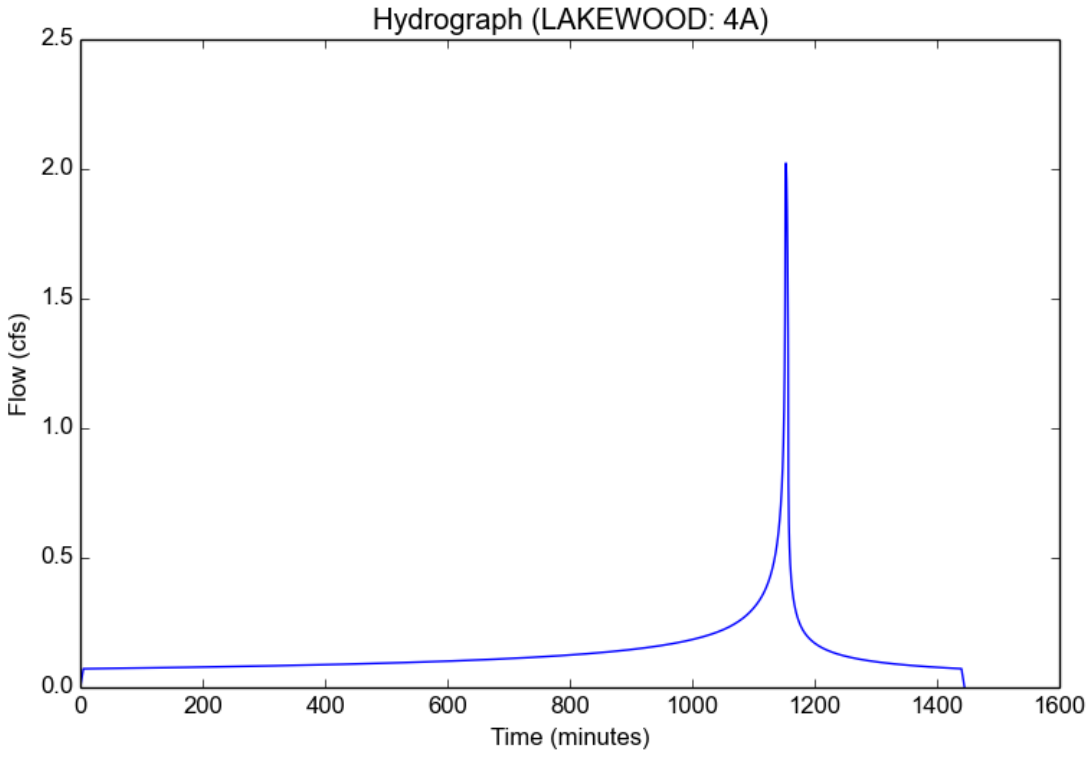
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Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	4A
Area (ac)	0.7
Flow Path Length (ft)	228.0
Flow Path Slope (vft/hft)	0.004
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.95
Soil Type	6
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.8379
Developed Runoff Coefficient (Cd)	0.8969
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	2.0227
Burned Peak Flow Rate (cfs)	2.0227
24-Hr Clear Runoff Volume (ac-ft)	0.2703
24-Hr Clear Runoff Volume (cu-ft)	11773.0996



APPENDIX A.5: PRE-PROJECT AREA 5A RATIONAL METHOD CALCULATIONS

Peak Flow Hydrologic Analysis

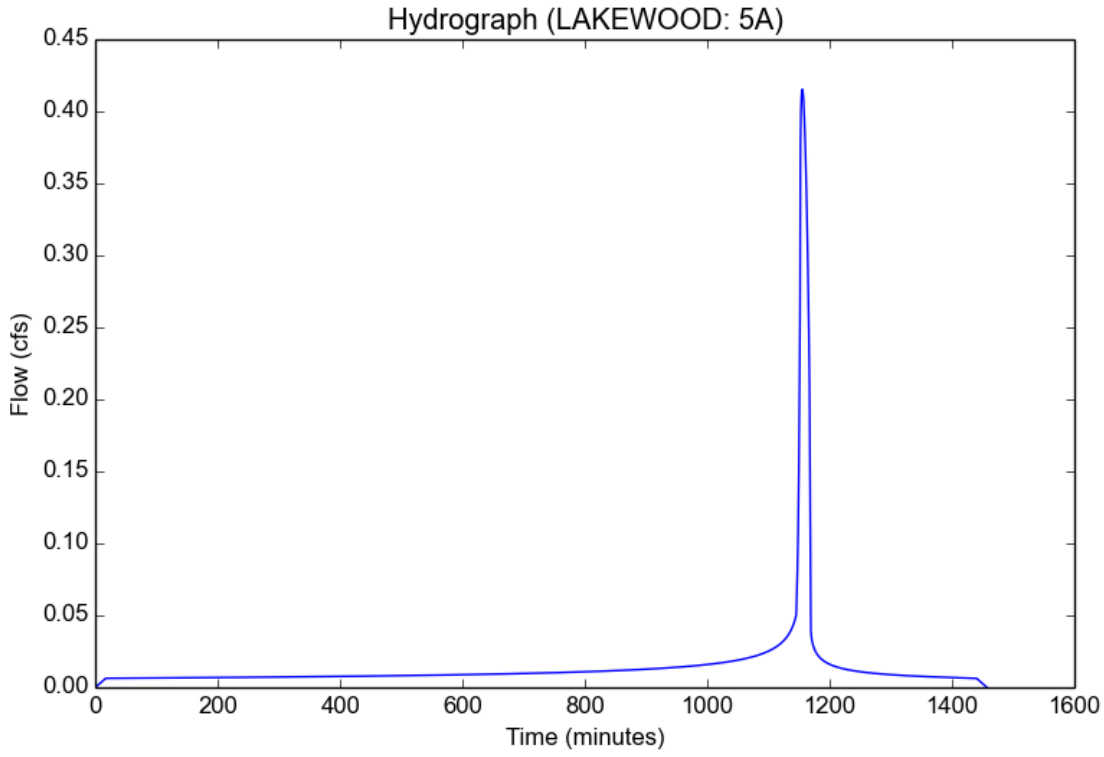
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/PRE_PROJECT/LAKEWOOD - 5A-2YR.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	5A
Area (ac)	1.26
Flow Path Length (ft)	334.0
Flow Path Slope (vft/hft)	0.0096
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	6
Design Storm Frequency	2-yr
Fire Factor	0
LID	False

Output Results

Modeled (2-yr) Rainfall Depth (in)	2.0898
Peak Intensity (in/hr)	0.7015
Undeveloped Runoff Coefficient (Cu)	0.4657
Developed Runoff Coefficient (Cd)	0.47
Time of Concentration (min)	17.0
Clear Peak Flow Rate (cfs)	0.4154
Burned Peak Flow Rate (cfs)	0.4154
24-Hr Clear Runoff Volume (ac-ft)	0.03
24-Hr Clear Runoff Volume (cu-ft)	1305.8803



Peak Flow Hydrologic Analysis

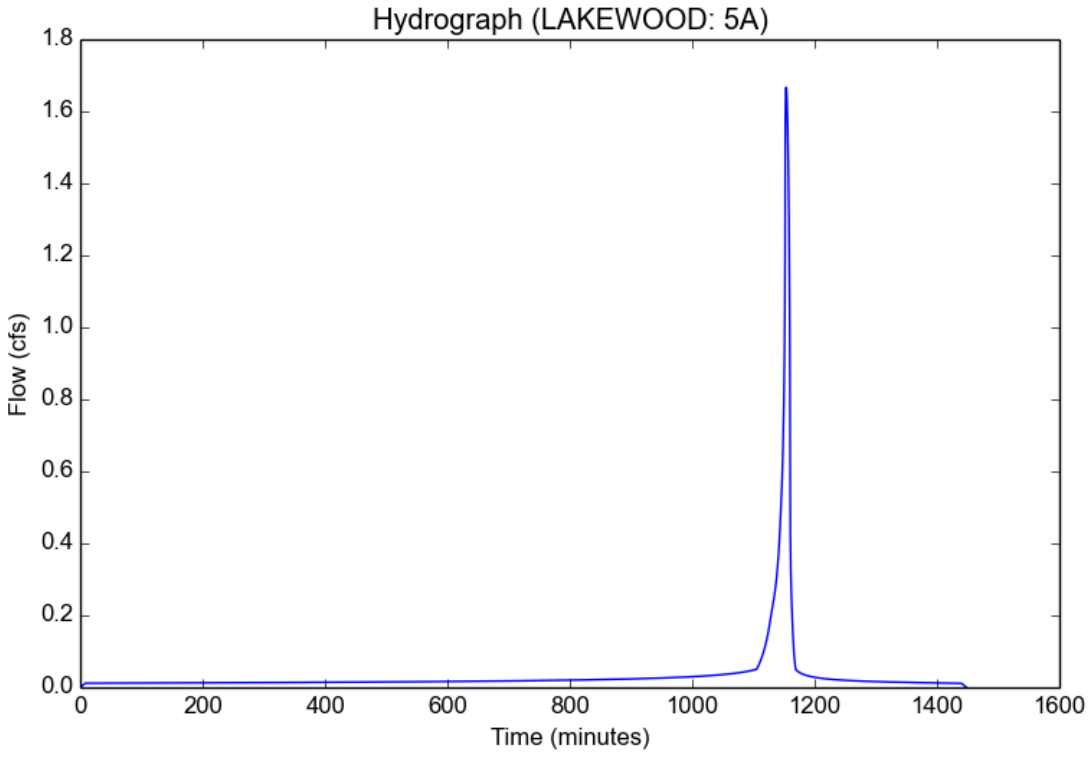
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/PRE_PROJECT/LAKEWOOD - 5A-10YR.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	5A
Area (ac)	1.26
Flow Path Length (ft)	334.0
Flow Path Slope (vft/hft)	0.0096
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	3.8556
Peak Intensity (in/hr)	1.8444
Undeveloped Runoff Coefficient (Cu)	0.7152
Developed Runoff Coefficient (Cd)	0.7171
Time of Concentration (min)	8.0
Clear Peak Flow Rate (cfs)	1.6664
Burned Peak Flow Rate (cfs)	1.6664
24-Hr Clear Runoff Volume (ac-ft)	0.0707
24-Hr Clear Runoff Volume (cu-ft)	3081.5543



Peak Flow Hydrologic Analysis

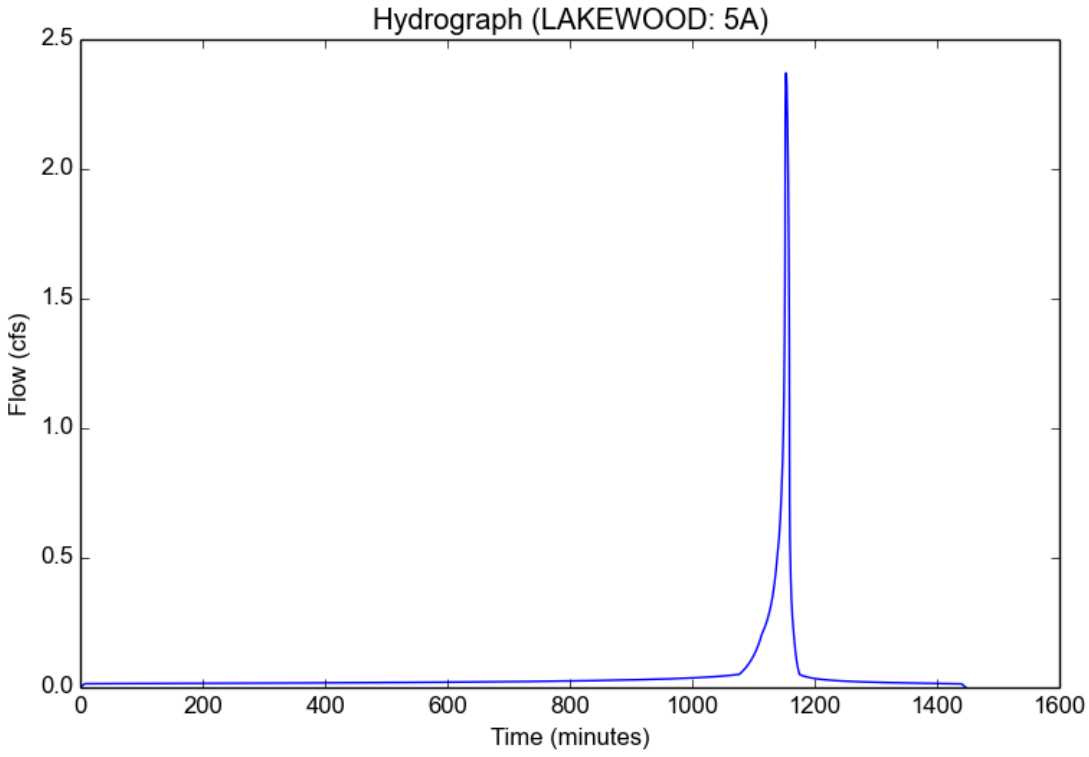
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/PRE_PROJECT/LAKEWOOD - 5A-25YR.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	5A
Area (ac)	1.26
Flow Path Length (ft)	334.0
Flow Path Slope (vft/hft)	0.0096
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	6
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.415
Undeveloped Runoff Coefficient (Cu)	0.7778
Developed Runoff Coefficient (Cd)	0.7791
Time of Concentration (min)	7.0
Clear Peak Flow Rate (cfs)	2.3706
Burned Peak Flow Rate (cfs)	2.3706
24-Hr Clear Runoff Volume (ac-ft)	0.0964
24-Hr Clear Runoff Volume (cu-ft)	4198.6735



Peak Flow Hydrologic Analysis

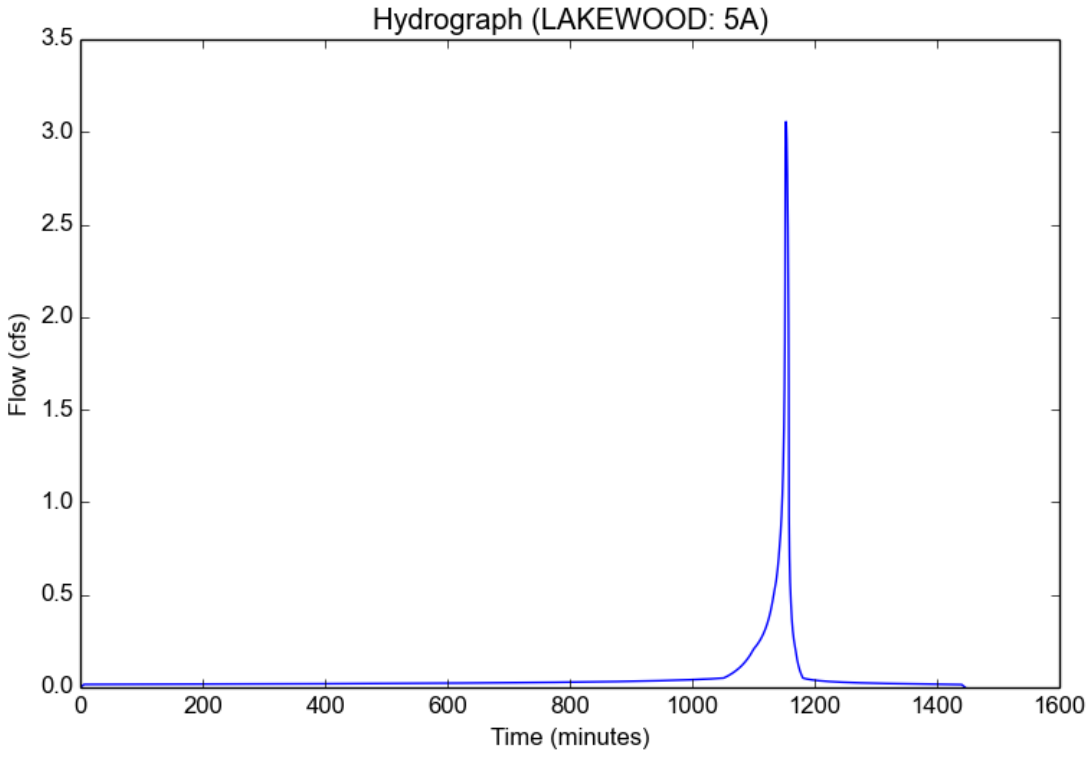
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/PRE_PROJECT/LAKEWOOD - 5A-50YR.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	5A
Area (ac)	1.26
Flow Path Length (ft)	334.0
Flow Path Slope (vft/hft)	0.0096
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	6
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	2.9572
Undeveloped Runoff Coefficient (Cu)	0.8193
Developed Runoff Coefficient (Cd)	0.8201
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	3.0557
Burned Peak Flow Rate (cfs)	3.0557
24-Hr Clear Runoff Volume (ac-ft)	0.118
24-Hr Clear Runoff Volume (cu-ft)	5140.4408



APPENDIX A.6: PRE-PROJECT AREA 6A RATIONAL METHOD CALCULATIONS

Peak Flow Hydrologic Analysis

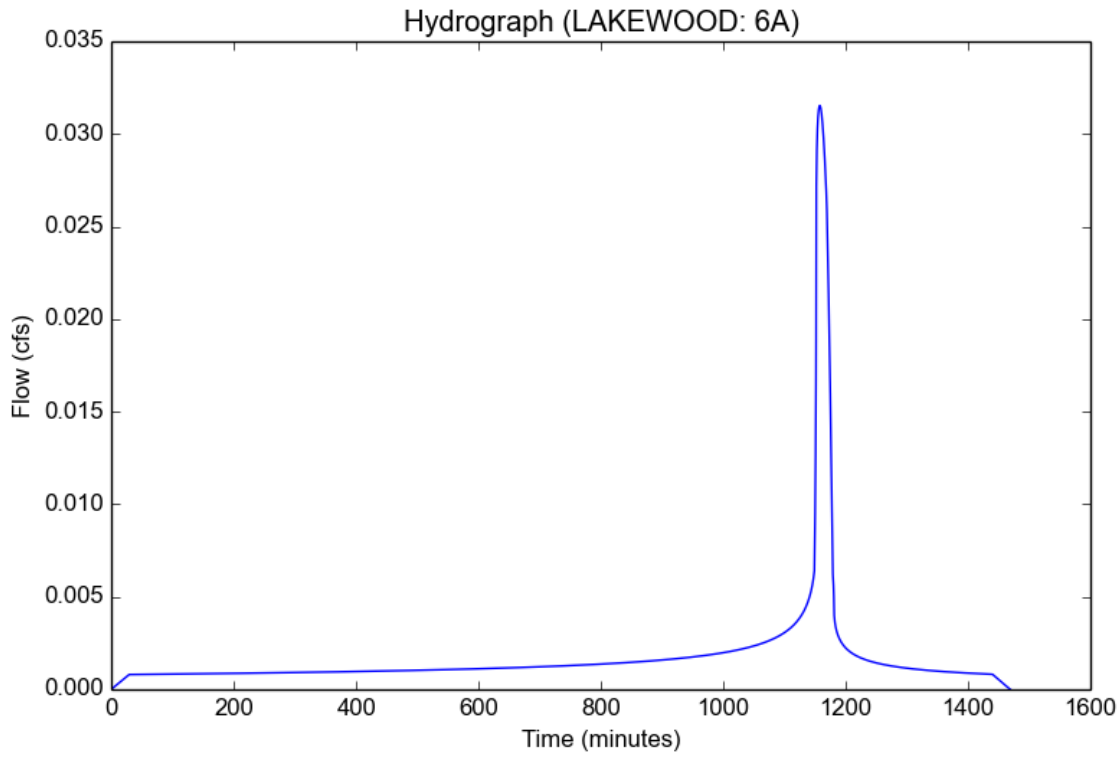
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/PRE_PROJECT/LAKEWOOD - 6A-2YR.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	6A
Area (ac)	0.16
Flow Path Length (ft)	386.0
Flow Path Slope (vft/hft)	0.0024
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	6
Design Storm Frequency	2-yr
Fire Factor	0
LID	False

Output Results

Modeled (2-yr) Rainfall Depth (in)	2.0898
Peak Intensity (in/hr)	0.5458
Undeveloped Runoff Coefficient (Cu)	0.3557
Developed Runoff Coefficient (Cd)	0.3611
Time of Concentration (min)	29.0
Clear Peak Flow Rate (cfs)	0.0315
Burned Peak Flow Rate (cfs)	0.0315
24-Hr Clear Runoff Volume (ac-ft)	0.0036
24-Hr Clear Runoff Volume (cu-ft)	157.7987



Peak Flow Hydrologic Analysis

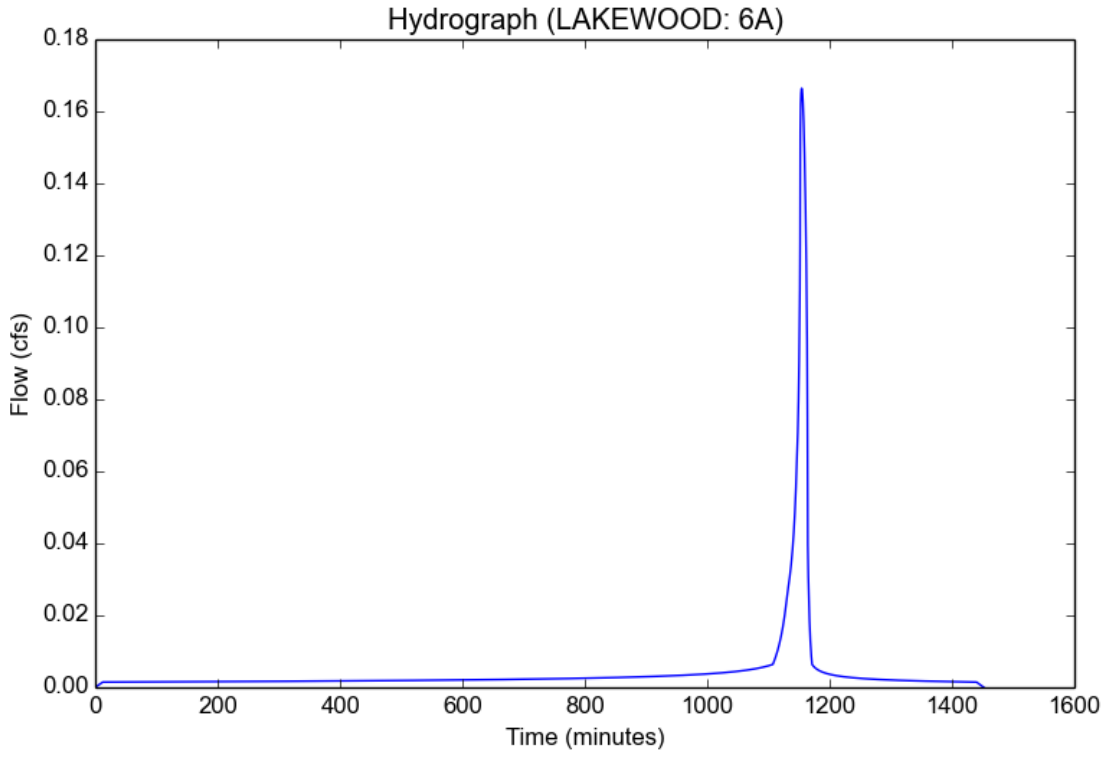
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/PRE_PROJECT/LAKEWOOD - 6A--10YR.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	6A
Area (ac)	0.16
Flow Path Length (ft)	386.0
Flow Path Slope (vft/hft)	0.0024
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	3.8556
Peak Intensity (in/hr)	1.5244
Undeveloped Runoff Coefficient (Cu)	0.6801
Developed Runoff Coefficient (Cd)	0.6823
Time of Concentration (min)	12.0
Clear Peak Flow Rate (cfs)	0.1664
Burned Peak Flow Rate (cfs)	0.1664
24-Hr Clear Runoff Volume (ac-ft)	0.009
24-Hr Clear Runoff Volume (cu-ft)	390.4721



Peak Flow Hydrologic Analysis

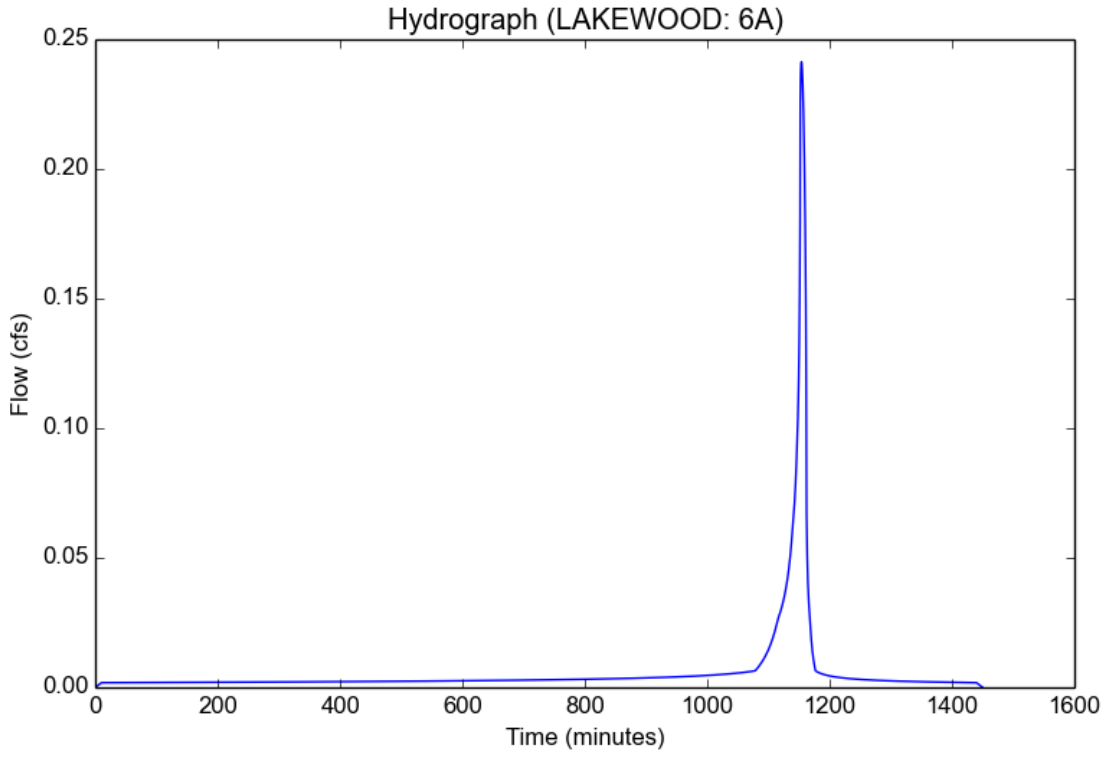
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/PRE_PROJECT/LAKEWOOD - 6A-25YR.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	6A
Area (ac)	0.16
Flow Path Length (ft)	386.0
Flow Path Slope (vft/hft)	0.0024
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	6
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.0422
Undeveloped Runoff Coefficient (Cu)	0.7369
Developed Runoff Coefficient (Cd)	0.7386
Time of Concentration (min)	10.0
Clear Peak Flow Rate (cfs)	0.2413
Burned Peak Flow Rate (cfs)	0.2413
24-Hr Clear Runoff Volume (ac-ft)	0.0122
24-Hr Clear Runoff Volume (cu-ft)	531.0572



Peak Flow Hydrologic Analysis

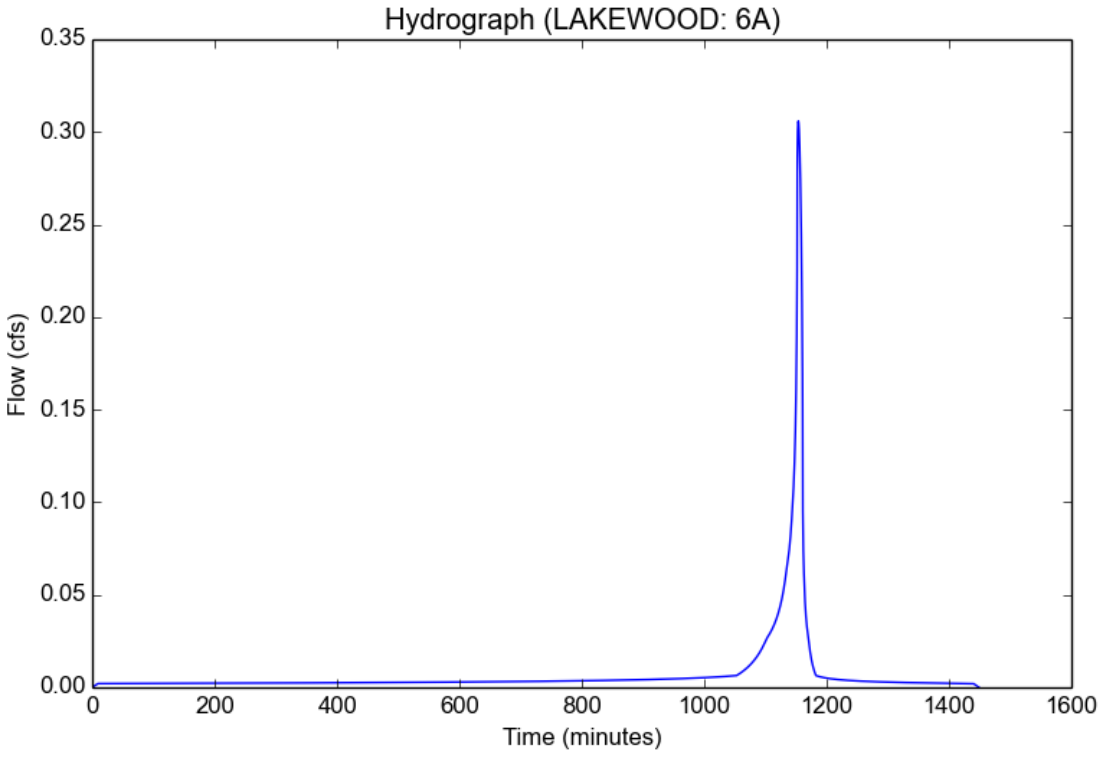
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Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	6A
Area (ac)	0.16
Flow Path Length (ft)	386.0
Flow Path Slope (vft/hft)	0.0024
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	6
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	2.4441
Undeveloped Runoff Coefficient (Cu)	0.781
Developed Runoff Coefficient (Cd)	0.7822
Time of Concentration (min)	9.0
Clear Peak Flow Rate (cfs)	0.3059
Burned Peak Flow Rate (cfs)	0.3059
24-Hr Clear Runoff Volume (ac-ft)	0.0149
24-Hr Clear Runoff Volume (cu-ft)	650.3536



APPENDIX B: POST-PROJECT HYDROLOGY CALCULATIONS

APPENDIX B.1: POST-PROJECT AREA 1A RATIONAL METHOD CALCULATIONS

Peak Flow Hydrologic Analysis

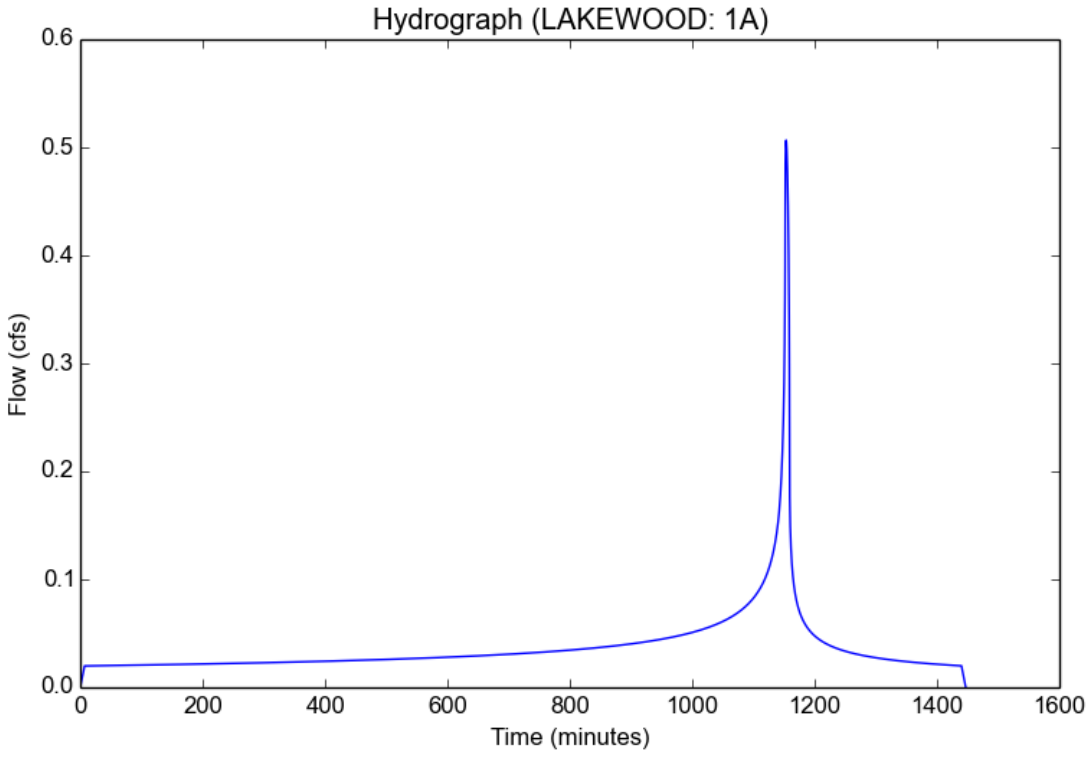
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/POST_PROJECT/LAKEWOOD - 1A-2yr.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	1A
Area (ac)	0.56
Flow Path Length (ft)	165.0
Flow Path Slope (vft/hft)	0.0133
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.835
Soil Type	6
Design Storm Frequency	2-yr
Fire Factor	0
LID	False

Output Results

Modeled (2-yr) Rainfall Depth (in)	2.0898
Peak Intensity (in/hr)	1.0645
Undeveloped Runoff Coefficient (Cu)	0.5971
Developed Runoff Coefficient (Cd)	0.85
Time of Concentration (min)	7.0
Clear Peak Flow Rate (cfs)	0.5067
Burned Peak Flow Rate (cfs)	0.5067
24-Hr Clear Runoff Volume (ac-ft)	0.0748
24-Hr Clear Runoff Volume (cu-ft)	3259.1098



Peak Flow Hydrologic Analysis

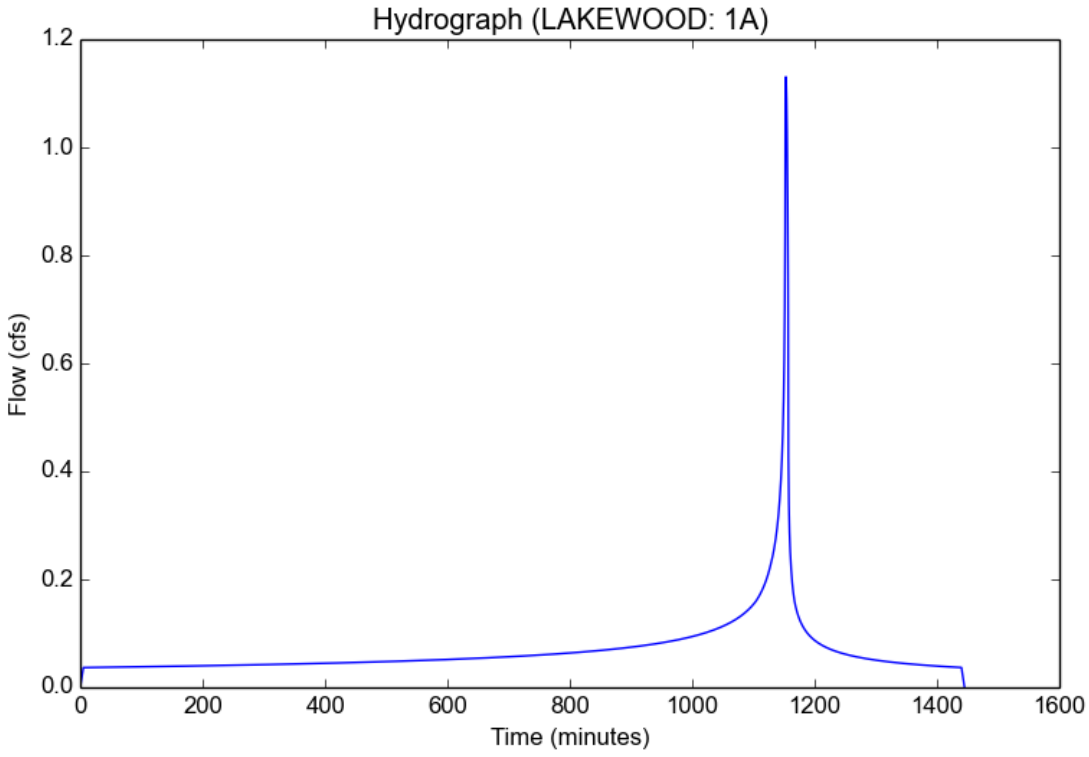
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Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	1A
Area (ac)	0.56
Flow Path Length (ft)	165.0
Flow Path Slope (vft/hft)	0.0133
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.835
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	3.8556
Peak Intensity (in/hr)	2.3004
Undeveloped Runoff Coefficient (Cu)	0.7653
Developed Runoff Coefficient (Cd)	0.8778
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.1307
Burned Peak Flow Rate (cfs)	1.1307
24-Hr Clear Runoff Volume (ac-ft)	0.1391
24-Hr Clear Runoff Volume (cu-ft)	6058.8344



Peak Flow Hydrologic Analysis

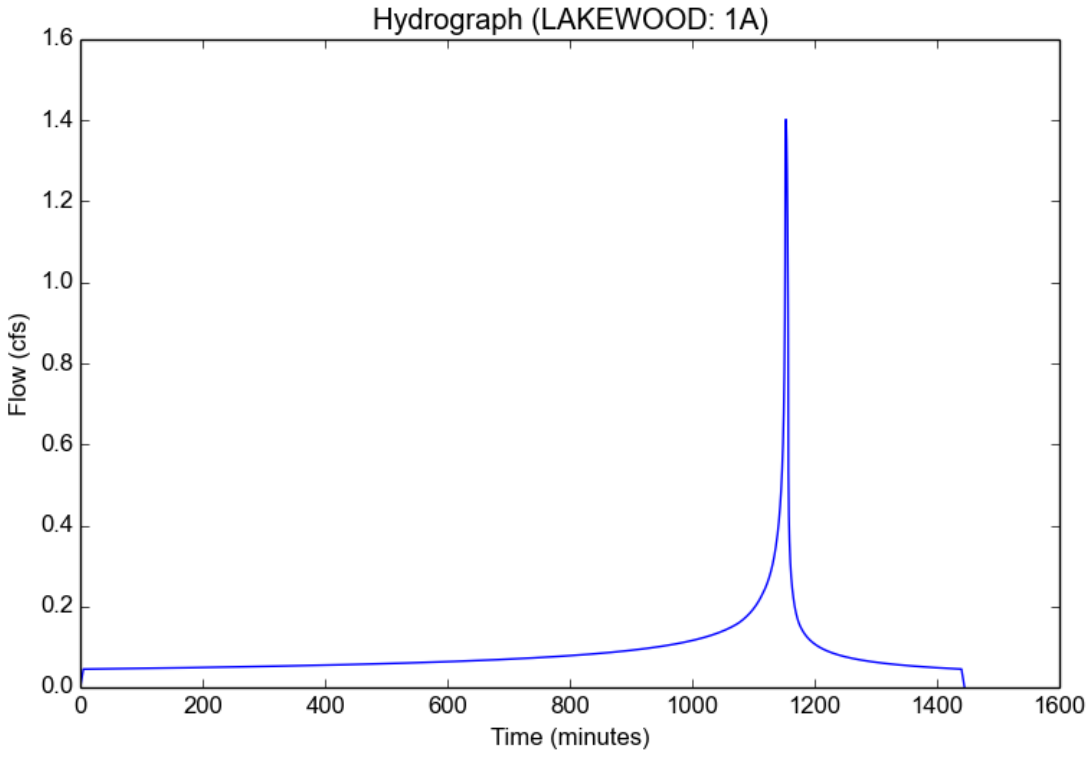
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Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	1A
Area (ac)	0.56
Flow Path Length (ft)	165.0
Flow Path Slope (vft/hft)	0.0133
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.835
Soil Type	6
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.8287
Undeveloped Runoff Coefficient (Cu)	0.8103
Developed Runoff Coefficient (Cd)	0.8852
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.4022
Burned Peak Flow Rate (cfs)	1.4022
24-Hr Clear Runoff Volume (ac-ft)	0.1717
24-Hr Clear Runoff Volume (cu-ft)	7480.6666



Peak Flow Hydrologic Analysis

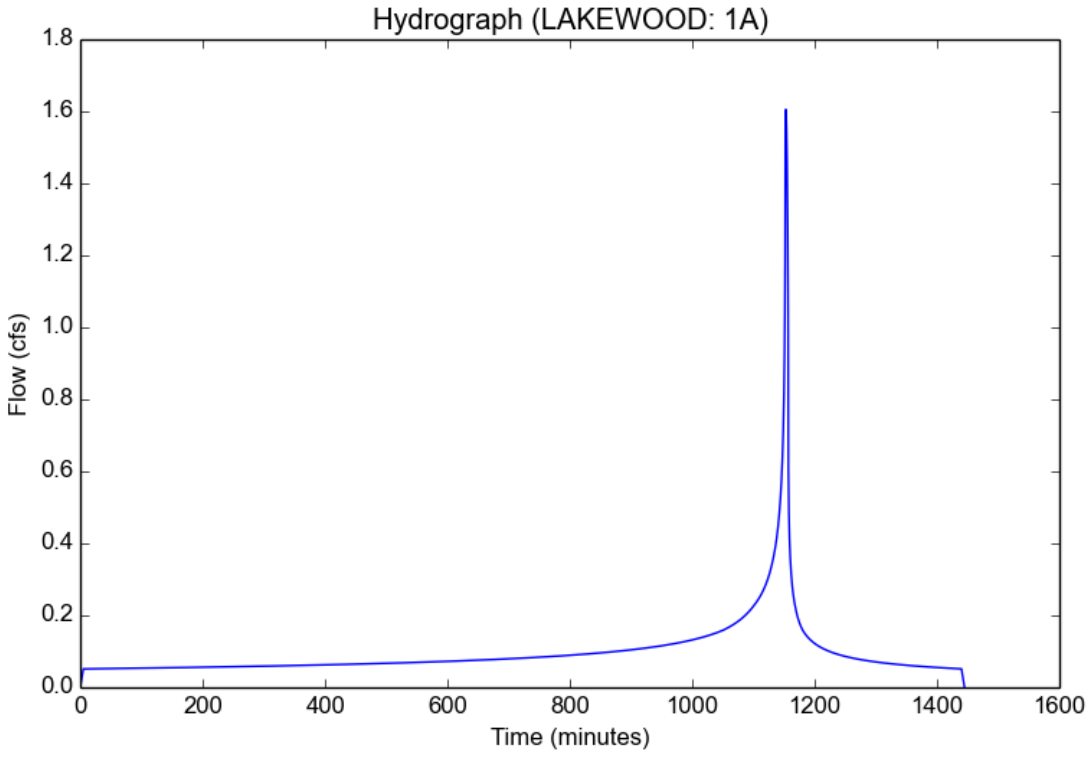
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/POST_PROJECT/LAKEWOOD - 1A-50yr.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	1A
Area (ac)	0.56
Flow Path Length (ft)	165.0
Flow Path Slope (vft/hft)	0.0133
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.835
Soil Type	6
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.8379
Developed Runoff Coefficient (Cd)	0.8897
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.6053
Burned Peak Flow Rate (cfs)	1.6053
24-Hr Clear Runoff Volume (ac-ft)	0.1962
24-Hr Clear Runoff Volume (cu-ft)	8546.1278



APPENDIX B.2: POST-PROJECT AREA 2A RATIONAL METHOD CALCULATIONS

Peak Flow Hydrologic Analysis

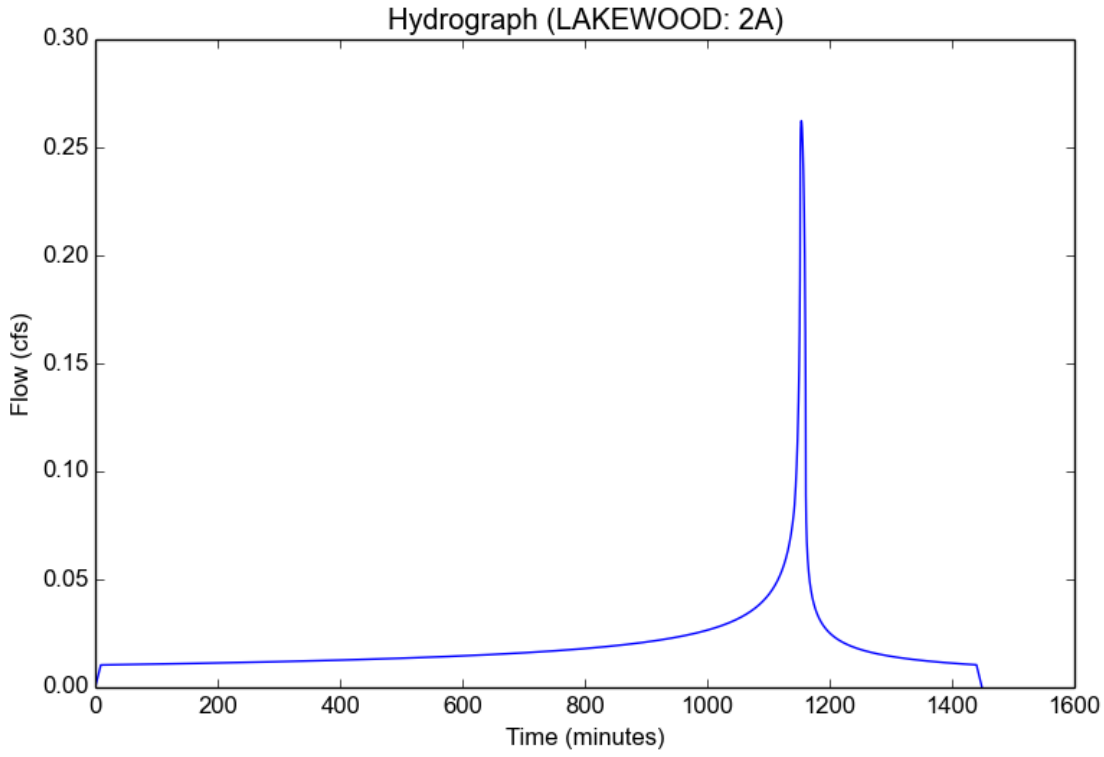
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Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	2A
Area (ac)	0.35
Flow Path Length (ft)	235.0
Flow Path Slope (vft/hft)	0.0123
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.677
Soil Type	6
Design Storm Frequency	2-yr
Fire Factor	0
LID	False

Output Results

Modeled (2-yr) Rainfall Depth (in)	2.0898
Peak Intensity (in/hr)	0.9459
Undeveloped Runoff Coefficient (Cu)	0.5667
Developed Runoff Coefficient (Cd)	0.7924
Time of Concentration (min)	9.0
Clear Peak Flow Rate (cfs)	0.2623
Burned Peak Flow Rate (cfs)	0.2623
24-Hr Clear Runoff Volume (ac-ft)	0.0394
24-Hr Clear Runoff Volume (cu-ft)	1717.7807



Peak Flow Hydrologic Analysis

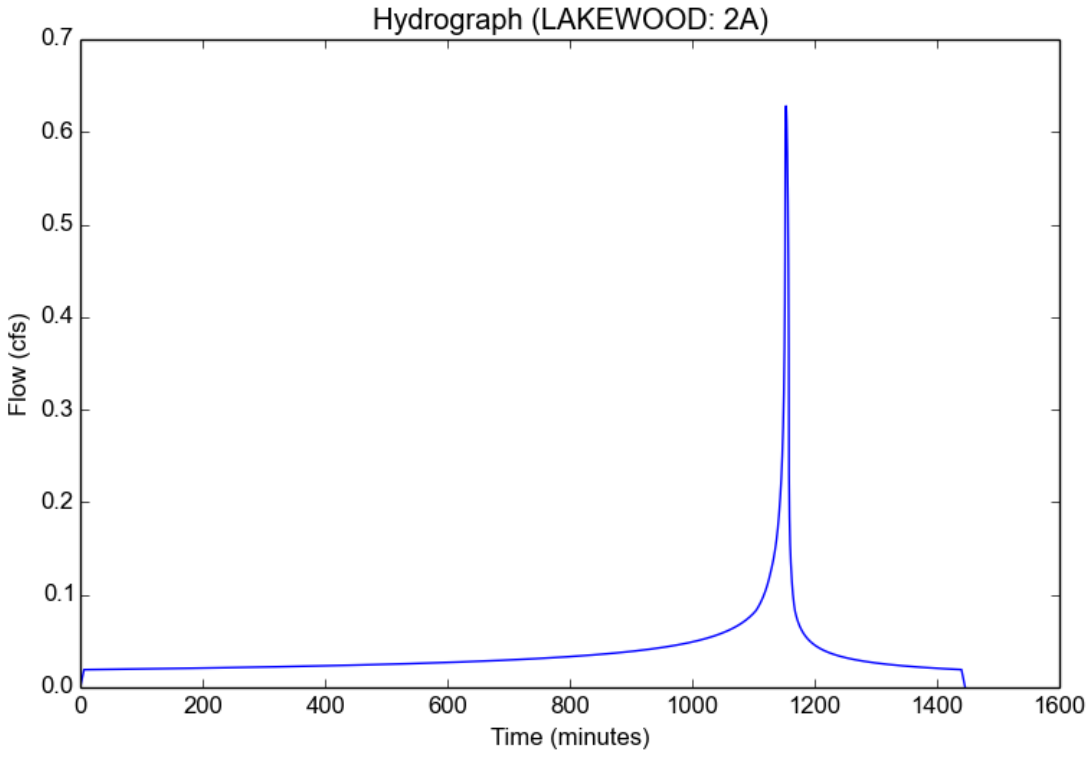
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/POST_PROJECT/LAKEWOOD - 2A-10yr.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	2A
Area (ac)	0.35
Flow Path Length (ft)	235.0
Flow Path Slope (vft/hft)	0.0123
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.677
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	3.8556
Peak Intensity (in/hr)	2.1114
Undeveloped Runoff Coefficient (Cu)	0.7445
Developed Runoff Coefficient (Cd)	0.8498
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	0.628
Burned Peak Flow Rate (cfs)	0.628
24-Hr Clear Runoff Volume (ac-ft)	0.0741
24-Hr Clear Runoff Volume (cu-ft)	3225.6469



Peak Flow Hydrologic Analysis

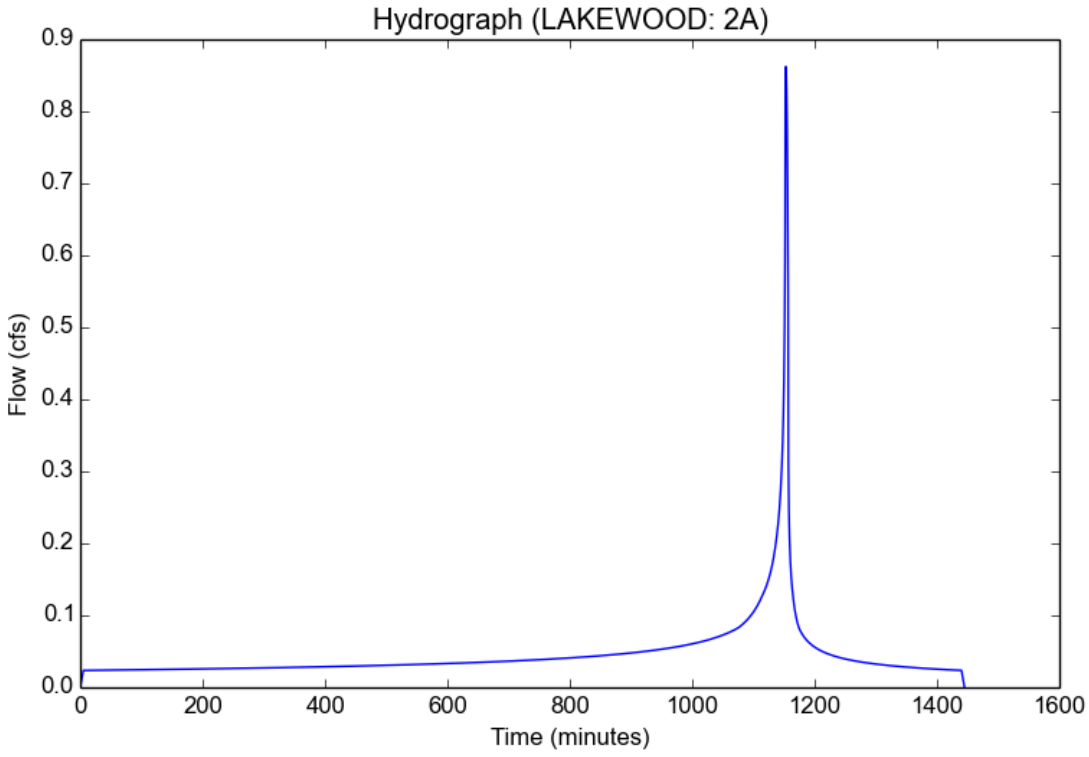
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/POST_PROJECT/LAKEWOOD - 2A-25yr.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	2A
Area (ac)	0.35
Flow Path Length (ft)	235.0
Flow Path Slope (vft/hft)	0.0123
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.677
Soil Type	6
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.8287
Undeveloped Runoff Coefficient (Cu)	0.8103
Developed Runoff Coefficient (Cd)	0.871
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.8623
Burned Peak Flow Rate (cfs)	0.8623
24-Hr Clear Runoff Volume (ac-ft)	0.0919
24-Hr Clear Runoff Volume (cu-ft)	4004.0546



Peak Flow Hydrologic Analysis

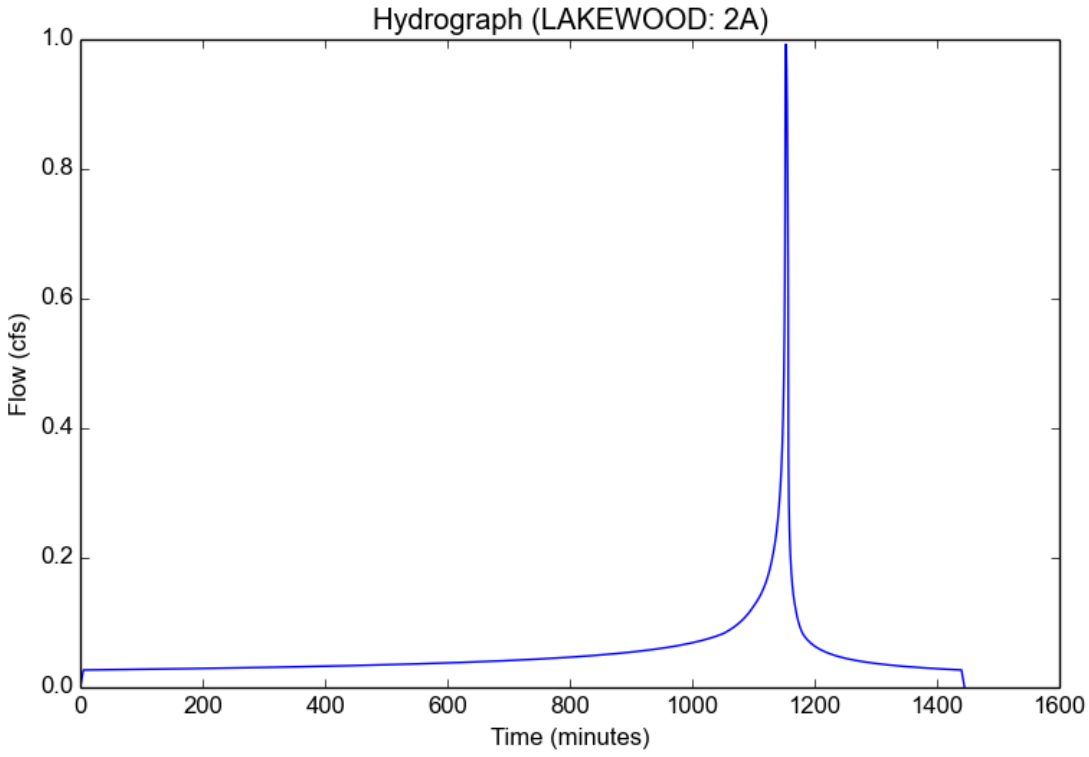
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Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	2A
Area (ac)	0.35
Flow Path Length (ft)	235.0
Flow Path Slope (vft/hft)	0.0123
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.677
Soil Type	6
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.8379
Developed Runoff Coefficient (Cd)	0.8799
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.9922
Burned Peak Flow Rate (cfs)	0.9922
24-Hr Clear Runoff Volume (ac-ft)	0.1054
24-Hr Clear Runoff Volume (cu-ft)	4592.2451



APPENDIX B.3: POST-PROJECT AREA 3A RATIONAL METHOD CALCULATIONS

Peak Flow Hydrologic Analysis

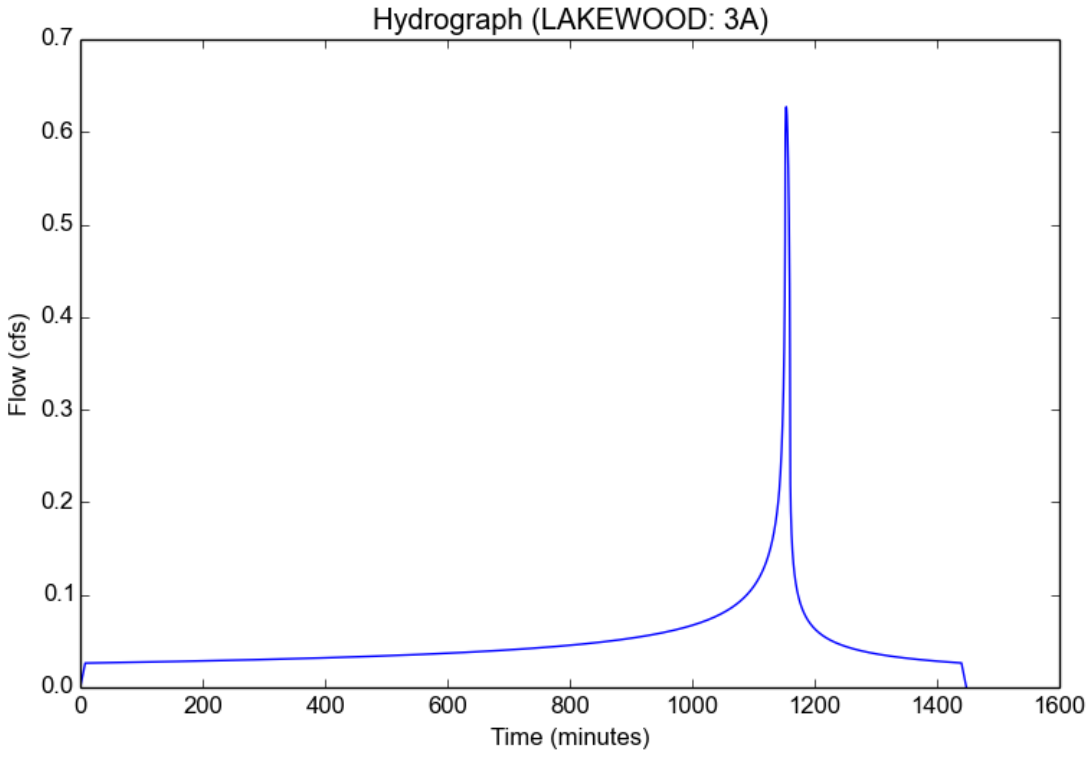
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/POST_PROJECT/LAKEWOOD - 3A-2yr.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	3A
Area (ac)	0.74
Flow Path Length (ft)	274.0
Flow Path Slope (vft/hft)	0.0259
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.834
Soil Type	6
Design Storm Frequency	2-yr
Fire Factor	0
LID	False

Output Results

Modeled (2-yr) Rainfall Depth (in)	2.0898
Peak Intensity (in/hr)	0.9997
Undeveloped Runoff Coefficient (Cu)	0.5851
Developed Runoff Coefficient (Cd)	0.8477
Time of Concentration (min)	8.0
Clear Peak Flow Rate (cfs)	0.6271
Burned Peak Flow Rate (cfs)	0.6271
24-Hr Clear Runoff Volume (ac-ft)	0.0988
24-Hr Clear Runoff Volume (cu-ft)	4302.2686



Peak Flow Hydrologic Analysis

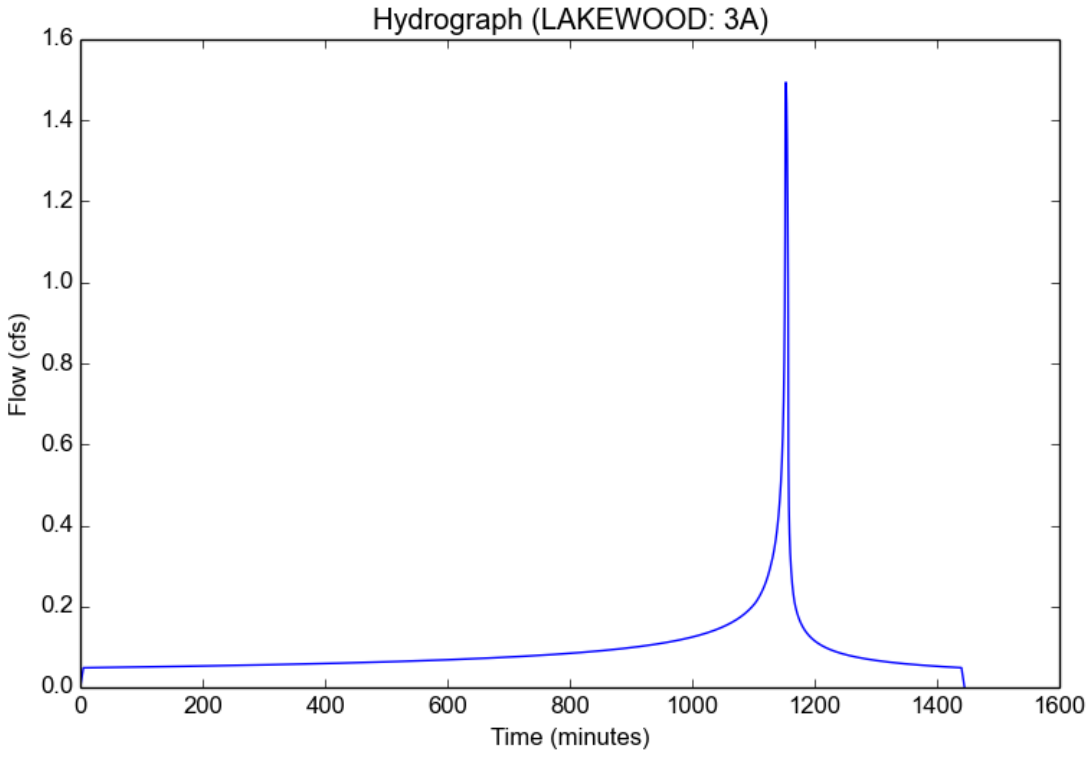
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/POST_PROJECT/LAKEWOOD - 3A-10yr.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	3A
Area (ac)	0.74
Flow Path Length (ft)	274.0
Flow Path Slope (vft/hft)	0.0259
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.834
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	3.8556
Peak Intensity (in/hr)	2.3004
Undeveloped Runoff Coefficient (Cu)	0.7653
Developed Runoff Coefficient (Cd)	0.8776
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.494
Burned Peak Flow Rate (cfs)	1.494
24-Hr Clear Runoff Volume (ac-ft)	0.1836
24-Hr Clear Runoff Volume (cu-ft)	7998.8146



Peak Flow Hydrologic Analysis

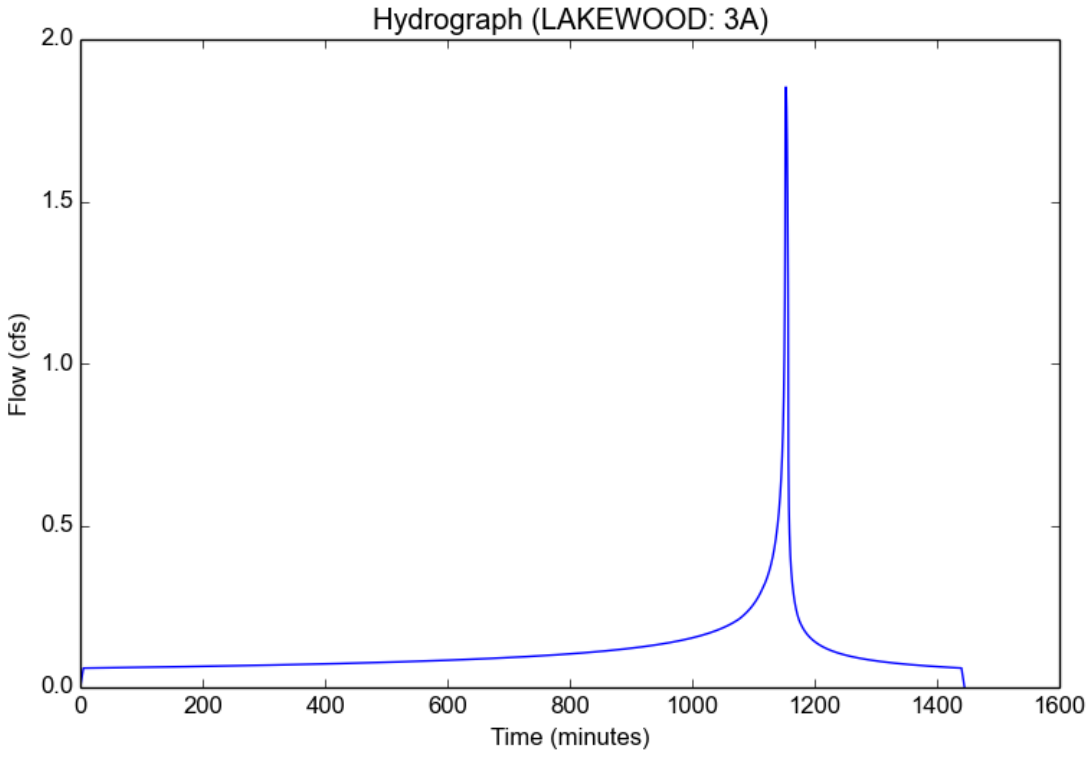
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/POST_PROJECT/LAKEWOOD - 3A-25yr.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	3A
Area (ac)	0.74
Flow Path Length (ft)	274.0
Flow Path Slope (vft/hft)	0.0259
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.834
Soil Type	6
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.8287
Undeveloped Runoff Coefficient (Cu)	0.8103
Developed Runoff Coefficient (Cd)	0.8851
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.8527
Burned Peak Flow Rate (cfs)	1.8527
24-Hr Clear Runoff Volume (ac-ft)	0.2267
24-Hr Clear Runoff Volume (cu-ft)	9876.1827



Peak Flow Hydrologic Analysis

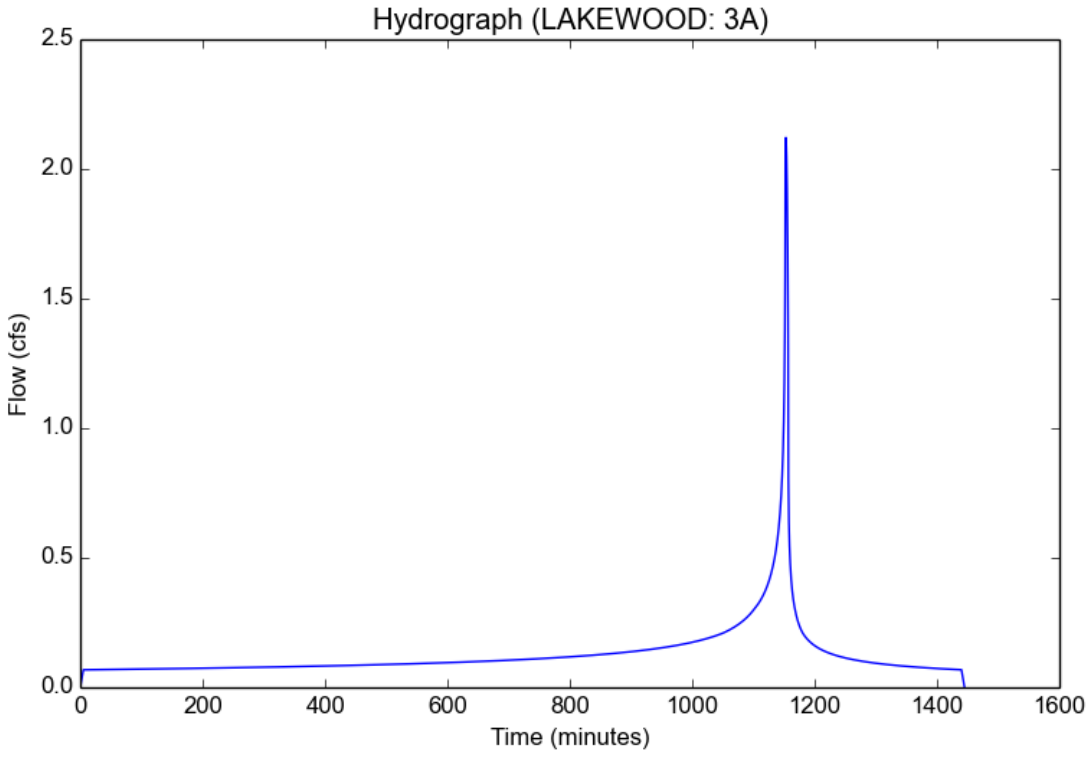
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/POST_PROJECT/LAKEWOOD - 3A-50yr.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	3A
Area (ac)	0.74
Flow Path Length (ft)	274.0
Flow Path Slope (vft/hft)	0.0259
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.834
Soil Type	6
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.8379
Developed Runoff Coefficient (Cd)	0.8897
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	2.1211
Burned Peak Flow Rate (cfs)	2.1211
24-Hr Clear Runoff Volume (ac-ft)	0.259
24-Hr Clear Runoff Volume (cu-ft)	11283.0735



APPENDIX B.4: POST-PROJECT AREA 4A RATIONAL METHOD CALCULATIONS

Peak Flow Hydrologic Analysis

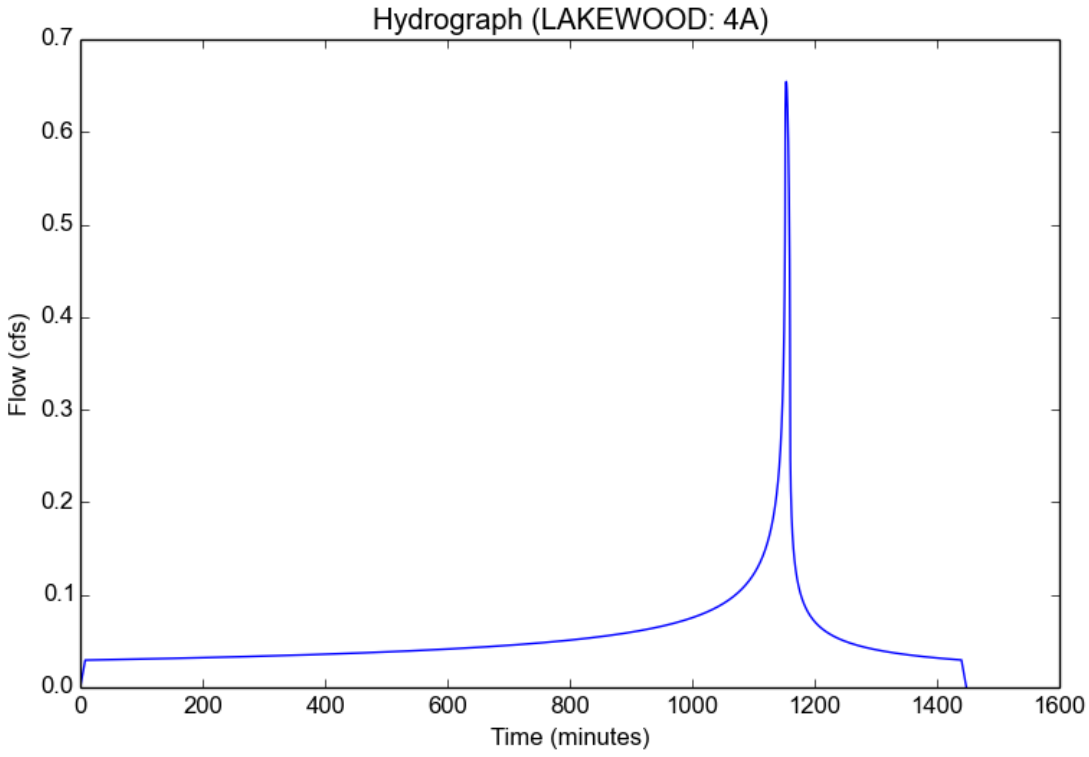
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/POST_PROJECT/LAKEWOOD - 4A-2yr.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	4A
Area (ac)	0.74
Flow Path Length (ft)	214.0
Flow Path Slope (vft/hft)	0.0089
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.951
Soil Type	6
Design Storm Frequency	2-yr
Fire Factor	0
LID	False

Output Results

Modeled (2-yr) Rainfall Depth (in)	2.0898
Peak Intensity (in/hr)	0.9997
Undeveloped Runoff Coefficient (Cu)	0.5851
Developed Runoff Coefficient (Cd)	0.8846
Time of Concentration (min)	8.0
Clear Peak Flow Rate (cfs)	0.6544
Burned Peak Flow Rate (cfs)	0.6544
24-Hr Clear Runoff Volume (ac-ft)	0.1102
24-Hr Clear Runoff Volume (cu-ft)	4801.4497



Peak Flow Hydrologic Analysis

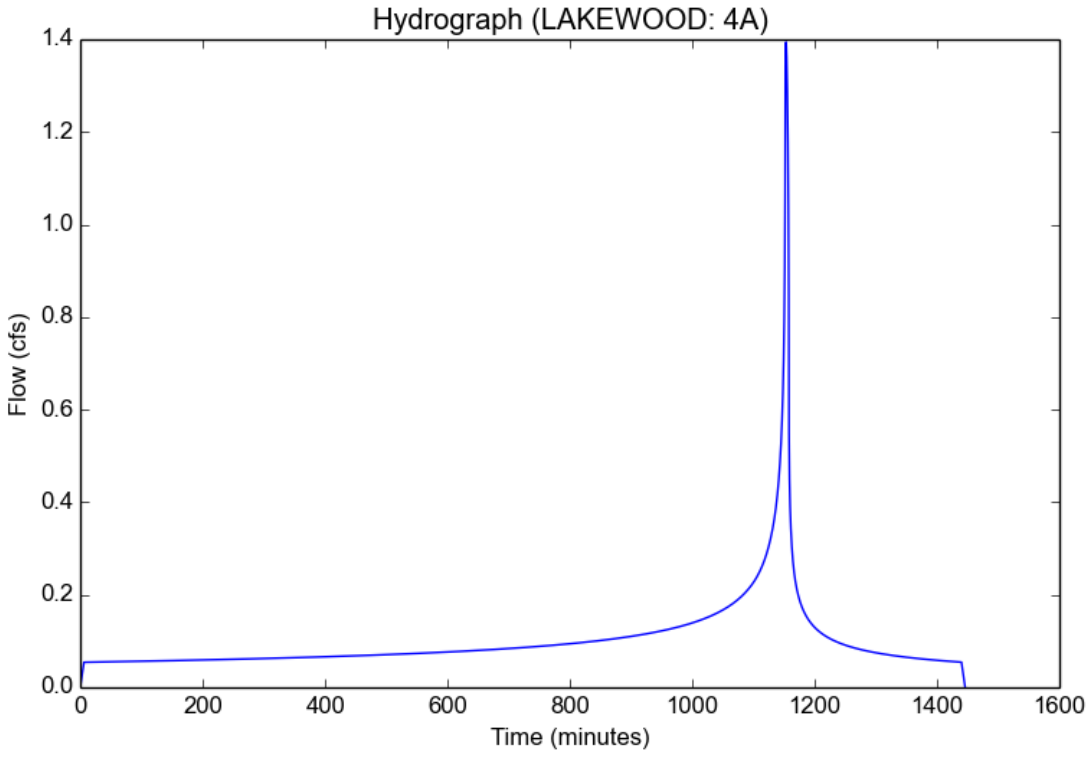
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/POST_PROJECT/LAKEWOOD - 4A-10yr.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	4A
Area (ac)	0.74
Flow Path Length (ft)	214.0
Flow Path Slope (vft/hft)	0.0089
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.951
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	3.8556
Peak Intensity (in/hr)	2.1114
Undeveloped Runoff Coefficient (Cu)	0.7445
Developed Runoff Coefficient (Cd)	0.8924
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	1.3943
Burned Peak Flow Rate (cfs)	1.3943
24-Hr Clear Runoff Volume (ac-ft)	0.2038
24-Hr Clear Runoff Volume (cu-ft)	8876.425



Peak Flow Hydrologic Analysis

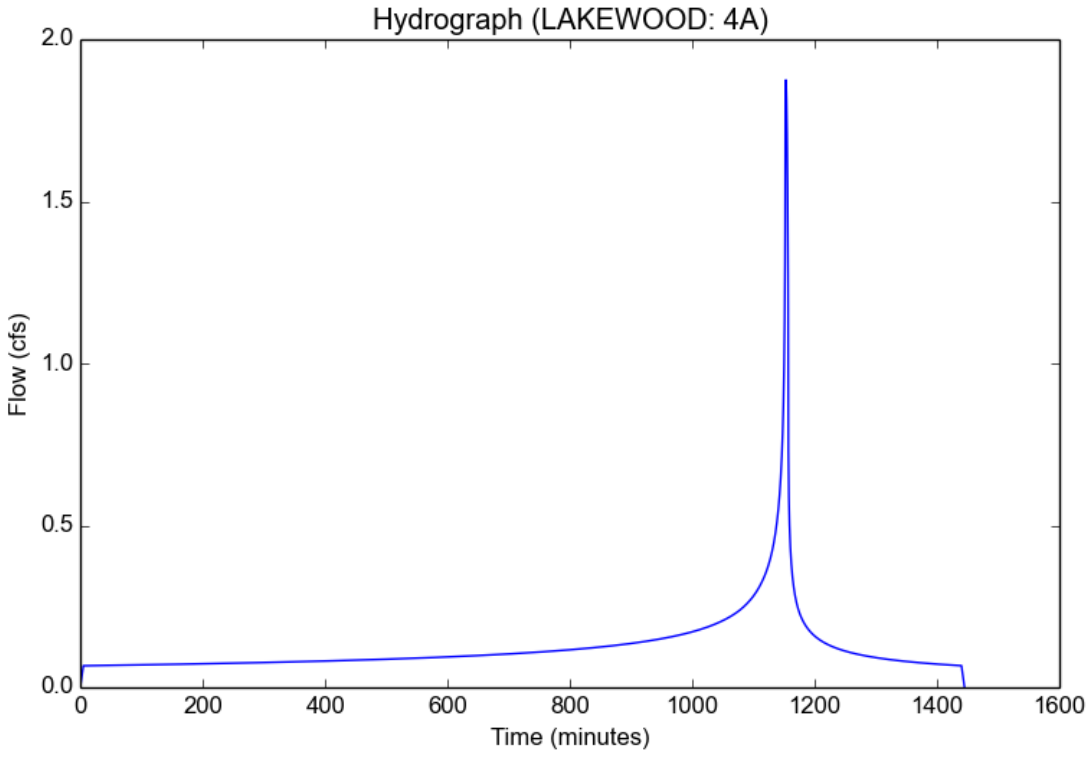
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/POST_PROJECT/LAKEWOOD - 4A-25yr.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	4A
Area (ac)	0.74
Flow Path Length (ft)	214.0
Flow Path Slope (vft/hft)	0.0089
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.951
Soil Type	6
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.8287
Undeveloped Runoff Coefficient (Cu)	0.8103
Developed Runoff Coefficient (Cd)	0.8956
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.8747
Burned Peak Flow Rate (cfs)	1.8747
24-Hr Clear Runoff Volume (ac-ft)	0.2509
24-Hr Clear Runoff Volume (cu-ft)	10927.2952



Peak Flow Hydrologic Analysis

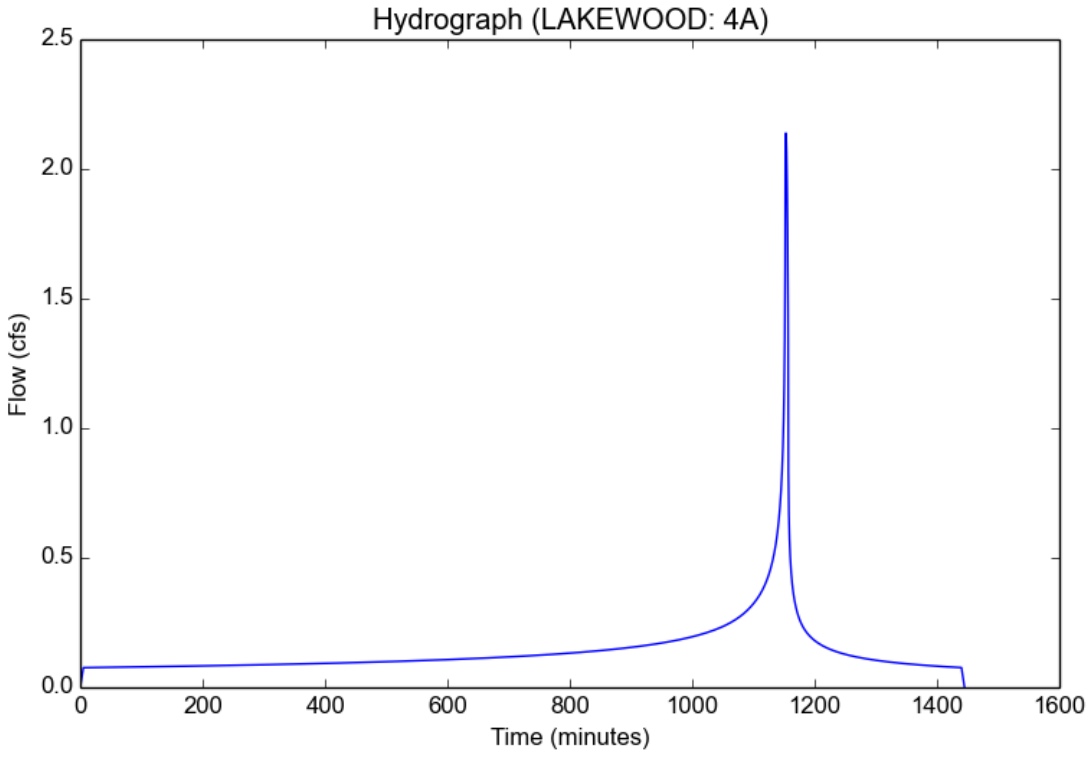
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/POST_PROJECT/LAKEWOOD - 4A-50yr.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	4A
Area (ac)	0.74
Flow Path Length (ft)	214.0
Flow Path Slope (vft/hft)	0.0089
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.951
Soil Type	6
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.8379
Developed Runoff Coefficient (Cd)	0.897
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	2.1385
Burned Peak Flow Rate (cfs)	2.1385
24-Hr Clear Runoff Volume (ac-ft)	0.2859
24-Hr Clear Runoff Volume (cu-ft)	12455.872



APPENDIX B.5: POST-PROJECT AREA 5A RATIONAL METHOD CALCULATIONS

Peak Flow Hydrologic Analysis

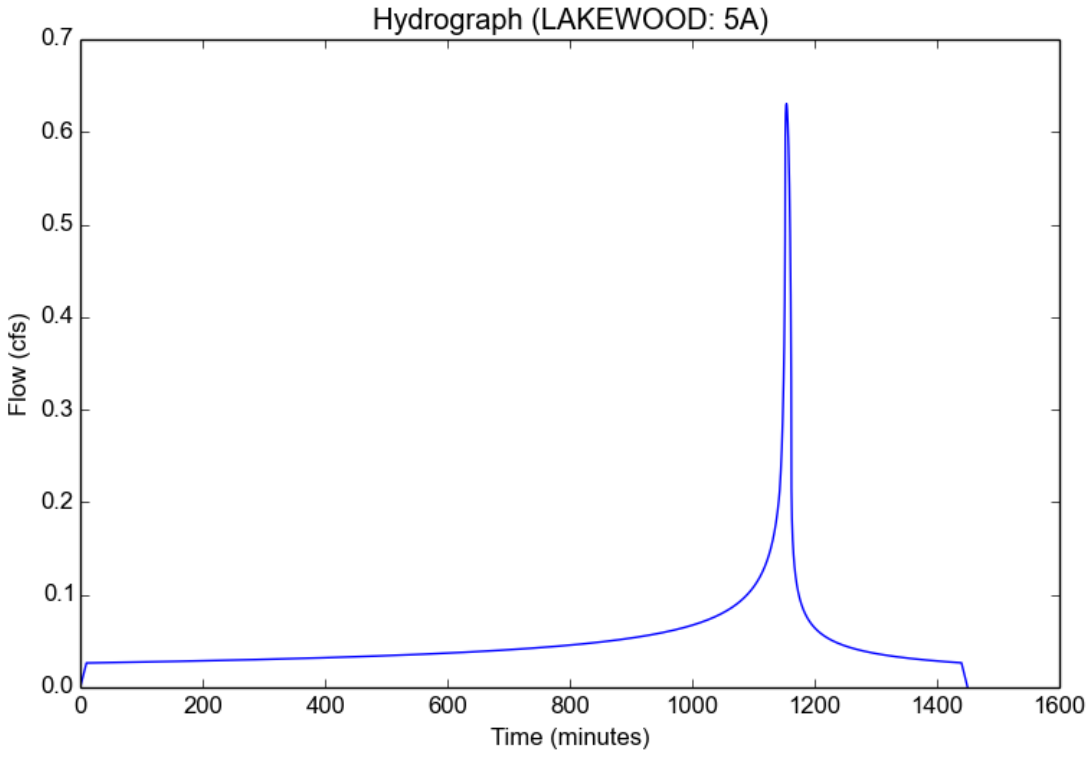
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/POST_PROJECT/LAKEWOOD - 5A-2yr.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	5A
Area (ac)	0.89
Flow Path Length (ft)	273.0
Flow Path Slope (vft/hft)	0.015
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.676
Soil Type	6
Design Storm Frequency	2-yr
Fire Factor	0
LID	False

Output Results

Modeled (2-yr) Rainfall Depth (in)	2.0898
Peak Intensity (in/hr)	0.9002
Undeveloped Runoff Coefficient (Cu)	0.5511
Developed Runoff Coefficient (Cd)	0.787
Time of Concentration (min)	10.0
Clear Peak Flow Rate (cfs)	0.6305
Burned Peak Flow Rate (cfs)	0.6305
24-Hr Clear Runoff Volume (ac-ft)	0.1001
24-Hr Clear Runoff Volume (cu-ft)	4362.3516



Peak Flow Hydrologic Analysis

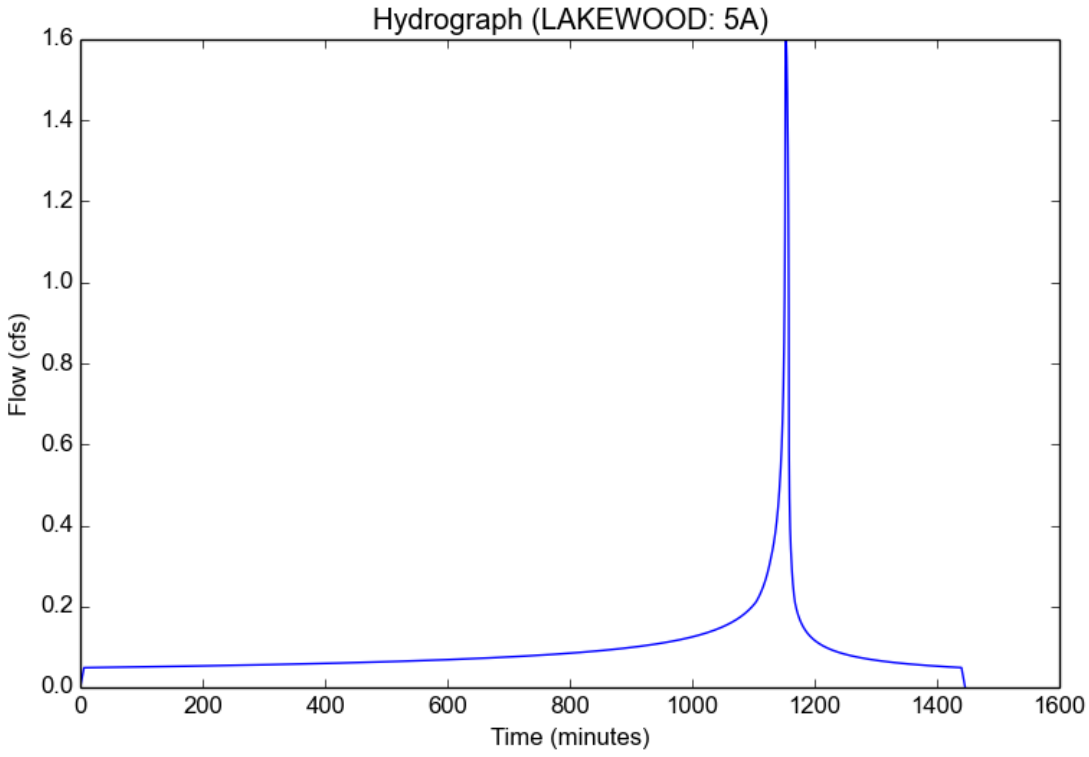
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/POST_PROJECT/LAKEWOOD - 5A-10yr.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	5A
Area (ac)	0.89
Flow Path Length (ft)	273.0
Flow Path Slope (vft/hft)	0.015
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.676
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	3.8556
Peak Intensity (in/hr)	2.1114
Undeveloped Runoff Coefficient (Cu)	0.7445
Developed Runoff Coefficient (Cd)	0.8496
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	1.5966
Burned Peak Flow Rate (cfs)	1.5966
24-Hr Clear Runoff Volume (ac-ft)	0.1881
24-Hr Clear Runoff Volume (cu-ft)	8193.3325



Peak Flow Hydrologic Analysis

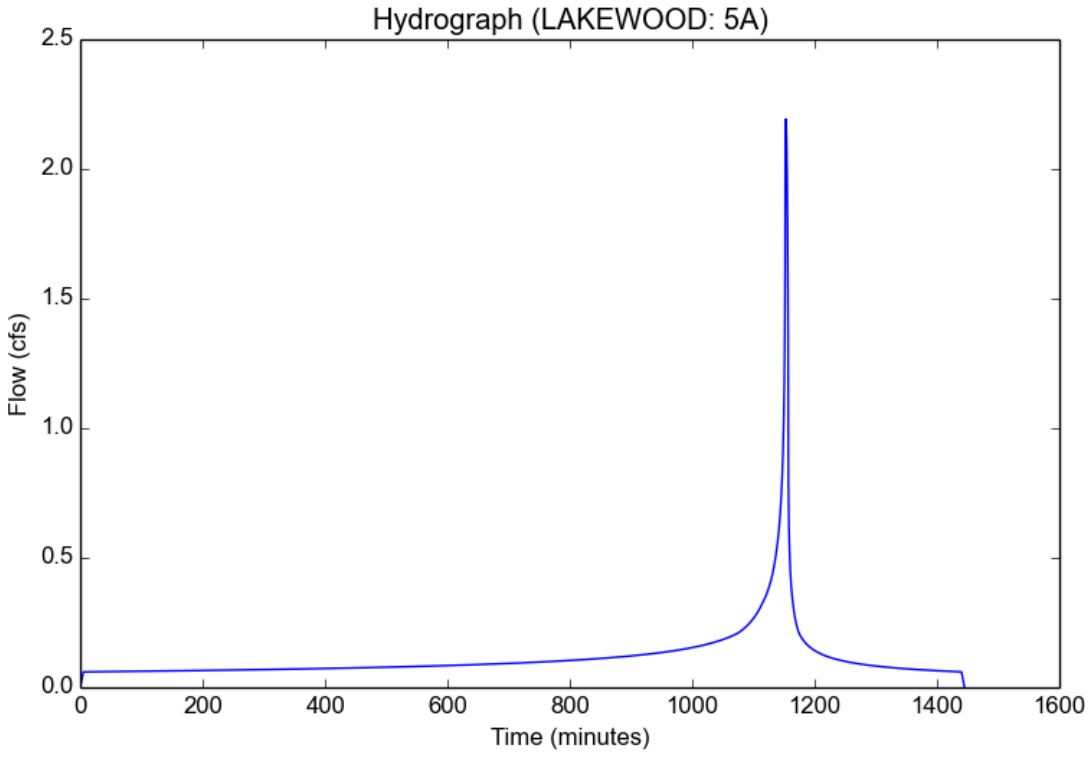
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Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	5A
Area (ac)	0.89
Flow Path Length (ft)	273.0
Flow Path Slope (vft/hft)	0.015
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.676
Soil Type	6
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.8287
Undeveloped Runoff Coefficient (Cu)	0.8103
Developed Runoff Coefficient (Cd)	0.8709
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	2.1926
Burned Peak Flow Rate (cfs)	2.1926
24-Hr Clear Runoff Volume (ac-ft)	0.2335
24-Hr Clear Runoff Volume (cu-ft)	10170.9339



Peak Flow Hydrologic Analysis

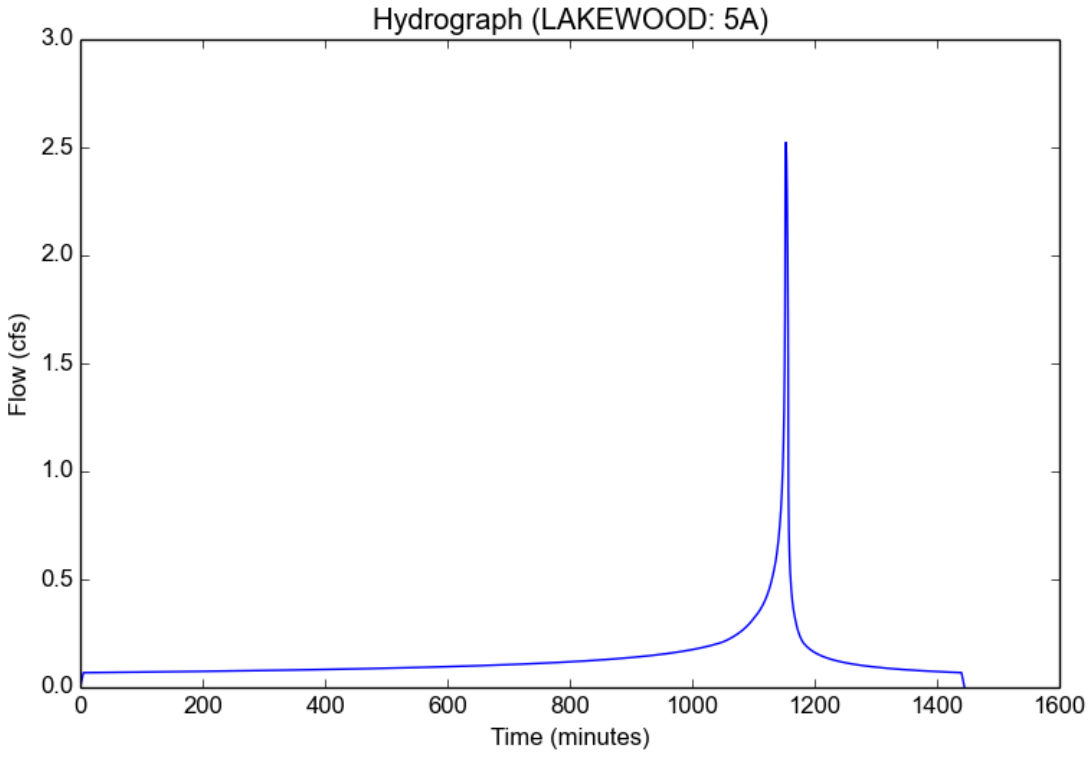
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Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	5A
Area (ac)	0.89
Flow Path Length (ft)	273.0
Flow Path Slope (vft/hft)	0.015
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.676
Soil Type	6
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.8379
Developed Runoff Coefficient (Cd)	0.8799
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	2.5229
Burned Peak Flow Rate (cfs)	2.5229
24-Hr Clear Runoff Volume (ac-ft)	0.2678
24-Hr Clear Runoff Volume (cu-ft)	11665.3676



APPENDIX B.6: POST-PROJECT AREA 6A RATIONAL METHOD CALCULATIONS

Peak Flow Hydrologic Analysis

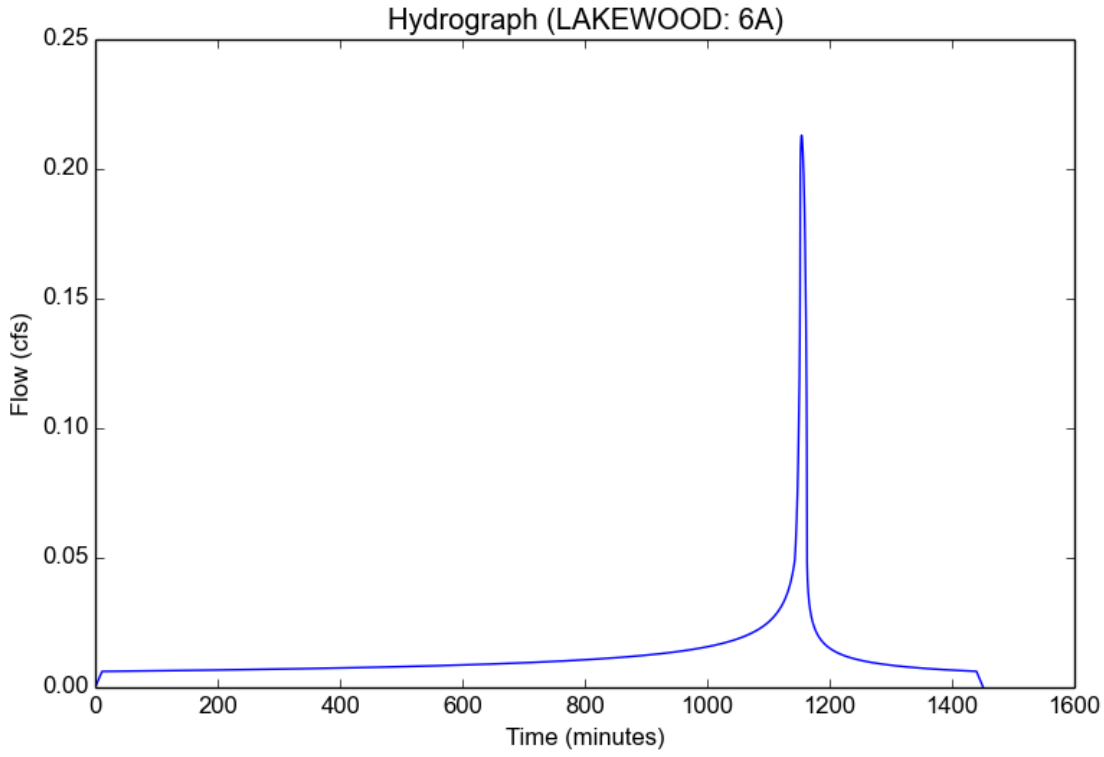
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Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	6A
Area (ac)	0.38
Flow Path Length (ft)	239.0
Flow Path Slope (vft/hft)	0.0096
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.313
Soil Type	6
Design Storm Frequency	2-yr
Fire Factor	0
LID	False

Output Results

Modeled (2-yr) Rainfall Depth (in)	2.0898
Peak Intensity (in/hr)	0.8607
Undeveloped Runoff Coefficient (Cu)	0.5377
Developed Runoff Coefficient (Cd)	0.6511
Time of Concentration (min)	11.0
Clear Peak Flow Rate (cfs)	0.213
Burned Peak Flow Rate (cfs)	0.213
24-Hr Clear Runoff Volume (ac-ft)	0.0245
24-Hr Clear Runoff Volume (cu-ft)	1066.1866



Peak Flow Hydrologic Analysis

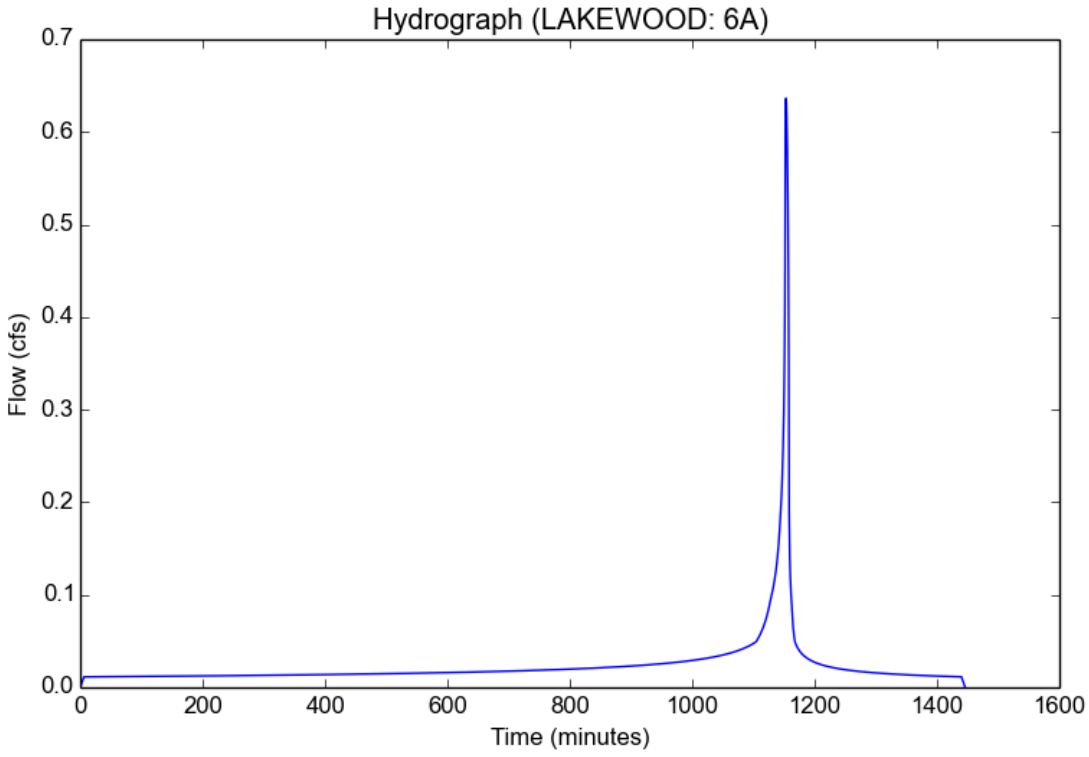
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Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	6A
Area (ac)	0.38
Flow Path Length (ft)	239.0
Flow Path Slope (vft/hft)	0.0096
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.313
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	3.8556
Peak Intensity (in/hr)	2.1114
Undeveloped Runoff Coefficient (Cu)	0.7445
Developed Runoff Coefficient (Cd)	0.7932
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	0.6364
Burned Peak Flow Rate (cfs)	0.6364
24-Hr Clear Runoff Volume (ac-ft)	0.0482
24-Hr Clear Runoff Volume (cu-ft)	2099.2254



Peak Flow Hydrologic Analysis

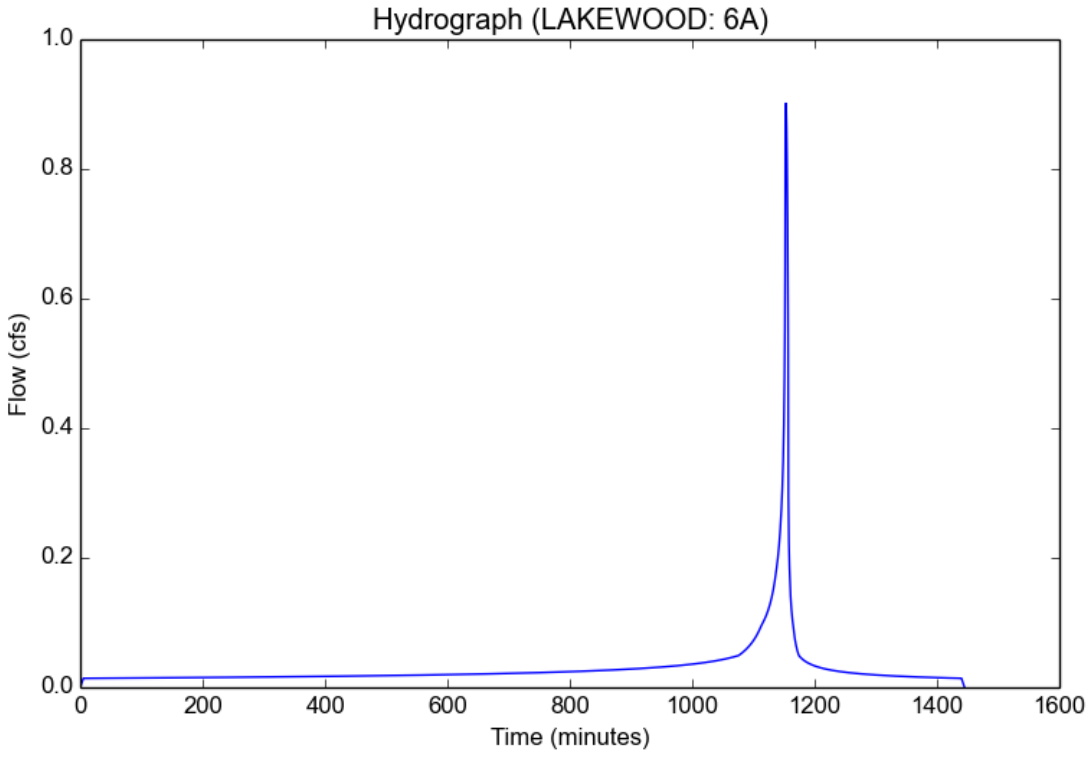
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Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	6A
Area (ac)	0.38
Flow Path Length (ft)	239.0
Flow Path Slope (vft/hft)	0.0096
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.313
Soil Type	6
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.8287
Undeveloped Runoff Coefficient (Cu)	0.8103
Developed Runoff Coefficient (Cd)	0.8383
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.9012
Burned Peak Flow Rate (cfs)	0.9012
24-Hr Clear Runoff Volume (ac-ft)	0.0612
24-Hr Clear Runoff Volume (cu-ft)	2668.0045



Peak Flow Hydrologic Analysis

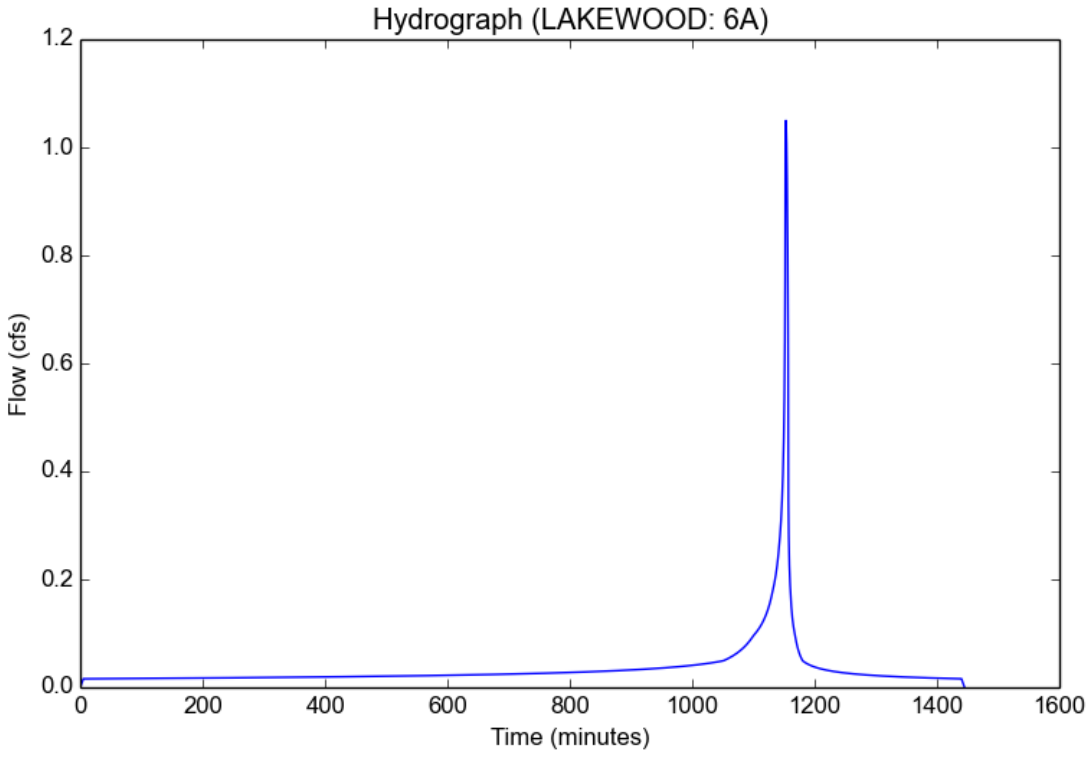
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Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	6A
Area (ac)	0.38
Flow Path Length (ft)	239.0
Flow Path Slope (vft/hft)	0.0096
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.313
Soil Type	6
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.8379
Developed Runoff Coefficient (Cd)	0.8573
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.0496
Burned Peak Flow Rate (cfs)	1.0496
24-Hr Clear Runoff Volume (ac-ft)	0.0714
24-Hr Clear Runoff Volume (cu-ft)	3112.2061



APPENDIX B.7: POST-PROJECT AREA 7A RATIONAL METHOD CALCULATIONS

Peak Flow Hydrologic Analysis

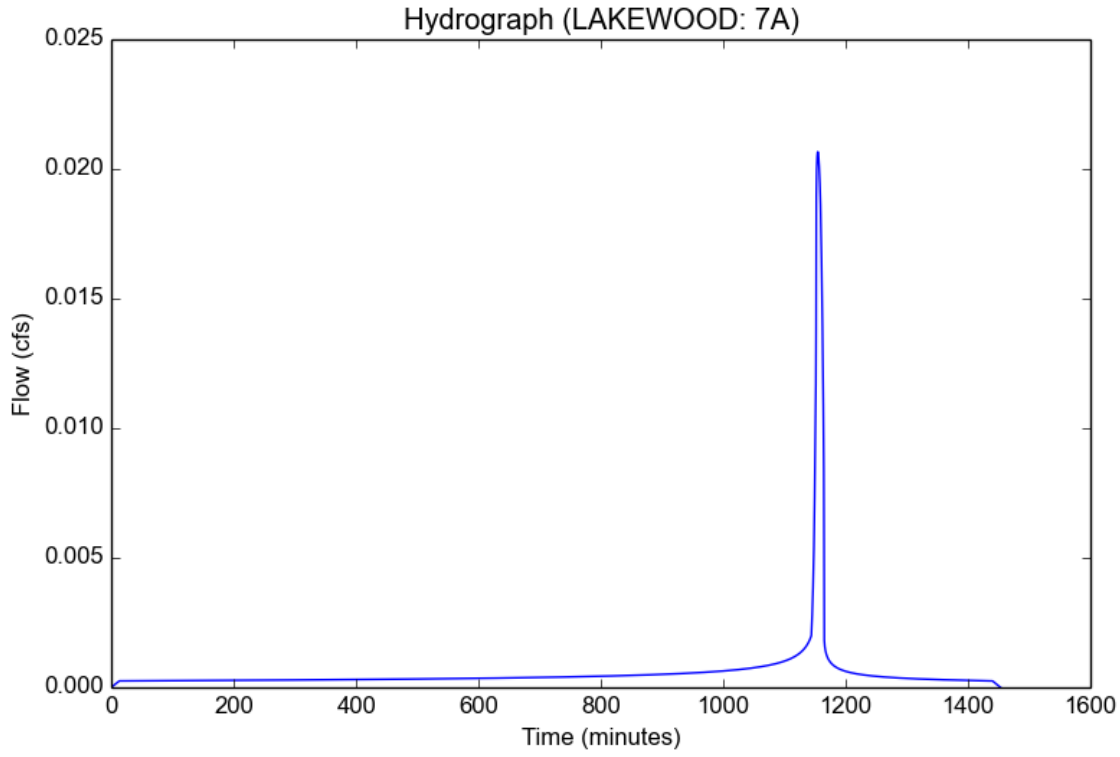
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/POST_PROJECT/LAKEWOOD - 7A-2yr.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	7A
Area (ac)	0.05
Flow Path Length (ft)	144.0
Flow Path Slope (vft/hft)	0.0014
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	6
Design Storm Frequency	2-yr
Fire Factor	0
LID	False

Output Results

Modeled (2-yr) Rainfall Depth (in)	2.0898
Peak Intensity (in/hr)	0.7957
Undeveloped Runoff Coefficient (Cu)	0.5155
Developed Runoff Coefficient (Cd)	0.5194
Time of Concentration (min)	13.0
Clear Peak Flow Rate (cfs)	0.0207
Burned Peak Flow Rate (cfs)	0.0207
24-Hr Clear Runoff Volume (ac-ft)	0.0012
24-Hr Clear Runoff Volume (cu-ft)	52.6312



Peak Flow Hydrologic Analysis

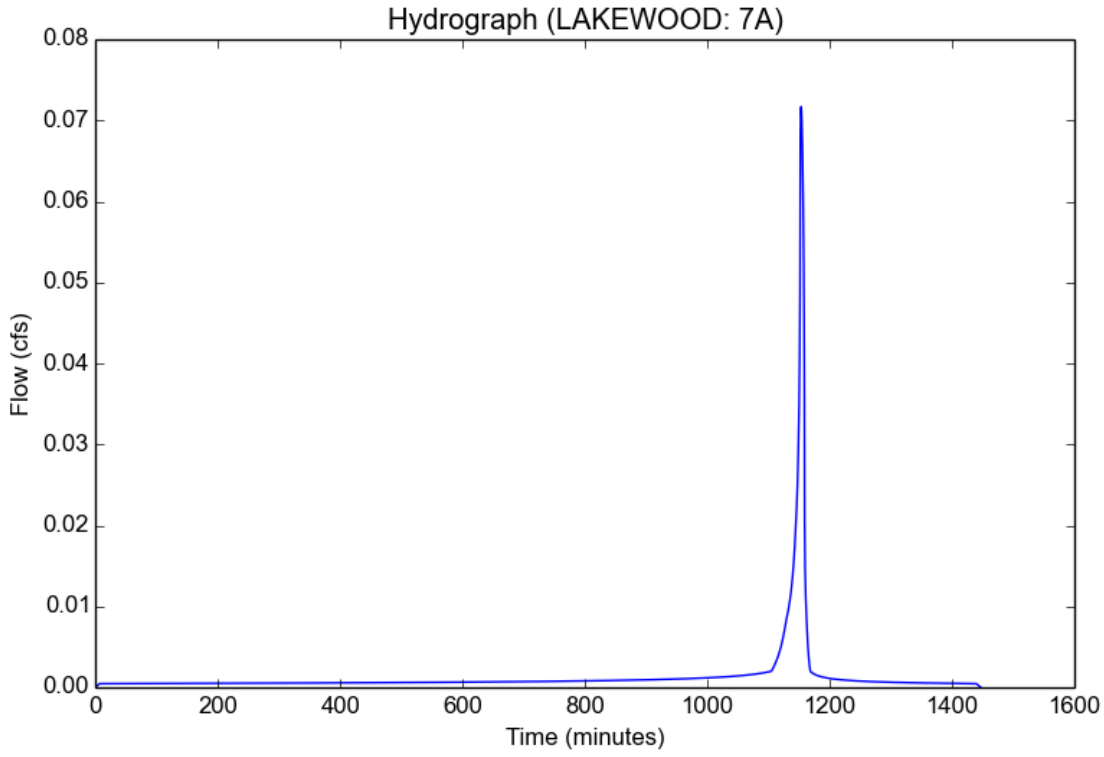
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Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	7A
Area (ac)	0.05
Flow Path Length (ft)	144.0
Flow Path Slope (vft/hft)	0.0014
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	6
Design Storm Frequency	10-yr
Fire Factor	0
LID	False

Output Results

Modeled (10-yr) Rainfall Depth (in)	3.8556
Peak Intensity (in/hr)	1.9639
Undeveloped Runoff Coefficient (Cu)	0.7283
Developed Runoff Coefficient (Cd)	0.73
Time of Concentration (min)	7.0
Clear Peak Flow Rate (cfs)	0.0717
Burned Peak Flow Rate (cfs)	0.0717
24-Hr Clear Runoff Volume (ac-ft)	0.0028
24-Hr Clear Runoff Volume (cu-ft)	122.3973



Peak Flow Hydrologic Analysis

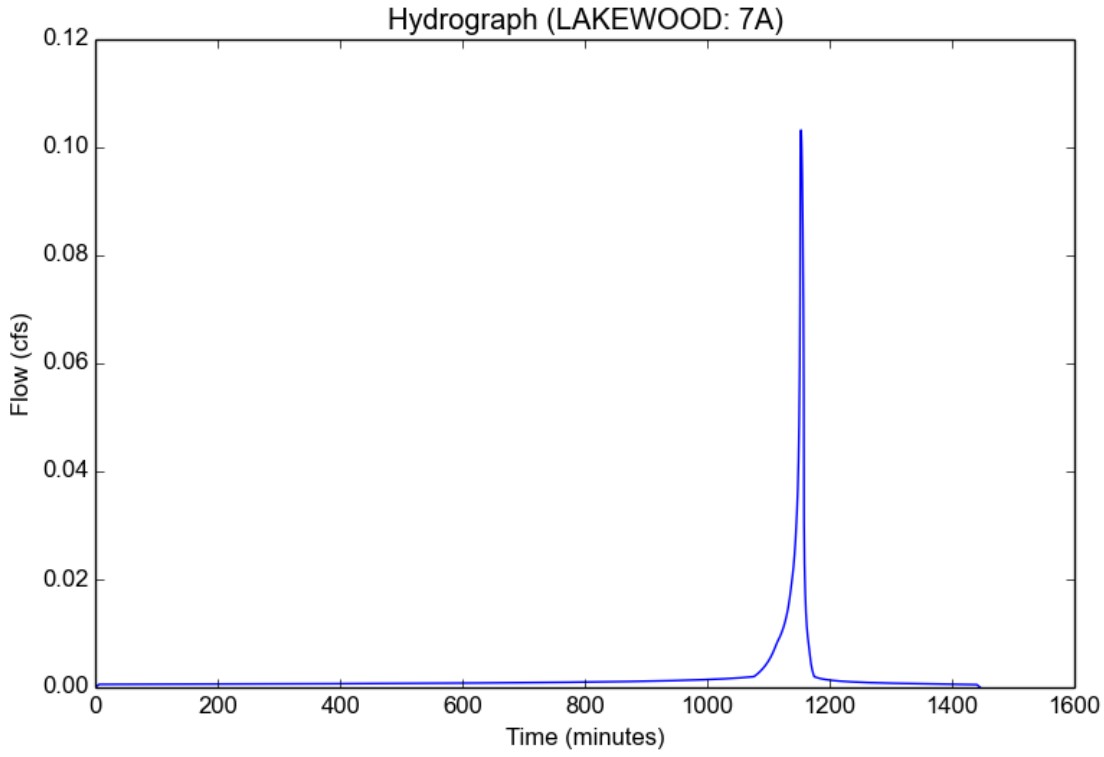
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/POST_PROJECT/LAKEWOOD - 7A-25yr.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	7A
Area (ac)	0.05
Flow Path Length (ft)	144.0
Flow Path Slope (vft/hft)	0.0014
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	6
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.5964
Undeveloped Runoff Coefficient (Cu)	0.7939
Developed Runoff Coefficient (Cd)	0.795
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	0.1032
Burned Peak Flow Rate (cfs)	0.1032
24-Hr Clear Runoff Volume (ac-ft)	0.0038
24-Hr Clear Runoff Volume (cu-ft)	166.9002



Peak Flow Hydrologic Analysis

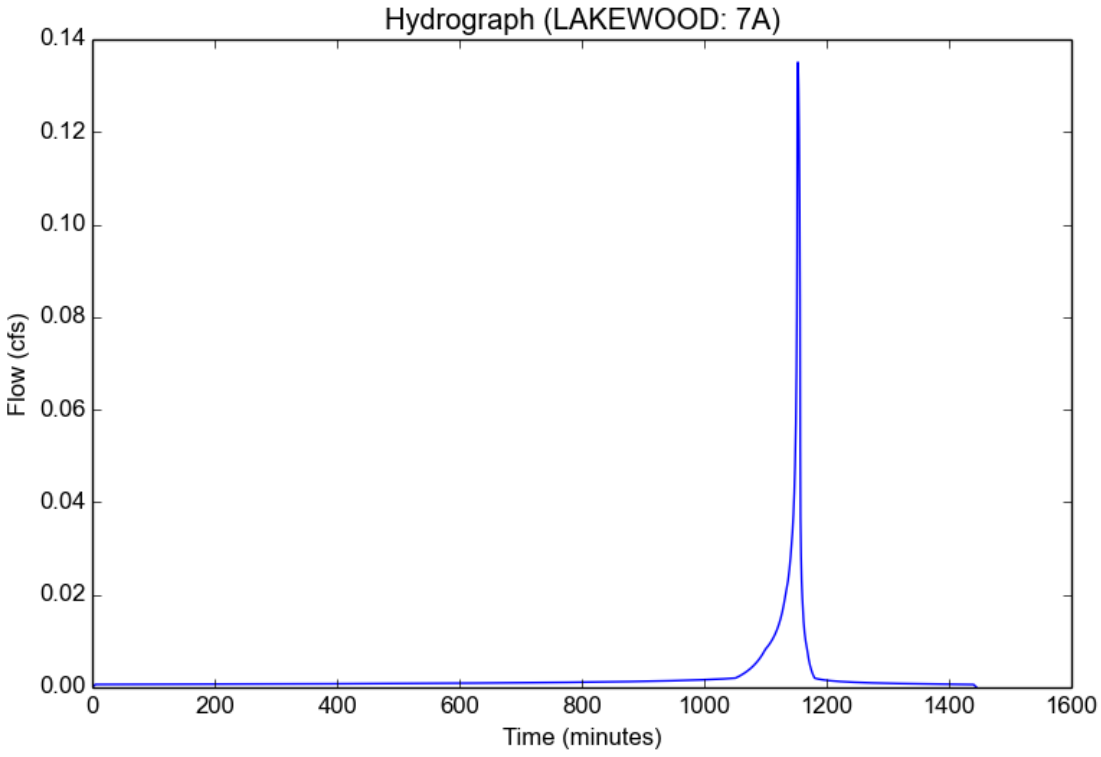
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Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	7A
Area (ac)	0.05
Flow Path Length (ft)	144.0
Flow Path Slope (vft/hft)	0.0014
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	6
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.8379
Developed Runoff Coefficient (Cd)	0.8385
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.1351
Burned Peak Flow Rate (cfs)	0.1351
24-Hr Clear Runoff Volume (ac-ft)	0.0047
24-Hr Clear Runoff Volume (cu-ft)	204.2814



APPENDIX C: LOW IMPACT DEVELOPMENT HYDROLOGY

APPENDIX C.1: POST-PROJECT AREA 1A LID CALCULATION

Peak Flow Hydrologic Analysis

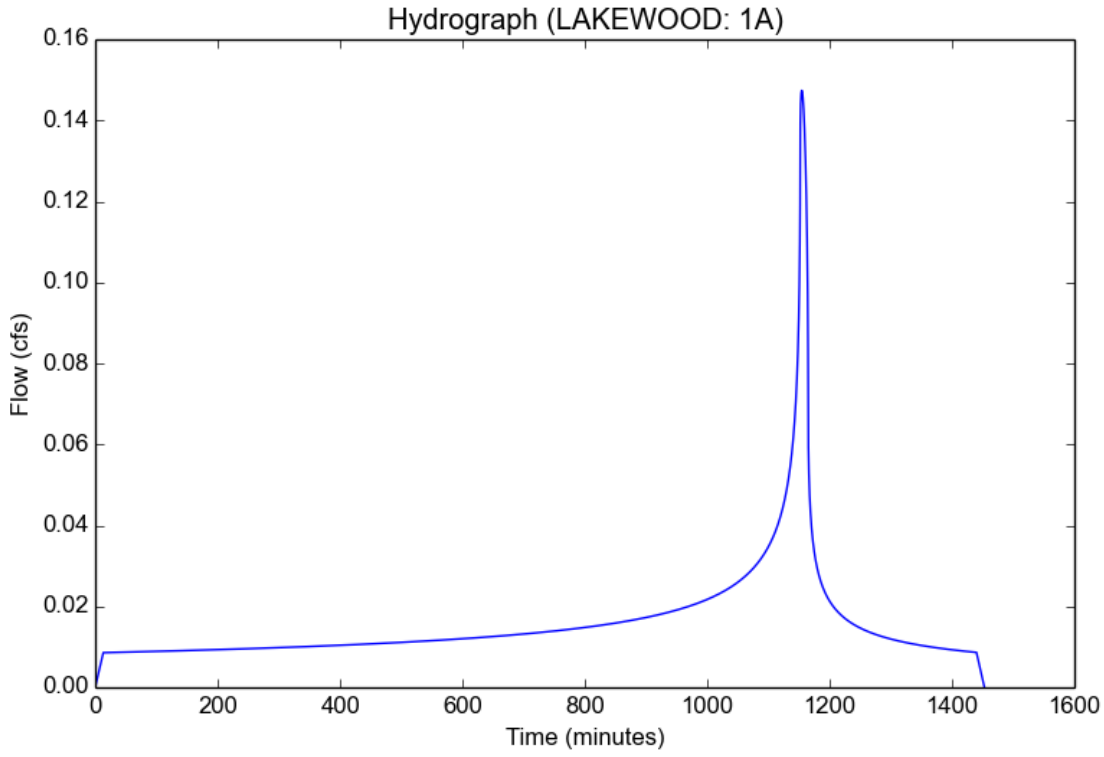
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/POST_PROJECT/LAKEWOOD - 1A-WQ-85th.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	1A
Area (ac)	0.56
Flow Path Length (ft)	165.0
Flow Path Slope (vft/hft)	0.0133
85th Percentile Rainfall Depth (in)	0.9
Percent Impervious	0.835
Soil Type	6
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.9
Peak Intensity (in/hr)	0.3427
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.768
Time of Concentration (min)	13.0
Clear Peak Flow Rate (cfs)	0.1474
Burned Peak Flow Rate (cfs)	0.1474
24-Hr Clear Runoff Volume (ac-ft)	0.032
24-Hr Clear Runoff Volume (cu-ft)	1393.4622



APPENDIX C.2: POST-PROJECT AREA 2A LID CALCULATION

Peak Flow Hydrologic Analysis

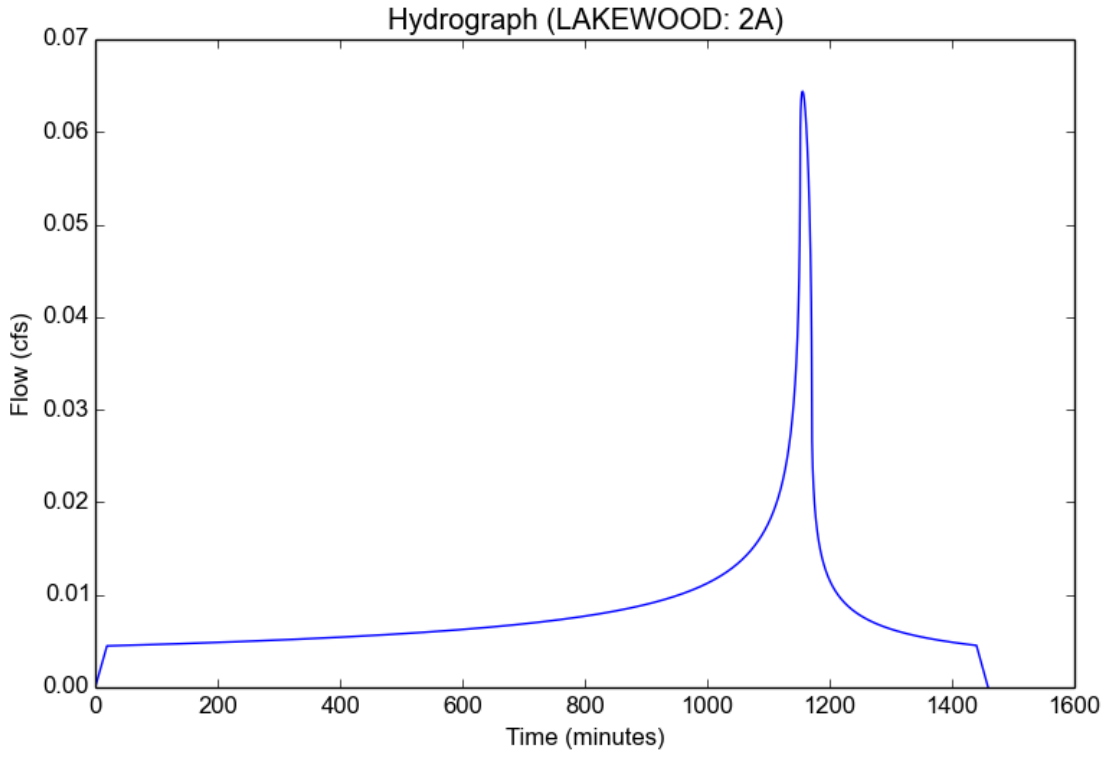
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/POST_PROJECT/LAKEWOOD - 2A-WQ-85th.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	2A
Area (ac)	0.35
Flow Path Length (ft)	235.0
Flow Path Slope (vft/hft)	0.0123
85th Percentile Rainfall Depth (in)	0.9
Percent Impervious	0.677
Soil Type	6
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.9
Peak Intensity (in/hr)	0.2867
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.6416
Time of Concentration (min)	19.0
Clear Peak Flow Rate (cfs)	0.0644
Burned Peak Flow Rate (cfs)	0.0644
24-Hr Clear Runoff Volume (ac-ft)	0.0167
24-Hr Clear Runoff Volume (cu-ft)	727.5777



APPENDIX C.3: POST-PROJECT AREA 3A LID CALCULATION

Peak Flow Hydrologic Analysis

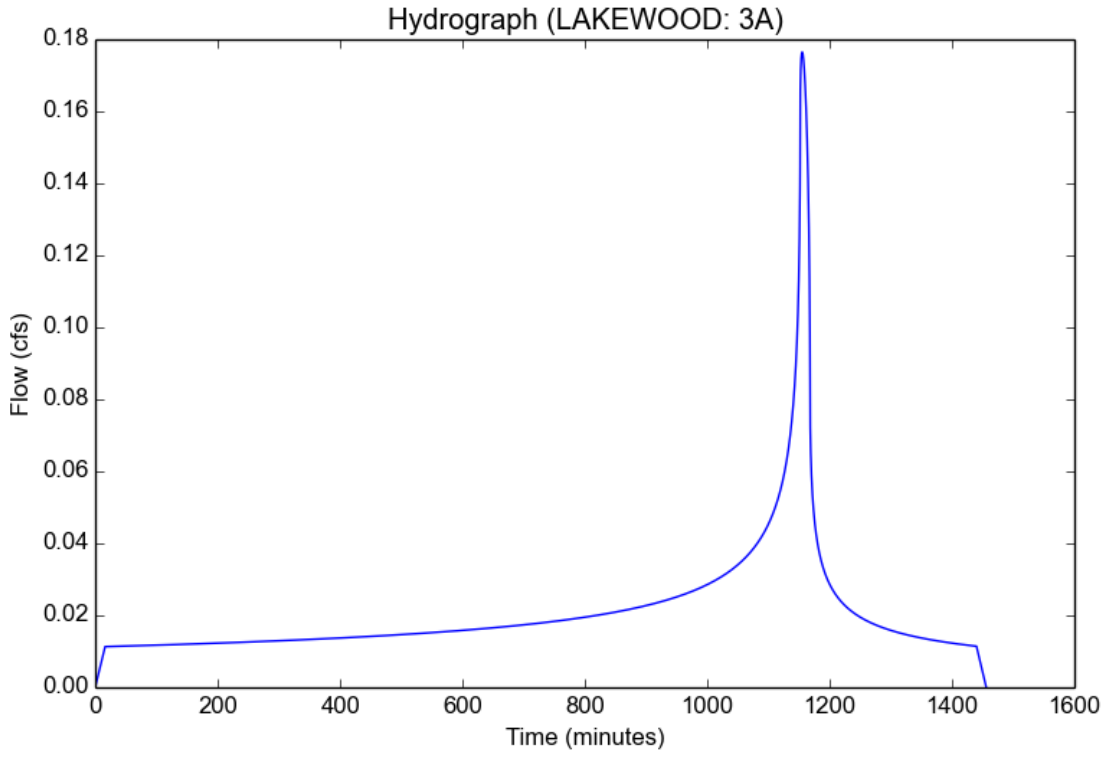
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/POST_PROJECT/LAKEWOOD - 3A-WQ-85th.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	3A
Area (ac)	0.74
Flow Path Length (ft)	274.0
Flow Path Slope (vft/hft)	0.0259
85th Percentile Rainfall Depth (in)	0.9
Percent Impervious	0.834
Soil Type	6
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.9
Peak Intensity (in/hr)	0.3108
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.7672
Time of Concentration (min)	16.0
Clear Peak Flow Rate (cfs)	0.1765
Burned Peak Flow Rate (cfs)	0.1765
24-Hr Clear Runoff Volume (ac-ft)	0.0422
24-Hr Clear Runoff Volume (cu-ft)	1839.4447



APPENDIX C.4: POST-PROJECT AREA 5A LID CALCULATION

Peak Flow Hydrologic Analysis

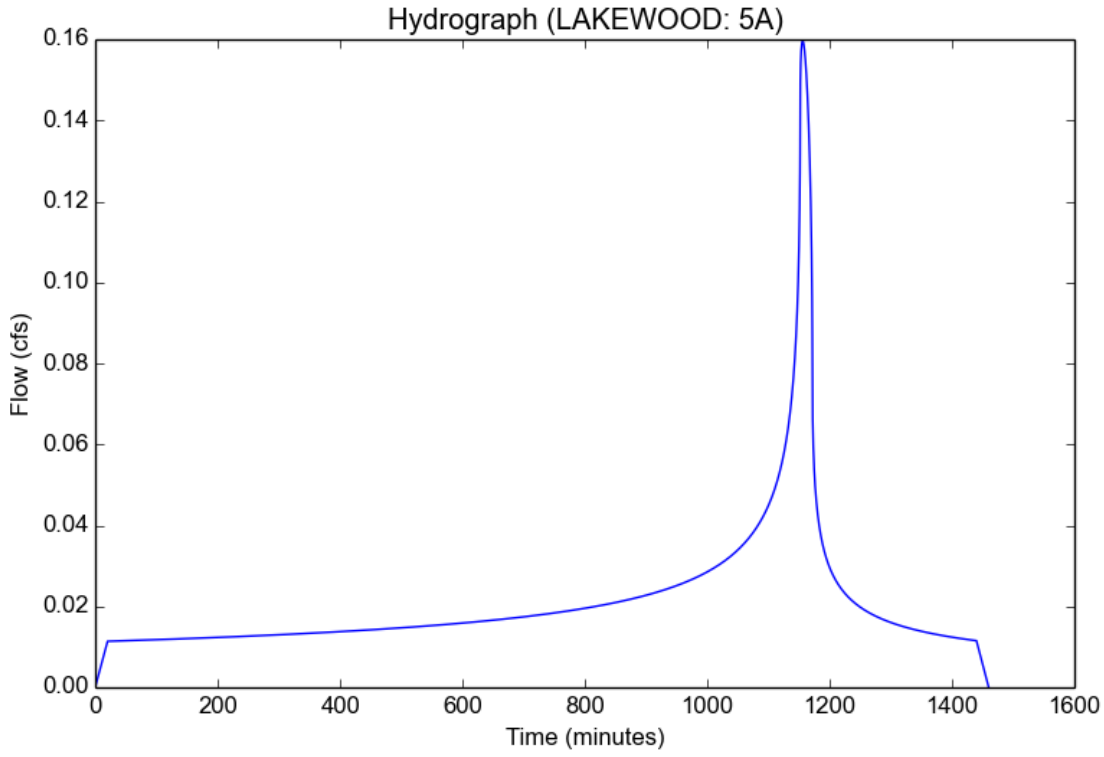
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/POST_PROJECT/LAKEWOOD - 5A-WQ-85th.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	5A
Area (ac)	0.89
Flow Path Length (ft)	273.0
Flow Path Slope (vft/hft)	0.015
85th Percentile Rainfall Depth (in)	0.9
Percent Impervious	0.676
Soil Type	6
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.9
Peak Intensity (in/hr)	0.2799
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.6408
Time of Concentration (min)	20.0
Clear Peak Flow Rate (cfs)	0.1596
Burned Peak Flow Rate (cfs)	0.1596
24-Hr Clear Runoff Volume (ac-ft)	0.0424
24-Hr Clear Runoff Volume (cu-ft)	1847.8202



APPENDIX C.5: POST-PROJECT AREA 6A LID CALCULATION

Peak Flow Hydrologic Analysis

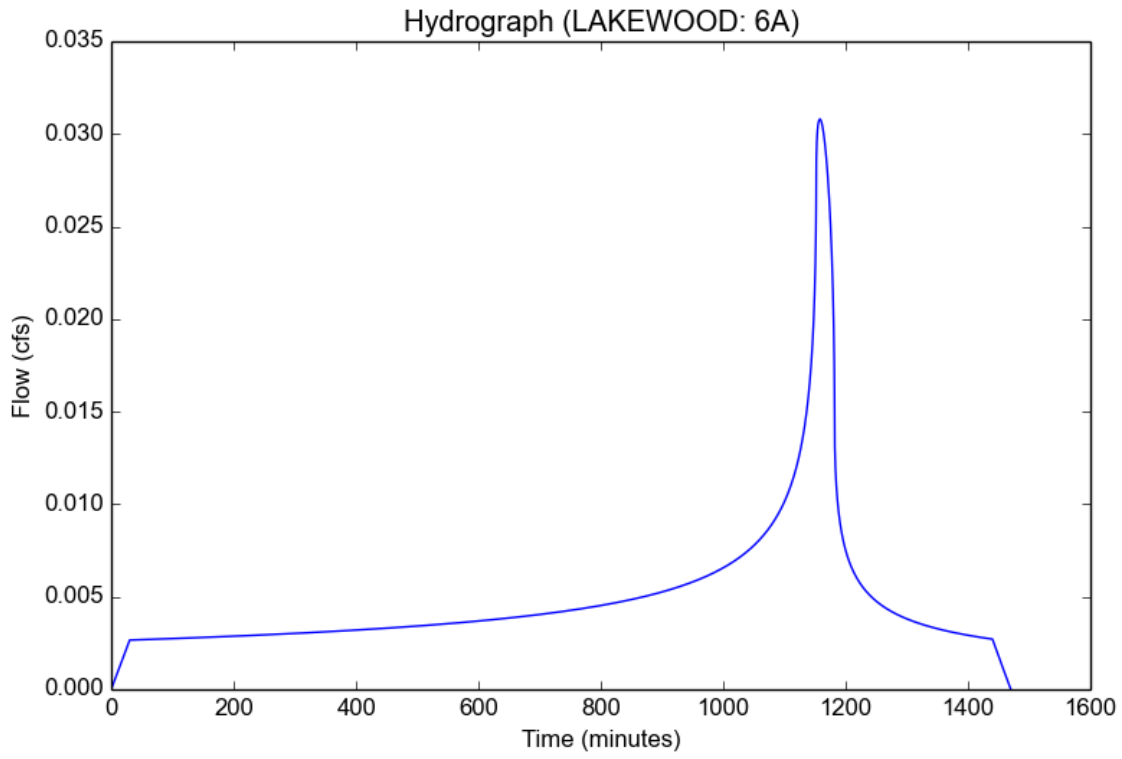
File location: O:/166.14.24/Engineering/Hydrology_Plan/Calcs/POST_PROJECT/LAKEWOOD - 6A-WQ-85th.pdf
Version: HydroCalc 1.0.3

Input Parameters

Project Name	LAKEWOOD
Subarea ID	6A
Area (ac)	0.38
Flow Path Length (ft)	239.0
Flow Path Slope (vft/hft)	0.0096
85th Percentile Rainfall Depth (in)	0.9
Percent Impervious	0.313
Soil Type	6
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.9
Peak Intensity (in/hr)	0.2313
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.3504
Time of Concentration (min)	30.0
Clear Peak Flow Rate (cfs)	0.0308
Burned Peak Flow Rate (cfs)	0.0308
24-Hr Clear Runoff Volume (ac-ft)	0.0099
24-Hr Clear Runoff Volume (cu-ft)	431.4174



APPENDIX D: BIORETENTION BASIN SIZING TABLES

City of Lakewood LID Manual

Step 1

Bioretention, Planter Box, Bioinfiltration, and High-Flow Biotreatment Sizing

With the exception of swales and filter strips, biofiltration facilities can be sized using one of two methods: a simple sizing method or a hydrologic routing modeling method. With either method the design capture volume must be completely infiltrated within the drawdown time. Steps for the simple sizing method are provided below.

Step 1: Calculate the Design Volume

Biofiltration facilities shall be sized to capture and treat 150% of the design capture volume (V_{design}) based on the runoff produced from a 0.75-inch (0.0625 ft) storm event.

$$V_{design} \text{ (cu ft)} = 1.5 * 0.0625 \text{ ft} * \textit{Catchment Area} \text{ (sq. ft.)}$$

Where

Catchment area = (Impervious Area x 0.9) + [(Pervious Area + Undeveloped Area) x 0.1]

Method #1: Utilize the above outlined process with a 0.90-inch (0.075') storm event (instead of 0.75"). This 0.9" value is based on the MS4 permit

Drainage Area Designation	Area (sf)	Impervious Area (sf)	Pervious Area (sf)	Catchment area (sf)	Vdesign (cf)
1A	24,590	20535	4055	18887	2125
2A	15,197	10285	4912	9747.7	1097
3A	32,046	26741	5305	24597.4	2768
5A	38,579	26090	12489	24729.9	2783
6A	16,643	5205	11438	5828.3	656

Method #2: Utilize the volumes calculated by the HydroCalc Program, multiplied by a factor of 1.5.

Drainage Area Designation	HydroCalc Volume (cf)	Vdesign (cf)
1A	1,393	2090
2A	728	1092
3A	1,839	2759
5A	1,848	2772
6A	431	647

For basin sizing calculations, the higher Vdesign between the two methods was used.

Drainage Area Designation	Vdesign (cf)	Method
1A	2125	#1
2A	1097	#1
3A	2768	#1
5A	2783	#1
6A	656	#1

Lakewood Corner Lot Development
City of Lakewood LID Manual
Step 2

Step 2: Determine the Design Infiltration Rate

The infiltration rate will decline between maintenance cycles as the surface and underlying soil matrix becomes clogged with particulates and debris. Monitoring of actual facility performance has shown that the full-scale infiltration rate is far lower than the rate measured by small-scale testing. It is important that adequate conservatism is incorporated in the sizing of facilities depending on a site's infiltration rate and expected surface loading. Unlike infiltration BMPs, the measured infiltration rate discussed here is the infiltration rate of the filter media bed or engineered surface soils in the biofilter. A target long-term $K_{sat,media}$ of 5 in/hr is recommended for non-proprietary amended soil media. Facility maintenance is required to maintain the infiltration rate for the life of the project. Infiltration rates used for design must be divided by the appropriate factors of safety.

$$K_{sat,design} = K_{sat,media}/FS$$

Ksat,media	5	in/hr
Safety Factor	2	
Ksat,design	2.5	in/hr

Lakewood Corner Lot Development
City of Lakewood LID Manual
Step 3

Step 3: Calculate the BMP Ponding Depth

Select a ponding depth (d_p) that satisfies geometric criteria and is congruent with the constraints of the site. The ponding depth must satisfy the maximum ponding depth constraint as well as the following:

$$d_p \text{ (ft)} = (K_{sat,design} \times T) / 12$$

Where:

d_p = Ponding depth (ft)
$K_{sat,design}$= Design infiltration rate of filter media (in/hr)
T = Required surface drain time (hrs), from Table 4.5

Ksat,design	2.5	in/hr
T	48	hrs
dp	10	ft

The above value represents the calcualted maximum ponding depth

A design ponding depth of 1 ' will be used.

Design dp	1	ft

Lakewood Corner Lot Development
City of Lakewood LID Manual
Step 4

Step 4: Calculate the BMP Surface Area

Calculate infiltrating surface area (filter bottom area) required:

$$A_{min} = \frac{V_{design}}{[(T_{fill} K_{sat,design}/12) + d_p]}$$

Where:

A_{min} = Design infiltrating area (ft^2)

T_{fill}= Time to fill to max ponding depth with water (hrs) [unless a hydrologic routing model is used, assume a maximum of 3 hours]

The calculated BMP surface area only considers the surface area of the BMP where infiltration through amended media can occur. The total footprint of the BMP should include a buffer for side slopes and freeboard.

Bioinfiltration BMPs and high-flow biotreatment devices should incorporate a raised underdrain above the gravel sump to facilitate incidental infiltration where feasible. For these instances, infiltration screening in accordance with Section 4.2 must be carried out to show that infiltration BMPs are not allowed due to low infiltration rates or high depths of fill (i.e. there are not hazards associated with infiltration). These BMPs are not suitable for project sites that do not pass infiltration feasibility screening due to associated hazards of infiltration (e.g. high groundwater table, contaminated soil or groundwater, landslide zones, etc.)

Drainage Area Designation	Vdesign (cf)	Tfill (hr)	Ksat,design (in/hr)	Design dp (ft)	Amin (sf)
1A	2125	3	2.5	1	1308
2A	1097	3	2.5	1	676
3A	2768	3	2.5	1	1704
5A	2783	3	2.5	1	1713
6A	656	3	2.5	1	404

City of Lakewood LID Manual
Comparison: Calculated Minimum Required Area to Propsoed

Drainage Area Designation	Minimum Area (sf)	Provided Area (sf)
1A	1308	1313
2A	676	688
3A	1704	849
5A	1713	849
6A	404	2143

Runoff will equalize between the bio-retention basins for Area 3A, Area 5A, and Area 6A

Drainage Area Designation	Minimum Area (sf)	Provided Area (sf)
3A+5A+6A	3821	3841

APPENDIX E: PIPE CAPACITY CALCULATIONS

APPENDIX E.1: 12” PIPE CAPACITY CALCULATIONS

Worksheet for Circular Pipe - 12" - slope=0.41% (full full)

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data		
Roughness Coefficient	0.013	
Channel Slope	0.0041	ft/ft
Normal Depth	1.0000	ft
Diameter	12.00	in
Discharge	2.28	cfs

Results		
Discharge	2.28	cfs
Normal Depth	1.0000	ft
Flow Area	0.8	ft²
Wetted Perimeter	3.14	ft
Hydraulic Radius	0.2500	ft
Top Width	0.00	ft
Critical Depth	0.6462	ft
Percent Full	100.0	%
Critical Slope	0.0073	ft/ft
Velocity	2.90	ft/s
Velocity Head	0.13	ft
Specific Energy	1.13	ft
Froude Number	(N/A)	
Maximum Discharge	2.45	cfs
Discharge Full	2.28	cfs
Slope Full	0.0041	ft/ft
Flow Type	Subcritical	

GVF Input Data		
Downstream Depth	0.0000	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0000	ft
Profile Description	N/A	
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.0	%
Normal Depth Over Rise	67.4	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.0000	ft
Critical Depth	0.6462	ft
Channel Slope	0.0041	ft/ft
Critical Slope	0.0073	ft/ft

APPENDIX E.2: 6" PIPE CAPACITY CALCULATIONS

Worksheet for Circular Pipe - 6" - 2A to 12" - slope=0.33% (full flow)

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data		
Roughness Coefficient	0.013	
Channel Slope	0.0033	ft/ft
Normal Depth	0.5000	ft
Diameter	6.00	in
Discharge	0.32	cfs

Results		
Discharge	0.32	cfs
Normal Depth	0.5000	ft
Flow Area	0.2	ft²
Wetted Perimeter	1.57	ft
Hydraulic Radius	0.1250	ft
Top Width	0.00	ft
Critical Depth	0.2875	ft
Percent Full	100.0	%
Critical Slope	0.0083	ft/ft
Velocity	1.64	ft/s
Velocity Head	0.04	ft
Specific Energy	0.54	ft
Froude Number	(N/A)	
Maximum Discharge	0.35	cfs
Discharge Full	0.32	cfs
Slope Full	0.0033	ft/ft
Flow Type	Supercritical	

GVF Input Data		
Downstream Depth	0.0000	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0000	ft
Profile Description	N/A	
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.0	%
Normal Depth Over Rise	100.0	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.5000	ft
Critical Depth	0.2875	ft
Channel Slope	0.0033	ft/ft
Critical Slope	0.0083	ft/ft

Worksheet for Circular Pipe - 6" - 3A to 12" - slope=1.29% (full flow)

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data		
Roughness Coefficient	0.013	
Channel Slope	0.0129	ft/ft
Normal Depth	0.5000	ft
Diameter	6.00	in
Discharge	0.64	cfs

Results		
Discharge	0.64	cfs
Normal Depth	0.5000	ft
Flow Area	0.2	ft²
Wetted Perimeter	1.57	ft
Hydraulic Radius	0.1250	ft
Top Width	0.00	ft
Critical Depth	0.4051	ft
Percent Full	100.0	%
Critical Slope	0.0132	ft/ft
Velocity	3.25	ft/s
Velocity Head	0.16	ft
Specific Energy	0.66	ft
Froude Number	(N/A)	
Maximum Discharge	0.69	cfs
Discharge Full	0.64	cfs
Slope Full	0.0129	ft/ft
Flow Type	Supercritical	

GVF Input Data		
Downstream Depth	0.0000	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0000	ft
Profile Description	N/A	
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.0	%
Normal Depth Over Rise	100.0	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.5000	ft
Critical Depth	0.4051	ft
Channel Slope	0.0129	ft/ft
Critical Slope	0.0132	ft/ft

Worksheet for Circular Pipe - 6" - 5A to 12" - slope=0.52% (full flow)

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data		
Roughness Coefficient	0.013	
Channel Slope	0.0052	ft/ft
Normal Depth	0.5000	ft
Diameter	6.00	in
Discharge	0.40	cfs

Results		
Discharge	0.40	cfs
Normal Depth	0.5000	ft
Flow Area	0.2	ft²
Wetted Perimeter	1.57	ft
Hydraulic Radius	0.1250	ft
Top Width	0.00	ft
Critical Depth	0.3239	ft
Percent Full	100.0	%
Critical Slope	0.0092	ft/ft
Velocity	2.06	ft/s
Velocity Head	0.07	ft
Specific Energy	0.57	ft
Froude Number	(N/A)	
Maximum Discharge	0.44	cfs
Discharge Full	0.40	cfs
Slope Full	0.0052	ft/ft
Flow Type	Supercritical	

GVF Input Data		
Downstream Depth	0.0000	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0000	ft
Profile Description	N/A	
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.0	%
Normal Depth Over Rise	100.0	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.5000	ft
Critical Depth	0.3239	ft
Channel Slope	0.0052	ft/ft
Critical Slope	0.0092	ft/ft

Worksheet for Circular Pipe - 6" - 5A to 12" - slope=2.94% (full flow)

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data		
Roughness Coefficient	0.013	
Channel Slope	0.0294	ft/ft
Normal Depth	0.5000	ft
Diameter	6.00	in
Discharge	0.96	cfs

Results		
Discharge	0.96	cfs
Normal Depth	0.5000	ft
Flow Area	0.2	ft²
Wetted Perimeter	1.57	ft
Hydraulic Radius	0.1250	ft
Top Width	0.00	ft
Critical Depth	0.4683	ft
Percent Full	100.0	%
Critical Slope	0.0254	ft/ft
Velocity	4.90	ft/s
Velocity Head	0.37	ft
Specific Energy	0.87	ft
Froude Number	(N/A)	
Maximum Discharge	1.03	cfs
Discharge Full	0.96	cfs
Slope Full	0.0294	ft/ft
Flow Type	Supercritical	

GVF Input Data		
Downstream Depth	0.0000	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0000	ft
Profile Description	N/A	
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.0	%
Normal Depth Over Rise	100.0	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.5000	ft
Critical Depth	0.4683	ft
Channel Slope	0.0294	ft/ft
Critical Slope	0.0254	ft/ft

Worksheet for Circular Pipe - 6" - 6A to 6" - slope=0.56% (full flow)

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data		
Roughness Coefficient	0.013	
Channel Slope	0.0056	ft/ft
Normal Depth	0.5000	ft
Diameter	6.00	in
Discharge	0.42	cfs

Results		
Discharge	0.42	cfs
Normal Depth	0.5000	ft
Flow Area	0.2	ft²
Wetted Perimeter	1.57	ft
Hydraulic Radius	0.1250	ft
Top Width	0.00	ft
Critical Depth	0.3299	ft
Percent Full	100.0	%
Critical Slope	0.0094	ft/ft
Velocity	2.14	ft/s
Velocity Head	0.07	ft
Specific Energy	0.57	ft
Froude Number	(N/A)	
Maximum Discharge	0.45	cfs
Discharge Full	0.42	cfs
Slope Full	0.0056	ft/ft
Flow Type	Supercritical	

GVF Input Data		
Downstream Depth	0.0000	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0000	ft
Profile Description	N/A	
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.0	%
Normal Depth Over Rise	100.0	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.5000	ft
Critical Depth	0.3299	ft
Channel Slope	0.0056	ft/ft
Critical Slope	0.0094	ft/ft

Worksheet for Circular Pipe - 6" - Trench to 2A - slope=1.19% (full flow)

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data		
Roughness Coefficient	0.013	
Channel Slope	0.0119	ft/ft
Normal Depth	0.5000	ft
Diameter	6.00	in
Discharge	0.61	cfs

Results		
Discharge	0.61	cfs
Normal Depth	0.5000	ft
Flow Area	0.2	ft²
Wetted Perimeter	1.57	ft
Hydraulic Radius	0.1250	ft
Top Width	0.00	ft
Critical Depth	0.3975	ft
Percent Full	100.0	%
Critical Slope	0.0126	ft/ft
Velocity	3.12	ft/s
Velocity Head	0.15	ft
Specific Energy	0.65	ft
Froude Number	(N/A)	
Maximum Discharge	0.66	cfs
Discharge Full	0.61	cfs
Slope Full	0.0119	ft/ft
Flow Type	Supercritical	

GVF Input Data		
Downstream Depth	0.0000	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0000	ft
Profile Description	N/A	
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.0	%
Normal Depth Over Rise	100.0	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.5000	ft
Critical Depth	0.3975	ft
Channel Slope	0.0119	ft/ft

Worksheet for Circular Pipe - 6" - Trench to 2A - slope=1.19% (full flow)

GVF Output Data	
Critical Slope	0.0126 ft/ft

Worksheet for Circular Pipe - 6" - Trench to 3A - slope=2.51% (full flow)

Project Description	
Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data		
Roughness Coefficient	0.013	
Channel Slope	0.0251	ft/ft
Normal Depth	0.5000	ft
Diameter	6.00	in
Discharge	0.89	cfs

Results		
Discharge	0.89	cfs
Normal Depth	0.5000	ft
Flow Area	0.2	ft²
Wetted Perimeter	1.57	ft
Hydraulic Radius	0.1250	ft
Top Width	0.00	ft
Critical Depth	0.4590	ft
Percent Full	100.0	%
Critical Slope	0.0218	ft/ft
Velocity	4.53	ft/s
Velocity Head	0.32	ft
Specific Energy	0.82	ft
Froude Number	(N/A)	
Maximum Discharge	0.96	cfs
Discharge Full	0.89	cfs
Slope Full	0.0251	ft/ft
Flow Type	Supercritical	

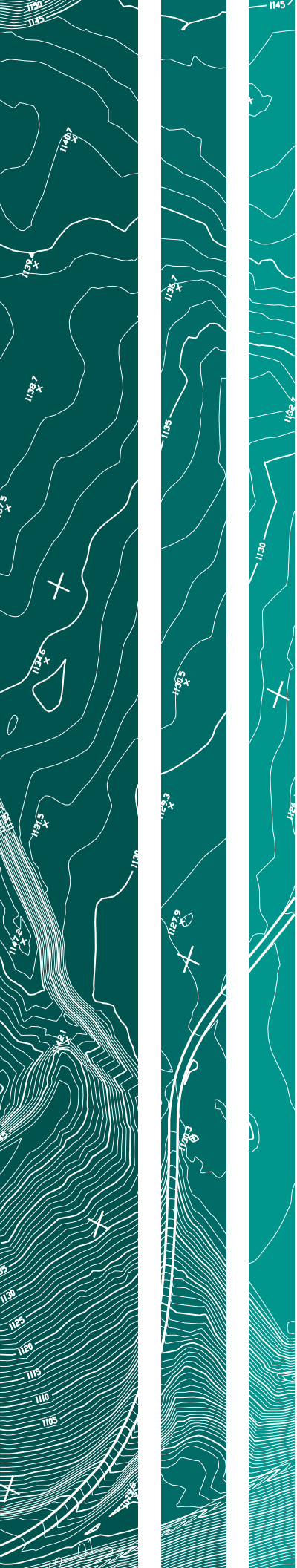
GVF Input Data		
Downstream Depth	0.0000	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0000	ft
Profile Description	N/A	
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.0	%
Normal Depth Over Rise	100.0	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.5000	ft
Critical Depth	0.4590	ft
Channel Slope	0.0251	ft/ft

Worksheet for Circular Pipe - 6" - Trench to 3A - slope=2.51% (full flow)

GVF Output Data	
Critical Slope	0.0218 ft/ft

APPENDIX F: GEOTECHNICAL REPORT BY GEOCON



GEOCON

GEOTECHNICAL INVESTIGATION

LAKEWOOD CIVIC PARK
4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

SEPTEMBER 17, 2024
PROJECT NO. W1974-06-01

PREPARED FOR:
Dahlin Group, Inc.
Pleasanton, California

GEOCON
WEST, INC.
GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

Project No. W1974-06-01
September 17, 2024

Dahlin Group, Inc.
5865 Owens Drive
Pleasanton, CA 94588

Subject: GEOTECHNICAL INVESTIGATION
LAKEWOOD CIVIC PARK
4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

Ladies and Gentlemen:

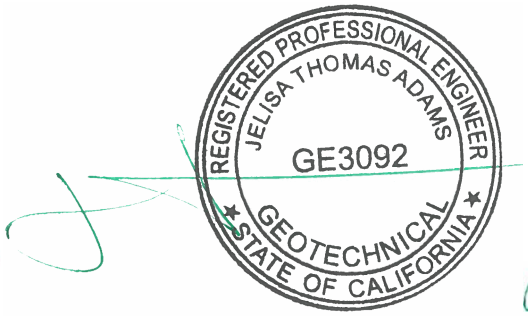
In accordance with your authorization of our proposal dated July 22, 2023, we have performed a geotechnical investigation for proposed Lakewood Civic Park planned for 4900 Clark Avenue in the City of Lakewood, California. The accompanying report presents the findings of our study and our conclusions and recommendations pertaining to the geotechnical aspects of the proposed design and construction. Based on the results of our investigation, it is our opinion that the site can be developed as proposed, provided the recommendations in this report are followed and implemented during design and construction.

If you have any questions regarding this report, or if we may be of further service, please contact the undersigned.

Very truly yours,

GEOCON WEST, INC.







Andrew Sover,
PE 92879

Jelisa Adams
GE 3092

Lisa Battiato
CEG 2316

(email) Addressee

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GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report presents the results of a geotechnical investigation for the proposed Lakewood Civic Park planned for 4900 Clark Avenue in the City of Lakewood, California (see Vicinity Map, Figure1). The purpose of the investigation was to evaluate subsurface soil and geologic conditions underlying the site and, based on conditions encountered, to provide conclusions and recommendations pertaining to the geotechnical aspects of proposed design and construction.

The scope of this investigation included a site reconnaissance, field exploration, laboratory testing, engineering analysis, and the preparation of this report. The site was explored on August 2, 2024, by excavating five 8-inch-diameter borings using a truck-mounted hollow-stem auger drilling machine to depths between 5½ and 63½ feet beneath the ground surface. Additionally, percolation testing was performed in four of the borings (B-1 through B-4) to determine the infiltration rate of site soils. The approximate locations of the exploratory borings are depicted on the Site Plan (see Figure 2). A detailed discussion of the field investigation, including boring logs, is presented in Appendix A.

Laboratory tests were performed on selected soil samples obtained during the investigation to determine pertinent physical and chemical soil properties. Appendix B presents a summary of the laboratory test results.

The recommendations presented herein are based on analysis of the data obtained during the investigation and our experience with similar soil and geologic conditions. References reviewed to prepare this report are provided in the *List of References* section.

If project details vary significantly from those described herein, Geocon should be contacted to determine the necessity for review and possible revision of this report.

2. SITE AND PROJECT DESCRIPTION

The subject site is located at 4900 Clark Avenue in the City of Lakewood, California. The northern half of the site is an asphalt parking lot and the southern half of the site is a vacant lot. The site is bounded a drive aisle and a public library to the north, by an asphalt parking lot and Civic Center Way to the east, by Del Amo Boulevard to the south, and by Clark Avenue to the west. The site is relatively level and surface water drainage at the site appears to flow southeast to the city streets.

Based on the information provided by the Client, it is our understanding that two conceptual plans are being considered for the proposed park. Option 1 includes flatwork and landscape improvements, a restroom and storage building, play area, artistic wall, and trash enclosure. Option 2 depicts two large shade structures over synthetic turf, two stages, a restroom, paved dining area and food truck parking/serving zone. The northeastern parking lot will be preserved to serve either park option. Based on the current site grades with respect to the surrounding roadways, we expect the improvements will be constructed near current site elevations. Plans depicting the proposed improvements are provided on the Site Plan (see Figure 2).

Based on the preliminary nature of the design at this time, wall and column loads were not available. It is anticipated that column loads for the proposed structures will be up to 25 kips, and wall loads will be up to 2 kips per linear foot.

Once the design phase and foundation loading configuration proceeds to a more finalized plan, the recommendations within this report should be reviewed and revised, if necessary. Any changes in the design, location or elevation of any structure, as outlined in this report, should be reviewed by this office. Geocon should be contacted to determine the necessity for review and possible revision of this report.

3. GEOLOGIC SETTING

The site is located in the Los Angeles Basin. The Los Angeles Basin is a coastal plain between the Santa Monica Mountains to the north, the Elysian Hills and Repetto Hills to the northeast, the Puente Hills and Whittier Fault to the east, the Palos Verdes Peninsula and Pacific Ocean on the west and south, and the Santa Ana Mountains and San Joaquin Hills on the southeast. Regionally, the site is located within the Peninsular Ranges geomorphic province, characterized by northwest-trending physiographic and geologic structures such as the nearby Whittier Fault and Newport-Inglewood Fault Zone.

4. SOIL AND GEOLOGIC CONDITIONS

Based on published geologic maps of the area, the site is underlain by younger alluvium and Terrace Deposits/Palos Verdes Sand at depth (Johns, et.al, 1954) most recently referred to as Older Alluvium. The terrace deposits were not encountered in our borings. Artificial fill is present across the site from the previous development. The younger alluvium consists of sandy silt, clay, silt and poorly graded sand. Detailed stratigraphic profiles of the materials encountered at the site are provided on the boring logs in Appendix A.

4.1 Artificial Fill

Artificial fill was encountered in our explorations to a maximum depth of 3 feet below existing ground surface. The artificial fill generally consists of brown sandy silt and can be characterized as slightly moist and soft. The fill is likely the result of past grading or construction activities at the site. Deeper fill may exist between excavations and in other portions of the site that were not directly explored.

4.2 Younger Alluvium

Holocene-age alluvium was encountered beneath the fill in each boring to the maximum depth explored of 63½ feet below existing ground surface. The alluvium generally consists of brown to grey brown interbedded silt, clay, silty sand and poorly graded sand. The alluvial soils are characterized as moist to wet and soft to hard or medium dense to dense.

5. GROUNDWATER

Review of the Seismic Hazard Zone Report for the Long Beach Quadrangle (California Division of Mines and Geology [CDMG], 1998) indicates the historically highest groundwater level in the area is approximately 20 feet beneath the ground surface. Groundwater information presented in this document is generated from data collected in the early 1900's to the late 1990s. Based on current groundwater basin management practices, it is unlikely that groundwater levels will ever exceed the historic high levels.

Groundwater was encountered at a depth of 31 feet below the ground surface during site exploration. The groundwater measurements were performed in a manner that is typical of geotechnical exploration and should not be interpreted as representing a fully equalized water level; the depth to water at the time of construction may be higher or lower than what was observed in the boreholes

Based on the depth of groundwater encountered in our borings and the depth of proposed construction, static groundwater is neither expected to be encountered during construction, nor have a detrimental effect on the project. However, it is not uncommon for groundwater levels to vary seasonally or for groundwater seepage conditions to develop where none previously existed (especially in impermeable fine-grained soils which are heavily irrigated or after seasonal rainfall), groundwater seepage levels encountered during construction may be actually higher than those encountered during our investigation. In addition, recent requirements for stormwater infiltration could result in shallower seepage conditions in the region. Proper surface drainage of irrigation and precipitation will be critical for future performance of the project. Recommendations for drainage are provided in the Surface Drainage section of this report (see Section 7.16).

6. GEOLOGIC HAZARDS

6.1 Surface Fault Rupture

The numerous faults in Southern California include Holocene-active, pre-Holocene, and inactive faults. The criteria for these major groups are based on criteria developed by the California Geological Survey (CGS, formerly known as CDMG) for the Alquist-Priolo Earthquake Fault Zone Program (CGS, 2018). By definition, a Holocene-active fault is one that has had surface displacement within Holocene time (about the last 11,700 years). A pre-Holocene fault has demonstrated surface displacement during Quaternary time (approximately the last 1.6 million years) but has had no known Holocene movement. Faults that have not moved in the last 1.6 million years are considered inactive.

The site is not within a state-designated Alquist-Priolo Earthquake Fault Zone (CGS, 1986) for surface fault rupture hazards. However, the Los Alamos Fault terminates immediately southeast of the site. No Holocene-active or pre-Holocene faults with the potential for surface fault rupture are known to pass directly beneath the site. Therefore, the potential for surface rupture due to faulting occurring beneath the site during the design life of the proposed development is considered low. However, the site is located in the seismically active Southern California region and could be subjected to moderate to strong ground shaking in the event of an earthquake on one of the many active Southern California faults. The faults in the vicinity of the site are shown in Figure 3, Regional Fault Map.

The closest surface trace of an active fault to the site is the Los Alamitos Fault located approximately 50 feet southeast of the site (Jennings & Bryant, 2010). Other nearby active faults are the Newport-Inglewood Fault, the Palos Verdes Fault, the Whittier Fault, and the Hollywood Fault, located approximately 3.5 miles southwest, 11 miles northeast, 11.5 miles to the southwest, and 20 miles to the northwest of the site, respectively (USGS, 2006; Ziony and Jones, 1989). The active San Andreas Fault Zone is located approximately 45 miles northeast of the site (USGS, 2006; Ziony and Jones, 1989).

Several buried thrust faults, commonly referred to as blind thrusts, underlie the Southern California area at depth. These faults are not exposed at the ground surface and are typically identified at depths greater than 3.0 kilometers. The October 1, 1987 M_w 5.9 Whittier Narrows earthquake and the January 17, 1994 M_w 6.7 Northridge earthquake were a result of movement on the Puente Hills Blind Thrust and the Northridge Thrust, respectively. The Puente Hills Blind Thrust underlies the site at depth. These thrust faults and others in the Los Angeles area are not exposed at the surface and do not present a potential surface fault rupture hazard at the site; however, these deep thrust faults are considered active features capable of generating future earthquakes that could result in moderate to significant ground shaking at the site.

6.2 Seismicity

As with all of Southern California, the site has experienced historic earthquakes from various regional faults. The seismicity of the region surrounding the site was formulated based on research of an electronic database of earthquake data. The epicenters of recorded earthquakes with magnitudes equal to or greater than 5.0 in the site vicinity are depicted on Figure 4, Regional Seismicity Map. A partial list of moderate to major magnitude earthquakes that have occurred in the Southern California area within the last 100 years is included in the following table.

LIST OF HISTORIC EARTHQUAKES

Earthquake (Oldest to Youngest)	Date of Earthquake	Magnitude	Distance to Epicenter (Miles)	Direction to Epicenter
Long Beach	March 10, 1933	6.4	19	SE
Tehachapi	July 21, 1952	7.5	94	NW
San Fernando	February 9, 1971	6.6	42	NNW
Whittier Narrows	October 1, 1987	5.9	15	NNE
Sierra Madre	June 28, 1991	5.8	30	NNE
Landers	June 28, 1992	7.3	100	ENE
Big Bear	June 28, 1992	6.4	79	ENE
Northridge	January 17, 1994	6.7	34	NW
Hector Mine	October 16, 1999	7.1	118	ENE
Ridgecrest China Lake Fault	July 5, 2019	7.1	136	NNE

The site could be subjected to strong ground shaking in the event of an earthquake. However, this hazard is common in Southern California and the effects of ground shaking can be minimized if the proposed structures are designed and constructed in conformance with current building codes and engineering practices.

6.3 Seismic Design Criteria

The following table summarizes the site-specific design criteria obtained from the 2022 California Building Code (CBC; Based on the 2021 International Building Code [IBC] and ASCE 7-16), Chapter 16 Structural Design, Section 1613 Earthquake Loads. The data was calculated using the online application U.S. Seismic Design Maps, provided by the Structural Engineers Association of California (SEAOC). The short spectral response uses a period of 0.2 second. We evaluated the Site Class based on the discussion in Section 1613.2.2 of the 2022 CBC and Table 20.3-1 of ASCE 7-16. The values presented on the following page are for the risk-targeted maximum considered earthquake (MCE_R).

2022 CBC SEISMIC DESIGN PARAMETERS

Parameter	Value	2022 CBC Reference
Site Class	D	Section 1613.2.2
MCE_R Ground Motion Spectral Response Acceleration – Class B (short), S_S	1.565g	Figure 1613.2.1(1)
MCE_R Ground Motion Spectral Response Acceleration – Class B (1 sec), S_1	0.559g	Figure 1613.2.1(2)
Site Coefficient, F_A	1	Table 1613.2.3(1)
Site Coefficient, F_V	1.741*	Table 1613.2.3(2)
Site Class Modified MCE_R Spectral Response Acceleration (short), S_{MS}	1.565g	Section 1613.2.3 (Eqn 16-20)
Site Class Modified MCE_R Spectral Response Acceleration – (1 sec), S_{M1}	0.973g*	Section 1613.2.3 (Eqn 16-21)
5% Damped Design Spectral Response Acceleration (short), S_{DS}	1.043g	Section 1613.2.4 (Eqn 16-22)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.649*	Section 1613.2.4 (Eqn 16-23)

*Per Supplement 3 of ASCE 7-16, a ground motion hazard analysis (GMHA) shall be performed for projects on Site Class "D" sites with 1-second spectral acceleration (S1) greater than or equal to 0.2g, which is true for this site. However, Supplement 3 of ASCE 7-16 provides an exception stating that that the GMHA may be waived provided that the parameter SM1 is increased by 50% for all applications of SM1. The values for parameters SM1 and SD1 presented above have **not** been increased in accordance with Supplement 3 of ASCE 7-16.

The table below presents the mapped maximum considered geometric mean (MCE_G) seismic design parameters for projects located in Seismic Design Categories of D through F in accordance with ASCE 7-16.

ASCE 7-16 PEAK GROUND ACCELERATION

Parameter	Value	ASCE 7-16 Reference
Mapped MCE_G Peak Ground Acceleration, PGA	0.671g	Figure 22-9
Site Coefficient, F_{PGA}	1.1	Table 11.8-1
Site Class Modified MCE_G Peak Ground Acceleration, PGA_M	0.738g	Section 11.8.3 (Eqn 11.8-1)

Deaggregation of the MCE peak ground acceleration was performed using the USGS online Unified Hazard Tool, 2014 Conterminous U.S. Dynamic edition (v4.2.0). The result of the deaggregation analysis indicates that the predominant earthquake contributing to the MCE peak ground acceleration is characterized as a 7.3 magnitude event occurring at a hypocentral distance of 10.67 kilometers from the site.

Conformance to the criteria in the above tables for seismic design does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur if a large earthquake occurs. The primary goal of seismic design is to protect life, not to avoid all damage, since such design may be economically prohibitive.

6.4 Liquefaction Potential

Liquefaction is a phenomenon in which loose, saturated, relatively cohesionless soil deposits lose shear strength during strong ground motions. Primary factors controlling liquefaction include intensity and duration of ground motion, gradation characteristics of the subsurface soils, in-situ stress conditions, and the depth to groundwater. Liquefaction is typified by a loss of shear strength in the liquefied layers due to rapid increases in pore water pressure generated by earthquake accelerations.

The current standard of practice, as outlined in the "Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California" and "Special Publication 117A, Guidelines for Evaluating and Mitigating Seismic Hazards in California" requires liquefaction analysis to a depth of 50 feet below the lowest portion of the proposed structure. Liquefaction typically occurs in areas where the soils below the water table are composed of poorly consolidated, fine- to medium-grained, primarily sandy soil. In addition to the requisite soil conditions, the ground acceleration and duration of the earthquake must also be of a sufficient level to induce liquefaction.

The State of California Seismic Hazard Zone Map for the Long Beach Quadrangle (CDMG, 1999) indicates that the site is located in an area designated as having a potential for liquefaction.

The historic high groundwater level in the site vicinity is at a depth of 20 feet beneath the ground surface. Groundwater was encountered in boring B5 at an approximate depth of 31 feet beneath the ground surface.

Liquefaction analysis of the soils underlying the site was performed using the 1996 NCEER method of analysis with the updates by Youd et al. (2001). This semi-empirical method is based on a correlation between values of Standard Penetration Test (SPT) resistance and field performance data.

Screening criteria developed by Bray and Sancio (2006) characterize fine-grained soils which are not susceptible to liquefaction as soils with a plasticity index (PI) that is greater than 18 or with a saturated moisture content that is less than 80 percent of the liquid limit. In order to apply the screening criteria, laboratory testing was performed to evaluate the Atterberg Limits of select soil samples. Laboratory test results used for the screening criteria are presented as Figure B5.

The liquefaction analysis was performed for the Maximum Considered Earthquake level by using a groundwater table of 20 feet below the ground surface, a magnitude 7.3 earthquake, and a peak horizontal acceleration of 0.738g (PGA_M). The enclosed liquefaction analysis, included herein for boring B5, indicates that the alluvium below the historic high groundwater level could be susceptible to approximately 1.6 inches of liquefaction settlement during Maximum Considered Earthquake ground motion (see enclosed calculation sheets, Figures 5 and 6).

6.5 Seismically-Induced Settlement

Dynamic compaction of dry and loose sands may occur during a major earthquake. Typically, settlements occur in thick beds of such soils. The seismically-induced settlement calculations were performed in accordance with the American Society of Civil Engineers, Technical Engineering and Design Guides as adapted from the US Army Corps of Engineers, No. 9.

The calculations provided herein for boring B1 indicates that the soil above the historic high groundwater level of 20 feet could be susceptible to approximately 0.35 inches of settlement as a result of the Maximum Considered Earthquake peak ground acceleration (PGA_M). Calculation of the anticipated seismically-induced settlements is provided as Figure 7.

6.6 Slope Stability

The topography at the site is relatively level and the topography in the immediate site vicinity slopes very gently to the south-southwest. The Seismic Hazards Zones Map of the Long Beach Quadrangle (CGS, 1999). Additionally, the site is not within an area identified as having a potential for seismic slope instability (CGS 1999). There are no known landslides near the site, nor is the site in the path of any known or potential landslides. Therefore, the potential for slope stability hazards to adversely affect the proposed development is considered low.

6.7 Earthquake-Induced Flooding

Earthquake-induced flooding is inundation caused by failure of dams or other water-retaining structures due to earthquakes. Based on a review of the California Department of Water Resources Dam Breach Inundation Map Web Publisher, the site is not located within a potential inundation area for an earthquake-induced dam failure. Therefore, the probability of earthquake-induced flooding is considered very low.

6.8 Tsunamis, Seiches, and Flooding

The site is not located within a coastal area. Therefore, tsunamis are not considered a significant hazard at the site.

Seiches are large waves generated in enclosed bodies of water in response to ground shaking. No major water-retaining structures are located immediately up gradient from the project site. Therefore, flooding resulting from a seismically induced seiche is considered unlikely.

The site is within an area of reduced flood risk due to levee (Zone X) as defined by the Federal Emergency Management Agency (FEMA, 2008).

6.9 Oil Fields & Methane Potential

Based on a review of the California Geologic Energy Management Division (CalGEM) Well Finder Website, the site is not located within an oil field and oil or gas wells are not documented within ½-mile of the site (CalGEM, 2024). However, due to the voluntary nature of record reporting by the oil well drilling companies, wells may be improperly located or not shown on the location map and undocumented wells could be encountered during construction. Any wells encountered during construction will need to be properly abandoned in accordance with the current requirements of CalGEM.

Since the site is not located within the boundaries of a known oil field, the potential for the presence of methane or other volatile gases at the site is considered low. However, should it be determined that a methane study is required for the proposed development it is recommended that a qualified methane consultant be retained to perform the study and provide mitigation measures as necessary.

6.10 Subsidence

Subsidence occurs when a large portion of land is displaced vertically, usually due to the withdrawal of groundwater, oil, or natural gas. Soils that are particularly subject to subsidence include those with high silt or clay content. The site is located within an area of known ground subsidence due to groundwater pumping (USGS, 2024). Ground subsidence typically over a region and may not necessarily result in differential settlement within relatively small areas such as the subject site.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 General

7.1.1 It is our opinion that neither soil nor geologic conditions were encountered during the investigation that would preclude the construction of the proposed development provided the recommendations presented herein are followed and implemented during design and construction.

7.1.2 Up to 3 feet of existing artificial fill was encountered during the site investigation. The existing fill encountered is believed to be the result of past grading and construction activities at the site. Deeper fill may exist in other areas of the site that were not directly explored. It is our opinion that the existing fill, in its present condition, is not suitable for direct support of proposed foundations or slabs. The existing fill and site soils are suitable for re-use as engineered fill provided the recommendations in the *Grading* section of this report are followed (see Section 7.4).

7.1.3 The enclosed seismically-induced settlement analyses indicate that the site soils could be susceptible to up to approximately 2 inches of total settlement as a result of the Maximum Considered Earthquake peak ground acceleration (PGA_M). The resulting differential settlement at the ground surface is anticipated to be less than 1 inch over a distance of 30 feet. The grading and foundation design recommendations presented herein are intended to reduce the effects of settlement on proposed improvements.

7.1.4 Based on these considerations, is recommended that proposed habitable structures be supported on a conventional foundation system deriving support in a blanket of newly placed engineered fill. All foundation excavations must be observed and approved in writing by the Geotechnical Engineer prior to placement of steel or concrete. Recommendations for the *Foundation Design* are provided in Sections 7.5 and 7.6.

7.1.4 As a minimum, it is recommended that the upper 3 feet of existing earth materials within proposed habitable structure footprint areas be excavated and properly compacted for foundation and slab support. Deeper excavations should be conducted as needed to remove any deeper fill or soft soils as necessary at the direction of the Geotechnical Engineer (a representative of Geocon). The excavation should extend laterally a minimum distance of 3 feet beyond the building footprint areas, including building appurtenances, or a distance equal to the depth of fill below the foundation, whichever is greater. The limits of existing fill and/or soft soil removal will be verified by the Geocon representative during site grading activities. Recommendations for earthwork are provided in the Grading section of this report (see Section 6.4).7.1.6 All excavations must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon) prior to the placement of bedding materials, fill, gravel, steel, or concrete.

7.1.5 The upper alluvial soils at the site are currently very moist and the grading contractor should be aware that the existing soils are currently near or slightly above optimum moisture content. Conditions could change seasonally. If the soils are in excess of 3 percent above optimum moisture content at the time of construction the soils will likely require some spreading and drying activities in order to achieve proper compaction. Additionally, stabilization of the excavation bottom may be required prior to the placement and compaction of engineered fill.

7.1.6 It is anticipated that stable excavations for the recommended grading associated with the proposed structures can be achieved with sloping measures. However, if excavations in close proximity to an adjacent property line and/or structure are required, special excavation measures may be necessary in order to maintain lateral support of offsite improvements. Excavation recommendations are provided in the *Temporary Excavations* section of this report (Section 7.13).

7.1.7 It should be noted that implementation of the recommendations presented herein is not intended to completely prevent damage to the structure during the occurrence of strong ground shaking as a result of nearby earthquakes. It is intended that the structure be designed in such a way that the amount of damage incurred as a result of strong ground shaking be minimized.

7.1.8 It is recommended that flexible utility connections be considered for all rigid utilities to minimize or prevent damage to utilities from minor differential movements.

7.1.9 Foundations for small outlying structures, such as block walls up to 6 feet high, planter walls or trash enclosures, which will not be tied-in to the proposed structure, may be supported on conventional foundations bearing on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and proper compaction cannot be performed, foundations may derive support directly in the undisturbed alluvial soils at or below a depth of 2½ feet and should be deepened as necessary to maintain a minimum of 12-inch embedment into recommended bearing materials. If the soils exposed in the excavation bottom are soft or loose, compaction of the soft soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved in writing by a Geocon representative.

7.1.9 Cast-in-place friction piles may be utilized for support of proposed lighting improvements, as well as proposed shade structures, provided foundations derive support in the competent alluvium found at or below a depth of 3 feet. Recommendations for friction pile design are provided in Section 6.7 of this report.

7.1.10 Where new paving is to be placed, it is recommended that all existing fill soils and soft alluvial soils be excavated and properly compacted for paving support. The client should be aware that excavation and compaction of all existing fill in the area of new paving is not required; however, paving constructed over existing uncertified fill or unsuitable soils may experience increased settlement and/or cracking, and may therefore have a shorter design life and increased maintenance costs. As a minimum, the upper 12 inches of soil should be scarified and properly compacted for paving support. Paving recommendations are provided in the *Preliminary Pavement Recommendations* section of this report (see Section 7.12).

7.1.11 Based on the results of the percolation testing, stormwater infiltration is not considered feasible for this project. It is recommended that stormwater be retained, filtered, and discharged in accordance with the requirements of the local governing agency. Discussion on the percolation test results are provided in Section 7.15.

7.1.12 Once the design and foundation loading configuration for the proposed structures proceeds to a more finalized plan, the recommendations within this report should be reviewed and revised, if necessary. Based on the final foundation loading configurations, the potential for settlement should be re-evaluated by this office.

7.1.13 Any changes in the design, location or elevation, as outlined in this report, should be reviewed by this office. Geocon should be contacted to determine the necessity for review and possible revision of this report.

7.1.14 The most recent ASTM standards apply to this project and must be utilized, even if older ASTM standards are indicated in this report.

7.2 Soil and Excavation Characteristics

7.2.1 The in-situ soils can be excavated with moderate effort using conventional excavation equipment. Some caving should be anticipated in unshored excavations, especially where granular soils are encountered.

7.2.2 It is the responsibility of the contractor to ensure that all excavations and trenches are properly shored and maintained in accordance with applicable OSHA rules and regulations to maintain safety and maintain the stability of existing adjacent improvements.

7.2.3 All onsite excavations must be conducted in such a manner that potential surcharges from existing structures, construction equipment, and vehicle loads are resisted. The surcharge area may be defined by a 1:1 projection down and away from the bottom of an existing foundation or vehicle load. Penetrations below this 1:1 projection will require special excavation measures such as sloping or shoring. Excavation recommendations are provided in the *Temporary Excavations* section of this report (see Section 7.13).

7.2.4 The upper five feet of existing site soils encountered during the investigation are considered to have a “low” expansive potential (EI = 27) and are classified as “expansive” in accordance with the 2022 California Building Code (CBC) Section 1803.5.3. The recommendations presented herein assume that foundations and slabs as well as new paving and hardscape will derive support in these materials.

7.3 Minimum Resistivity, pH, and Water-Soluble Sulfate

7.3.1 Potential of Hydrogen (pH) and resistivity testing as well as chloride content testing were performed on representative samples of soil to generally evaluate the corrosion potential to surface utilities. The tests were performed in accordance with California Test Method Nos. 643 and 422 and indicate that the soils are considered “severely corrosive” with respect to corrosion of buried ferrous metals on site. The results are presented in Appendix B (Figure B9) and should be considered for design of underground structures. Due to the corrosive potential of the soils, it is recommended that PVC, ABS or other approved plastic piping be utilized in lieu of cast-iron when in direct contact with the site soils.

7.3.2 Laboratory tests were performed on representative samples of the on-site soil to measure the percentage of water-soluble sulfate content. Results from the laboratory water-soluble sulfate tests are presented in Appendix B (Figure B9) and indicate that the on-site soil possess a sulfate exposure class of "S0" to concrete structures as defined by 2022 CBC Section 1904 and ACI 318-19 Chapter 19.

7.3.3 Geocon West, Inc. does not practice in the field of corrosion engineering and mitigation. If corrosion sensitive improvements are planned, it is recommended that a corrosion engineer be retained to evaluate corrosion test results and incorporate the necessary precautions to avoid premature corrosion of buried metal pipes and concrete structures in direct contact with the soils.

7.4 Grading

7.4.1 Grading is anticipated to include preparation of building pads, excavation of site soils for the foundations and utility trenches, placement of backfill for trenches, and preparation of paving and hardscape subgrade.

7.4.2 A preconstruction conference should be held at the site prior to the beginning of excavation operations with the owner, contractor, civil engineer, geotechnical engineer, and building official in attendance. Special soil handling requirements can be discussed at that time.

7.4.3 Earthwork should be observed, and compacted fill tested by representatives of Geocon West, Inc. The existing fill and alluvial soil encountered during exploration are suitable for re-use as an engineered fill, provided any encountered oversize material (greater than 6 inches) and any encountered deleterious debris are removed.

7.4.4 Grading should commence with the removal of all existing vegetation and existing improvements from the area to be graded. Deleterious debris such as wood and root structures should be exported from the site and should not be mixed with the fill soils. Asphalt and concrete should not be mixed with the fill soils unless approved by the Geotechnical Engineer. All existing underground improvements planned for removal should be completely excavated and the resulting depressions properly backfilled in accordance with the procedures described herein. Once a clean excavation bottom has been established it must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.).

7.1.4 As a minimum, it is recommended that the upper 3 feet of existing earth materials within proposed habitable structure footprint areas be excavated and properly compacted for foundation and slab support. Deeper excavations should be conducted as needed to remove any deeper fill or soft soils as necessary at the direction of the Geotechnical Engineer (a representative of Geocon). The excavation should extend laterally a minimum distance of 3 feet beyond the building footprint areas, including building appurtenances, or a distance equal to the depth of fill below the foundation, whichever is greater. The limits of existing fill and/or soft soil removal will be verified by the Geocon representative during site grading activities. All excavations must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon).

7.4.5 Based on the conditions encountered during site exploration, areas of soft and overly moist soils may be encountered during grading operations. These conditions may change seasonally. If the soils are more than 3 percent above the optimum moisture content at the time of construction the soils will likely require some spreading and drying activities in order to achieve proper compaction.

7.4.6 Prior to placing fill, a stable excavation bottom must be established. In areas where the subgrade is saturated or soft, proper compaction will likely not be possible or achieved in a timely manner without introducing stabilization measures. If subgrade stabilization is required at the excavation bottom, rubber tire equipment should not be allowed in the excavation bottom until it is stabilized or extensive soil disturbance could result. It is suggested that excavation and grading be performed during the summer season to promote moisture control of the soils. In addition, the use of track equipment should be used to minimize disturbance to the soils at the excavation bottom.

7.4.7 Bottom stabilization, if necessary, may be achieved placing a thin lift of 3- to 6-inch-diameter crushed angular rock into the soft excavation bottom. The use of crushed concrete will also be acceptable. The crushed rock should be spread thinly across the excavation bottom and pressed into the soils by track rolling or wheel rolling with heavy equipment. It is very important that voids between the rock fragments are not created so the rock must be thoroughly pressed or blended into the soils. All subgrade soils must be properly compacted and proof-rolled in the presence of the Geotechnical Engineer (a representative of Geocon West, Inc.).

7.4.8 An additional method of subgrade stabilization would be to place a minimum 12 inches thick layer of aggregate base over Tensar InterAx NX850 geogrid or equivalent extruded (nonwoven) geotextile. The Tensar geogrids should be installed taught and should overlap in accordance with the manufacturer's recommendations. Prior to placing the geogrid, excessively soft or wet materials should be removed and the resulting excavation bottom should be free of loose material. Non-vibratory compaction methods should be used for compaction of the base material. The aggregate base should be compacted to a dry density of at least 95 percent of the laboratory maximum density near the optimum moisture. If pumping of the subgrade continues, a thicker layer of aggregate base may be placed. It is very important that subgrade stabilization be performed uniformly across the entire excavation bottom.

7.4.9 Stable excavations for the recommended grading can be achieved with sloping measures. However, if excavations in close proximity to an adjacent property line and/or structure are required, special excavation measures such as slot cutting may be necessary in order to maintain lateral support of the existing offsite improvements. Excavation recommendations are provided in the Temporary Excavations section of this report (Section 7.13).

7.4.10 All fill and backfill soils should be placed in horizontal loose layers approximately 6 to 8 inches thick, moisture conditioned to near to slightly above optimum moisture content, and properly compacted to a minimum 90 percent of the maximum dry density in accordance with ASTM D 1557 (latest edition).

7.4.11 Although not anticipated for this project, all imported fill shall be observed, tested, and approved by Geocon West, Inc. prior to bringing soil to the site. Import fill should consist of the characteristics presented in the table below.

SUMMARY OF IMPORT FILL RECOMMENDATIONS

Soil Characteristic	Values
Expansion Potential	"Low" (Expansion Index of 50 or less)
Particle Size	Maximum Dimension Less Than 6 Inches
	Free of Debris
Corrosivity	Less Detrimental Than Existing Onsite Soils

7.4.12. Where new paving is to be placed, it is recommended that all existing fill and soft alluvium be excavated and properly compacted for paving support. As a minimum, the upper 12 inches of soil should be scarified, moisture conditioned to near to slightly above optimum moisture content, and compacted to at least 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition). Paving recommendations are provided in *Preliminary Pavement Recommendations* section of this report (see Section 7.12).

7.4.13 Foundations for small outlying structures, such as block walls up to 6 feet high, planter walls or trash enclosures, which will not be tied to the proposed building, may be supported on conventional foundations deriving support on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and proper compaction cannot be performed, foundations may derive support directly in the undisturbed alluvial soils at and below a depth of 2½ feet below the existing ground surface and should be deepened as necessary to maintain a minimum 12-inch embedment into the recommended bearing materials. If the soils exposed in the excavation bottom are soft or loose, compaction of the soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved by a Geocon representative.

7.4.14 Utility trenches should be properly backfilled in accordance with the following requirements. The pipe should be bedded with clean sands (Sand Equivalent greater than 30) to a depth of at least 1 foot over the pipe, and the bedding material must be inspected and approved in writing by the Geotechnical Engineer (a representative of Geocon). The use of gravel is not acceptable unless used in conjunction with filter fabric to prevent the gravel from having direct contact with soil. The remainder of the trench backfill may be derived from onsite soil or approved import soil, compacted as necessary, until the required compaction is obtained. The use of minimum 2-sack slurry as backfill is also acceptable. Prior to placing any bedding materials or pipes, the excavation bottom must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon).

7.4.15 All trench and foundation excavation bottoms must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon), prior to placing bedding materials, fill, steel, gravel, or concrete.

7.5 Shrinkage

7.5.1 Shrinkage results when a volume of material removed at one density is compacted to a higher density. A shrinkage factor of between 10 and 18 percent should be anticipated when excavating and compacting the upper few feet of existing earth materials on the site to an average relative compaction of 92 percent.

7.4.2 If import soils will be utilized in the building pad, the soils must be placed uniformly and at equal thickness at the direction of the Geotechnical Engineer (a representative of Geocon West, Inc.). Soils can be borrowed from non-building pad areas and later replaced with imported soils.

7.6 Conventional Foundation Design

7.6.1 Once the foundation loading configuration for the proposed structures proceeds to a more finalized plan, the recommendations within this report should be reviewed and revised, if necessary.

7.6.2 A conventional shallow spread foundation system may be utilized for support of the proposed structures provided foundations derive support in a blanket of newly placed engineered fill. All foundation excavations must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon), prior to placing steel or concrete.

7.6.3 Conventional shallow spread foundations for proposed structures should consist of continuous strip footings and/or isolated spread footings and should be designed using the parameters in the table on the following page.

SUMMARY OF FOUNDATION RECOMMENDATIONS

Parameter	Value
Minimum Continuous Foundation Width	12 Inches
Minimum Isolated Foundation Width	24 Inches
Minimum Foundation Depth	18 Inches Below Lowest Adjacent Grade & 12 Inches into Recommended Bearing Material
Minimum Steel Reinforcement	4 No. 4 Bars, 2 Top and 2 Bottom
Allowable Bearing Capacity – Continuous Foundation	2,000 psf
Allowable Bearing Capacity – Isolated Foundation	2,500 psf
Bearing Capacity Increase	250 psf per Foot of Width
	600 psf per Foot of Depth
Maximum Allowable Bearing Capacity	3,500 psf
Estimated Total Settlement	½ Inch
Estimated Differential Settlement	¼ Inch over 20 Feet

7.6.4 The above foundation dimensions and minimum reinforcement recommendations are based on soil conditions and building code requirements only and are not intended to be used in lieu of those required for structural purposes.

7.6.5 The allowable bearing pressure may be increased by up to one-third for transient loads due to wind or seismic forces.

7.6.6 The enclosed liquefaction analyses indicate that the site soils could be susceptible to up to approximately 2 inches of total settlement as a result of the MCE peak ground acceleration (PGA_M). The resulting differential settlement at the ground surface is anticipated to be less than 1 inch over a distance of 30 feet. These settlements are in addition to the static settlements indicated in the table above and must be considered in the structural design.

7.6.7 Once the design and foundation loading configurations for the proposed structures proceeds to a more finalized plan, the estimated settlements presented in this report should be reviewed and revised, if necessary. If the final foundation loading configurations are greater than the assumed loading conditions, the potential for settlement should be reevaluated by this office.

7.6.8 No special subgrade presaturation is required prior to placement of concrete. However, the moisture in the foundation subgrade should be sprinkled as necessary to maintain a moist condition at the time of concrete placement.

7.6.9 Foundation excavations should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to the placement of reinforcing steel and concrete to verify that the excavations and exposed soil conditions are consistent with those anticipated. If unanticipated soil conditions are encountered, foundation modifications may be required.

7.6.10 This office should be provided with a copy of the final construction plans so that the excavation recommendations presented herein could be properly reviewed and revised if necessary.

7.7 Miscellaneous Foundations

7.7.1 Foundations for small outlying structures, such as block walls up to 6 feet in height, planter walls or trash enclosures, which will not be tied to the proposed structure, may be supported on conventional foundations deriving support on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and compaction cannot be performed, foundations may derive support directly in the competent undisturbed alluvial soils at and below a depth of 2½ feet and should be deepened as necessary to maintain a minimum 12-inch embedment into the recommended bearing materials.

7.7.2 If the soils exposed in the excavation bottom are soft, compaction of the soft soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved by a Geocon representative. Miscellaneous foundations may be designed for a bearing value of 1,500 psf and should be a minimum of 12 inches in width, 18 inches in depth below the lowest adjacent grade and 12 inches into the recommended bearing material. The allowable bearing pressure may be increased by up to one-third for transient loads due to wind or seismic forces.

7.7.3 Foundation excavations should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to the placement of reinforcing steel and concrete to verify that the excavations and exposed soil conditions are consistent with those anticipated.

7.8 Lateral Design

7.8.1 Resistance to lateral loading may be provided by friction acting at the base of foundations, slabs and by passive earth pressure. An allowable coefficient of friction of 0.35 may be used with the dead load forces in the newly placed engineered fill or alluvial soils.

7.8.2 Passive earth pressure for the sides of foundations and slabs poured against newly placed engineered fill or undisturbed alluvial soils may be computed as an equivalent fluid having a density of 230 pounds per cubic foot (pcf) with a maximum earth pressure of 2,300 psf. When combining passive and friction for lateral resistance, the passive component should be reduced by one-third. A one-third increase in the passive value may be used for wind or seismic loads.

7.9 Friction Pile Foundations – Light Standards

7.9.1 Typical light standards are between 10 and 15 feet in height and are supported on pile foundations. Cast-in-place friction piles may be utilized for support of the proposed lighting poles as well as proposed shade structures provided foundations derive support in or the competent alluvium found at and below a depth of 3 feet.

7.9.2 Friction piles should be a minimum of 18 inches in diameter and should be embedded a minimum of 6 feet into the recommended bearing materials (undisturbed alluvium). Where not protected by pavement, the upper two feet of soil should be ignored when calculating axial and lateral capacity.

7.9.3 Friction piles may be designed based on a skin friction capacity of 100 pounds per square foot and do not require the complete removal of all loose earth materials from the bottom of the excavation since the end-bearing capacity is not being considered for design. However, a cleanout of the excavation bottom will be required. Piles may be assumed fixed at an embedment depth of 5 feet below the ground surface. Single pile uplift capacity can be taken as 60 percent of the allowable downward capacity. The allowable downward capacity and allowable uplift capacity may be increased by one-third when considering transient wind or seismic loads.

7.9.4 For design purposes, an allowable passive value for the soils may be assumed to be 230 psf per foot with a maximum earth pressure of 2,300 psf. To develop the full lateral value, provisions should be implemented to assure firm contact between the piles and the engineered fill and underlying alluvium. A one-third increase in the passive value may be used for wind or seismic loads. The allowable capacity may be doubled for isolated piles spaced more than three times the diameter on-center.

7.9.5 All drilled pile excavations should be continuously observed by personnel of this firm to verify adequate penetration into the recommended bearing materials. The capacity presented is based on the strength of the soils. The compressive and tensile strength of the pile sections should be checked to verify the structural capacity of the piles.

7.10 Pile Installation

7.10.1 Caving may occur in granular soils and the contractor should have casing available prior to commencement of pile excavation. When casing is used, extreme care should be employed so that the pile is not pulled apart as the casing is withdrawn. At no time should the distance between the surface of the concrete and the bottom of the casing be less than 5 feet. Continuous observation of the drilling and pouring of the piles by the Geotechnical Engineer (a representative of Geocon West, Inc.), is required.

7.10.2 Groundwater was encountered during exploration at a depth of 31 feet beneath the ground surface. Groundwater is not expected to be encountered during construction. However, should groundwater or seepage be encountered during pile installation, the contractor should be prepared. Piles placed below the water level require the use of a tremie to place the concrete into the bottom of the hole. A tremie should consist of a rigid, water-tight tube having a diameter of not less than 6 inches with a hopper at the top. The tube should be equipped with a device that will close the discharge end and prevent water from entering the tube while it is being charged with concrete. The tremie should be supported so as to permit free movement of the discharge end over the entire top surface of the work and to permit rapid lowering when necessary to retard or stop the flow of concrete. The discharge end should be closed at the start of the work to prevent water entering the tube and should be entirely sealed at all times, except when the concrete is being placed. The tremie tube should be kept full of concrete. The flow should be continuous until the work is completed and the resulting concrete seal should be monolithic and homogeneous. The tip of the tremie tube should always be kept about 5 feet below the surface of the concrete and definite steps and safeguards should be taken to insure that the tip of the tremie tube is never raised above the surface of the concrete.

7.10.3 A special concrete mix should be used for concrete to be placed below water. The design should provide for concrete with an unconfined compressive strength psi of 1,000 pounds per square inch (psi) over the initial job specification. An admixture that reduces the problem of segregation of paste/aggregates and dilution of paste should be included. The slump should be commensurate to any research report for the admixture, provided that it should also be the minimum for a reasonable consistency for placing when water is present.

7.10.4 Closely spaced piles should be drilled and filled alternately, with the concrete permitted to set at least eight hours before drilling an adjacent hole. Unless the holes are fully cased from top to bottom, it is not recommended that holes be left open overnight.

7.11 Concrete Slabs-on-Grade

7.11.1 Concrete slabs-on-grade subject to vehicle loading should be designed in accordance with the recommendations in the Preliminary Pavement Recommendations section of this report (Section 7.12).

7.11.2 Subsequent to the recommended grading, concrete slabs-on-grade for structures, not subject to vehicle loading, should be a minimum of 4 inches thick and minimum slab reinforcement should consist of No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions. Steel reinforcing should be positioned vertically near the slab midpoint.

7.11.3 Slabs-on-grade at the ground surface that may receive moisture-sensitive floor coverings or may be used to store moisture-sensitive materials should be underlain by a vapor retarder placed directly beneath the slab. The vapor retarder and acceptable permeance should be specified by the project architect or developer based on the type of floor covering that will be installed. The vapor retarder selection and design should be consistent with the guidelines presented in Section 9.3 of the American Concrete Institute's (ACI) Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials (ACI 302.2R-06) as well as ASTM E1745 and should be installed in general conformance with ASTM E 1643 (latest edition) and the manufacturer's recommendations. A minimum thickness of 15 mils extruded polyolefin plastic is recommended; vapor retarders which contain recycled content or woven materials are not recommended. The vapor retarder should have a permeance of less than 0.01 perms demonstrated by testing before and after mandatory conditioning is recommended. The vapor retarder should be installed in direct contact with the concrete slab with proper perimeter seal. If the California Green Building Code requirements apply to this project, the vapor retarder should be underlain by 4 inches of clean aggregate. It is important that the vapor retarder be puncture resistant since it will be in direct contact with angular gravel. As an alternative to the clean aggregate suggested in the Green Building Code, it is our opinion that the concrete slab-on-grade may be underlain by a vapor retarder over 4-inches of clean sand (sand equivalent greater than 30), since the sand will serve a capillary break and will minimize the potential for punctures and damage to the vapor barrier.

7.11.4 For seismic design purposes, a coefficient of friction of 0.35 may be utilized between concrete slabs and subgrade soils without a moisture barrier, and 0.15 for slabs underlain by a moisture barrier.

7.11.5 Exterior slabs for walkways and flatwork, not subject to traffic loads, should be at least 4 inches thick and reinforced with No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions, positioned near the slab midpoint. Prior to construction of slabs, the upper 12 inches of subgrade should be moistened to near to slightly above optimum moisture content and properly compacted to at least 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition). Crack control joints should be spaced at intervals not greater than 10 feet and should be constructed using saw-cuts or other methods as soon as practical following concrete placement. Crack control joints should extend a minimum depth of one-fourth the slab thickness. Construction joints should be designed by the project structural engineer.

7.11.6 The moisture content of the slab subgrade should be maintained and sprinkled as necessary to maintain a moist condition as would be expected in any concrete placement.

7.11.7 The recommendations of this report are intended to reduce the potential for cracking of slabs due to settlement. However, even with the incorporation of the recommendations presented herein, foundations, stucco walls, and slabs-on-grade may exhibit some cracking due to minor soil movement and/or concrete shrinkage. The occurrence of concrete shrinkage cracks is independent of the supporting soil characteristics. Their occurrence may be reduced and/or controlled by limiting the slump of the concrete, proper concrete placement and curing, and by the placement of crack control joints at periodic intervals, in particular, where re-entrant slab corners occur.

7.12 Preliminary Pavement Recommendations

7.12.1 Where new paving is to be placed, it is recommended that all existing fill and soft alluvium materials be excavated and properly compacted for paving support. The client should be aware that excavation and compaction of all existing artificial fill and soft alluvium in the area of new paving is not required; however, paving constructed over existing uncertified fill or unsuitable alluvium material may experience increased settlement and/or cracking, and may therefore have a shorter design life and increased maintenance costs. As a minimum, the upper 12 inches of paving subgrade should be scarified, moisture conditioned to near to slightly above optimum moisture content, and properly compacted to at least 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition).

7.12.2 The following pavement sections are based on a R-Value of 25. Once site grading activities are complete an R-Value should be obtained by laboratory testing to confirm the properties of the soils serving as paving subgrade, prior to placing pavement.

7.12.3 The Traffic Indices listed below are estimates. Geocon does not practice in the field of traffic engineering. The actual Traffic Index for each area should be determined by the project civil engineer. If pavement sections for Traffic Indices other than those listed below are required, Geocon should be contacted to provide additional recommendations. Pavement thicknesses were determined following procedures outlined in the *California Highway Design Manual* (Caltrans). It is anticipated that the majority of traffic will consist of automobile and large truck traffic.

PRELIMINARY PAVEMENT DESIGN SECTIONS

Location	Estimated Traffic Index (TI)	Asphalt Concrete (inches)	Class 2 Aggregate Base (inches)
Automobile Parking and Driveways	4.0	3.0	4.0
Trash Truck & Fire Lanes	7.0	4.0	12.0

7.12.4 Asphalt concrete should conform to Section 203-6 of the "*Standard Specifications for Public Works Construction"* (Green Book). Class 2 aggregate base materials should conform to Section 26-1.02A of the "*Standard Specifications of the State of California, Department of Transportation"* (Caltrans). The use of Crushed Miscellaneous Base (CMB) in lieu of Class 2 aggregate base is acceptable. Crushed Miscellaneous Base should conform to Section 200-2.4 of the "*Standard Specifications for Public Works Construction"* (Green Book).

7.12.5 Unless specifically designed and evaluated by the project structural engineer, where exterior concrete paving will be utilized for support of vehicles, it is recommended that the concrete be a minimum of 6 inches of concrete reinforced with No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions. Concrete paving supporting vehicular traffic should be underlain by a minimum of 4 inches of aggregate base and a properly compacted subgrade. The subgrade and base material should be compacted to 95 percent relative compaction as determined by ASTM Test Method D 1557 (latest edition).

7.12.6 The performance of pavements is highly dependent upon providing positive surface drainage away from the edge of pavements. Ponding of water on or adjacent to the pavement will likely result in saturation of the subgrade materials and subsequent cracking, subsidence and pavement distress. If planters are planned adjacent to paving, it is recommended that the perimeter curb be extended at least 12 inches below the bottom of the aggregate base to minimize the introduction of water beneath the paving.

7.13 Temporary Excavations

7.13.1 Excavations less than 5 feet in height are anticipated for grading and construction activities. The excavations are expected to expose artificial fill and alluvial soils, which may be subject to caving where granular soils are exposed. Temporary vertical excavations up to 5 feet in height may be attempted where loose soils or caving sands are not present, and where excavations are not surcharged by adjacent traffic or structures.

7.13.2 Vertical excavations greater than 5 feet or where surcharged by existing structures will require sloping or shoring measures in order to provide a stable excavation. Where sufficient space is available, temporary unsurcharged embankments could be sloped back at a uniform 1:1 slope gradient or flatter up to a maximum of 8 feet in height. A uniform slope does not have a vertical portion.

7.13.3 Where temporary construction slopes are utilized, the top of the slope should be barricaded to prevent vehicles and storage loads at the top of the slope within a horizontal distance equal to the height of the slope. If the temporary construction slopes are to be maintained during the rainy season, berms are suggested along the tops of the slopes where necessary to prevent runoff water from entering the excavation and eroding the slope faces. The soils exposed in the cut slopes should be inspected during excavation by our personnel and the contractor's competent person so that modifications of the slopes can be made if variations in the soil conditions occur. All excavations should be stabilized within 30 days of initial excavation.

7.14 Stormwater Infiltration

7.14.1 During the site exploration, borings B1, B2, B3 and B4 were used to perform percolation testing. The borings were excavated to depths of approximately 5 to 10 feet below ground surface, as indicated in the table below. Slotted casing was placed in the borings and the borings were then filled with water to pre-saturate the soils. The casing was refilled with water and percolation test readings were performed after repeated flooding of the cased excavation.

7.14.2 Based on the test results, the field-measured percolation rate and the design infiltration rate are provided in the following table. The Reduction Factor (Rf), to convert the field-measured percolation rate to an infiltration rate, is also shown in the table below. This value has been calculated in accordance with the Small Diameter Boring Infiltration Test Procedure in the County of Los Angeles Department of Public Works GMED *Guidelines for Design, Investigation, and Reporting Low Impact Development Stormwater Infiltration* (June 2021). Calculations of the percolation rate, reduction factor, and infiltration rate are provided on Figures 8 through 11.

Boring	Infiltration Depth (ft)	Field Measured Infiltration Rate (in/hour)	Reduction Factor (Rf)	Design Infiltration Rate (in / hour)
B1	5-10	0.11	3.0	0.04
B2	2-5	0.04	3.0	0.01
B3	2-5	0.06	3.0	0.02
B4	2-5	0.01	3.0	0.0

7.14.3 The results of the percolation testing indicated that the infiltration rate within the alluvial soils is less than the accepted minimum accepted infiltration rate of 0.3 inches per hour. Therefore, based on the results of percolation testing performed at the site, a stormwater infiltration system is not recommended for this project. It is recommended that stormwater be retained, filtered, and discharged in accordance with the requirements of the local governing agency.

7.15 Surface Drainage

7.15.1 Proper surface drainage is critical to the future performance of the project. Uncontrolled infiltration of irrigation excess and storm runoff into the soils can adversely affect the performance of the planned improvements. Saturation of a soil can cause it to lose internal shear strength and increase its compressibility, resulting in a change in the original designed engineering properties. Proper drainage should be maintained at all times.

7.15.2 All site drainage should be collected and controlled in non-erosive drainage devices. Drainage should not be allowed to pond anywhere on the site, and especially not against any foundation or retaining wall. The site should be graded and maintained such that surface drainage is directed away from structures in accordance with 2022 CBC 1804.4 or other applicable standards. In addition, drainage should not be allowed to flow uncontrolled over any descending slope. Discharge from downspouts, roof drains and scuppers are not recommended onto unprotected soils within 5 feet of the building perimeter. Planters which are located adjacent to foundations should be sealed to prevent moisture intrusion into the soils providing foundation support. Landscape irrigation is not recommended within 5 feet of the building perimeter footings except when enclosed in protected planters.

7.15.3 Positive site drainage should be provided away from structures, pavement, and the tops of slopes to swales or other controlled drainage structures.

7.15.4 Landscaping planters immediately adjacent to paved areas are not recommended due to the potential for surface or irrigation water to infiltrate the pavement's subgrade and base course. Either a subdrain, which collects excess irrigation water and transmits it to drainage structures, or impervious above-grade planter boxes should be used. In addition, where landscaping is planned adjacent to the pavement, it is recommended that consideration be given to providing a cutoff wall along the edge of the pavement that extends at least 12 inches below the base material.

7.16 Plan Review

7.16.1 Grading, foundation, and shoring plans should be reviewed by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to finalization to verify that the plans have been prepared in substantial conformance with the recommendations of this report and to provide additional analyses or recommendations.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The firm that performed the geotechnical investigation for the project should be retained to provide testing and observation services during construction to provide continuity of geotechnical interpretation and to check that the recommendations presented for geotechnical aspects of site development are incorporated during site grading, construction of improvements, and excavation of foundations. If another geotechnical firm is selected to perform the testing and observation services during construction operations, that firm should prepare a letter indicating their intent to assume the responsibilities of project geotechnical engineer of record. A copy of the letter should be provided to the regulatory agency for their records. In addition, that firm should provide revised recommendations concerning the geotechnical aspects of the proposed development, or a written acknowledgement of their concurrence with the recommendations presented in our report. They should also perform additional analyses deemed necessary to assume the role of Geotechnical Engineer of Record.

2. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon Incorporated should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon Incorporated.

3. This report is issued with the understanding that it is the responsibility of the owner or his representative to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

4. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.

LIST OF REFERENCES

1. California Department of Water Resources, 2024*, Division of Safety of Dams, Dam Breach Inundation Maps.*

2. California Department of Water Resources, 1961, *Planned Utilization of Groundwater Basins of the Coastal Plain of Los Angeles County, Bulletin 104, Appendix A.*

3. California Division of Mines and Geology, 1999*, State of California Seismic Hazard Zones, Long Beach Quadrangle, Official Map, Released: March 25.*

4. California Division of Mines and Geology, 1998, *Seismic Hazard Evaluation of the Long Beach 7.5-Minute Quadrangle, Los Angeles and San Bernardino Counties, California,* Open File Report 98-19.

5. California Division of Mines and Geology, 1986*, Long Beach Quadrangle, Earthquake Fault Zones, Released July 1.*

6. California Geologic Energy Management Division, 2024*, CalGEM Resources Well Finder, http://maps.conservation.ca.gov.doggr/index.html#close.*

7. California Geological Survey, 2024*, CGS Information Warehouse, Regulatory Map Portal, http://maps.conservation.ca.gov/cgs/informationwarehouse/index.html?map=regulatorymaps.*

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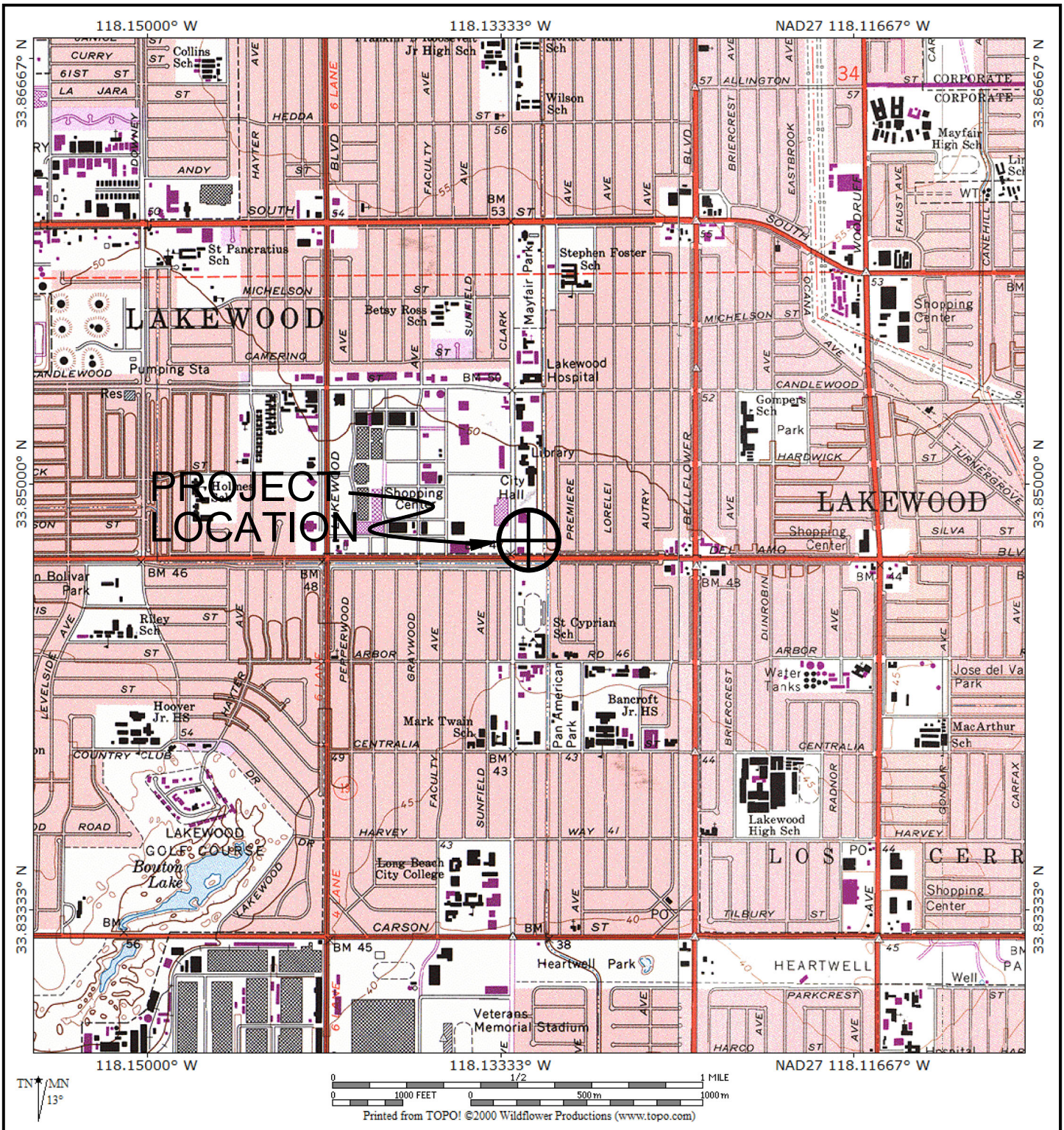
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VICINITY MAP

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

DRAFTED BY: ACS	CHECKED BY: JTA

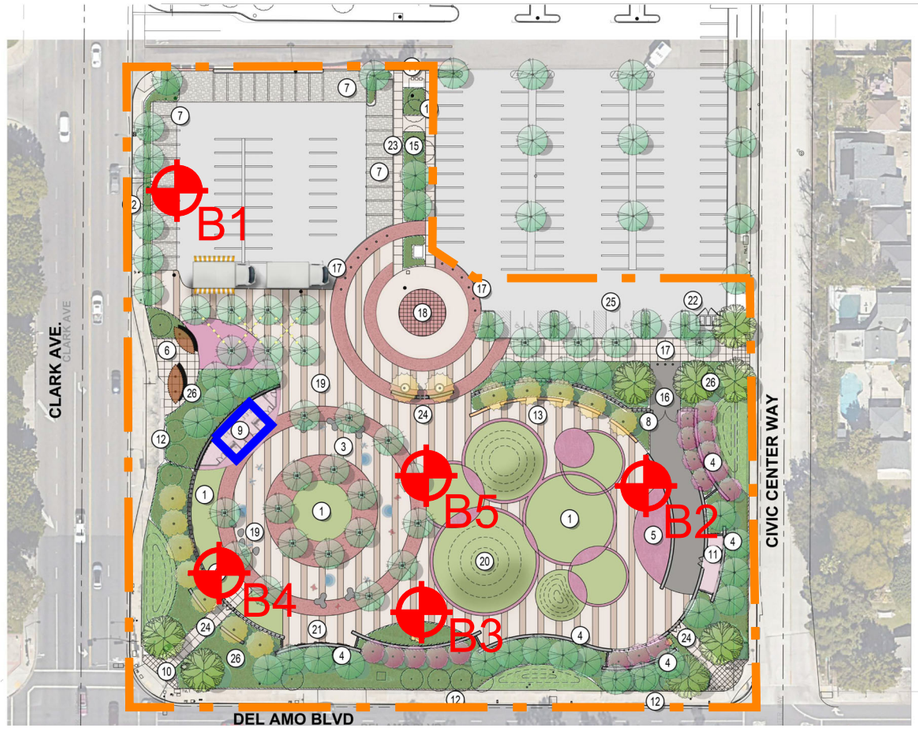
SEPT 2024	PROJECT NO. W1974-06-01	FIG. 1

LEGEND

B5 Approximate Boring Locations

Approximate Project Limits

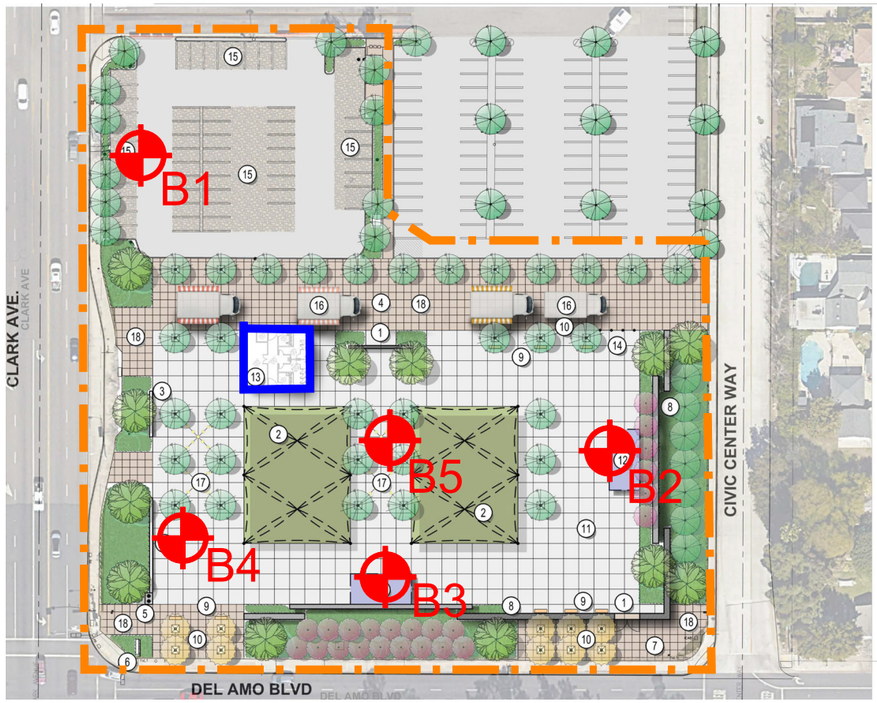
Proposed Restroom



Plan Option 1

LEGEND

1. FLAT SYNTHETIC TURF
2. CHRISTMAS TREE AREA
3. ACCENT PAVING
4. 10' HIGH SOUND WALL
5. MOBILE STAGE (14' X 36')
6. BUS SHELTER AND SHADE AREA
7. PERMEABLE PAVING
8. 6' HIGH WROUGHT IRON FENCE WITH MOW CURB
9. RESTROOM
10. PARK ENTRY SIGN
11. STORAGE ROOM
12. EXISTING STREET TREES
13. SEAT WALLS
14. EXISTING TRASH ENCLOSURE
15. EXISTING EUCALYPTUS TREES
16. SERVICE ACCESS WITH LOCKING GATE
17. BOLLARDS
18. REMOVABLE CHRISTMAS TREE
19. ARTISTIC PLAY FEATURE
20. MOUNDED SYNTHETIC TURF FOR STAGE SEATING AND PLAY
21. CHILDREN'S ARTISTIC WALL
22. PROPOSED TRASH ENCLOSURE
23. FORMAL ACCESS THROUGH EXISTING PARKING LOT
24. VERTICAL GATEWAY FEATURE
25. PROPOSED PARKING
26. LOW WATER TREES BUFFER AND PLANTING



Plan Option 2

LEGEND

1. GATEWAY ARCH
2. SHADE OVER SYNTHETIC TURF
3. LOW WALL
4. CHRISTMAS TREE AREA
5. FLAG LOCATION
6. PARK SIGN
7. OPEN TO STREET
8. SOUND WALL
9. CONCRETE BENCH (TYP.)
10. TREE WELL (TYP.)
11. 10'X10' PAVING JOINT GRID
12. STAGE LOCATION
13. RESTROOM
14. REMOVABLE BOLLARDS FOR TRUCK ACCESS
15. PERMEABLE PAVING
16. FOOD TRUCK PARKING
17. BISTRO LIGHTING OPTIONAL DINING AREA
18. 5'X5' PAVING JOINT GRID

NORTH

0 100' 200'

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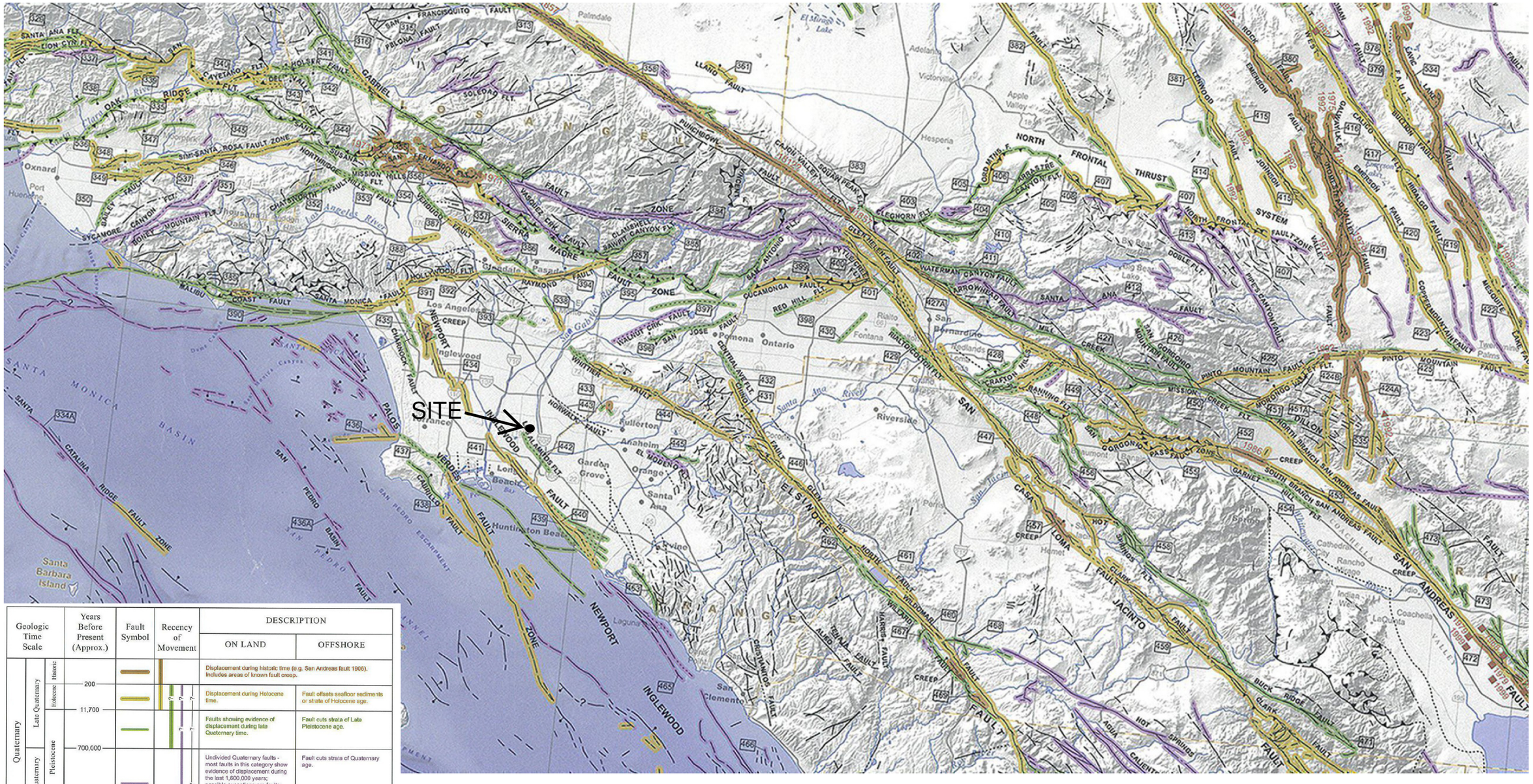
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SITE PLAN

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

SEPT 2024	PROJECT NO. W1974-06-01	FIG. 2

Reference: Jennings, C.W. and Bryant, W. A., 2010, Fault Activity Map of California, California Geological Survey Geologic Data Map No. 6.



Geologic Time Scale			Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION: ON LAND	DESCRIPTION: OFFSHORE
Quaternary	Late Quaternary	Historic				Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
		Holocene	200			Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
	Pleistocene		11,700			Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
	Early Quaternary		700,000			Undivided Quaternary faults - most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	Fault cuts strata of Quaternary age.
Pre-Quaternary			1,600,000*			Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.
			4.5 billion (Age of Earth)				

* Quaternary now recognized as extending to 2.6 Ma (Walker and Geissman, 2009). Quaternary faults in this map were established using the previous 1.6 Ma criterion.

N

0 12 24 Miles

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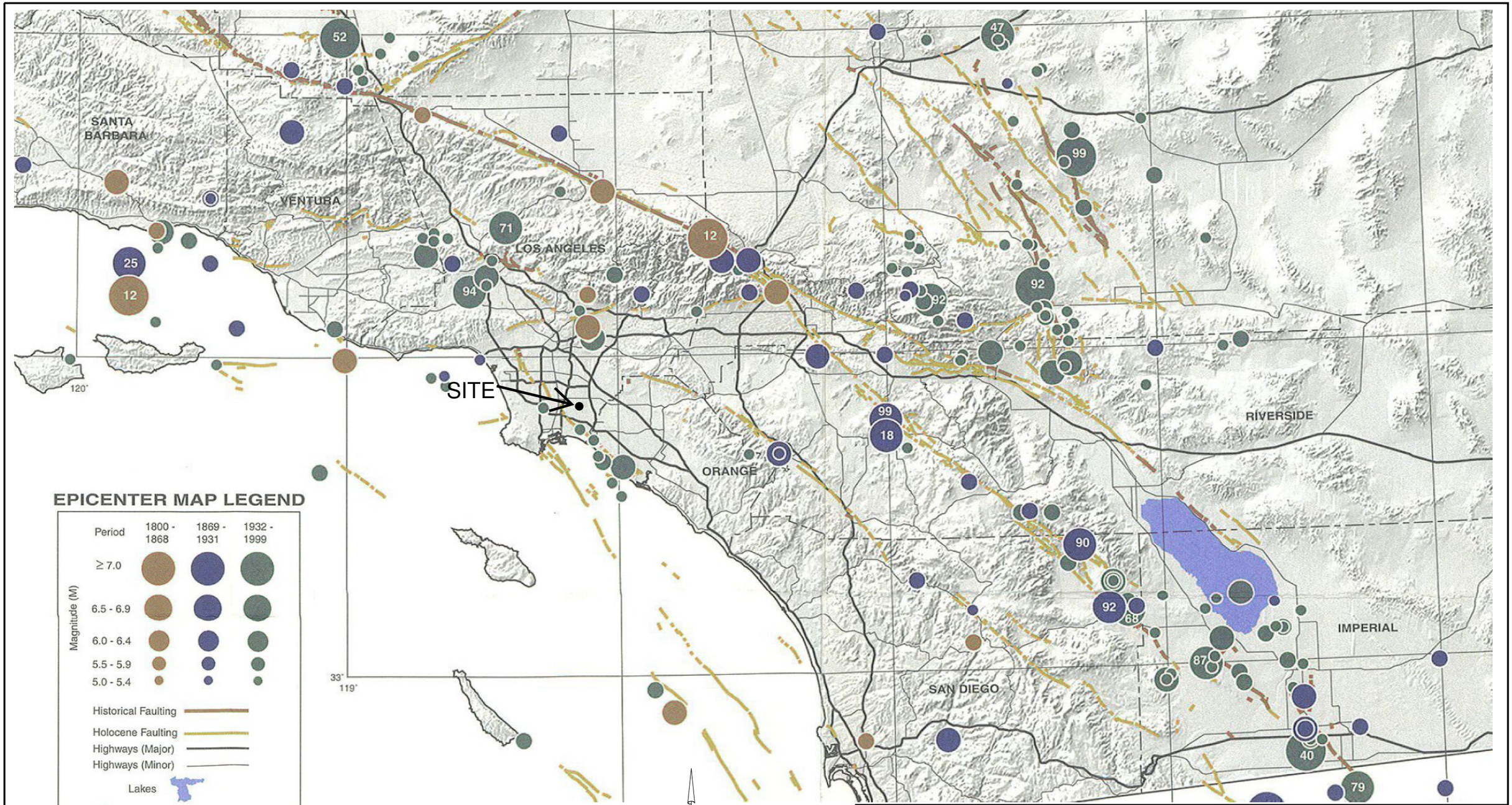
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REGIONAL FAULT MAP

4900 CLARK AVENUE!
LAKEWOOD, CALIFORNIA

SEPT 2024 | PROJECT NO. W1974-06-01 | FIG. 3



Reference: Toppozada, T., Branum, D., Petersen, M., Hallstrom, C., Cramer, C., and Reichle, M., 2000, Epicenters and Areas Damaged by M>5 California Earthquakes, 1800 - 1999, California Geological Survey, Map Sheet 49.

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REGIONAL SEISMICITY MAP

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

SEPT 2024 | PROJECT NO. W1974-06-01 | FIG.4

EMPIRICAL ESTIMATION OF LIQUEFACTION POTENTIAL
MAXIMUM CONSIDERED EARTHQUAKE

NCEER (1996) METHOD W 2001 UPDATES

EARTHQUAKE INFORMATION:

Earthquake Magnitude:	7.30
Peak Horiz. Acceleration PGA_M (g):	0.738
Magnitude Scaling Factor:	1.071
Historic High Groundwater:	20.0
Groundwater Depth During Exploratio	31.0

ENERGY & ROD CORRECTIONS:

Energy Correction (CE) for N60:	1.25
Rod Len.Corr.(CR) (0-no or 1-yes):	1
Bore Dia. Corr. (CB):	1.00
Sampler Corr. (CS):	1.20
Use Ksigma (0-no or 1-yes):	1

Boring ID: B5

LIQUEFACTION CALCULATIONS:

Unit Wt. Water (pcf): 62.4

Depth to Base (ft)	Total Unit Wt. (pcf)	Water (0 or 1)	Field SPT (N)	Depth of SPT (ft)	Liq.Sus. (0 or 1)	-200 (%)		Est. Dr (%)	CN Factor	Corrected (N1)60cs	Eff. Unit Wt. (psf)	Resist. CRR 7.5	rd Factor	Induced CSR	Liquefac. Safe.Fact.
1.0	125.0	0	6.0	1.0	1	50	*	59	1.700	18.8	125.0	0.201	1.000	0.480	--
2.0	125.0	0	6.0	2.0	1	50	*	58	1.700	18.8	125.0	0.201	0.998	0.479	--
3.0	125.0	0	6.0	3.0	1	50	*	56	1.700	18.8	125.0	0.201	0.996	0.478	--
4.0	125.0	0	6.0	4.0	1	50	*	55	1.700	18.8	125.0	0.201	0.994	0.477	--
5.0	125.0	0	6.0	5.0	1	50	*	53	1.700	18.8	125.0	0.201	0.991	0.476	--
6.0	125.0	0	6.0	6.0	1	50	*	52	1.700	18.8	125.0	0.201	0.989	0.474	--
7.0	125.0	0	6.0	7.0	1	50	*	51	1.603	18.0	125.0	0.192	0.987	0.473	--
8.0	125.0	0	6.0	8.0	1	50	*	50	1.492	17.1	125.0	0.182	0.985	0.472	--
9.0	125.0	0	6.0	9.0	1	50	*	49	1.402	16.4	125.0	0.174	0.982	0.471	--
10.0	125.0	0	8.0	12.5	1	50	*	53	1.326	19.3	125.0	0.207	0.980	0.470	--
11.0	125.0	0	8.0	12.5	1	50	*	53	1.261	18.6	125.0	0.199	0.978	0.469	--
12.5	125.0	0	8.0	12.5	1	50	*	53	1.192	17.9	125.0	0.190	0.975	0.468	--
13.0	125.0	0	8.0	12.5	1	50	*	53	1.168	17.6	125.0	0.187	0.973	0.467	--
14.0	125.0	0	8.0	12.5	1	50	*	53	1.112	17.0	125.0	0.181	0.972	0.466	--
15.0	125.0	0	8.0	12.5	1	50	*	53	1.073	16.6	125.0	0.176	0.970	0.465	--
16.0	125.0	0	10.0	17.5	0	88			1.038	21.0	125.0	~	0.967	0.464	~
17.0	125.0	0	10.0	17.5	0	88			1.006	20.5	125.0	~	0.965	0.463	~
18.0	125.0	0	10.0	17.5	0	88			0.977	20.0	125.0	~	0.963	0.462	~
19.0	125.0	0	10.0	17.5	0	88			0.950	19.6	125.0	~	0.961	0.461	~
20.0	125.0	0	10.0	17.5	0	88			0.926	19.3	125.0	~	0.958	0.460	~
21.0	125.0	1	10.0	17.5	0	88			0.903	18.9	62.6	~	0.956	0.464	~
22.5	125.0	1	10.0	17.5	0	88			0.876	18.5	62.6	~	0.952	0.476	~
23.0	125.0	1	14.0	22.5	0	55			0.866	25.3	62.6	~	0.949	0.480	~
24.0	125.0	1	14.0	22.5	0	55			0.843	24.7	62.6	~	0.947	0.491	~
25.0	125.0	1	14.0	22.5	0	55			0.826	24.3	62.6	~	0.944	0.498	~
26.0	125.0	1	14.0	22.5	0	55			0.809	23.9	62.6	~	0.940	0.505	~
27.5	125.0	1	14.0	22.5	0	55			0.790	23.5	62.6	~	0.935	0.513	~
28.0	125.0	1	18.0	27.5	1	52		66	0.783	29.8	62.6	0.457	0.931	0.515	0.81
29.0	125.0	1	18.0	27.5	1	52		66	0.766	29.3	62.6	0.425	0.928	0.523	0.73
30.0	125.0	1	18.0	27.5	1	52		66	0.752	28.9	62.6	0.404	0.923	0.528	0.68
31.0	125.0	1	23.0	32.5	1	22		73	0.743	32.0	62.6	Infin.	0.918	0.532	Non-Liq.
32.0	125.0	1	23.0	32.5	1	22		73	0.737	31.7	62.6	Infin.	0.912	0.535	Non-Liq.
33.0	125.0	1	23.0	32.5	1	22		73	0.731	31.5	62.6	Infin.	0.907	0.538	Non-Liq.
34.0	125.0	1	23.0	32.5	1	22		73	0.725	31.3	62.6	Infin.	0.900	0.541	Non-Liq.
35.0	125.0	1	23.0	32.5	1	22		73	0.720	31.1	62.6	Infin.	0.894	0.543	Non-Liq.
36.0	125.0	1	23.0	32.5	1	22		73	0.714	30.9	62.6	Infin.	0.887	0.544	Non-Liq.
37.5	125.0	1	23.0	32.5	1	22		73	0.707	30.6	62.6	Infin.	0.878	0.545	Non-Liq.
38.0	125.0	1	17.0	37.5	1	3		61	0.705	18.0	62.6	0.192	0.870	0.543	0.31
39.0	125.0	1	17.0	37.5	1	3		61	0.698	17.8	62.6	0.190	0.864	0.545	0.30
40.0	125.0	1	17.0	37.5	1	3		61	0.693	17.7	62.6	0.188	0.855	0.544	0.30
41.0	125.0	1	17.0	37.5	1	3		61	0.688	17.6	62.6	0.187	0.846	0.543	0.29
42.0	125.0	1	17.0	37.5	1	3		61	0.683	17.4	62.6	0.185	0.837	0.542	0.29
43.0	125.0	1	20.0	42.5	1	6		64	0.679	20.5	62.6	0.222	0.828	0.540	0.34
44.0	125.0	1	20.0	42.5	1	6		64	0.674	20.3	62.6	0.220	0.818	0.537	0.34
45.0	125.0	1	20.0	42.5	1	6		64	0.670	20.2	62.6	0.218	0.808	0.535	0.34
46.0	125.0	1	11.0	47.5	0	89			0.665	18.2	62.6	~	0.798	0.532	~
47.5	125.0	1	11.0	47.5	0	89			0.660	18.1	62.6	~	0.786	0.528	~
48.0	125.0	1	11.0	47.5	0	89			0.658	18.0	62.6	~	0.775	0.522	~
49.0	125.0	1	11.0	47.5	0	89			0.652	17.9	62.6	~	0.768	0.521	~
50.0	125.0	1	11.0	47.5	0	89			0.648	17.8	62.6	~	0.757	0.517	~
51.0	125.0	1	33.0	52.5	1	15	*	78	0.644	35.9	62.6	Infin.	0.747	0.513	Non-Liq.
52.5	125.0	1	33.0	52.5	1	15	*	78	0.639	35.7	62.6	Infin.	0.735	0.508	Non-Liq.
53.0	125.0	1	33.0	52.5	1	15	*	78	0.637	35.6	62.6	Infin.	0.725	0.502	Non-Liq.
54.0	125.0	1	33.0	52.5	1	15	*	78	0.632	35.3	62.6	Infin.	0.717	0.501	Non-Liq.
55.0	125.0	1	33.0	52.5	1	15	*	78	0.629	35.1	62.6	Infin.	0.708	0.496	Non-Liq.
56.0	125.0	1	33.0	52.5	1	15	*	78	0.625	34.9	62.6	Infin.	0.698	0.492	Non-Liq.
57.0	125.0	1	33.0	52.5	1	15	*	78	0.621	34.7	62.6	Infin.	0.689	0.488	Non-Liq.
58.0	125.0	1	33.0	52.5	1	15	*	78	0.618	34.5	62.6	Infin.	0.680	0.484	Non-Liq.
59.0	125.0	1	33.0	52.5	1	15	*	78	0.614	34.4	62.6	Infin.	0.671	0.480	Non-Liq.
60.0	125.0	1	33.0	52.5	1	15	*	78	0.611	34.2	62.6	Infin.	0.663	0.476	Non-Liq.
61.0	125.0	1	33.0	52.5	1	15	*	78	0.607	34.0	62.6	Infin.	0.655	0.472	Non-Liq.
62.0	125.0	1	33.0	52.5	1	15	*	78	0.604	33.8	62.6	Infin.	0.647	0.468	Non-Liq.
63.5	125.0	1	33.0	52.5	1	15	*	78	0.600	33.6	62.6	Infin.	0.638	0.463	Non-Liq.

* Indicates Assumed Value

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LIQUEFACTION POTENTIAL - MAXIMUM CONSIDERED EARTHQUAKE

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

DRAFTED BY: ACS	CHECKED BY: JTA	SEPT 2024	PROJECT NO. W1974-06-01	FIG. 5

LIQUEFACTION SETTLEMENT ANALYSIS
MAXIMUM CONSIDERED EARTHQUAKE

NCEER (1996) METHOD W 2001 UPDATES

Boring ID: B5

EARTHQUAKE INFORMATION:

Earthquake Magnitude:	7.30
PGA_M (g):	0.738
Magnitude Scaling Factor:	1.071
Historic High Groundwater:	20.0
Groundwater @ Exploration:	31.0

DEPTH TO BASE	BLOW COUNT N	WET DENSITY (PCF)	TOTAL STRESS O (TSF)	EFFECT STRESS O' (TSF)	REL. DEN. Dr (%)	ADJUST BLOWS (N1)60	Tav/σ'o	LIQUEFACTION SAFETY FACTOR	VOL. STRAIN [e_{15}] (%)	EQ. SETTLE. Pe (in.)
1.0	6	125.0	0.031	0.031	59	19	0.480	--	0.00	0.00
2.0	6	125.0	0.094	0.094	58	19	0.480	--	0.00	0.00
3.0	6	125.0	0.156	0.156	56	19	0.480	--	0.00	0.00
4.0	6	125.0	0.219	0.219	55	19	0.480	--	0.00	0.00
5.0	6	125.0	0.281	0.281	53	19	0.480	--	0.00	0.00
6.0	6	125.0	0.344	0.344	52	19	0.480	--	0.00	0.00
7.0	6	125.0	0.406	0.406	51	18	0.480	--	0.00	0.00
8.0	6	125.0	0.469	0.469	50	17	0.480	--	0.00	0.00
9.0	6	125.0	0.531	0.531	49	16	0.480	--	0.00	0.00
10.0	8	125.0	0.594	0.594	53	19	0.480	--	0.00	0.00
11.0	8	125.0	0.656	0.656	53	19	0.480	--	0.00	0.00
12.5	8	125.0	0.734	0.734	53	18	0.480	--	0.00	0.00
13.0	8	125.0	0.766	0.766	53	18	0.480	--	0.00	0.00
14.0	8	125.0	0.844	0.844	53	17	0.480	--	0.00	0.00
15.0	8	125.0	0.906	0.906	53	17	0.480	--	0.00	0.00
16.0	10	125.0	0.969	0.969		21	0.480	~	0.00	0.00
17.0	10	125.0	1.031	1.031		20	0.480	~	0.00	0.00
18.0	10	125.0	1.094	1.094		20	0.480	~	0.00	0.00
19.0	10	125.0	1.156	1.156		20	0.480	~	0.00	0.00
20.0	10	125.0	1.219	1.219		19	0.480	~	0.00	0.00
21.0	10	125.0	1.281	1.266		19	0.486	~	0.00	0.00
22.5	10	125.0	1.359	1.305		18	0.500	~	0.00	0.00
23.0	14	125.0	1.391	1.320		25	0.505	~	0.00	0.00
24.0	14	125.0	1.469	1.360		25	0.518	~	0.00	0.00
25.0	14	125.0	1.531	1.391		24	0.528	~	0.00	0.00
26.0	14	125.0	1.594	1.422		24	0.538	~	0.00	0.00
27.5	14	125.0	1.672	1.461		23	0.549	~	0.00	0.00
28.0	18	125.0	1.703	1.477	66	30	0.553	0.81	0.75	0.05
29.0	18	125.0	1.781	1.516	66	29	0.564	0.73	0.75	0.09
30.0	18	125.0	1.844	1.547	66	29	0.572	0.68	0.75	0.09
31.0	23	125.0	1.906	1.579	73	32	0.579	Non-Liq.	0.00	0.00
32.0	23	125.0	1.969	1.610	73	32	0.587	Non-Liq.	0.00	0.00
33.0	23	125.0	2.031	1.641	73	31	0.594	Non-Liq.	0.00	0.00
34.0	23	125.0	2.094	1.673	73	31	0.601	Non-Liq.	0.00	0.00
35.0	23	125.0	2.156	1.704	73	31	0.607	Non-Liq.	0.00	0.00
36.0	23	125.0	2.219	1.735	73	31	0.613	Non-Liq.	0.00	0.00
37.5	23	125.0	2.297	1.774	73	31	0.621	Non-Liq.	0.00	0.00
38.0	17	125.0	2.328	1.790	61	18	0.624	0.31	1.70	0.10
39.0	17	125.0	2.406	1.829	61	18	0.631	0.30	1.70	0.20
40.0	17	125.0	2.469	1.860	61	18	0.637	0.30	1.70	0.20
41.0	17	125.0	2.531	1.892	61	18	0.642	0.29	1.70	0.20
42.0	17	125.0	2.594	1.923	61	17	0.647	0.29	1.70	0.20
43.0	20	125.0	2.656	1.954	64	20	0.652	0.34	1.40	0.17
44.0	20	125.0	2.719	1.986	64	20	0.657	0.34	1.40	0.17
45.0	20	125.0	2.781	2.017	64	20	0.662	0.34	1.40	0.17
46.0	11	125.0	2.844	2.048		18	0.666	~	0.00	0.00
47.5	11	125.0	2.922	2.087		18	0.672	~	0.00	0.00
48.0	11	125.0	2.953	2.103		18	0.674	~	0.00	0.00
49.0	11	125.0	3.031	2.142		18	0.679	~	0.00	0.00
50.0	11	125.0	3.094	2.173		18	0.683	~	0.00	0.00
51.0	33	125.0	3.156	2.205	78	36	0.687	Non-Liq.	0.00	0.00
52.5	33	125.0	3.234	2.244	78	36	0.691	Non-Liq.	0.00	0.00
53.0	33	125.0	3.266	2.259	78	36	0.693	Non-Liq.	0.00	0.00
54.0	33	125.0	3.344	2.299	78	35	0.698	Non-Liq.	0.00	0.00
55.0	33	125.0	3.406	2.330	78	35	0.701	Non-Liq.	0.00	0.00
56.0	33	125.0	3.469	2.361	78	35	0.705	Non-Liq.	0.00	0.00
57.0	33	125.0	3.531	2.392	78	35	0.708	Non-Liq.	0.00	0.00
58.0	33	125.0	3.594	2.424	78	35	0.711	Non-Liq.	0.00	0.00
59.0	33	125.0	3.656	2.455	78	34	0.714	Non-Liq.	0.00	0.00
60.0	33	125.0	3.719	2.486	78	34	0.717	Non-Liq.	0.00	0.00
61.0	33	125.0	3.781	2.518	78	34	0.720	Non-Liq.	0.00	0.00
62.0	33	125.0	3.844	2.549	78	34	0.723	Non-Liq.	0.00	0.00
63.5	33	125.0	3.922	2.588	78	34	0.727	Non-Liq.	0.00	0.00

TOTAL SETTLEMENT = 1.6 inches

GEOCON WEST, INC.

ENVIRONMENTAL GEOTECHNICAL MATERIALS
500 NORTH VICTORY BOULEVARD - BURBANK, CA 91502
PHONE: 818-841-8388 FAX: 818-841-1704

LIQUEFACTION INDUCED SETTLEMENT - MAXIMUM CONSIDERED EARTHQUAKE

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

DRAFTED BY: ACS	CHECKED BY: JTA	SEPT 2024	PROJECT NO. W1974-06-01	FIG. 6

MCE EARTHQUAKE INFORMATION

Earthquake Magnitude	7.30
Peak Horiz. Acceleration (g)	0.738

Boring ID: B5

Depth of Base of Strate (ft)	Thickness of Layer (ft)	Depth of Mid-point of Layer (ft)	Soil Unit Weight (pcf)	Overburden Pressure at Mid-point (tsf)	Mean Effective Pressure at Mid-point (tsf)	Average Cyclic Shear Stress [Tav]	Field SPT [N]	Correction Factor [Cer]	Relative Density [Dr] (%)	Correction Factor [Cn]	Corrected [N1]60	rd Factor	Maximum Shear Mod. [Gmax] (tsf)	[yeff]*[Geff] [Gmax]	yeff Shear Strain	[yeff]*100%	Volumetric Strain M7.5 [E15] (%)	Number of Strain Cycles [Nc]	Corrected Vol. Strains [Ec]	Estimated Settlement [S] (inches)
1.0	1.0	0.5	125.0	0.03	0.02	0.015	6	1.25	59.3	1.7	18.8	1.0	171.9	8.63E-05	1.60E-04	0.016	1.73E-02	13.3	1.64E-02	0.00
2.0	1.0	1.5	125.0	0.09	0.06	0.045	6	1.25	57.6	1.7	18.8	1.0	297.7	1.47E-04	2.30E-04	0.023	2.48E-02	13.3	2.35E-02	0.01
3.0	1.0	2.5	125.0	0.16	0.10	0.075	6	1.25	56.0	1.7	18.8	1.0	384.4	1.86E-04	1.70E-04	0.017	1.83E-02	13.3	1.74E-02	0.00
4.0	1.0	3.5	125.0	0.22	0.15	0.105	6	1.25	54.5	1.7	18.8	1.0	454.8	2.15E-04	8.10E-04	0.081	8.74E-02	13.3	8.29E-02	0.02
5.0	1.0	4.5	125.0	0.28	0.19	0.135	6	1.25	53.2	1.7	18.8	1.0	515.7	2.40E-04	8.10E-04	0.081	8.74E-02	13.3	8.29E-02	0.02
6.0	1.0	5.5	125.0	0.34	0.23	0.164	6	1.25	51.9	1.7	18.8	1.0	570.1	2.60E-04	4.50E-04	0.045	4.86E-02	13.3	4.61E-02	0.01
7.0	1.0	6.5	125.0	0.41	0.27	0.194	6	1.25	50.8	1.6	18.0	1.0	611.0	2.81E-04	4.50E-04	0.045	5.11E-02	13.3	4.85E-02	0.01
8.0	1.0	7.5	125.0	0.47	0.31	0.224	6	1.25	49.7	1.5	17.1	1.0	645.2	3.02E-04	1.00E-03	0.100	1.21E-01	13.3	1.15E-01	0.03
9.0	1.0	8.5	125.0	0.53	0.36	0.253	6	1.25	48.7	1.4	16.4	1.0	676.9	3.20E-04	1.00E-03	0.100	1.27E-01	13.3	1.21E-01	0.03
10.0	1.0	9.5	125.0	0.59	0.40	0.282	8	1.25	52.8	1.3	19.3	1.0	756.5	3.14E-04	1.00E-03	0.100	1.04E-01	13.3	9.89E-02	0.02
11.0	1.0	10.5	125.0	0.66	0.44	0.311	8	1.25	52.8	1.3	18.6	1.0	785.6	3.28E-04	1.00E-03	0.100	1.09E-01	13.3	1.03E-01	0.02
12.5	1.5	11.8	125.0	0.73	0.49	0.347	8	1.25	52.8	1.2	17.9	1.0	819.9	3.44E-04	1.00E-03	0.100	1.14E-01	13.3	1.09E-01	0.04
13.0	0.5	12.8	125.0	0.80	0.53	0.376	8	1.25	52.8	1.2	17.6	1.0	849.8	3.54E-04	7.10E-04	0.071	8.27E-02	13.3	7.85E-02	0.01
14.0	1.0	13.5	125.0	0.84	0.57	0.398	8	1.25	52.8	1.1	17.0	1.0	864.4	3.63E-04	7.10E-04	0.071	8.62E-02	13.3	8.18E-02	0.02
15.0	1.0	14.5	125.0	0.91	0.61	0.426	8	1.25	52.8	1.1	16.6	1.0	888.4	3.73E-04	7.10E-04	0.071	8.88E-02	13.3	8.43E-02	0.02
16.0	1.0	15.5	125.0	0.97	0.65	0.454	10	1.25		1.0	21.0	1.0	993.3	3.51E-04	7.10E-04	0.071	6.70E-02	13.3	6.36E-02	0.02
17.0	1.0	16.5	125.0	1.03	0.69	0.482	10	1.25		1.0	20.5	1.0	1016.8	3.58E-04	7.10E-04	0.071	6.90E-02	13.3	6.54E-02	0.02
18.0	1.0	17.5	125.0	1.09	0.73	0.509	10	1.25		1.0	20.0	1.0	1039.4	3.66E-04	7.10E-04	0.071	7.08E-02	13.3	6.72E-02	0.02
19.0	1.0	18.5	125.0	1.16	0.77	0.536	10	1.25		1.0	19.6	1.0	1061.4	3.72E-04	7.10E-04	0.071	7.26E-02	13.3	6.89E-02	0.02
20.0	1.0	19.5	125.0	1.22	0.82	0.563	10	1.25		0.9	19.3	1.0	1082.6	3.78E-04	7.10E-04	0.071	7.43E-02	13.3	7.05E-02	0.02
21.0	1.0	20.5	125.0	1.28	0.86	0.590	10	1.25		0.9	18.9	1.0	1103.2	3.84E-04	7.10E-04	0.071	7.60E-02	13.3	7.21E-02	0.00
22.5	1.5	21.8	125.0	1.36	0.91	0.623	10	1.25		0.9	18.5	1.0	1128.1	3.90E-04	7.10E-04	0.071	7.80E-02	13.3	7.40E-02	0.00
23.0	0.5	22.8	125.0	1.42	0.95	0.649	14	1.25		0.9	25.3	0.9	1280.0	3.54E-04	7.10E-04	0.071	5.37E-02	13.3	5.09E-02	0.00
24.0	1.0	23.5	125.0	1.47	0.98	0.668	14	1.25		0.8	24.7	0.9	1291.5	3.58E-04	7.10E-04	0.071	5.51E-02	13.3	5.23E-02	0.00
25.0	1.0	24.5	125.0	1.53	1.03	0.693	14	1.25		0.8	24.3	0.9	1311.5	3.61E-04	5.20E-04	0.052	4.12E-02	13.3	3.90E-02	0.00
26.0	1.0	25.5	125.0	1.59	1.07	0.718	14	1.25		0.8	23.9	0.9	1330.9	3.65E-04	5.20E-04	0.052	4.19E-02	13.3	3.98E-02	0.00
27.5	1.5	26.8	125.0	1.67	1.12	0.748	14	1.25		0.8	23.5	0.9	1354.6	3.69E-04	5.20E-04	0.052	4.29E-02	13.3	4.07E-02	0.00
28.0	0.5	27.8	125.0	1.73	1.16	0.772	18	1.25	66.5	0.8	29.8	0.9	1494.5	3.41E-04	5.20E-04	0.052	3.22E-02	13.3	3.05E-02	0.00
29.0	1.0	28.5	125.0	1.78	1.19	0.790	18	1.25	66.5	0.8	29.3	0.9	1505.2	3.44E-04	5.20E-04	0.052	3.29E-02	13.3	3.12E-02	0.00
30.0	1.0	29.5	125.0	1.84	1.24	0.814	18	1.25	66.5	0.8	28.9	0.9	1524.1	3.46E-04	5.20E-04	0.052	3.35E-02	13.3	3.18E-02	0.00
31.0	1.0	30.5	125.0	1.91	1.28	0.837	23	1.25	72.5	0.7	32.0	0.9	1603.0	3.35E-04	5.20E-04	0.052	2.96E-02	13.3	2.81E-02	0.00
32.0	1.0	31.5	125.0	1.97	1.32	0.859	23	1.25	72.5	0.7	31.7	0.9	1625.2	3.36E-04	5.20E-04	0.052	2.99E-02	13.3	2.84E-02	0.00
33.0	1.0	32.5	125.0	2.03	1.36	0.881	23	1.25	72.5	0.7	31.5	0.9	1646.9	3.37E-04	5.20E-04	0.052	3.02E-02	13.3	2.86E-02	0.00
34.0	1.0	33.5	125.0	2.09	1.40	0.903	23	1.25	72.5	0.7	31.3	0.9	1668.1	3.38E-04	5.20E-04	0.052	3.04E-02	13.3	2.88E-02	0.00
35.0	1.0	34.5	125.0	2.16	1.44	0.924	23	1.25	72.5	0.7	31.1	0.9	1689.0	3.39E-04	5.20E-04	0.052	3.07E-02	13.3	2.91E-02	0.00
36.0	1.0	35.5	125.0	2.22	1.49	0.945	23	1.25	72.5	0.7	30.9	0.9	1709.5	3.39E-04	5.20E-04	0.052	3.09E-02	13.3	2.93E-02	0.00
37.5	1.5	36.8	125.0	2.30	1.54	0.971	23	1.25	72.5	0.7	30.6	0.9	1734.5	3.40E-04	5.20E-04	0.052	3.12E-02	13.3	2.96E-02	0.00
38.0	0.5	37.8	125.0	2.36	1.58	0.991	17	1.25	60.8	0.7	18.0	0.9	1472.1	4.05E-04	8.10E-04	0.081	9.21E-02	13.3	8.74E-02	0.00
39.0	1.0	38.5	125.0	2.41	1.61	1.005	17	1.25	60.8	0.7	17.8	0.9	1482.1	4.06E-04	8.10E-04	0.081	9.31E-02	13.3	8.83E-02	0.00
40.0	1.0	39.5	125.0	2.47	1.65	1.024	17	1.25	60.8	0.7	17.7	0.9	1497.6	4.06E-04	8.10E-04	0.081	9.39E-02	13.3	8.91E-02	0.00
41.0	1.0	40.5	125.0	2.53	1.70	1.043	17	1.25	60.8	0.7	17.6	0.8	1512.8	4.07E-04	8.10E-04	0.081	9.47E-02	13.3	8.99E-02	0.00
42.0	1.0	41.5	125.0	2.59	1.74	1.061	17	1.25	60.8	0.7	17.4	0.8	1527.8	4.07E-04	8.10E-04	0.081	9.55E-02	13.3	9.06E-02	0.00
43.0	1.0	42.5	125.0	2.66	1.78	1.079	20	1.25	64.0	0.7	20.5	0.8	1631.7	3.85E-04	5.20E-04	0.052	5.05E-02	13.3	4.79E-02	0.00
44.0	1.0	43.5	125.0	2.72	1.82	1.097	20	1.25	64.0	0.7	20.3	0.8	1647.0	3.85E-04	5.20E-04	0.052	5.09E-02	13.3	4.83E-02	0.00
45.0	1.0	44.5	125.0	2.78	1.86	1.114	20	1.25	64.0	0.7	20.2	0.8	1662.1	3.84E-04	5.20E-04	0.052	5.14E-02	13.3	4.87E-02	0.00
46.0	1.0	45.5	125.0	2.84	1.91	1.130	11	1.25		0.7	18.2	0.8	1622.1	3.97E-04	5.20E-04	0.052	5.84E-02	13.3	5.54E-02	0.00
47.5	1.5	46.8	125.0	2.92	1.96	1.150	11	1.25		0.7	18.1	0.8	1640.9	3.97E-04	5.20E-04	0.052	5.88E-02	13.3	5.57E-02	0.00
48.0	0.5	47.8	125.0	2.98	2.00	1.166	11	1.25		0.7	18.0	0.8	1657.1	3.96E-04	5.20E-04	0.052	5.89E-02	13.3	5.59E-02	0.00
49.0	1.0	48.5	125.0	3.03	2.03	1.177	11	1.25		0.7	17.9	0.8	1666.8	3.96E-04	1.00E-02	1.000	1.14E+00	13.3	1.08E+00	0.00
50.0	1.0	49.5	125.0	3.09	2.07	1.192	11	1.25		0.6	17.8	0.8	1681.4	3.95E-04	1.00E-02	1.000	1.15E+00	13.3	1.09E+00	0.00
51.0	1.0	50.5	125.0	3.16	2.11	1.206	33	1.25	78.4	0.6	35.9	0.7	2144.6	3.12E-04	1.00E-02	1.000	4.95E-01	13.3	4.70E-01	0.00
52.5	1.5	51.8	125.0	3.23	2.17	1.224	33	1.25	78.4	0.6	35.7	0.7	2165.8	3.11E-04	1.00E-02	1.000	5.00E-01	13.3	4.74E-01	0.00
53.0	0.5	52.8	125.0	3.30	2.21	1.237	33	1.25	78.4	0.6	35.6	0.7	2184.6	3.10E-04	1.00E-02	1.000	5.01E-01	13.3	4.76E-01	0.00
54.0	1.0	53.5	125.0	3.34	2.24	1.247	33	1.25	78.4	0.6	35.3	0.7	2194.9	3.10E-04	1.00E-02	1.000	5.06E-01	13.3	4.80E-01	0.00
55.0	1.0	54.5	125.0	3.41	2.28	1.260	33	1.25	78.4	0.6	35.1	0.7	2211.2	3.10E-04	1.00E-02	1.000	5.09E-01	13.3	4.83E-01	0.00
56.0	1.0	55.5	125.0	3.47	2.32	1.272	33	1.25	78.4	0.6	34.9	0.7	2227.4	3.09E-04	1.00E-02	1.000	5.12E-01	13.3	4.86E-01	0.00
57.0	1.0	56.5	125.0	3.53	2.37	1.284	33	1.25	78.4	0.6	34.7	0.7	2243.3	3.08E-04	1.00E-02	1.000	5.16E-01	13.3	4.89E-01	0.00
58.0	1.0	57.5	125.0	3.59	2.41	1.296	33	1.25	78.4	0.6	34.5	0.7	2259.0	3.08E-04	1.00E-02	1.000	5.19E-01	13.3	4.92E-01	0.00
59.0	1.0	58.5	125.0	3.66	2.45	1.307	33	1.25	78.4	0.6	34.4	0.7	2274.6	3.07E-04	1.00E-02	1.000	5.22E-01	13.3	4.95E-01	0.00
60.0	1.0	59.5	125.0	3.72	2.49	1.317	33	1.25	78.4	0.6	34.2	0.7	2290.0	3.06E-04	1.00E-02	1.000	5.26E-01	13.3	4.99E-01	0.00
61.0	1.0	60.5	125.0	3.78	2.53	1.328	33	1.25	78.4	0.6	34.0	0.7	2305.2	3.05E-04	1.00E-02	1.000	5.29E-01	13.3	5.02E-01	0.00
62.0	1.0	61.5	125.0	3.84	2.58	1.338	33	1.25	78.4	0.6	33.8	0.6	2320.2	3.05E-04	1.00E-02	1.000	5.32E-01	13.3	5.05E-01	0.00
63.5	1.5	62.8	125.0	3.92	2.63	1.350	33	1.25	78.4	0.6	33.6	0.6	2338.8	3.04E-04	1.00E-02	1.000	5.36E-01	13.3	5.09E-01	0.00

REFERENCE: TECHNICAL ENGINEERING AND DESIGN GUIDES AS ADAPTED FROM THE US ARMY CORPS OF ENGINEERS, NO. 9

TOTAL SETTLEMENT (inches) = 0.35

GEOCON WEST, INC.

ENVIRONMENTAL GEOTECHNICAL MATERIALS
500 NORTH VICTORY BOULEVARD - BURBANK, CA 91502
PHONE: 818-841-8388 FAX: 818-841-1704

DRAFTED BY: ACS | CHECKED BY: JTA

EVALUATION OF EARTHQUAKE-INDUCED SETTLEMENTS IN DRY SANDY SOILS

MAXIMUM CONSIDERED EARTHQUAKE

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

SEPT 2024 | PROJECT NO. W1974-06-01 | FIG. 7

BORING PERCOLATION TEST FIELD LOG

Date:	Friday, August 2, 2024		**Boring/Test Number:**	Boring B1	
Project Number:	W1974-06-01		**Diameter of Boring:**	8	inches
Project Location:	4900 Clark Avenue		**Diameter of Casing:**	2	inches
Earth Description:	ML-CL		**Depth of Boring:**	10	feet
Tested By:	RA		**Depth to Invert of BMP:**	5	feet
Liquid Description:	Water		**Depth to Water Table:**	32	feet
Measurement Method:	Sounder		**Depth to Initial Water Depth (d_1)**	45	inches

Start Time for Pre-Soak:	7:00 AM	**Water Remaining in Boring (Y/N):**	Yes
Start Time for Standard:	8:00 AM	**Standard Time Interval Between Readings:**	30 min

Reading Number	Start Time (hh:mm)	Time End (hh:mm)	Elasped Time Δtime (min)	Water Drop During Standard Time Interval, Δd (in)	Soil Despcription Notes Comments
1	8:27 AM	8:57 AM	30	3.6	
2	8:58 AM	9:28 AM	30	3.2	
3	9:23 AM	9:53 AM	30	2.2	
4	10:04 AM	10:34 AM	30	2.2	
5	10:35 AM	11:05 AM	30	2.2	
6	11:06 AM	11:36 AM	30	2.2	Stabilized Readings
7	11:37 AM	12:07 PM	30	2.2	Achieved with Readings
8	12:08 PM	12:38 PM	30	2.3	6, 7, and 8

MEASURED PERCOLATION RATE AND DESIGN INFILTRATION RATE CALCULATIONS*

* Calculations Below Based on Stabilized Readings Only

Boring Radius, r: **4** inches
Test Section Height, h: **75** inches

$$Test\ Section\ Surface\ Area, A = 2\pi rh + \pi r^2$$

A= **1935** in^2

$$Discharged\ Water\ Volume, V = \pi r^2 \Delta d$$

Reading 6	V= **109**	in^3
Reading 7	V= **109**	in^3
Reading 8	V= **115**	in^3

$$Percolation\ Rate = \left(\frac{V/A}{\Delta T}\right)$$

Percolation Rate =	0.11	inches/hour
Percolation Rate =	0.11	inches/hour
Percolation Rate =	0.12	inches/hour

Measured Percolation Rate = **0.11** inches/hour

Reduction Factors

Small Diameter Boring, RF_t =	1
Site Variability, RF_v =	1
Long Term Siltation, RF_s =	1

$$Total\ Reduction\ Factor, RF = RF_t + RF_v + RF_s$$

Total Reduction Factor = 3

Design Infiltration Rate

Design Infiltration Rate = **0.04** inches/hour

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PERCOLATION TEST RESULTS AND CALCULATIONS

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

DRAFTED BY: ACS	CHECKED BY: JTA	SEPT 2024	PROJECT NO. W1974-06-01	FIG. 8

BORING PERCOLATION TEST FIELD LOG

Date:	Friday, August 2, 2024		**Boring/Test Number:**	Boring B2	
Project Number:	W1974-06-01		**Diameter of Boring:**	8	inches
Project Location:	4900 Clark Avenue		**Diameter of Casing:**	2	inches
Earth Description:	ML-CL		**Depth of Boring:**	5	feet
Tested By:	RA		**Depth to Invert of BMP:**	2	feet
Liquid Description:	Water		**Depth to Water Table:**	32	feet
Measurement Method:	Sounder		**Depth to Initial Water Depth (d_1)**	17.76	inches

Start Time for Pre-Soak:	7:15 AM	**Water Remaining in Boring (Y/N):**	Yes
Start Time for Standard:	8:15 AM	**Standard Time Interval Between Readings:**	30 min

Reading Number	Start Time (hh:mm)	Time End (hh:mm)	Elasped Time Δtime (min)	Water Drop During Standard Time Interval, Δd (in)	Soil Despcription Notes Comments
1	8:32 AM	9:02 AM	30	0.0	
2	9:02 AM	9:32 AM	30	0.5	
3	9:34 AM	10:04 AM	30	0.8	
4	10:06 AM	10:36 AM	30	0.5	
5	10:40 AM	11:10 AM	30	0.4	
6	11:10 AM	11:40 AM	30	0.5	Stabilized Readings
7	11:40 AM	12:10 PM	30	0.5	Achieved with Readings
8	12:10 PM	12:40 PM	30	0.5	6, 7, and 8

MEASURED PERCOLATION RATE AND DESIGN INFILTRATION RATE CALCULATIONS*

* Calculations Below Based on Stabilized Readings Only

Boring Radius, r: **4** inches
Test Section Height, h: **42.24** inches

$$Test\ Section\ Surface\ Area, A = 2\pi rh + \pi r^2$$

A= **1112** in^2

$$Discharged\ Water\ Volume, V = \pi r^2 \Delta d$$

$$Percolation\ Rate = \left(\frac{V/A}{\Delta T}\right)$$

Reading 6	V= **24** in^3	Percolation Rate =	0.04 inches/hour
Reading 7	V= **24** in^3	Percolation Rate =	0.04 inches/hour
Reading 8	V= **24** in^3	Percolation Rate =	0.04 inches/hour

Measured Percolation Rate = **0.04** inches/hour

Reduction Factors

Small Diameter Boring, RF_t = 1
Site Variability, RF_v = 1
Long Term Siltation, RF_s = 1

$$Total\ Reduction\ Factor, RF = RF_t + RF_v + RF_s$$

Total Reduction Factor = 3

Design Infiltration Rate

Design Infiltration Rate = **0.01** inches/hour

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PERCOLATION TEST RESULTS AND CALCULATIONS

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

DRAFTED BY: ACS	CHECKED BY: JTA	SEPT 2024	PROJECT NO. W1974-06-01	FIG. 9

BORING PERCOLATION TEST FIELD LOG

Date:	Friday, August 2, 2024		**Boring/Test Number:**	Boring B3	
Project Number:	W1974-06-01		**Diameter of Boring:**	8	inches
Project Location:	4900 Clark Avenue		**Diameter of Casing:**	2	inches
Earth Description:	ML-CL		**Depth of Boring:**	5	feet
Tested By:	RA		**Depth to Invert of BMP:**	2	feet
Liquid Description:	Water		**Depth to Water Table:**	32	feet
Measurement Method:	Sounder		**Depth to Initial Water Depth (d_1)**	18.6	inches

Start Time for Pre-Soak:	7:30 AM	**Water Remaining in Boring (Y/N):**	Yes
Start Time for Standard:	8:30 AM	**Standard Time Interval Between Readings:**	30 min

Reading Number	Start Time (hh:mm)	Time End (hh:mm)	Elasped Time Δtime (min)	Water Drop During Standard Time Interval, Δd (in)	Soil Despcription Notes Comments
1	8:48 AM	9:18 AM	30	0.6	
2	9:18 AM	9:48 AM	30	1.3	
3	9:48 AM	10:18 AM	30	1.2	
4	10:18 AM	10:48 AM	30	0.7	
5	10:48 AM	11:18 AM	30	0.8	
6	11:18 AM	11:48 AM	30	0.6	Stabilized Readings
7	11:48 AM	12:18 PM	30	0.6	Achieved with Readings
8	12:18 PM	12:48 PM	30	0.7	6, 7, and 8

MEASURED PERCOLATION RATE AND DESIGN INFILTRATION RATE CALCULATIONS*

* Calculations Below Based on Stabilized Readings Only

Boring Radius, r: **4** inches
Test Section Height, h: **41.4** inches

$$Test\ Section\ Surface\ Area, A = 2\pi rh + \pi r^2$$

A= **1091** in^2

$$Discharged\ Water\ Volume, V = \pi r^2 \Delta d$$

Reading 6	V= **30**	in^3
Reading 7	V= **30**	in^3
Reading 8	V= **36**	in^3

$$Percolation\ Rate = \left(\frac{V/A}{\Delta T}\right)$$

Percolation Rate =	0.06	inches/hour
Percolation Rate =	0.06	inches/hour
Percolation Rate =	0.07	inches/hour

Measured Percolation Rate = **0.06** inches/hour

Reduction Factors

Small Diameter Boring, RF_t =	1
Site Variability, RF_v =	1
Long Term Siltation, RF_s =	1

$$Total\ Reduction\ Factor, RF = RF_t + RF_v + RF_s$$

Total Reduction Factor = 3

Design Infiltration Rate

Design Infiltration Rate = **0.02** inches/hour

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PERCOLATION TEST RESULTS AND CALCULATIONS

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

DRAFTED BY: ACS	CHECKED BY: JTA	SEPT 2024	PROJECT NO. W1974-06-01	FIG. 10

BORING PERCOLATION TEST FIELD LOG

Date:	Friday, August 2, 2024		**Boring/Test Number:**	Boring B4	
Project Number:	W1974-06-01		**Diameter of Boring:**	8	inches
Project Location:	4900 Clark Avenue		**Diameter of Casing:**	2	inches
Earth Description:	ML-CL		**Depth of Boring:**	5	feet
Tested By:	RA		**Depth to Invert of BMP:**	2	feet
Liquid Description:	Water		**Depth to Water Table:**	32	feet
Measurement Method:	Sounder		**Depth to Initial Water Depth (d_1)**	9.6	inches

Start Time for Pre-Soak:	8:00 AM	**Water Remaining in Boring (Y/N):**	Yes
Start Time for Standard:	9:00 AM	**Standard Time Interval Between Readings:**	30 min

Reading Number	Start Time (hh:mm)	Time End (hh:mm)	Elasped Time Δtime (min)	Water Drop During Standard Time Interval, Δd (in)	Soil Despcription Notes Comments
1	9:15 AM	9:45 AM	30	0.6	
2	9:45 AM	10:15 AM	30	0.6	
3	10:15 AM	10:45 AM	30	0.2	
4	10:45 AM	11:15 AM	30	0.4	
5	11:15 AM	11:45 AM	30	0.5	
6	11:45 AM	12:15 PM	30	0.1	Stabilized Readings
7	12:15 PM	12:45 PM	30	0.1	Achieved with Readings
8	12:45 PM	1:15 PM	30	0.0	6, 7, and 8

MEASURED PERCOLATION RATE AND DESIGN INFILTRATION RATE CALCULATIONS*

* Calculations Below Based on Stabilized Readings Only

Boring Radius, r: **4** inches
Test Section Height, h: **50.4** inches

$$Test\ Section\ Surface\ Area, A = 2\pi rh + \pi r^2$$

A= **1317** in^2

$$Discharged\ Water\ Volume, V = \pi r^2 \Delta d$$

$$Percolation\ Rate = \left(\frac{V/A}{\Delta T}\right)$$

Reading 6	V= **6** in^3	Percolation Rate =	0.01 inches/hour
Reading 7	V= **6** in^3	Percolation Rate =	0.01 inches/hour
Reading 8	V= **0** in^3	Percolation Rate =	0.00 inches/hour

Measured Percolation Rate = **0.01** inches/hour

Reduction Factors

Small Diameter Boring, RF_t = 1
Site Variability, RF_v = 1
Long Term Siltation, RF_s = 1

$$Total\ Reduction\ Factor, RF = RF_t + RF_v + RF_s$$

Total Reduction Factor = 3

Design Infiltration Rate

Design Infiltration Rate = **0.00** inches/hour

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PERCOLATION TEST RESULTS AND CALCULATIONS

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

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APPENDIX A

APPENDIX A
FIELD INVESTIGATION

The site was explored on August 2, 2024, by excavating five 8-inch-diameter borings using a truck-mounted hollow-stem auger drilling machine to depths between 5½ and 63½ feet beneath the ground surface. Representative and relatively undisturbed samples were obtained by driving a 3-inch, O. D., California Modified Sampler into the "undisturbed" soil mass with blows from a 140-pound auto-hammer falling 30 inches. The California Modified Sampler was equipped with 1-inch by $2\frac{3}{8}$-inch diameter brass sampler rings to facilitate soil removal and testing. Bulk samples were also obtained.

The soil conditions encountered in the borings were visually examined, classified and logged in general accordance with the Unified Soil Classification System (USCS). The logs of the borings are presented on Figures A1 through A5. The logs depict the soil and geologic conditions encountered and the depth at which samples were obtained. The logs also include our interpretation of the conditions between sampling intervals. Therefore, the logs contain both observed and interpreted data. We determined the lines designating the interface between soil materials on the logs using visual observations, penetration rates, excavation characteristics and other factors. The transition between materials may be abrupt or gradual. Where applicable, the logs were revised based on subsequent laboratory testing. The approximate locations of the borings are shown on Figure 2.

PROJECT NO. W1974-06-01

BORING 1

ELEV. (MSL.) -- DATE COMPLETED **08/02/2024**

EQUIPMENT **HOLLOW STEM AUGER** BY: **ACS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-5'				**ASPHALT: 4" BASE: 5.5"** **ARTIFICIAL FILL** Sandy Silt, soft, slightly moist, brown, fine-grained, trace clay.			
2	B1@2.5'					7	89.3	26.3
4					**YOUNGER ALLUVIUM** Sandy Silt, firm, slightly moist, brown, fine-grained, some clay.			
6	B1@5'			ML		15	90.0	28.6
8	B1@7.5'				- soft, light brown	10	87.3	33.5
10	B1@10'				- stiff	23	97.1	27.0

Total depth of boring: 10.5 feet
Fill to 3 feet.
No groundwater encountered.
Percolation testing performed.
Backfilled with soil cuttings and tamped.
Patched with asphalt.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

W1974-06-01 BORING LOGS.GPJ

Figure A1,
Log of Boring 1, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1974-06-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**BORING 2** ELEV. (MSL.) -- DATE COMPLETED **08/02/2024** EQUIPMENT **HOLLOW STEM AUGER** BY: **ACS**	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0					**ARTIFICIAL FILL** Sandy Silt, stiff, slightly moist, brown, fine-grained, trace clay.			
2	B2@2.5'					22	99.7	18.8
4				ML	**YOUNGER ALLUVIUM** Sandy Silt, stiff, slightly moist, brown, fine-grained, trace clay.			
	B2@5'					25	100.6	17.0
					Total depth of boring: 5.5 feet Fill to 3 feet. No groundwater encountered. Percolation testing performed. Backfilled with soil cuttings and tamped. *Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

W1974-06-01 BORING LOGS.GPJ

Figure A2,
Log of Boring 2, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

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PROJECT NO. W1974-06-01

BORING 3

ELEV. (MSL.) -- DATE COMPLETED **08/02/2024**

EQUIPMENT **HOLLOW STEM AUGER** BY: **ACS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ARTIFICIAL FILL** Sandy Silt, firm, slightly moist, brown, fine-grained, trace clay.			
2	B3@2.5'					17	91.5	25.4
4				ML	**YOUNGER ALLUVIUM** Sandy Silt, slightly moist, brown, fine-grained, trace clay.			
	B3@5'					16	96.0	23.5
					Total depth of boring: 5.5 feet Fill to 3 feet. No groundwater encountered. Percolation testing performed. Backfilled with soil cuttings and tamped. *Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

W1974-06-01 BORING LOGS.GPJ

Figure A3,
Log of Boring 3, Page 1 of 1

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1974-06-01

BORING 4

ELEV. (MSL.) -- DATE COMPLETED **08/02/2024**

EQUIPMENT **HOLLOW STEM AUGER** BY: **ACS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-5'				**ARTIFICIAL FILL** Sandy Silt, firm, slightly moist, brown, fine-grained, trace clay.			
2	B4@2.5'				- asphalt	49	118.7	8.0
4				ML	**YOUNGER ALLUVIUM** Sandy Silt, stiff, slightly moist, brown, fine-grained, trace clay.			
	B4@5'					22	92.3	30.1

Total depth of boring: 5.5 feet
Fill to 3 feet.
No groundwater encountered.
Percolation testing performed.
Backfilled with soil cuttings and tamped.

*Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer.
NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.

W1974-06-01 BORING LOGS.GPJ

Figure A4,
Log of Boring 4, Page 1 of 1

SAMPLE SYMBOLS

☐ ... SAMPLING UNSUCCESSFUL ◧ ... STANDARD PENETRATION TEST ■ ... DRIVE SAMPLE (UNDISTURBED)
⊠ ... DISTURBED OR BAG SAMPLE ◥ ... CHUNK SAMPLE ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1974-06-01

BORING 5

ELEV. (MSL.) -- DATE COMPLETED **08/02/2024**

EQUIPMENT **HOLLOW STEM AUGER** BY: **ACS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-5'				**ARTIFICIAL FILL** Sandy Silt, soft, slightly moist, brown, fine-grained, trace clay.			
2	B5@2.5'				**YOUNGER ALLUVIUM** Sandy Silt, soft, slightly moist, brown, fine-grained, trace clay.	6		21.3
4	B5@5'				- firm	17	99.9	17.1
6	B5@7.5'			ML	- soft, increase in fine-grained	8		17.6
8	B5@10'				- firm	26	90.7	28.1
10	B5@12.5'				- soft, dark brown, increase in clay	8		28.7
12	B5@15'				Silty Clay, firm, slightly moist, dark brown, trace fine-grained sand.	19	93.2	27.4
14	B5@17.5'			CL	- soft, gray to brown	10		20.1
16	B5@20'				- stiff, gray	31	114.1	18.5
18	B5@22.5'				Sandy Clay, firm, slighlty moist, grayish brown, fine-grained, trace clay.	14		17.8
20	B5@25'			CL	- stiff, light brown	32	105.1	23.0
22	B5@27.5'				Sandy Silt, firm, slightly moist, grayish brown, fine-grained.	18		19.9
24				ML				
26								
28								

W1974-06-01 BORING LOGS.GPJ

Figure A5,
Log of Boring 5, Page 1 of 3

SAMPLE SYMBOLS

- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1974-06-01

BORING 5

ELEV. (MSL.) -- DATE COMPLETED **08/02/2024**

EQUIPMENT **HOLLOW STEM AUGER** BY: **ACS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B5@30'		▼		Silty Sand, medium dense, moist, grayish brown, fine-grained.	36	117.2	17.2
					- groundwater encountered			
32	B5@32.5'			SM		23		23.2
34								
36	B5@35'				- dense, decrease in silt	64	108.2	19.9
38	B5@37.5'				Sand, poorly graded, medium dense, wet, grayish brown, fine- to medium-grained.	17		19.7
40	B5@40'			SP	- no recovery	11		
42	B5@42.5'					20		20.3
44								
46	B5@45'				Clay, soft, wet, brown.	50	109.7	17.2
48	B5@47.5'			CL		11		34.2
50	B5@50'				Silty Sand, dense, wet, brown, fine-grained.	43	116.3	19.1
52	B5@52.5'					33		16.9
54				SM				
56								
58	B5@57.5'				- fine- to medium-grained	41		19.9

W1974-06-01 BORING LOGS.GPJ

Figure A5,
Log of Boring 5, Page 2 of 3

SAMPLE SYMBOLS

- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◥ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

GEOCON

PROJECT NO. W1974-06-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**BORING 5** ELEV. (MSL.) -- DATE COMPLETED **08/02/2024** EQUIPMENT **HOLLOW STEM AUGER** BY: **ACS**	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
60								
62	B5@62.5'			SM	- very dense	72		20.1
					Total depth of boring: 63.5 feet Fill to 2 feet. Groundwater encountered at 31 feet. Percolation testing performed. Backfilled with soil cuttings and tamped. *Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

W1974-06-01 BORING LOGS.GPJ

Figure A5,
Log of Boring 5, Page 3 of 3

SAMPLE SYMBOLS

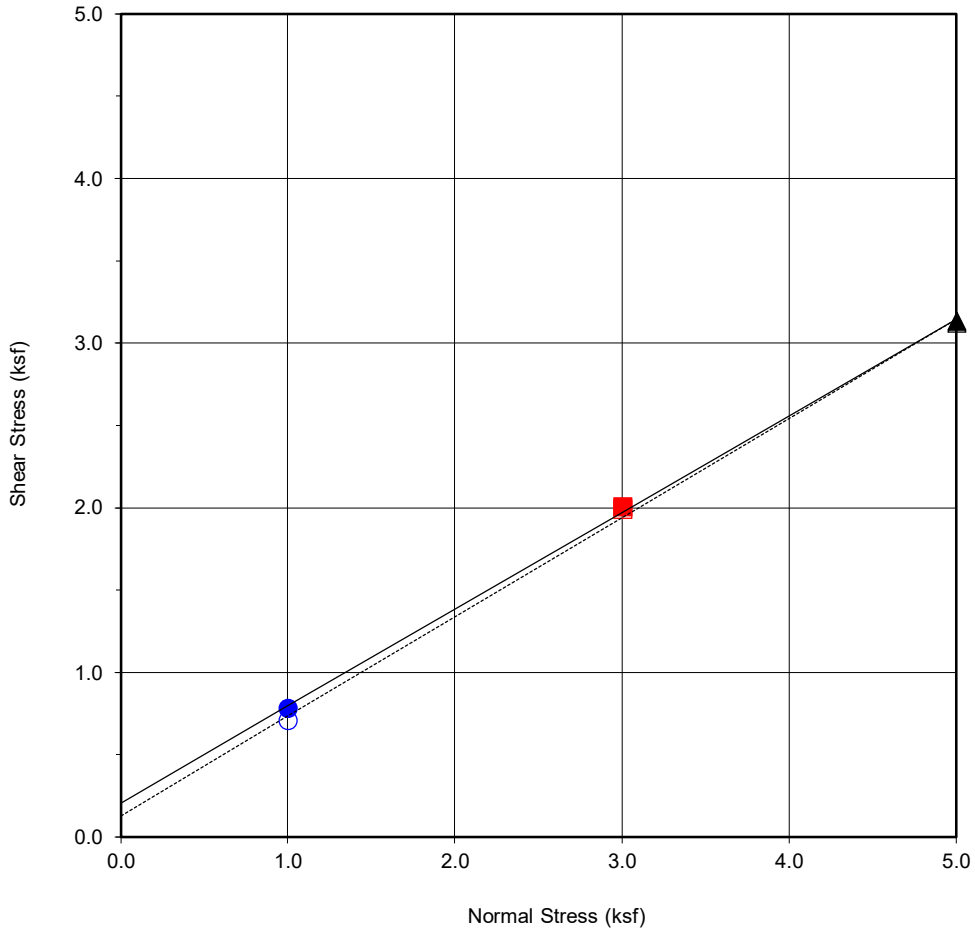
- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

APPENDIX B

APPENDIX B
LABORATORY TESTING

We performed laboratory tests in accordance with generally accepted test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. We tested selected soil samples for in-place dry density/moisture content, expansion index, water-soluble sulfate, pH, resistivity, water-soluble chloride ion content, consolidation, and direct shear strength. The in-place dry density and moisture content of the samples tested are presented on the boring logs, Appendix A.



Boring No.	**B5**
Sample No.	**B5@5'**
Depth (ft)	**5'**
Sample Type:	RING

Soil Identification:		
Sandy Silt (ML)		
Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	208	30
Ultimate	131	31

Normal Stress (kip/ft²)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.78	■ 2.00	▲ 3.13
Shear Stress @ End of Test (ksf)	○ 0.71	□ 1.99	△ 3.12
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	28.5	27.5	26.3
Initial Dry Density (pcf)	97.1	96.4	92.9
Initial Degree of Saturation (%)	104.4	99.3	87.2
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	30.2	28.4	27.7

GEOCON

DIRECT SHEAR TEST RESULTS

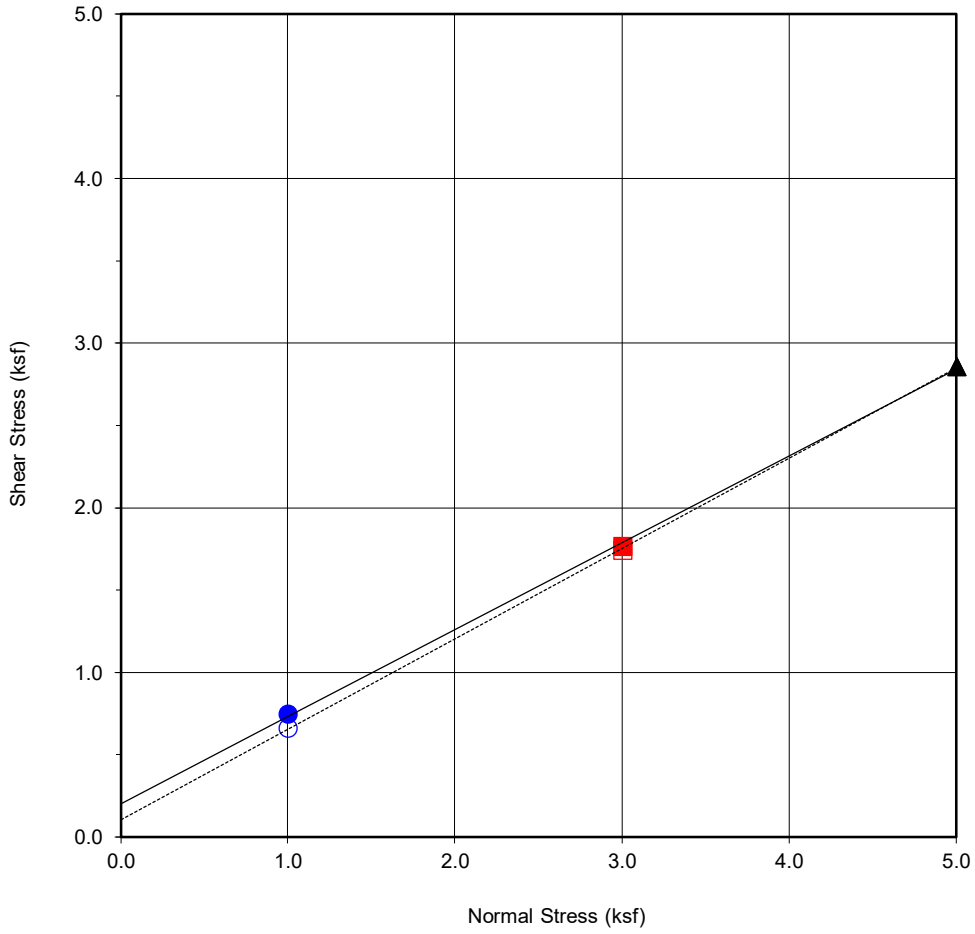
Consolidated Drained ASTM D-3080

Checked by: ACS

Project No.: W1974-06-01

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

September 2024 Figure B1



Boring No.	**B5**
Sample No.	**B5@10'**
Depth (ft)	**10'**
Sample Type:	RING

Soil Identification:		
Sandy Silt (ML)		
Strength Parameters		
	C (psf)	ϕ (^{o})
Peak	204	28
Ultimate	105	29

Normal Stress (kip/ft²)	1	3	5
Peak Shear Stress (kip/ft²)	● 0.74	■ 1.76	▲ 2.86
Shear Stress @ End of Test (ksf)	○ 0.66	□ 1.74	△ 2.86
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	28.7	27.1	36.2
Initial Dry Density (pcf)	93.3	90.9	89.2
Initial Degree of Saturation (%)	96.2	85.6	109.8
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	33.6	33.7	31.5

GEOCON

DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

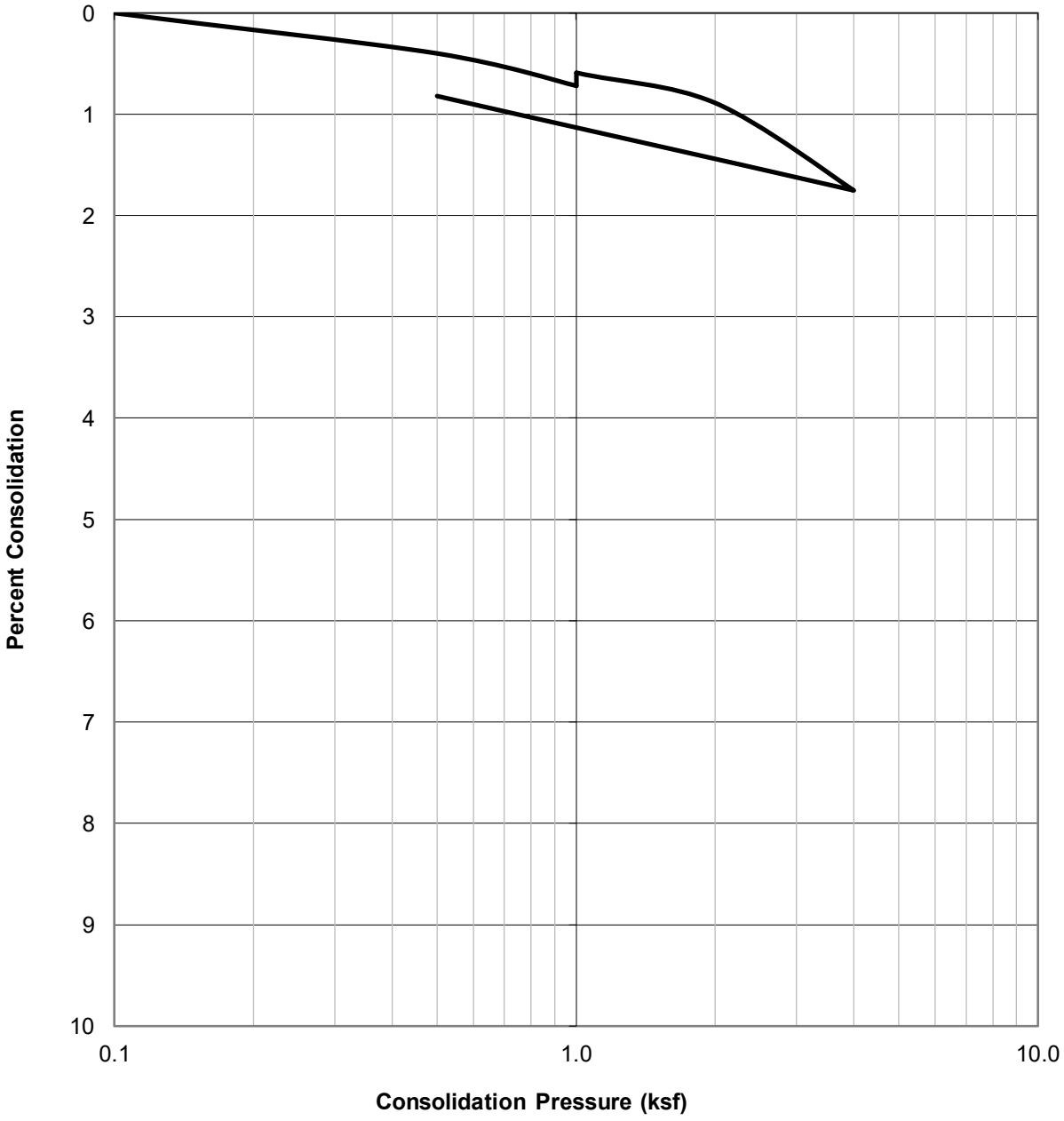
Checked by: ACS

Project No.: W1974-06-01

4900 CLARK AVENUE
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September 2024 Figure B2

WATER ADDED AT 1.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B5@5'	Sandy Silt (ML)	100.7	20.9	25.1

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CONSOLIDATION TEST RESULTS

ASTM D-2435

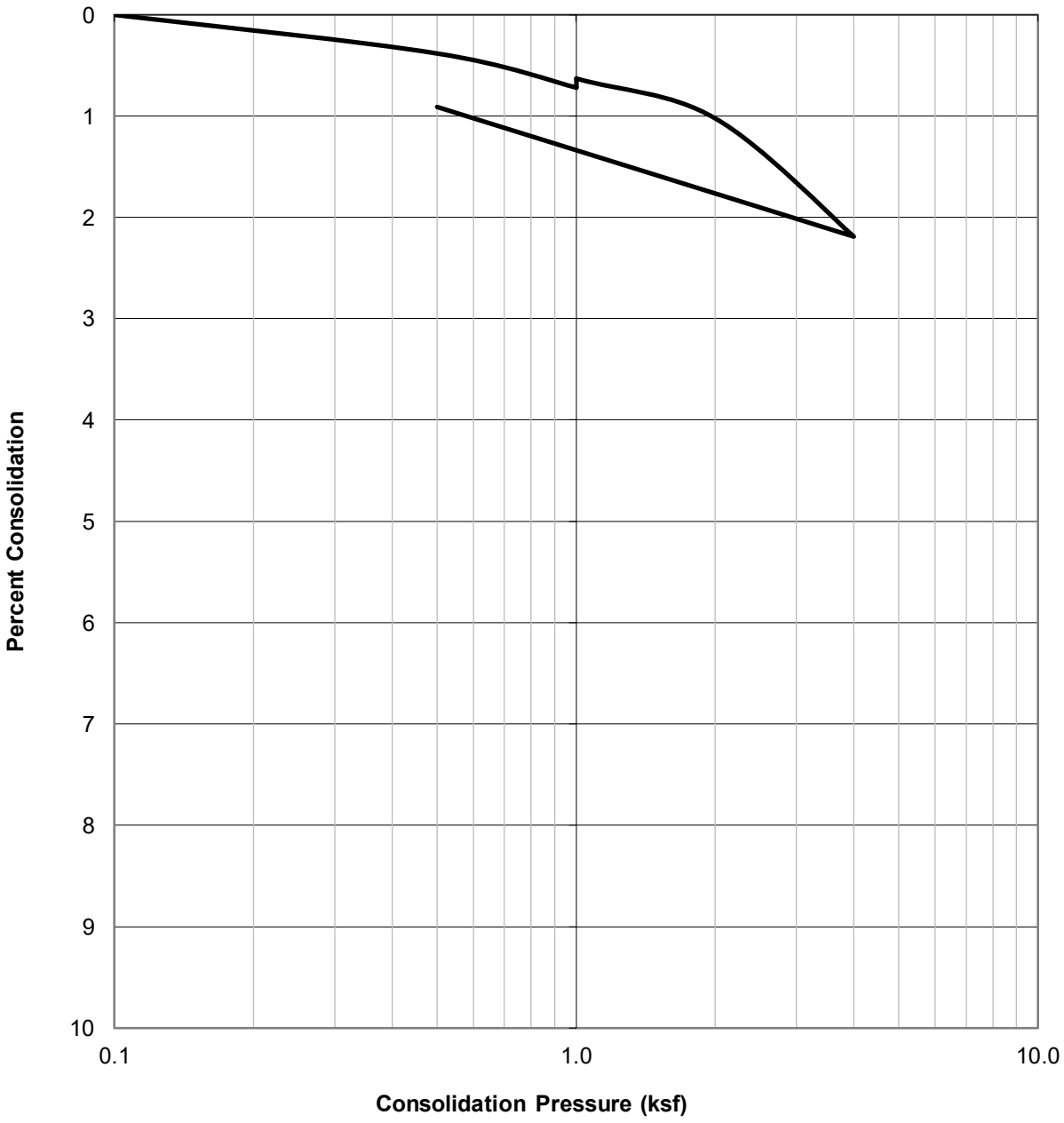
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Project No.: W1974-06-01

4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

September 2024 Figure B3

WATER ADDED AT 1.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B5@10'	Sandy Silt (ML)	90.0	31.7	33.3

GEOCON

CONSOLIDATION TEST RESULTS

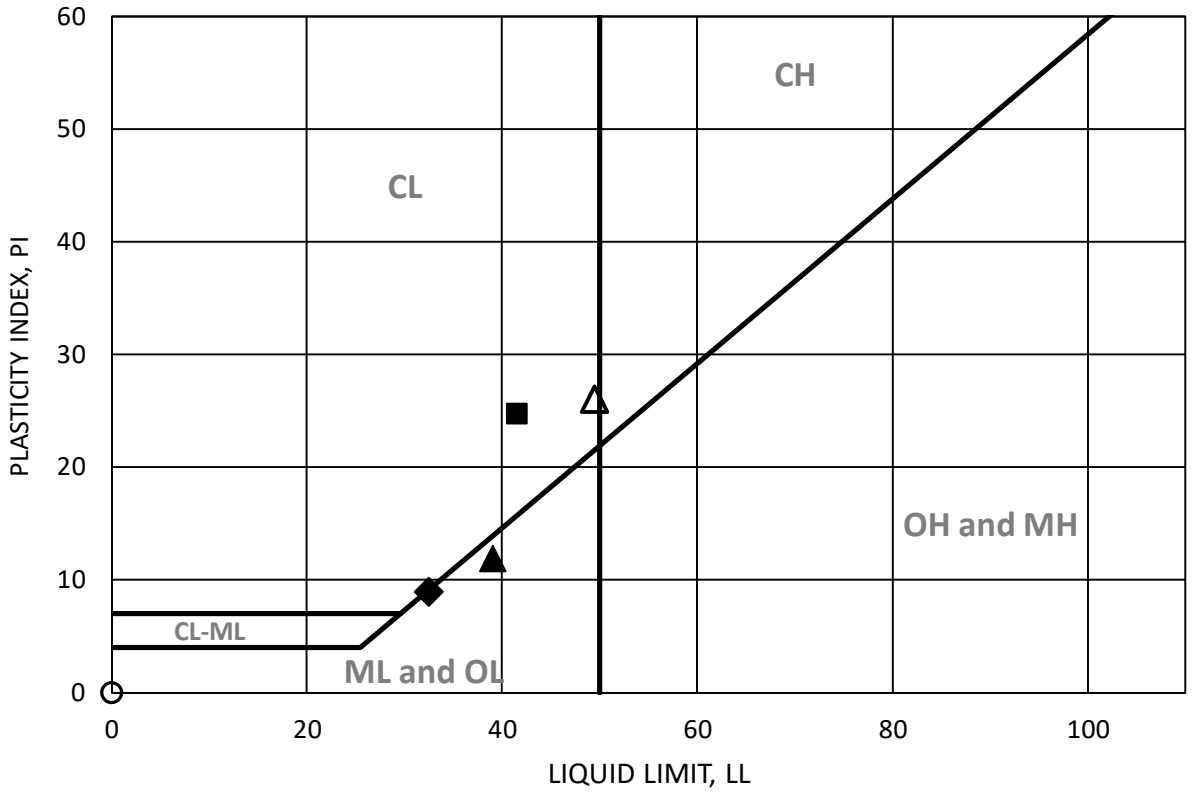
ASTM D-2435

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September 2024 Figure B4



SYMBOL	BORING	DEPTH (ft)	LL	PL	PI	MOISTURE CONTENT AT SATURATION	SOIL BEHAVIOR
■	B5	17.5'	41.5	17	25		CL
◆	B5	22.5'	33	24	9	23	CL
▲	B5	27.5'	39	27	12		ML
●	B5	32.5'	N/P	N/P	N/P		N/P
□	B5	37.5'	N/P	N/P	N/P		N/P
◇	B5	42.5'	N/P	N/P	N/P		N/P
△	B5	47.5'	50	23	26		CH
○							

N/P = Non-Plastic

GEOCON

ATTERBERG LIMITS

ASTM D-4318

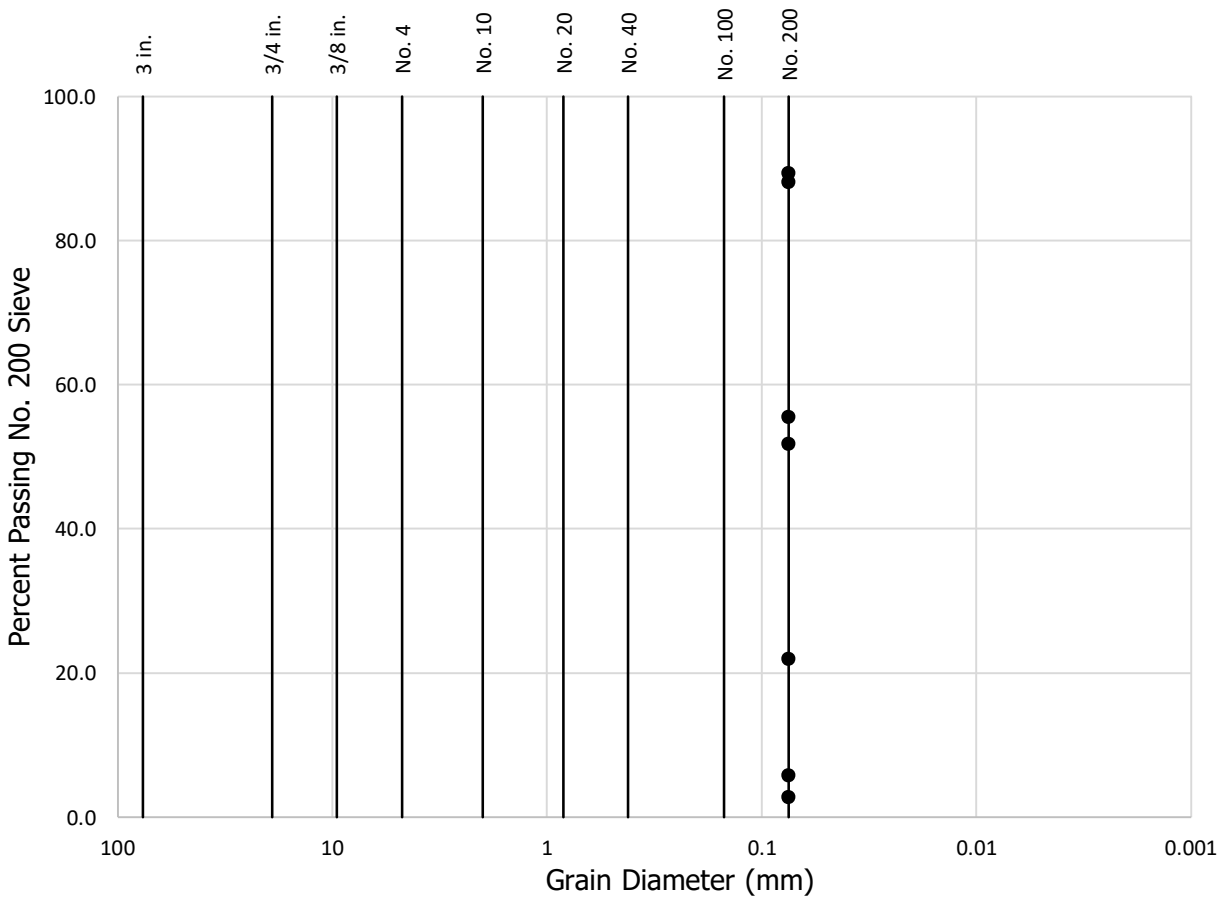
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4900 CLARK AVENUE
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September 2024 Figure B5

GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



Sample No.	Percent Passing No. 200 Sieve
B5 @ 17.5'	88.1
B5 @ 22.5'	55.5
B5 @ 27.5'	51.8
B5 @ 32.5'	21.9
B5 @ 37.5'	2.8
B5 @ 42.5'	5.8
B5 @ 47.5'	89.3

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GRAIN SIZE ANALYSIS

ASTM D-1140

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LAKEWOOD, CALIFORNIA

September 2024 Figure B6

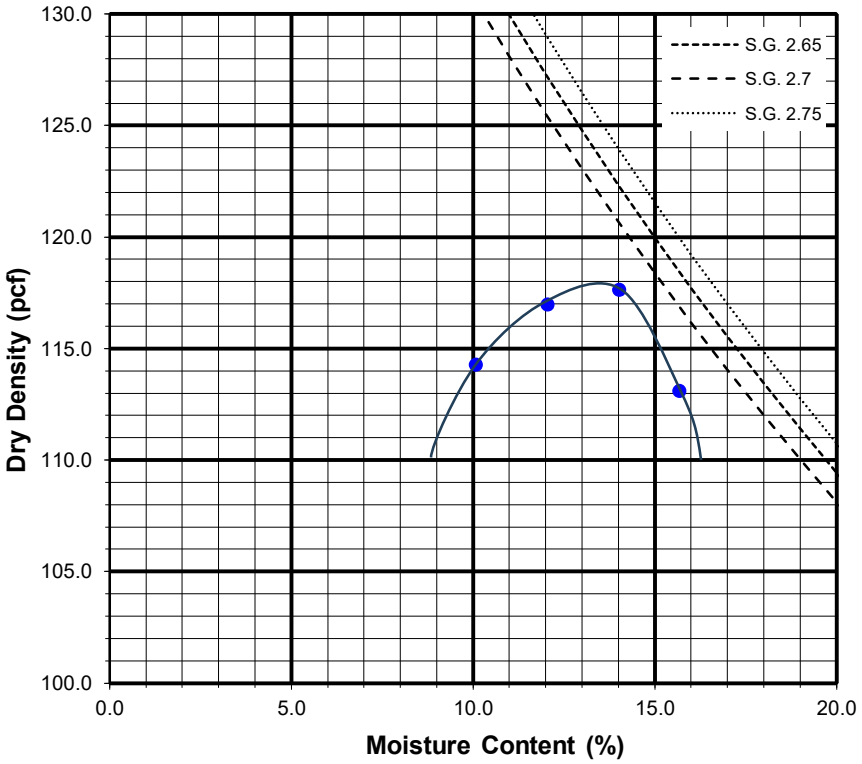
Sample No:

B1+B5 MIX	Sandy Silt (ML)

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6308	6258	6262	6182		
Weight of Mold	(g)	4282	4282	4282	4282		
Net Weight of Soil	(g)	2026	1976	1980	1900		
Wet Weight of Soil + Cont.	(g)	2393.4	2389.3	2357.8	2291.0		
Dry Weight of Soil + Cont.	(g)	2145.4	2120.9	2144.7	2116.0		
Weight of Container	(g)	378.0	408.5	377.3	378.7		
Moisture Content	(%)	14.0	15.7	12.1	10.1		
Wet Density	(pcf)	134.1	130.8	131.1	125.8		
Dry Density	(pcf)	117.6	113.1	117.0	114.3		

Maximum Dry Density (pcf)	**118.0**
Bulk Specific Gravity (dry)	**2.50**
Corrected Maximum Dry Density (pcf)	**120.0**

Optimum Moisture Content (%)	**13.0**
Oversized Fraction (%)	**7.0**
Corrected Moisture Content (%)	**12.1**



Preparation Method: A

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COMPACTION CHARACTERISTICS USING MODIFIED EFFORT TEST RESULTS

ASTM D-1557

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4900 CLARK AVENUE
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Sep 24

Figure B7

B1+B5 MIX

MOLDED SPECIMEN		BEFORE TEST	AFTER TEST
Specimen Diameter	(in.)	4.0	4.0
Specimen Height	(in.)	1.0	1.0
Wt. Comp. Soil + Mold	(gm)	585.0	611.6
Wt. of Mold	(gm)	195.2	195.2
Specific Gravity	(Assumed)	2.7	2.7
Wet Wt. of Soil + Cont.	(gm)	306.8	611.6
Dry Wt. of Soil + Cont.	(gm)	276.6	350.5
Wt. of Container	(gm)	6.8	195.2
Moisture Content	(%)	11.2	18.8
Wet Density	(pcf)	117.6	125.4
Dry Density	(pcf)	105.7	105.6
Void Ratio		0.6	0.6
Total Porosity		0.4	0.4
Pore Volume	(cc)	77.2	82.8
Degree of Saturation	(%) [S_{meas}]	51.3	79.5

Date	Time	Pressure (psi)	Elapsed Time (min)	Dial Readings (in.)
8/8/2024	10:00	1.0	0	0.3824
8/8/2024	10:10	1.0	10	0.3821
Add Distilled Water to the Specimen				
8/9/2024	10:00	1.0	1430	0.4094
8/9/2024	11:00	1.0	1490	0.4094

Expansion Index (EI meas) =	27.3
Expansion Index (Report) =	**27**

Expansion Index, EI_{50}	CBC CLASSIFICATION *	UBC CLASSIFICATION **
0-20	Non-Expansive	Very Low
21-50	Expansive	Low
51-90	Expansive	Medium
91-130	Expansive	High
>130	Expansive	Very High

* Reference: 2022 California Building Code, Section 1803.5.3
** Reference: 1997 Uniform Building Code, Table 18-I-B.

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EXPANSION INDEX TEST RESULTS
ASTM D-4829

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4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

September 2024 Figure B8

SUMMARY OF LABORATORY
POTENTIAL OF HYDROGEN (pH) AND RESISTIVITY TEST RESULTS
AASHTO T289 ASTM D4972 and AASHTO T288 ASTM G187

Sample No.	pH	Resistivity (ohm centimeters)
B1+B5 MIX	8.1	480 (Severely Corrosive)

SUMMARY OF LABORATORY CHLORIDE CONTENT TEST RESULTS
AASHTO T291 ASTM C1218

Sample No.	Chloride Ion Content (%)
B1+B5 MIX	0.017

SUMMARY OF LABORATORY WATER SOLUBLE SULFATE TEST RESULTS
AASHTO T290 ASTM C1580

Sample No.	Water Soluble Sulfate (% SO_4)	Sulfate Exposure
B1+B5 MIX	0.060	S0

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CORROSIVITY TEST RESULTS

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4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

September 2024 Figure B9

SUMMARY OF LABORATORY R-VALUE TEST RESULTS

Sample No.	Soil Description	R-Value
B1 + B5 MIX	Sandy Silt (ML)	25

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R-VALUE TEST RESULTS

ASTM D-2844

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4900 CLARK AVENUE
LAKEWOOD, CALIFORNIA

September 2024 Figure B10

APPENDIX G: AREA 1A SHEET FLOW NORMAL DEPTH CALCULATION

Worksheet for 1A Sheet Flow through Gravel (50yr flow rate)

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.038 ft/ft
Discharge	1.61 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00.0	50.50
0+00.0	50.27
0+26.5	50.30
0+53.5	50.34
0+80.5	50.38
1+08.0	50.41

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 50.50)	(1+08.0, 50.41)	0.035

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.8 in
Roughness Coefficient	0.035
Elevation	50.34 ft
Elevation Range	50.27 to 50.50 ft
Flow Area	1.8 ft²
Wetted Perimeter	51.19 ft
Hydraulic Radius	0.4 in
Top Width	51.13 ft
Normal Depth	0.8 in
Critical Depth	0.7 in
Critical Slope	0.056 ft/ft
Velocity	0.89 ft/s
Velocity Head	0.01 ft
Specific Energy	0.08 ft
Froude Number	0.831

Worksheet for 1A Sheet Flow through Gravel (50yr flow rate)

Results	
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.8 in
Critical Depth	0.7 in
Channel Slope	0.038 ft/ft
Critical Slope	0.056 ft/ft

APPENDIX H: TRENCH DRAIN CALCULATIONS

Worksheet for Flow in Trench Drain #2A (capacity)

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.012
Channel Slope	0.015 ft/ft
Normal Depth	6.4 in
Bottom Width	0.50 ft

Results	
Discharge	1.23 cfs
Flow Area	0.3 ft²
Wetted Perimeter	1.6 ft
Hydraulic Radius	2.0 in
Top Width	0.50 ft
Critical Depth	6.9 in
Critical Slope	0.012 ft/ft
Velocity	4.65 ft/s
Velocity Head	0.34 ft
Specific Energy	0.87 ft
Froude Number	1.126
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	6.4 in
Critical Depth	6.9 in
Channel Slope	0.015 ft/ft
Critical Slope	0.012 ft/ft

Worksheet for Flow in Trench Drain #3A (capacity)

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.012
Channel Slope	0.011 ft/ft
Normal Depth	8.8 in
Bottom Width	0.50 ft

Results	
Discharge	1.55 cfs
Flow Area	0.4 ft²
Wetted Perimeter	2.0 ft
Hydraulic Radius	2.2 in
Top Width	0.50 ft
Critical Depth	8.0 in
Critical Slope	0.014 ft/ft
Velocity	4.24 ft/s
Velocity Head	0.28 ft
Specific Energy	1.01 ft
Froude Number	0.874
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	8.8 in
Critical Depth	8.0 in
Channel Slope	0.011 ft/ft
Critical Slope	0.014 ft/ft

APPENDIX I: RECTANGULAR WALL OPENING CAPACITY CALCULATION

Worksheet for Rectangular Wall Opening (capacity)

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.020
Channel Slope	0.005 ft/ft
Normal Depth	6.0 in
Bottom Width	1.00 ft

Results	
Discharge	1.04 cfs
Flow Area	0.5 ft²
Wetted Perimeter	2.0 ft
Hydraulic Radius	3.0 in
Top Width	1.00 ft
Critical Depth	3.9 in
Critical Slope	0.017 ft/ft
Velocity	2.08 ft/s
Velocity Head	0.07 ft
Specific Energy	0.57 ft
Froude Number	0.520
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	6.0 in
Critical Depth	3.9 in
Channel Slope	0.005 ft/ft
Critical Slope	0.017 ft/ft

APPENDIX J: PROJECT OUTFLOW CALCULATIONS

APPENDIX J.1: PROJECT OUTFLOW SECTION 1A CALCULATIONS

Worksheet for Project Outflow Section 1A - 10-year

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.027 ft/ft
Discharge	0.62 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	50.50
0+00	50.00
0+60	50.17
1+10	50.27

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 50.50)	(1+10, 50.27)	0.015

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.6 in
Roughness Coefficient	0.015
Elevation	50.05 ft
Elevation Range	50.0 to 50.5 ft
Flow Area	0.4 ft²
Wetted Perimeter	17.73 ft
Hydraulic Radius	0.3 in
Top Width	17.68 ft
Normal Depth	0.6 in
Critical Depth	0.7 in
Critical Slope	0.011 ft/ft
Velocity	1.40 ft/s
Velocity Head	0.03 ft
Specific Energy	0.08 ft
Froude Number	1.559
Flow Type	Supercritical

Worksheet for Project Outflow Section 1A - 10-year

GVF Input Data	
Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.6 in
Critical Depth	0.7 in
Channel Slope	0.027 ft/ft
Critical Slope	0.011 ft/ft

Worksheet for Project Outflow Section 1A - 25-year

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.027 ft/ft
Discharge	0.89 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	50.50
0+00	50.00
0+60	50.17
1+10	50.27

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 50.50)	(1+10, 50.27)	0.015

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.7 in
Roughness Coefficient	0.015
Elevation	50.06 ft
Elevation Range	50.0 to 50.5 ft
Flow Area	0.6 ft²
Wetted Perimeter	20.38 ft
Hydraulic Radius	0.3 in
Top Width	20.32 ft
Normal Depth	0.7 in
Critical Depth	0.8 in
Critical Slope	0.010 ft/ft
Velocity	1.52 ft/s
Velocity Head	0.04 ft
Specific Energy	0.09 ft
Froude Number	1.580
Flow Type	Supercritical

Worksheet for Project Outflow Section 1A - 25-year

GVF Input Data	
Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.7 in
Critical Depth	0.8 in
Channel Slope	0.027 ft/ft
Critical Slope	0.010 ft/ft

Worksheet for Project Outflow Section 1A - 50-year

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.027 ft/ft
Discharge	1.10 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	50.50
0+00	50.00
0+60	50.17
1+10	50.27

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 50.50)	(1+10, 50.27)	0.015

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.7 in
Roughness Coefficient	0.015
Elevation	50.06 ft
Elevation Range	50.00 to 50.50 ft
Flow Area	0.7 ft²
Wetted Perimeter	22.02 ft
Hydraulic Radius	0.4 in
Top Width	21.96 ft
Normal Depth	0.7 in
Critical Depth	0.9 in
Critical Slope	0.010 ft/ft
Velocity	1.61 ft/s
Velocity Head	0.04 ft
Specific Energy	0.10 ft
Froude Number	1.610
Flow Type	Supercritical

Worksheet for Project Outflow Section 1A - 50-year

GVF Input Data	
Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.7 in
Critical Depth	0.9 in
Channel Slope	0.027 ft/ft
Critical Slope	0.010 ft/ft

APPENDIX J.2: PROJECT OUTFLOW SECTION 2A CALCULATIONS

Worksheet for Project Outflow Section 2A - 10-year

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.027 ft/ft
Discharge	0.37 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	49.71
0+00	49.21
0+60	49.45
0+90	49.64

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 49.71)	(0+90, 49.64)	0.015

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.6 in
Roughness Coefficient	0.015
Elevation	49.26 ft
Elevation Range	49.21 to 49.71 ft
Flow Area	0.3 ft²
Wetted Perimeter	11.86 ft
Hydraulic Radius	0.3 in
Top Width	11.81 ft
Normal Depth	0.6 in
Critical Depth	0.7 in
Critical Slope	0.011 ft/ft
Velocity	1.33 ft/s
Velocity Head	0.03 ft
Specific Energy	0.07 ft
Froude Number	1.521
Flow Type	Supercritical

Worksheet for Project Outflow Section 2A - 10-year

GVF Input Data	
Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.6 in
Critical Depth	0.7 in
Channel Slope	0.027 ft/ft
Critical Slope	0.011 ft/ft

Worksheet for Project Outflow Section 2A - 25-year

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.027 ft/ft
Discharge	0.60 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	49.71
0+00	49.21
0+60	49.45
0+90	49.64

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 49.71)	(0+90, 49.64)	0.015

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.7 in
Roughness Coefficient	0.015
Elevation	49.27 ft
Elevation Range	49.21 to 49.71 ft
Flow Area	0.4 ft²
Wetted Perimeter	14.15 ft
Hydraulic Radius	0.3 in
Top Width	14.09 ft
Normal Depth	0.7 in
Critical Depth	0.8 in
Critical Slope	0.010 ft/ft
Velocity	1.51 ft/s
Velocity Head	0.04 ft
Specific Energy	0.09 ft
Froude Number	1.586
Flow Type	Supercritical

Worksheet for Project Outflow Section 2A - 25-year

GVF Input Data	
Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.7 in
Critical Depth	0.8 in
Channel Slope	0.027 ft/ft
Critical Slope	0.010 ft/ft

Worksheet for Project Outflow Section 2A - 50-year

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.027 ft/ft
Discharge	0.73 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	49.71
0+00	49.21
0+60	49.45
0+90	49.64

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 49.71)	(0+90, 49.64)	0.015

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.7 in
Roughness Coefficient	0.015
Elevation	49.27 ft
Elevation Range	49.21 to 49.71 ft
Flow Area	0.5 ft²
Wetted Perimeter	15.30 ft
Hydraulic Radius	0.4 in
Top Width	15.24 ft
Normal Depth	0.7 in
Critical Depth	0.9 in
Critical Slope	0.010 ft/ft
Velocity	1.57 ft/s
Velocity Head	0.04 ft
Specific Energy	0.10 ft
Froude Number	1.587
Flow Type	Supercritical

Worksheet for Project Outflow Section 2A - 50-year

GVF Input Data	
Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.7 in
Critical Depth	0.9 in
Channel Slope	0.027 ft/ft
Critical Slope	0.010 ft/ft

APPENDIX J.3: PROJECT OUTFLOW SECTION 3A CALCULATIONS

Worksheet for Project Outflow Section 3A - 10-year

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.032 ft/ft
Discharge	0.86 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	48.94
0+00	48.44
0+30	48.69
0+80	48.86
1+10	49.03

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 48.94)	(1+10, 49.03)	0.015

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	1.0 in
Roughness Coefficient	0.015
Elevation	48.52 ft
Elevation Range	48.44 to 49.03 ft
Flow Area	0.4 ft²
Wetted Perimeter	9.98 ft
Hydraulic Radius	0.5 in
Top Width	9.90 ft
Normal Depth	1.0 in
Critical Depth	1.3 in
Critical Slope	0.009 ft/ft
Velocity	2.11 ft/s
Velocity Head	0.07 ft
Specific Energy	0.15 ft
Froude Number	1.829
Flow Type	Supercritical

Worksheet for Project Outflow Section 3A - 10-year

GVF Input Data	
Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.0 in
Critical Depth	1.3 in
Channel Slope	0.032 ft/ft
Critical Slope	0.009 ft/ft

Worksheet for Project Outflow Section 3A - 25-year

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.032 ft/ft
Discharge	1.22 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	48.94
0+00	48.44
0+30	48.69
0+80	48.86
1+10	49.03

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 48.94)	(1+10, 49.03)	0.015

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	1.1 in
Roughness Coefficient	0.015
Elevation	48.53 ft
Elevation Range	48.44 to 49.03 ft
Flow Area	0.5 ft²
Wetted Perimeter	11.40 ft
Hydraulic Radius	0.6 in
Top Width	11.31 ft
Normal Depth	1.1 in
Critical Depth	1.4 in
Critical Slope	0.008 ft/ft
Velocity	2.29 ft/s
Velocity Head	0.08 ft
Specific Energy	0.18 ft
Froude Number	1.859
Flow Type	Supercritical

Worksheet for Project Outflow Section 3A - 25-year

GVF Input Data	
Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.1 in
Critical Depth	1.4 in
Channel Slope	0.032 ft/ft
Critical Slope	0.008 ft/ft

Worksheet for Project Outflow Section 3A - 50-year

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.032 ft/ft
Discharge	1.49 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	48.94
0+00	48.44
0+30	48.69
0+80	48.86
1+10	49.03

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 48.94)	(1+10, 49.03)	0.015

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	1.2 in
Roughness Coefficient	0.015
Elevation	48.54 ft
Elevation Range	48.44 to 49.03 ft
Flow Area	0.6 ft²
Wetted Perimeter	12.25 ft
Hydraulic Radius	0.6 in
Top Width	12.15 ft
Normal Depth	1.2 in
Critical Depth	1.6 in
Critical Slope	0.008 ft/ft
Velocity	2.42 ft/s
Velocity Head	0.09 ft
Specific Energy	0.19 ft
Froude Number	1.898
Flow Type	Supercritical

Worksheet for Project Outflow Section 3A - 50-year

GVF Input Data	
Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.2 in
Critical Depth	1.6 in
Channel Slope	0.032 ft/ft
Critical Slope	0.008 ft/ft

APPENDIX J.4: PROJECT OUTFLOW SECTION 5A CALCULATIONS

Worksheet for Project Outflow Section 5A - 10-year

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.030 ft/ft
Discharge	0.97 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	48.48
0+30	48.35
0+60	48.24
0+90	48.44

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 48.48)	(0+90, 48.44)	0.015

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.7 in
Roughness Coefficient	0.015
Elevation	48.29 ft
Elevation Range	48.24 to 48.48 ft
Flow Area	0.6 ft²
Wetted Perimeter	22.98 ft
Hydraulic Radius	0.3 in
Top Width	22.98 ft
Normal Depth	0.7 in
Critical Depth	0.8 in
Critical Slope	0.010 ft/ft
Velocity	1.55 ft/s
Velocity Head	0.04 ft
Specific Energy	0.09 ft
Froude Number	1.660
Flow Type	Supercritical

Worksheet for Project Outflow Section 5A - 10-year

GVF Input Data	
Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.7 in
Critical Depth	0.8 in
Channel Slope	0.030 ft/ft
Critical Slope	0.010 ft/ft

Worksheet for Project Outflow Section 5A - 25-year

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.030 ft/ft
Discharge	1.56 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	48.48
0+30	48.35
0+60	48.24
0+90	48.44

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 48.48)	(0+90, 48.44)	0.015

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.8 in
Roughness Coefficient	0.015
Elevation	48.30 ft
Elevation Range	48.24 to 48.48 ft
Flow Area	0.9 ft²
Wetted Perimeter	27.37 ft
Hydraulic Radius	0.4 in
Top Width	27.37 ft
Normal Depth	0.8 in
Critical Depth	1.0 in
Critical Slope	0.010 ft/ft
Velocity	1.76 ft/s
Velocity Head	0.05 ft
Specific Energy	0.11 ft
Froude Number	1.725
Flow Type	Supercritical

Worksheet for Project Outflow Section 5A - 25-year

GVF Input Data	
Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.8 in
Critical Depth	1.0 in
Channel Slope	0.030 ft/ft
Critical Slope	0.010 ft/ft

Worksheet for Project Outflow Section 5A - 50-year

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.030 ft/ft
Discharge	1.89 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	48.48
0+30	48.35
0+60	48.24
0+90	48.44

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 48.48)	(0+90, 48.44)	0.015

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.8 in
Roughness Coefficient	0.015
Elevation	48.31 ft
Elevation Range	48.24 to 48.48 ft
Flow Area	1.0 ft²
Wetted Perimeter	29.48 ft
Hydraulic Radius	0.4 in
Top Width	29.48 ft
Normal Depth	0.8 in
Critical Depth	1.0 in
Critical Slope	0.009 ft/ft
Velocity	1.84 ft/s
Velocity Head	0.05 ft
Specific Energy	0.12 ft
Froude Number	1.735
Flow Type	Supercritical

Worksheet for Project Outflow Section 5A - 50-year

GVF Input Data	
Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.8 in
Critical Depth	1.0 in
Channel Slope	0.030 ft/ft
Critical Slope	0.009 ft/ft

APPENDIX J.5: PROJECT OUTFLOW SECTION 6A CALCULATIONS

Worksheet for Project Outflow Section 6A - 10-year

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Channel Slope	0.038	ft/ft
Discharge	0.43	cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	49.93
0+30	49.38
0+60	48.94
0+90	48.70
0+90	49.20

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 49.93)	(0+90, 49.20)	0.015

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results		
Normal Depth	0.7	in
Roughness Coefficient	0.015	
Elevation	48.76	ft
Elevation Range	48.70 to 49.93	ft
Flow Area	0.2	ft²
Wetted Perimeter	7.66	ft
Hydraulic Radius	0.4	in
Top Width	7.60	ft
Normal Depth	0.7	in
Critical Depth	0.9	in
Critical Slope	0.010	ft/ft
Velocity	1.86	ft/s
Velocity Head	0.05	ft
Specific Energy	0.11	ft
Froude Number	1.882	
Flow Type	Supercritical	

Worksheet for Project Outflow Section 6A - 10-year

GVF Input Data	
Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.7 in
Critical Depth	0.9 in
Channel Slope	0.038 ft/ft
Critical Slope	0.010 ft/ft

Worksheet for Project Outflow Section 6A - 25-year

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Channel Slope	0.038	ft/ft
Discharge	0.69	cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	49.93
0+30	49.38
0+60	48.94
0+90	48.70
0+90	49.20

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 49.93)	(0+90, 49.20)	0.015

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results		
Normal Depth	0.9	in
Roughness Coefficient	0.015	
Elevation	48.77	ft
Elevation Range	48.70 to 49.93	ft
Flow Area	0.3	ft²
Wetted Perimeter	9.13	ft
Hydraulic Radius	0.4	in
Top Width	9.06	ft
Normal Depth	0.9	in
Critical Depth	1.1	in
Critical Slope	0.009	ft/ft
Velocity	2.10	ft/s
Velocity Head	0.07	ft
Specific Energy	0.14	ft
Froude Number	1.948	
Flow Type	Supercritical	

Worksheet for Project Outflow Section 6A - 25-year

GVF Input Data	
Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.9 in
Critical Depth	1.1 in
Channel Slope	0.038 ft/ft
Critical Slope	0.009 ft/ft

Worksheet for Project Outflow Section 6A - 50-year

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.038 ft/ft
Discharge	0.84 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00	49.93
0+30	49.38
0+60	48.94
0+90	48.70
0+90	49.20

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 49.93)	(0+90, 49.20)	0.015

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	0.9 in
Roughness Coefficient	0.015
Elevation	48.78 ft
Elevation Range	48.70 to 49.93 ft
Flow Area	0.4 ft²
Wetted Perimeter	9.80 ft
Hydraulic Radius	0.5 in
Top Width	9.72 ft
Normal Depth	0.9 in
Critical Depth	1.2 in
Critical Slope	0.009 ft/ft
Velocity	2.22 ft/s
Velocity Head	0.08 ft
Specific Energy	0.15 ft
Froude Number	1.987
Flow Type	Supercritical

Worksheet for Project Outflow Section 6A - 50-year

GVF Input Data	
Downstream Depth	0.0 in
Length	0.00 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.9 in
Critical Depth	1.2 in
Channel Slope	0.038 ft/ft
Critical Slope	0.009 ft/ft

EXHIBITS

EXHIBIT A: PRE-PROJECT HYDROLOGY MAP

LAKEWOOD CORNER LOT DEVELOPMENT

IN THE CITY OF LAKEWOOD, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA

PRE-PROJECT CONDITION SITE HYDROLOGY MAP



LEGEND:

- XXX.X / XXXX — NODE/CONCENTRATION POINT / FLOWLINE ELEVATION
- XXXX.X — APPROXIMATE INVERT ELEVATION
- XXX / X.X — SUB AREA / ACRES
- L=XXX' — FLOW DISTANCE
- FLOW PATH
- WATERSHED BOUNDARY
- WATERSHED SUB-BOUNDARY

DESIGN NOTES:
1. 50 YEAR RAINFALL = 5.4
2. SOIL TYPE = 06

SCALE 1"=30'

30 15 0

SCALE: 1"=30'

RATIONAL METHOD RESULTS

SUBAREA	AREA (ACRES)	50-YEAR FLOW RATE (CFS)	25-YEAR FLOW RATE (CFS)	10-YEAR FLOW RATE (CFS)	2-YEAR FLOW RATE (CFS)
1A	0.58	1.68	1.47	1.09	0.48
2A	0.56	1.36	1.05	0.74	0.20
3A	0.44	1.19	0.91	0.63	0.18
4A	0.70	2.02	1.63	1.23	0.56
5A	1.26	3.06	2.37	1.67	0.42
6A	0.16	0.31	0.24	0.17	0.03

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

EXHIBIT "A"

LAKEWOOD CORNER LOT

PRE-PROJECT CONDITION HYDROLOGY MAP

Drawing Name: O:\166.14.24\Engineering\Hydrology_Plan\Exhibits\Exhibits_A_Pre-Project Condition.dwg
Last Opened: Jun 23, 2026 - 12:18pm by stanner

EXHIBIT B: POST-PROJECT HYDROLOGY MAP

LAKEWOOD CORNER LOT DEVELOPMENT

IN THE CITY OF LAKEWOOD, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA

POST-PROJECT CONDITION SITE HYDROLOGY MAP



LEGEND:

XXX.X / XXXX	NODE/CONCENTRATION POINT / FLOWLINE ELEVATION
XXXX.X	APPROXIMATE INVERT ELEVATION
XXX / X.X	SUB AREA / ACRES
L=XXX'	FLOW DISTANCE
	FLOW PATH
	WATERSHED BOUNDARY
	WATERSHED SUB-BOUNDARY

DESIGN NOTES:

1. 50 YEAR RAINFALL = 5.4
2. SOIL TYPE = 06
3. SEE EXHIBIT D FOR LAND USE AND IMPERVIOUS AREA MAP

PEAK FLOW HYDROLOGIC ANALYSIS RESULTS

SUBAREA	AREA (ACRES)	50-YEAR FLOW RATE (CFS)	25-YEAR FLOW RATE (CFS)	10-YEAR FLOW RATE (CFS)	2-YEAR FLOW RATE (CFS)
1A	0.56	1.61	1.40	1.13	0.51
2A	0.35	0.99	0.86	0.63	0.26
3A	0.74	2.12	1.85	1.49	0.63
4A	0.74	2.14	1.87	1.39	0.65
5A	0.89	2.52	2.19	1.60	0.63
6A	0.38	1.05	0.90	0.64	0.21
7A	0.05	0.14	0.10	0.07	0.03

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

EXHIBIT "B"

LAKEWOOD CORNER LOT

POST-PROJECT CONDITION HYDROLOGY MAP

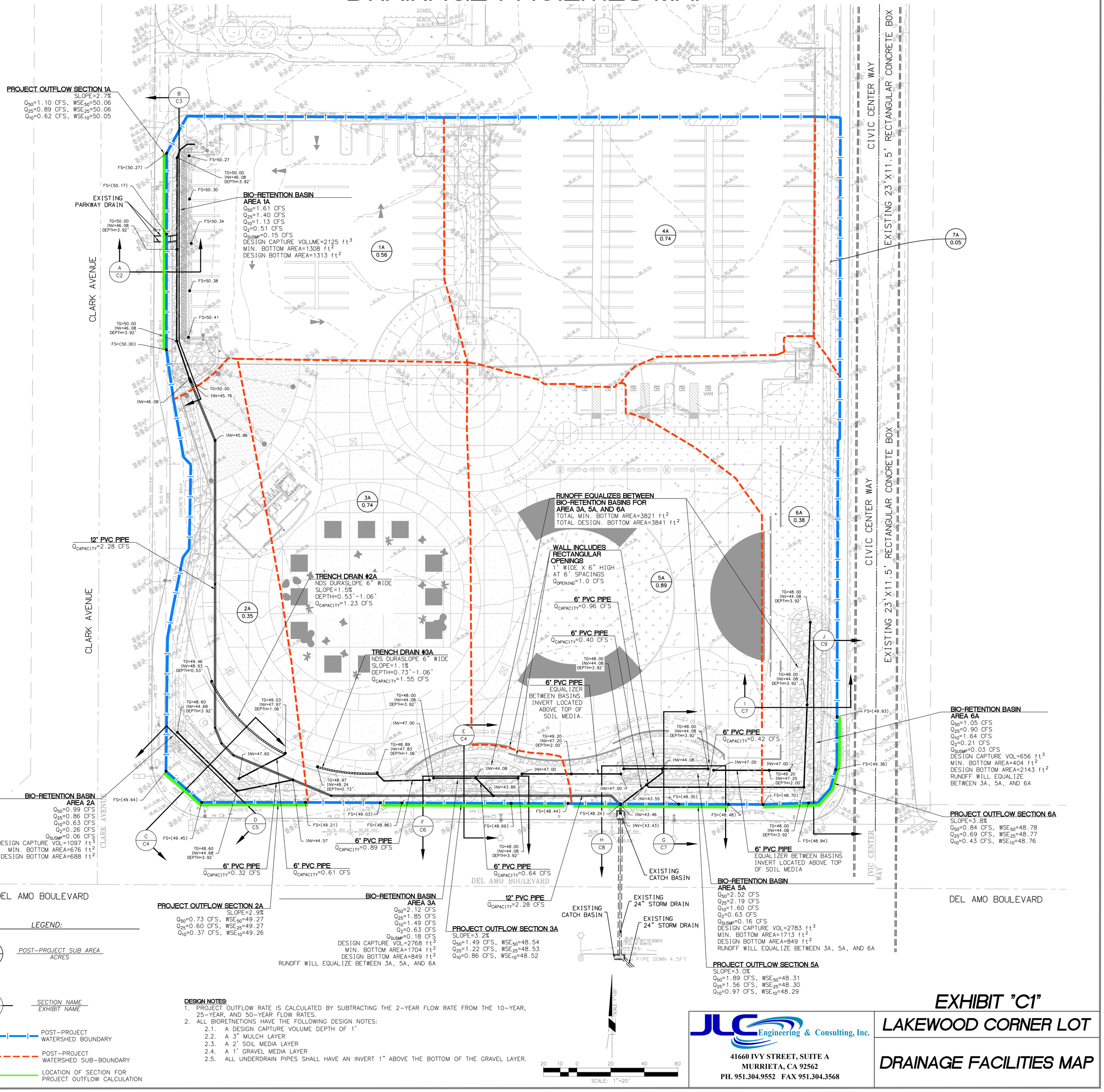
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Last Opened: Jun 23, 2026 - 12:05pm by stanner

EXHIBIT C: DRAINAGE FACILITIES MAP

LAKEWOOD CORNER LOT DEVELOPMENT

IN THE CITY OF LAKEWOOD, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA

DRAINAGE FACILITIES MAP



DESIGN NOTES:

1. PROJECT OUTFLOW RATE IS CALCULATED BY SUBTRACTING THE 2-YEAR FLOW RATE FROM THE 10-YEAR, 25-YEAR, AND 50-YEAR FLOW RATES.
2. ALL BIORETNETIONS HAVE THE FOLLOWING DESIGN NOTES:
   - 2.1. A DESIGN CAPTURE VOLUME DEPTH OF 1'
   - 2.2. A 3" MULCH LAYER
   - 2.3. A 2' SOIL MEDIA LAYER
   - 2.4. A 1' GRAVEL MEDIA LAYER
   - 2.5. ALL UNDERDRAIN PIPES SHALL HAVE AN INVERT 1" ABOVE THE BOTTOM OF THE GRAVEL LAYER.

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

EXHIBIT "C1"

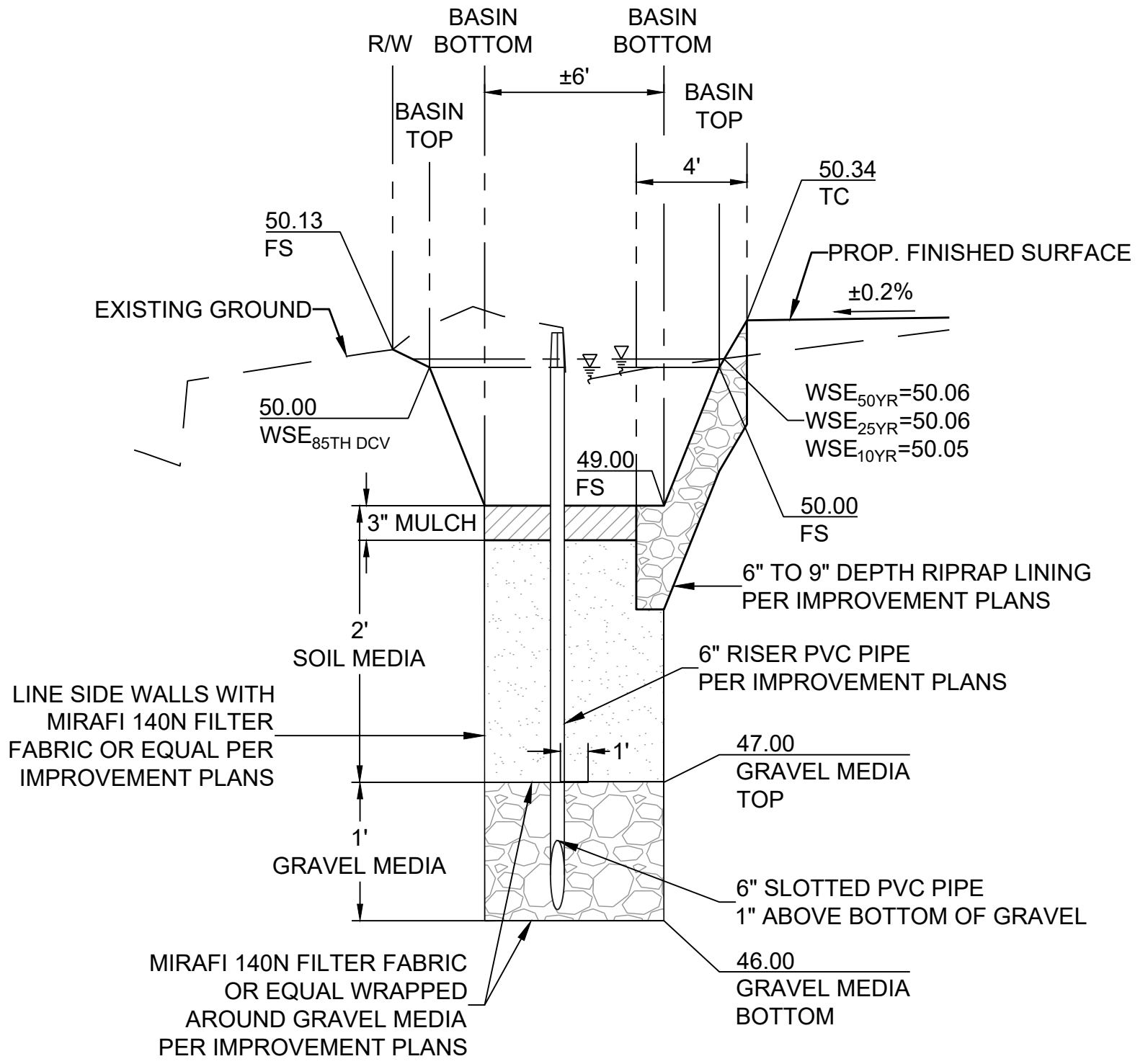
LAKEWOOD CORNER LOT

DRAINAGE FACILITIES MAP

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Last Opened: Jun 25, 2026 - 4:21pm by Rtesi0624

LAKEWOOD CORNER LOT DEVELOPMENT

IN THE CITY OF LAKEWOOD, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA



A / C1 BASIN 1A SECTION

SCALE: HORIZ.: 1"=5'
VERT.: 1"=1'

DESIGN NOTES:

1. SOIL MEDIA SPECIFICATION PER IMPROVEMENT PLANS
2. GRAVEL SPECIFICATION PER IMPROVEMENT PLANS



JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

EXHIBIT "C2"

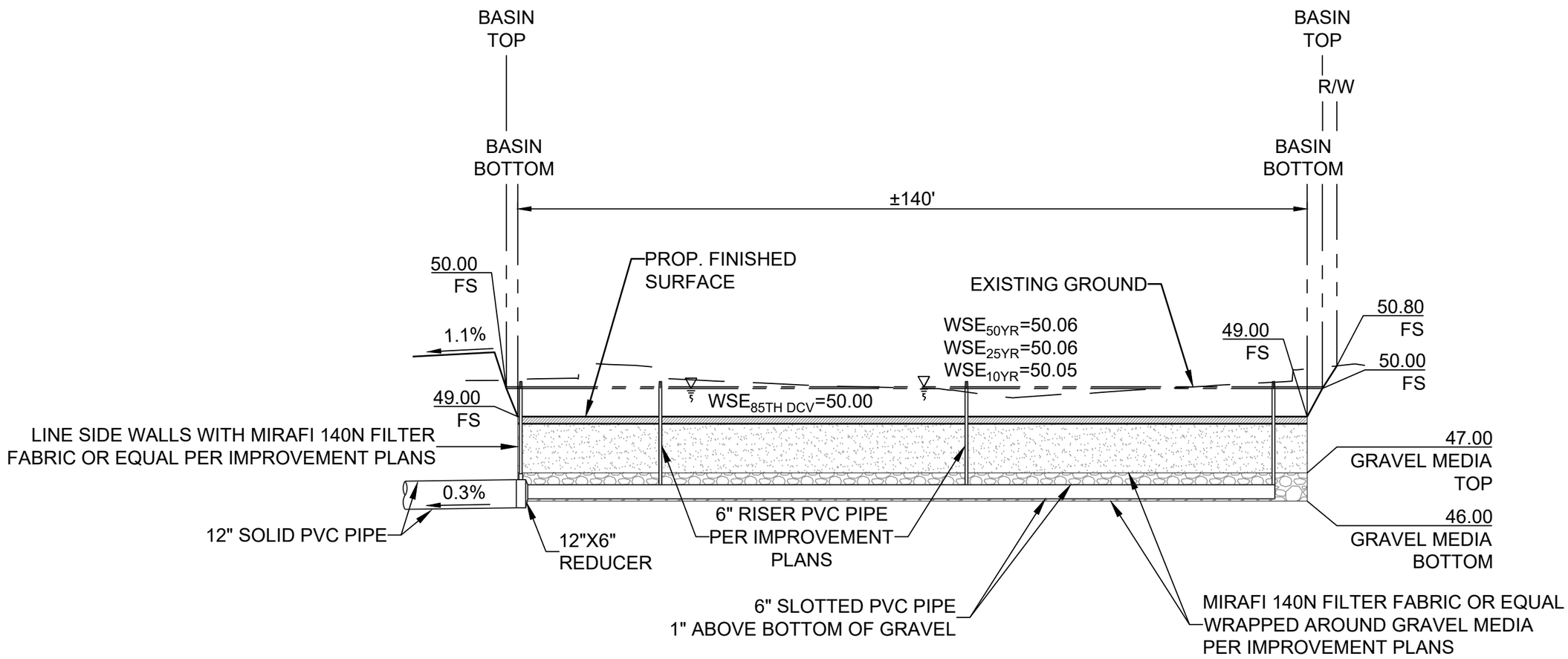
LAKEWOOD CORNER LOT

BASIN 1A CROSS SECTION

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Last Opened: Jun 25, 2026 - 4:21pm by RtecsOb24

LAKEWOOD CORNER LOT DEVELOPMENT

IN THE CITY OF LAKEWOOD, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA



B / C1 BASIN 1A SECTION

SCALE: HORIZ.: 1"=20'
VERT.: 1"=4'

DESIGN NOTES:

1. SOIL MEDIA SPECIFICATION PER IMPROVEMENT PLANS
2. GRAVEL SPECIFICATION PER IMPROVEMENT PLANS

20 10 0 20 40 60

SCALE: 1"=20'

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

EXHIBIT "C3"

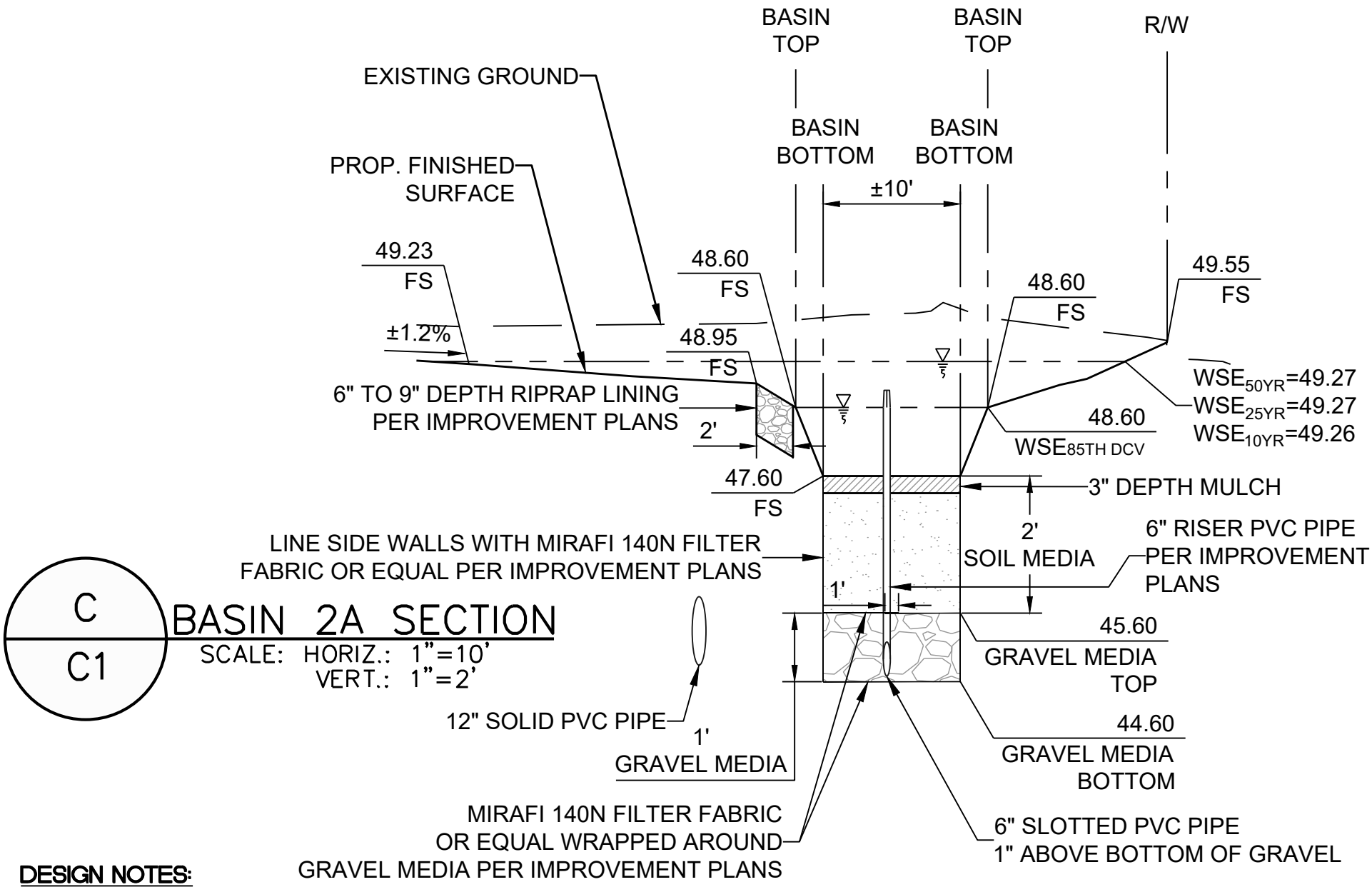
LAKEWOOD CORNER LOT

BASIN 1A LONGITUDINAL SECTION

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Last Opened: Jun 25, 2026 - 4:42pm by Rtees0624

LAKEWOOD CORNER LOT DEVELOPMENT

IN THE CITY OF LAKEWOOD, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA

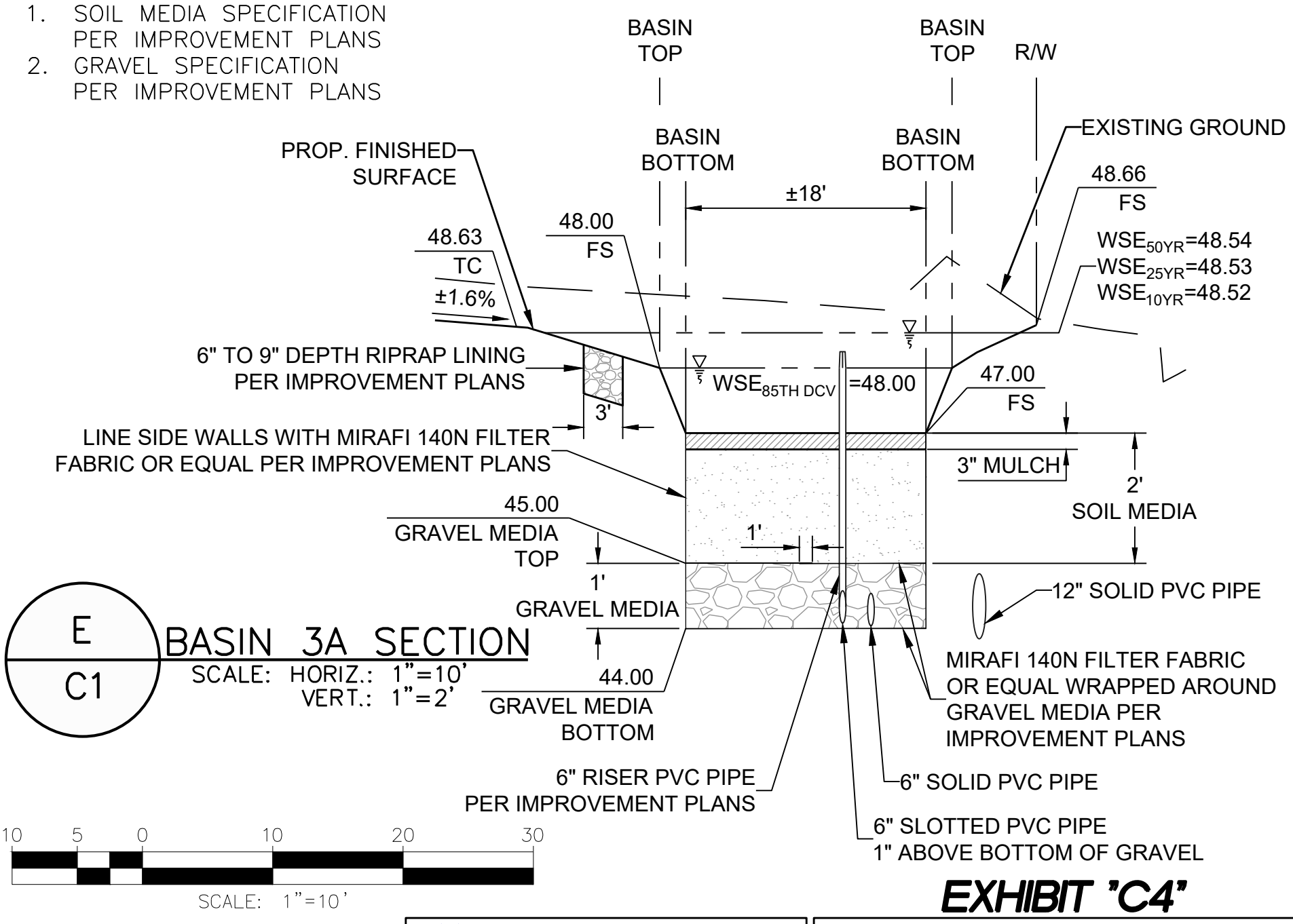


C / C1 BASIN 2A SECTION

SCALE: HORIZ.: 1"=10'
VERT.: 1"=2'

DESIGN NOTES:

1. SOIL MEDIA SPECIFICATION PER IMPROVEMENT PLANS
2. GRAVEL SPECIFICATION PER IMPROVEMENT PLANS



E / C1 BASIN 3A SECTION

SCALE: HORIZ.: 1"=10'
VERT.: 1"=2'

10 5 0 10 20 30

SCALE: 1"=10'

EXHIBIT "C4"

LAKEWOOD CORNER LOT

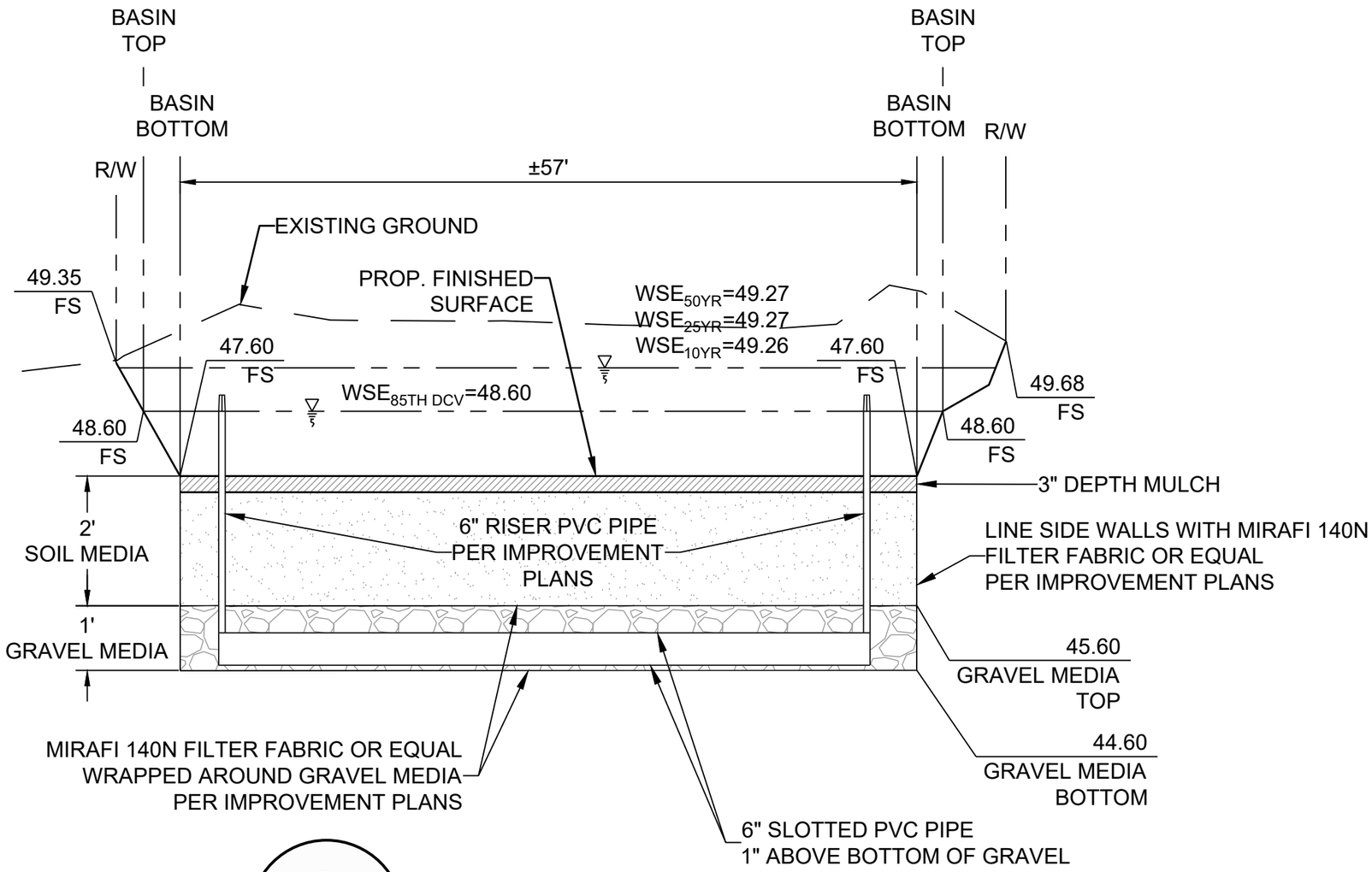
BASIN 2A AND 3A CROSS SECTION

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MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

Drawing Name: O:\166.14.24\HYDROLOGY\Exhibits\166.14.24_Exhibits_C2-C9_Basin Sections.dwg
Last Opened: Jun 25, 2026 - 4:21pm by Rtecs0624

LAKEWOOD CORNER LOT DEVELOPMENT

IN THE CITY OF LAKEWOOD, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA



D / C1 BASIN 2A SECTION

SCALE: HORIZ.: 1"=10'
VERT.: 1"=2'

DESIGN NOTES:

1. SOIL MEDIA SPECIFICATION PER IMPROVEMENT PLANS
2. GRAVEL SPECIFICATION PER IMPROVEMENT PLANS

10 5 0 10 20 30

SCALE: 1"=10'

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

EXHIBIT "C5"

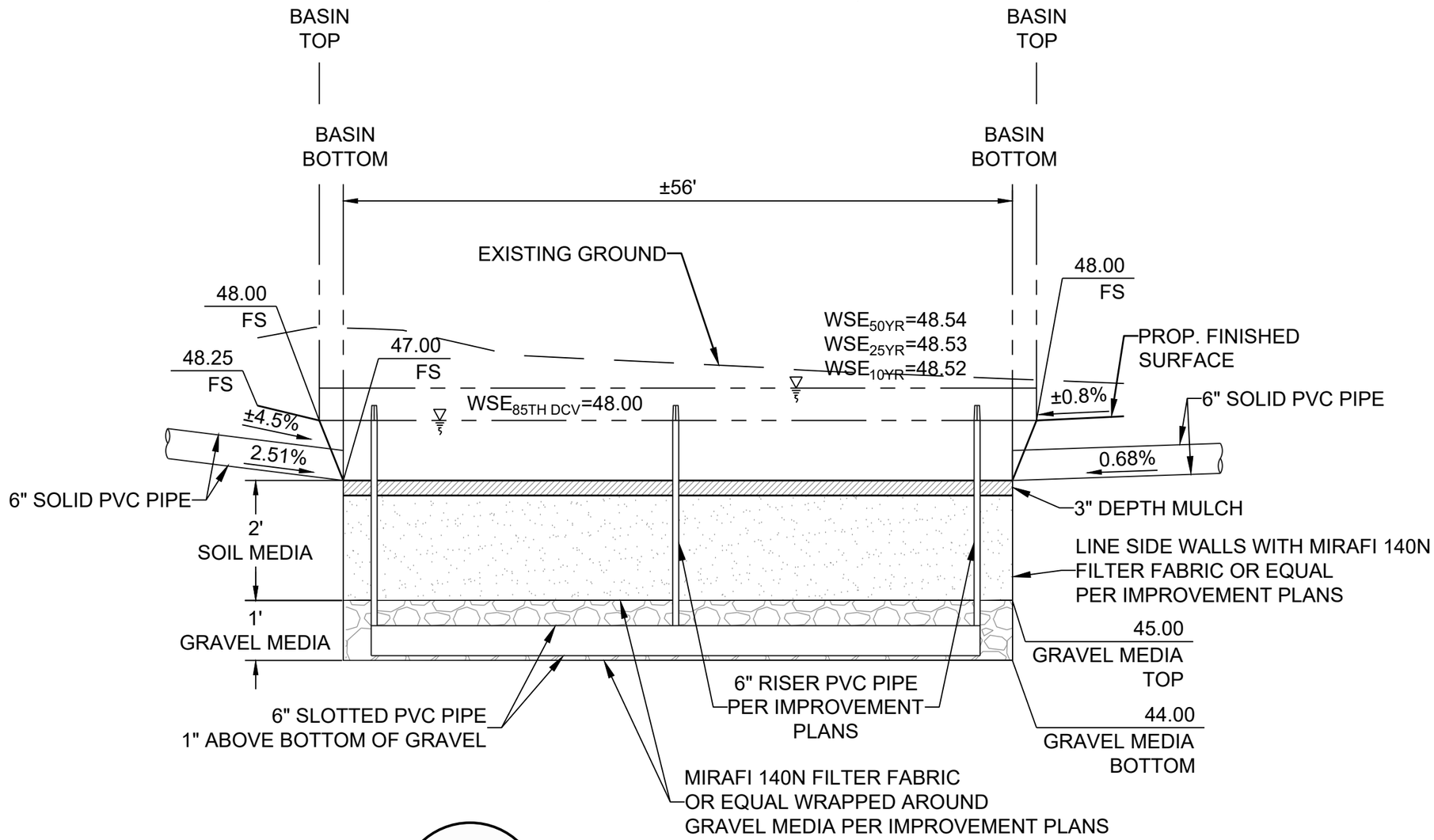
LAKEWOOD CORNER LOT

BASIN 2A LONGITUDINAL SECTION

Drawing Name: O:\166.14.24\HYDROLOGY\Exhibits\166.14.24_Exhibits_C2-C9_Basin Sections.dwg
Last Opened: Jun 25, 2026 - 4:21pm by Rtecs0624

LAKEWOOD CORNER LOT DEVELOPMENT

IN THE CITY OF LAKEWOOD, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA



F / C1 BASIN 3A SECTION

SCALE: HORIZ.: 1"=10'
VERT.: 1"=2'

DESIGN NOTES:

1. SOIL MEDIA SPECIFICATION PER IMPROVEMENT PLANS
2. GRAVEL SPECIFICATION PER IMPROVEMENT PLANS

10 5 0 10 20 30

SCALE: 1"=10'

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

EXHIBIT "C6"

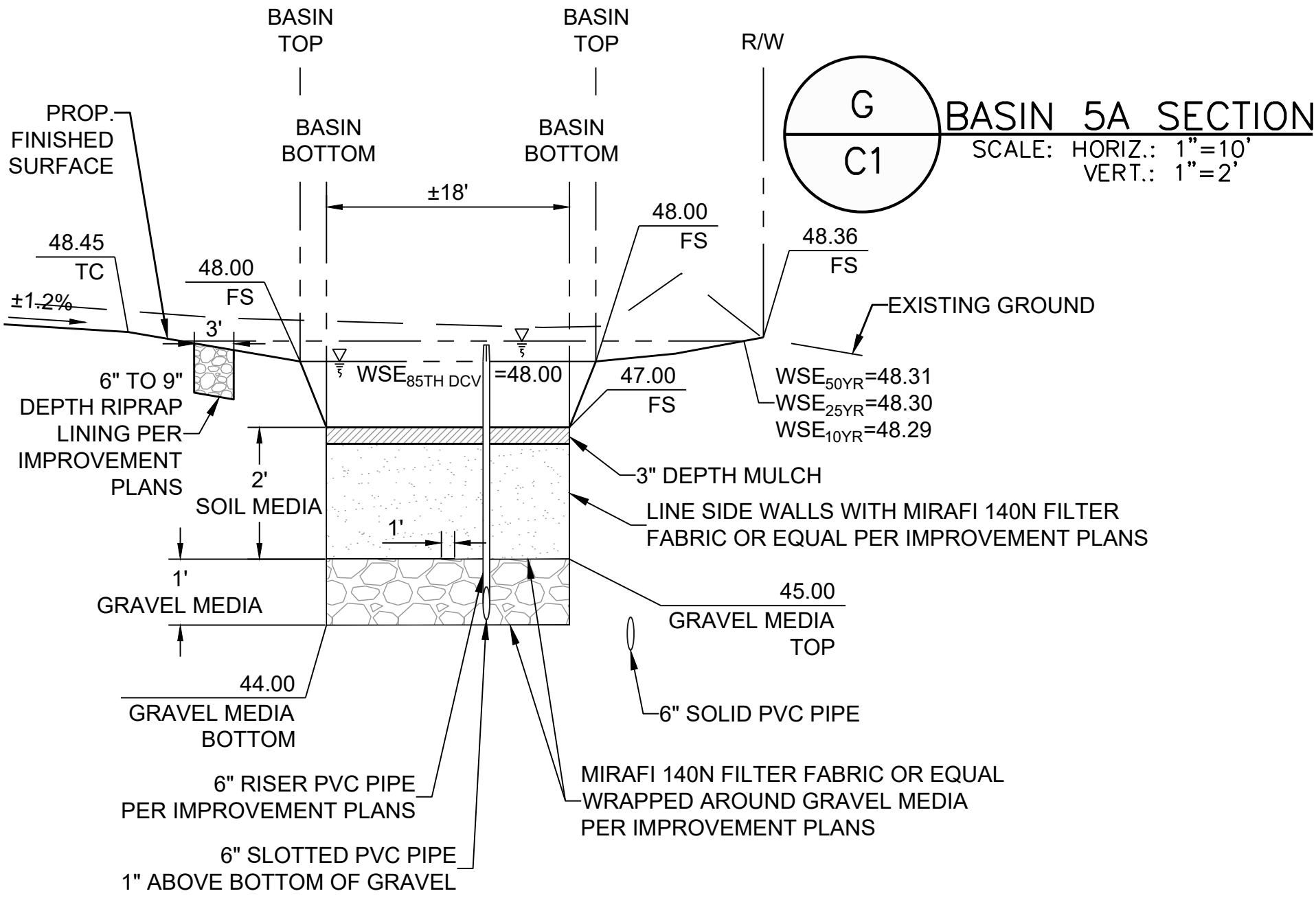
LAKEWOOD CORNER LOT

BASIN 3A LONGITUDINAL SECTION

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Last Opened: Jun 25, 2026 - 4:21pm by Rtecs0624

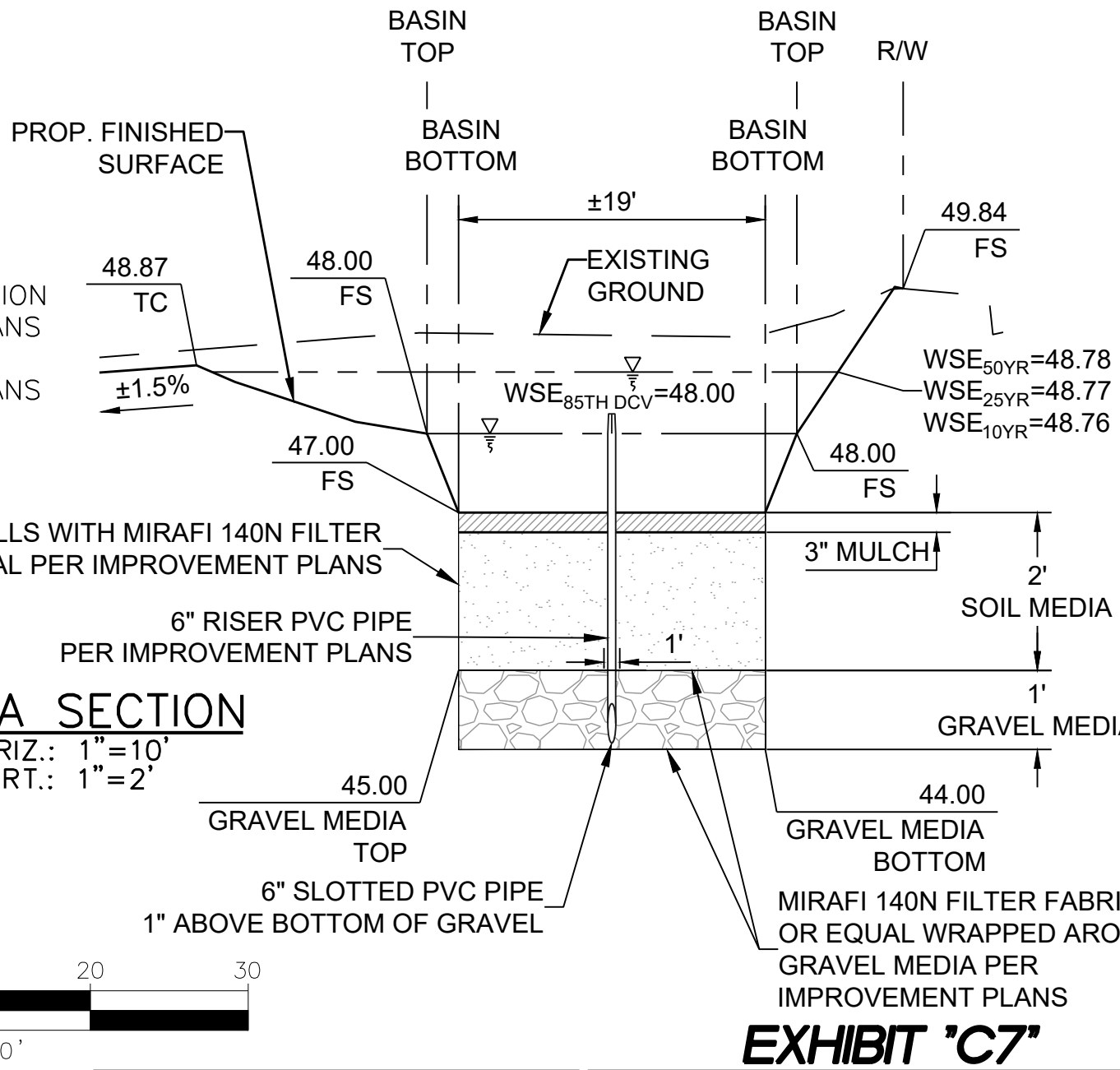
LAKEWOOD CORNER LOT DEVELOPMENT

IN THE CITY OF LAKEWOOD, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA



G / C1 BASIN 5A SECTION

SCALE: HORIZ.: 1"=10'
VERT.: 1"=2'

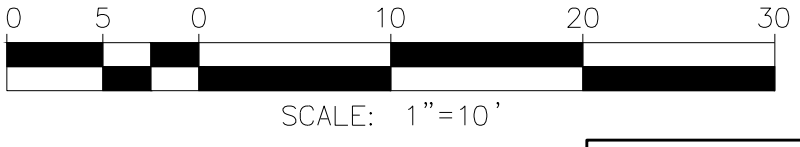


DESIGN NOTES:

1. SOIL MEDIA SPECIFICATION PER IMPROVEMENT PLANS
2. GRAVEL SPECIFICATION PER IMPROVEMENT PLANS

I / C1 BASIN 6A SECTION

SCALE: HORIZ.: 1"=10'
VERT.: 1"=2'



SCALE: 1"=10'

EXHIBIT "C7"

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MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

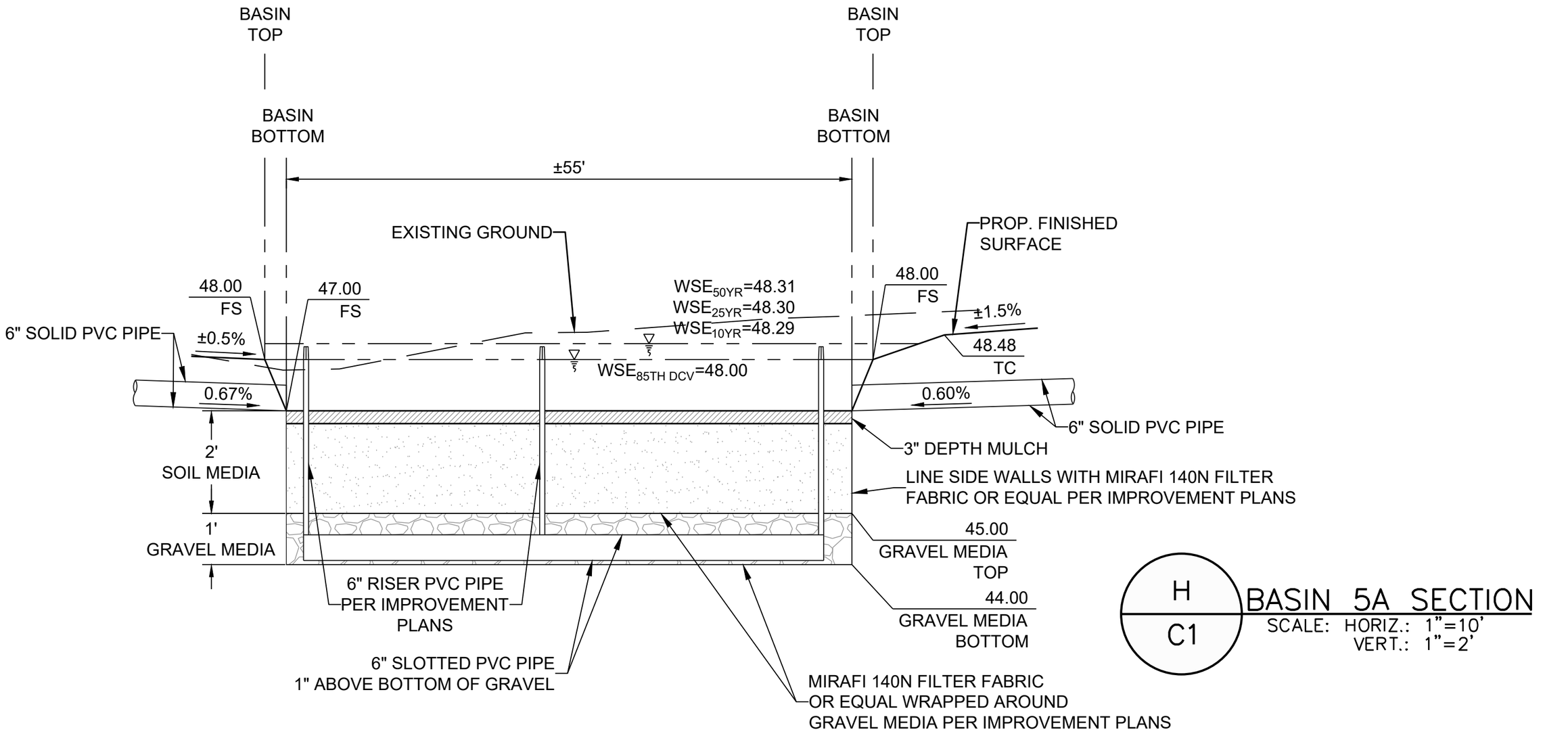
LAKEWOOD CORNER LOT

BASIN 5A AND 6A CROSS SECTION

Drawing Name: O:\166.14.24\HYDROLOGY\Exhibits\166.14.24_Exhibits_C2-C9_Basin Sections.dwg
Last Opened: Jun 25, 2026 - 4:21pm by Rtecs0624

LAKEWOOD CORNER LOT DEVELOPMENT

IN THE CITY OF LAKEWOOD, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA



H / C1 BASIN 5A SECTION

SCALE: HORIZ.: 1"=10'
VERT.: 1"=2'

DESIGN NOTES:

1. SOIL MEDIA SPECIFICATION PER IMPROVEMENT PLANS
2. GRAVEL SPECIFICATION PER IMPROVEMENT PLANS

10 5 0 10 20 30

SCALE: 1"=10'

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

EXHIBIT "C8"

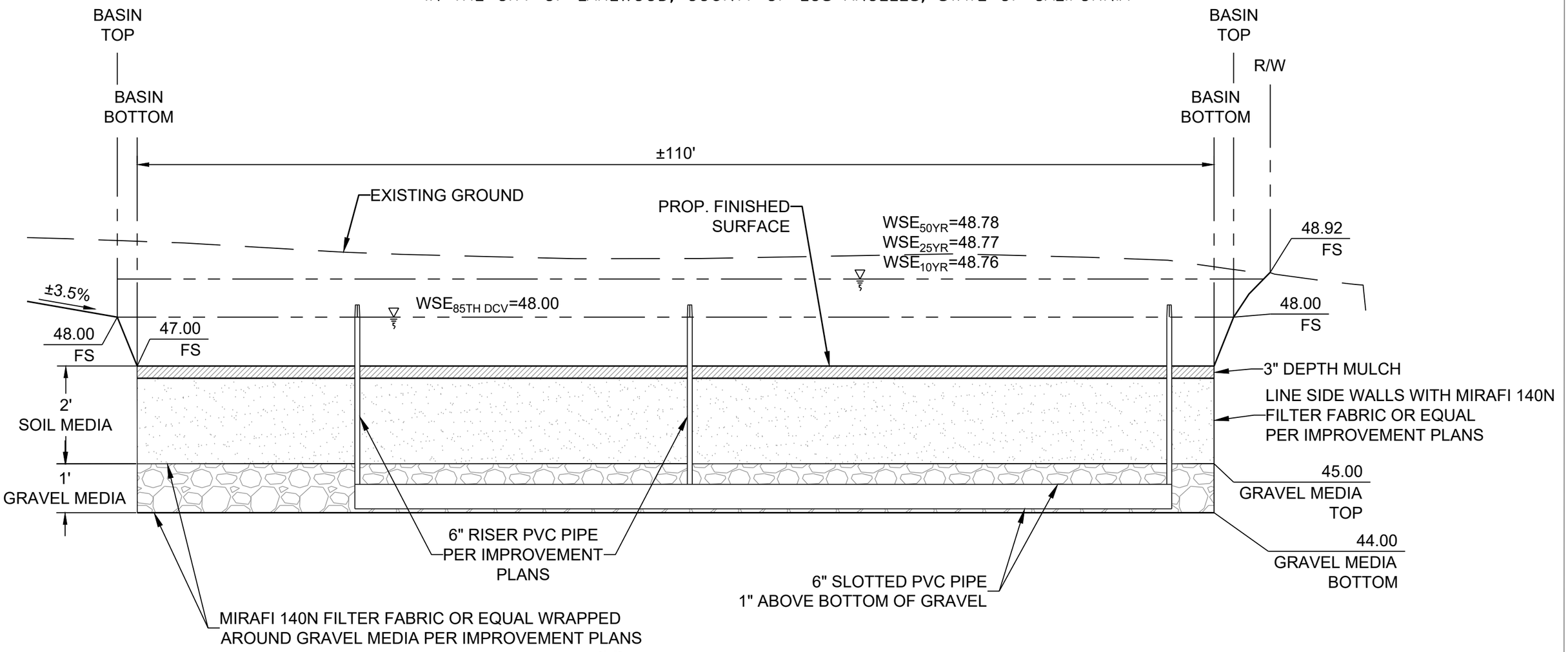
LAKEWOOD CORNER LOT

BASIN 5A LONGITUDINAL SECTION

Drawing Name: 0:\166.14.24\HYDROLOGY\Exhibits\166.14.24_Exhibits_C2-C9_Basin Sections.dwg
Last Opened: Jun 25, 2026 - 4:21pm by Rtecs0624

LAKEWOOD CORNER LOT DEVELOPMENT

IN THE CITY OF LAKEWOOD, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA



J / C1 BASIN 5A SECTION

SCALE: HORIZ.: 1"=10'
VERT.: 1"=2'

DESIGN NOTES:

1. SOIL MEDIA SPECIFICATION PER IMPROVEMENT PLANS
2. GRAVEL SPECIFICATION PER IMPROVEMENT PLANS

10 5 0 10 20 30

SCALE: 1"=10'

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

EXHIBIT "C9"

LAKEWOOD CORNER LOT

BASIN 6A LONGITUDINAL SECTION

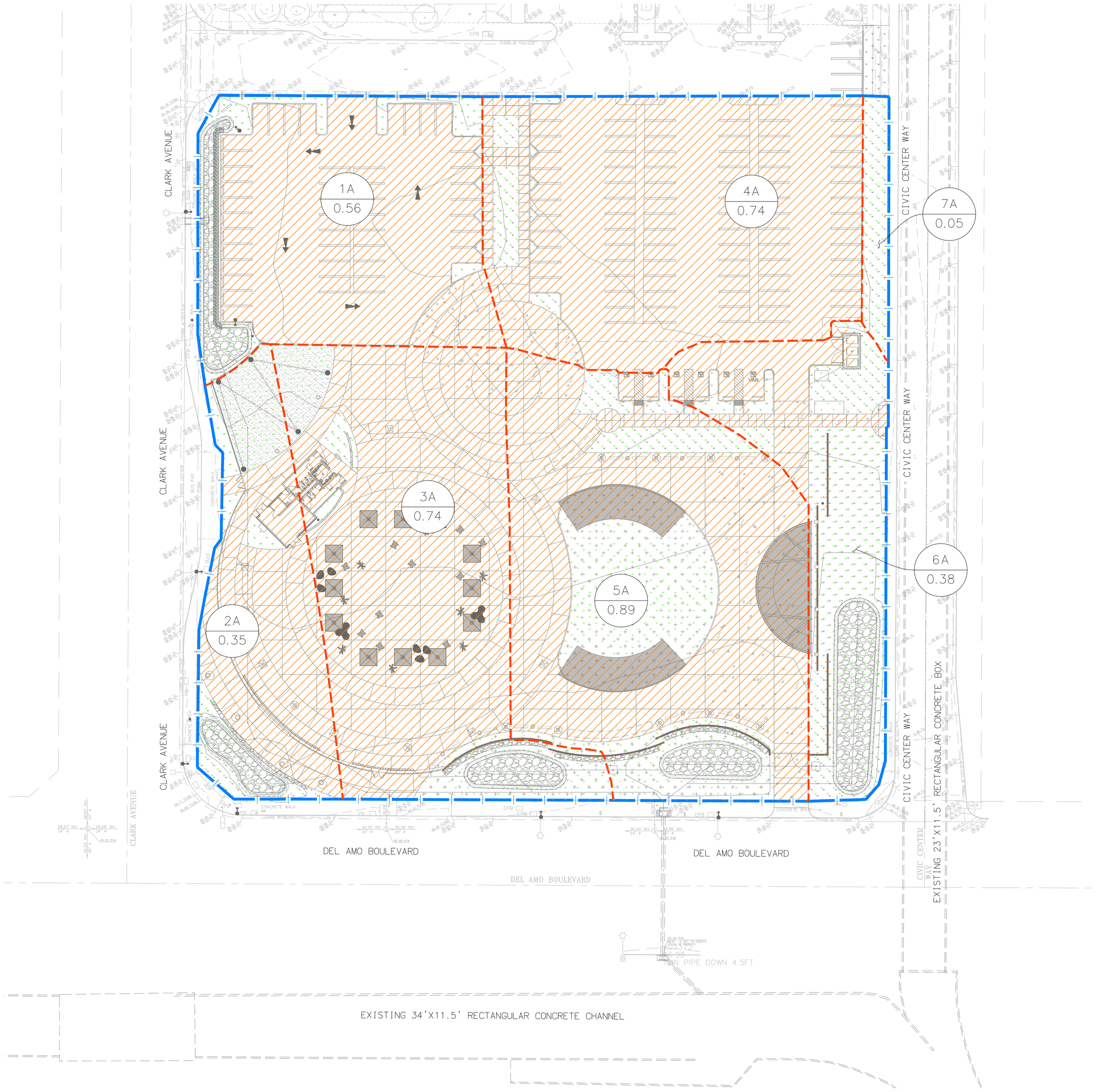
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Last Opened: Jun 25, 2026 - 4:21pm by Rtecs0624

EXHIBIT D: POST-PROJECT LAND COBER & IMPERVIOUS PERCENT MAP

LAKEWOOD CORNER LOT DEVELOPMENT

IN THE CITY OF LAKEWOOD, COUNTY OF LOS ANGELES, STATE OF CALIFORNIA

POST-PROJECT LAND COVER MAP



LAND COVER SUMMARY			
AREA	DESCRIPTION		A_i
1A	PERVIOUS AREA (S.F.)	4,055	0
	IMPERVIOUS AREA (S.F.)	20,535	1
	TOTAL AREA (S.F.)	24,590	
	WEIGHTED A_i (%)	83.5%	
2A	PERVIOUS AREA (S.F.)	4,912	0
	IMPERVIOUS AREA (S.F.)	10,285	1
	TOTAL AREA (S.F.)	15,197	
	WEIGHTED A_i (%)	67.7%	
3A	PERVIOUS AREA (S.F.)	5,305	0
	IMPERVIOUS AREA (S.F.)	26,741	1
	TOTAL AREA (S.F.)	32,046	
	WEIGHTED A_i (%)	83.4%	
4A	PERVIOUS AREA (S.F.)	1,573	0
	IMPERVIOUS AREA (S.F.)	30,569	1
	TOTAL AREA (S.F.)	32,142	
	WEIGHTED A_i (%)	95.1%	

LAND COVER SUMMARY			
AREA	DESCRIPTION		A_i
5A	PERVIOUS AREA (S.F.)	12,489	0
	IMPERVIOUS AREA (S.F.)	26,090	1
	TOTAL AREA (S.F.)	38,579	
	WEIGHTED A_i (%)	67.6%	
6A	PERVIOUS AREA (S.F.)	11,439	0
	IMPERVIOUS AREA (S.F.)	5,205	1
	TOTAL AREA (S.F.)	16,643	
	WEIGHTED A_i (%)	31.3%	
7A	PERVIOUS AREA (S.F.)	2,183	0
	IMPERVIOUS AREA (S.F.)	0	1
	TOTAL AREA (S.F.)	2,183	
	WEIGHTED A_i (%)	0%	

LEGEND:

- PERVIOUS AREA
- IMPERVIOUS AREA
- XXX / X.X — SUB AREA / ACRES
- WATERSHED BOUNDARY
- WATERSHED SUB-BOUNDARY

SCALE 1"=30'

30 15 0

SCALE: 1"=30'

JLC Engineering & Consulting, Inc.

41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

EXHIBIT "D"

LAKEWOOD CORNER LOT

POST-PROJECT LAND COVER MAP

Drawing Name: O:\166.14.24\Engineering\Hydrology_Plan\Exhibits\Exhibits_D_Land Cover Map.dwg
Last Opened: Jun 23, 2026 - 11:40am by stonner

APPENDIX E

Renderings (FOR REFERENCE ONLY)


LAKEWOOD
LAKEWOOD
TOWN SQUARE
DEC 5TH
CITY OF LAKEWOOD
CALIFORNIA
DAHLIN


SPACELY SPROUTS
LUCKY'S
CITY OF LAKEWOOD
CALIFORNIA
DAHLIN


THE GRILL TRUCK
CITY OF LAKEWOOD
CALIFORNIA
DAHLIN


CITY OF LAKEWOOD
CALIFORNIA
DAHLIN


LAKEWOOD
TOWN SQUARE
◀ PARKING
CITY OF LAKEWOOD
CALIFORNIA
DAHLIN


4970
LUCKY'S
CITY OF LAKEWOOD
CALIFORNIA
DAHLIN


CITY OF LAKEWOOD
CALIFORNIA
DAHLIN

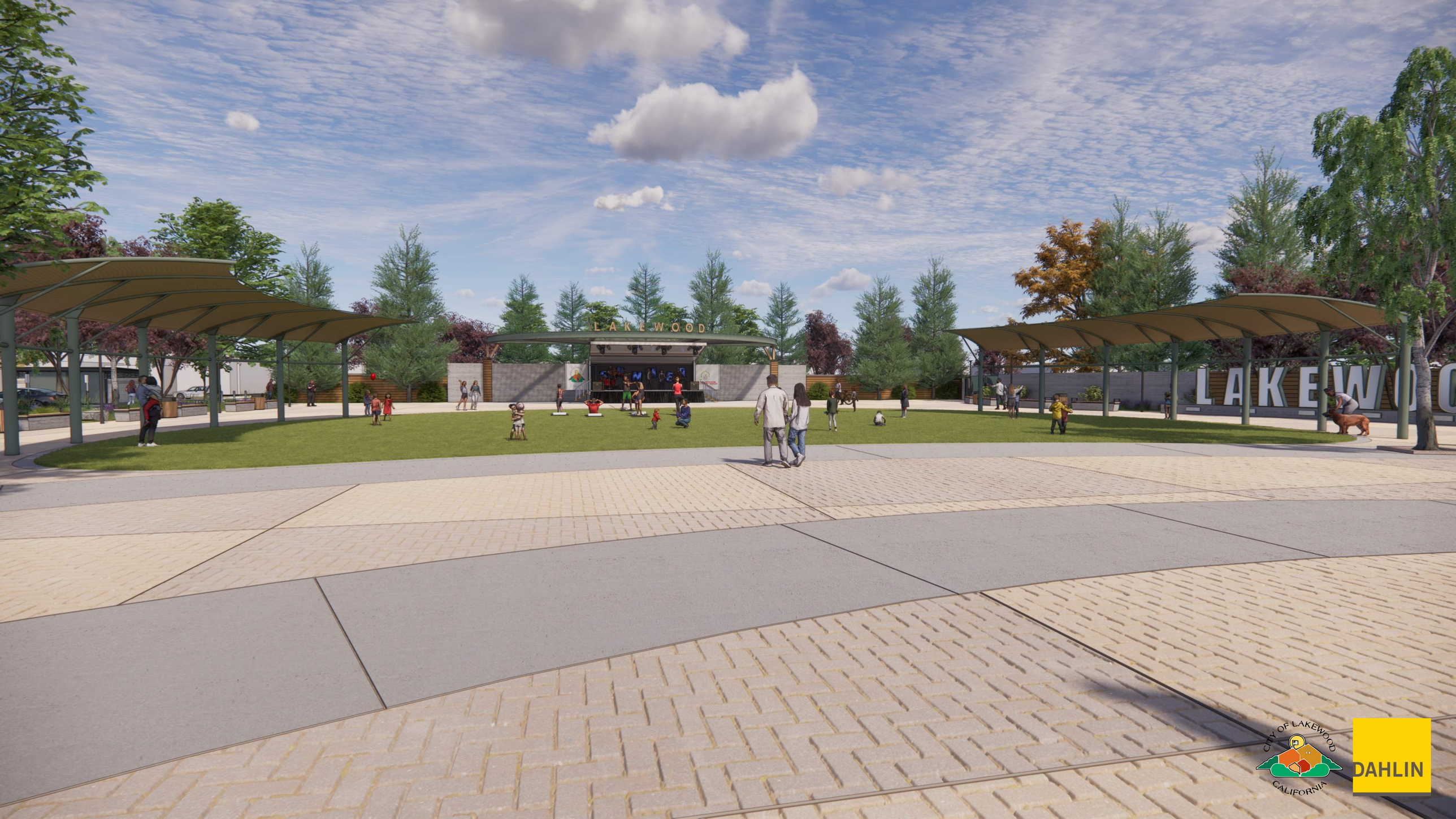

72°
LAKEWOOD
TOWN SQUARE
DEC. 5TH
CITY OF LAKEWOOD
DAHLIN


SPACELY SPROUTS
LUCKY'S


POLICE
CITY OF LAKEWOOD
CALIFORNIA
DAHLIN


AKEWOOD
CITY OF LAKEWOOD
CALIFORNIA
DAHLIN


LAKEWOOD


LAKEWOOD
CITY OF LAKEWOOD
CALIFORNIA
DAHLIN


LAKEWOOD
CITY OF LAKEWOOD
CALIFORNIA
DAHLIN