

Mayor ED 17-02 Priority Permit

MISSION ROCK PHASE 1 STREET IMPROVEMENT PLANS

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Project Number 20080006

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SECTION 01 50 50

EROSION CONTROL

PART 1 - GENERALS

1.1 SCOPE OF WORK

- A. In accordance with Federal, State, and local regulations, it is unlawful to discharge pollutants from construction sites into the City's combined sewer system. Best Management Practices (BMPs) must be implemented at all construction sites to minimize the discharge of pollutants into the combined sewer system. In addition, projects less than one acre must develop and Erosion and Sediment Control Plan (ESCP) for wind and rain. Projects greater than one acre must develop and implement a Storm Water Pollution Plan that includes an Erosion and Sediment Control Plan component.
- B. Contractors shall comply with all applicable requirements of the State General Permit for Discharges of Storm Water Associated with Construction Activity (Construction General Permit Order 2009-0009-DWQ), referred to herein as the "Construction General Permit", which was adopted September 2, 2009 and is effective as of July 1, 2010.
- C. Contractors must also comply with requirements of the City and County of San Francisco Sewer Use Ordinance (Article 4.1 of the Municipal Code), which prohibits discharge of substances of any kind into the City's sewer system which cause obstruction, damage or nuisance to the system.

1.2 RELATED SECTIONS

- A. Section 01 10 00, Supplemental General Requirements

1.3 RELATED DOCUMENTS

- A. Caltrans Standard Specifications, 2015
 - 1. Section 21, Erosion Control
- B. Association of Official Seed Analysts Procedures
- C. California State Seed Law of the Department of Food and Agriculture

1.4 CONTRACTOR SUBMITTALS

- A. Pursuant to the provisions of Section 01 33 00, Submittal Procedures, the Contractor shall submit an Erosion and Sediment Control Plan (ESCP) for sites less than one acre as per Part 1.7 of this Section, or a Storm Water Pollution Prevention Plan (SWPPP)

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(including Best Management Practices, and Erosion and Sediment Control Measures) as per Part 1.08 of this Section.

- B. The Contractor shall submit the ESCP or SWPPP to the City Representative for approval no later than (30) thirty days after the Notice to Proceed and before any commencement of earthwork activities. The Approving Agency shall also approve the ESCP or SWPPP, before any soil disturbance activity. The ESCP or SWPPP shall remain in effect for life of the Contract regardless of the year season. A copy of this plan must be on-site at all times.
- C. On approval of the above Plan, the Contractor shall provide six (6) copies and two (2) copies on a Compact Disc (CD) with a case.
- D. The SWPPP inspection reports as per Part 1.8 of this Section.

1.5 GENERAL REQUIREMENTS

- A. Water Control
 - 1. The Contractor is responsible for the continuous control of surface and ground water at all times during the course of the construction, including Saturdays, Sundays, holidays, work stoppages, during periods of labor strikes, and during periods of work stoppages.
 - 2. The Contractor is wholly responsible for obtaining the sewer discharge permit in a timely manner if required. The City will not honor any claims from the contractor arising from delays in obtaining the sewer discharge permit.
- B. Work Within Existing Sewers
 - 1. Comply with California Code of Regulations, General Industry Safety Orders, Article 108, Title 8, Sections 5156 through 5159 when entering and working in existing sewers.
 - 2. It is the responsibility of the Contractor to provide all equipment or assistance to make the confined space safe for entry by the City Representative or his/her representative per the California Code of Regulations, Title 8; General Industry Safety Orders entitled "Confined Spaces".
- C. Construction of Flow Diversion
 - 1. The Contractor may construct open or close conduits, wholly within the excavation for flow diversions at places where sewers cross the excavation. Existing sewer flows shall be maintained at all times.
- D. Discharges to the sewer system shall meet the requirements of the following:
 - 1. Waste Ordinance No. 116-97 (Chapter X (Public Works Code), Part II, San Francisco Municipal Code, Article 4.1).
 - 2. DPW Order No. 158170 for wastewater discharges into the City's sewerage system.

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3. Requirements for Batch Wastewater Discharges - the San Francisco Public Utilities Commission, Wastewater Enterprise (PUC- WWE).
 4. The Construction De-watering Site Discharge Limits of the Southeast Water Pollution Control Plant (SEWPCP) as per Section 31 23 19 Dewatering.
- E. The Contractor is permitted to discharge uncontaminated wastewater into the City's sewage system after he/she:
1. Submits, obtain approval and abides by the ESCP or SWPPP. The City Representative will forward the ESCP or SWPPP to the Approving Agency. The Approving Agency will only approve the Plans after the regulatory agencies approve the Plans.
 2. Submits, obtain approval and abides by sewer discharge permit. A batch discharge permit is required before releasing any construction site wastewater from dewatering activities into the combined sewer system.
- F. The Contractor is advised that both the WPCD and the WWE-CSD have the authority to order immediate ceasing of discharge(s) to the sewer system. The Contractor is solely responsible for all costs associated with ceasing discharges, and any and all costs for delay in operations.
- G. Should the existing wastewater be uncontaminated, and subsequently become contaminated due to the Contractor's operations, all costs related to satisfactory cleanup and disposal shall be the responsibility of the Contractor. Such costs shall include re- design, re-construction, pretreatment and, sewer service permit and usage fees costs necessary to satisfy the above requirements.

1.6 STORM WATER POLLUTION PREVENTION – MINIMUM BEST MANAGEMENT PRACTICE REQUIREMENTS

- A. Regardless of the size of the project, at a minimum, the Contractor shall implement the following BMPs at the project site:
- B. Management of Construction Materials
1. Cover and berm loose stockpiled construction materials that are not actively being used.
 2. Store chemicals in watertight containers (with appropriate secondary containment to prevent any spillage or leakage) or in a storage shed (completely enclosed).
 3. Materials and equipment that are designed to be outdoors and exposed to environmental conditions (i.e. poles, equipment pads, cabinets, conductors, insulators, bricks, etc.)
 4. Implement BMPs to prevent the off-site tracking of loose construction and landscape materials.
- C. Waste Management BMPs

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1. Prevent disposal of any rinse or wash waters or materials on impervious or pervious site surfaces or into the combined sewer system.
 2. Ensure the containment of sanitation facilities (e.g., portable toilets) to prevent discharges of pollutants to the combined sewer system.
 3. Clean or replace sanitation facilities and inspecting them regularly for leaks and spills.
 4. Cover waste disposal containers at the end of every business day and during a precipitation event.
 5. Prevent discharges from waste disposal containers to the combined sewer system.
 6. Contain and securely protect stockpiled waste material from wind and rain at all times unless actively being used.
 7. Implement procedures that effectively address hazardous and non-hazardous spills.
 8. Utilize spill response procedures that include: providing equipment and materials for cleanup of spills on site, so that spills and leaks may be cleaned up immediately and properly disposed, and assigning and training appropriate spill response personnel.
 9. Ensure the containment of concrete washout areas and other washout areas that may contain additional pollutants so there is no discharge into the underlying soil and onto the surrounding areas.
- D. Vehicle Storage and Maintenance BMPs
1. Prevent oil, grease, or fuel from leaking in to the ground, storm drains, and catch basins.
 2. Place all equipment or vehicles, which are to be fueled, maintained and stored in a designated area fitted with appropriate BMPs.
 3. Clean leaks immediately and dispose of leaked materials properly.
- E. Management of Landscaping Materials
1. Contain stockpiled materials such as mulches and topsoil when they are not actively being used.
 2. Contain fertilizers and other landscape materials when they are not actively being used.
 3. Discontinue the application of any erodible landscape material within two days before a forecasted precipitation event or during periods of precipitation.
 4. Apply erodible landscape material at quantities and application rates according to manufacture recommendations or based on written specifications by knowledgeable and experienced field personnel.
 5. Stack erodible landscape material on pallets, and cover or store such materials when not being used or applied.

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1.7 STORM WATER POLLUTION PREVENTION – EROSION AND SEDIMENT CONTROL PLAN (ESCP) REQUIREMENTS

- A. The ESCP shall include a site map that shows the site layout, construction site boundaries, discharge locations to the combined sewer system, and locations of erosion and sediment control BMPs.
- B. The ESCP shall provide a narrative description of the erosion and sediment control BMPs that will be implemented at the site.

1.8 STORM WATER POLLUTION PREVENTION – STORM WATER POLLUTION PREVENTION PLAN (SWPPP) REQUIREMENTS

- A. General Requirements
 - 1. Prepare and submit for approval a SWPPP in accordance with the outline provided below. The SWPPP must be submitted no later than (30) thirty days after the Notice to Proceed and shall be approved by the Approving Agency before any soil disturbance activity.
 - 2. The SWPPP shall be prepared, amended, and certified by a Qualified SWPPP Developer, who has retained the following certifications or registrations (state or registering entity in parentheses):
 - a. Professional Civil Engineer (CA)
 - b. Professional Geologist or Engineering Geologist (CA)
 - c. Landscape Architect (CA)
 - d. Professional Hydrologist (American Institute of Hydrology)
 - e. Certified Professional in Erosion and Sediment Control (EnviroCert International, Inc.)
 - f. Certified Inspector of Sediment and Erosion Control (Certified Inspector of Sediment and Erosion Control, Inc.)
 - g. Certified Erosion, Sediment and Storm Water Inspector (EnviroCert International, Inc.)
 - h. Certified Professional in Storm Water Quality (EnviroCert International, Inc.)
 - 3. A Qualified SWPPP Developer shall also be responsible for training all personnel involved in implementing the SWPPP.
 - a. The Contractor shall develop and amend or revise the SWPPP, when necessary, to meet the following objectives. Amendments will be implemented only after they have been approved:
 - b. Identify all pollutant sources including sources of sediment that may affect the quality of storm water discharges associated with construction activity (storm water discharges) from the construction site, and
 - c. Identify non-storm water discharges and eliminate the discharge of unauthorized non-stormwater discharges, and
 - d. Identify, construct, implement in accordance with a time schedule, and maintain Best Management Practices (BMPs) to reduce or eliminate

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- pollutants in storm water discharges and authorized non-storm water discharges from the construction site during construction, and
- e. Develop a long-term maintenance plan for BMPs installed during construction designed to reduce or eliminate pollutants after construction is completed (post-construction BMPs).
4. A Qualified SWPPP Developer representing the Contractor shall sign the SWPPP's certifications, amendments, and reports prepared for, or by the Contractor. Any person signing the aforementioned shall make the following certification in the SWPPP:

"I certify under penalty of law that I understand and shall comply with the terms and conditions.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, to the best of my knowledge and belief, the information submitted is, true, accurate, and complete.

I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations"
 5. When changes in a SWPPP during the course of a project are required, the Contractor shall prepare and certify an amendment to the SWPP and submit it to the SFPUC Collection System Division representative. Contact Audie Ilejay, SFPUC CSD 3801 3rd Street, #600, San Francisco, CA 94124 or ailejay@sflower.org (415-695-7339) for more information.
 6. The Contractor shall prepare an amendment when one or more of the following conditions exist, and amendments shall comply with the applicable requirements of the Construction General Permit:
 - a. Whenever there is a change in construction or operations which may affect the discharge of pollutants to surface waters, groundwater(s), the City's combined sewer system or a separate storm sewer system;
 - b. If any of the conditions of the Construction General Permit is violated and the general objective of reducing or eliminating pollutants in storm water discharges has not been achieved;
 - c. When deemed necessary by the SFPUC WPCD and WWE-CSD.
 7. Contractor is solely responsible for complying with the soil erosion and sediment control requirements of this Contract and for otherwise preventing silt-laden storm runoff from exiting the construction area. The Contractor shall be solely responsible for all delays and costs, and assessments, fines, penalties levied against the City by any local, state or federal agency resulting from Contractor's failure to fully comply with and/or fully execute and implement a SWPPP or ESCP and any related requirements of the construction General Permit. Contractor's responsibility includes completion of all clean-up operations and paying for all associated costs resulting from Contractor's non-

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compliance that causes damages to surface waters or the City's sewer system., or damages, which result from his/her failure to so comply.

B. Required SWPPP Elements

1. Site Description

- a. A description of the nature of the construction activity.
- b. A description of the intended sequence of major activities, which disturb soils for major portions of the site.
- c. Estimates of the total area of the site and the total area of the site that is to be disturbed by excavation, grading, or other land disturbing activities.
- d. An estimate of the runoff coefficient of the site after construction activities is completed and existing data describing the soil or the quality of any discharge from the site.
- e. A site map indicating drainage patterns and approximate slopes anticipated after major grading activities, areas of soil disturbance, location of structural and non-structural controls identified in the plan, location of areas where stabilization practices are expected to occur,
- f. All stormwater inlets and catchbasins identified locations and location of points of discharge to existing storm runoff conveyance systems.

2. Pollution Sources: The SWPPP shall identify all potential sources of storm water pollution in addition to land disturbing activities, including, but not limited to:

- a. Temporary fuel storage and handling – All fuel storage tanks shall be placed within a secondary containment area of sufficient size and strength to contain 150 percent of the volume stored. Refueling of equipment within the containment areas shall be addressed in the plan.
- b. Material storage and hazardous material storage. (Identify location on the site map)
- c. Equipment maintenance areas.
- d. Solid waste and hazardous waste disposal activities.

3. BMPs: The plan shall include a description, timing, and designated area as appropriate of controls and measures that will be implemented for each major activity and for each potential pollution source identified above. The SWPPP shall include elements of the Erosion and Sediment Control Plan as described in Section 1.07.

- a. Stabilization Practices – Seeding, mulching, installation of geotextile fabric, etc, on areas where construction activities have temporarily or permanently ceased.
- b. Structural Practices – Construction of silt fences, berms, dikes, sediment basins, sediment barriers, covered material, and waste storage areas, and other such devices to limit runoff and minimize the discharge of pollutants. Appropriate practices shall be incorporated for surface drainage.

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- c. Operational Practices – Dust Control, housekeeping, non-hazardous regular waste collection and disposal, control of equipment fluids and lubricants, and similar practices to minimize pollutant generation.
- d. Vehicle Washing – All vehicle washing shall occur at a designated equipment decontamination wash pad.
- e. Wheel washing - Wheel washing will occur at areas designated wheel-washing area.
- f. Concrete Washout – Concrete washout will neither be allowed on site nor into the sewerage. In the SWPPP, provide a plan for concrete trucks cleaning out during concrete cleaning operations. Per project conditions and limitations, approval of a concrete washout on site will be reviewed only if the Contractor submits a Concrete Washout Operations and Maintenance Work Plan under the Storm Water Pollution Control Plan containing the following:
 - i. Concrete washout station types and specifications,
 - ii. Proposed locations on site
 - iii. Operations and maintenance procedures including daily inspections and clean up schedules.
 - iv. Clean up and waste disposal methods.
- g. Saw cutting operations: Provide a means to vacuum slurry, generated from saw cutting operations, thereby preventing it from going in to the storm drain.
- 4. Maintenance: A description of procedures to maintain protective measures in proper operating condition.
- 5. Inspection: A description of inspection procedures and schedules of all structural and non-structural pollution control measures. At the minimum, it should be conducted once every two weeks for the dry season, once a week during the rainy season and 24 hours prior to forecast of precipitation events of 13 mm (0.5 in) or greater, and immediately after precipitation events of 13 mm (0.5 in) or greater with daily inspections on prolonged rainfalls.
- 6. Contractor identification and certification: Clearly identify the Contractor(s) or subcontractor(s) responsible for implementation of each control measure. All Contractors and subcontractors so identified must sign the certification provided in this section.
 - a. Prior to the Table of Contents, include a separate page identifying the name of the preparer (Contractor's key staff name), reviewer, revision number and date.
 - b. Storm Water Pollution Prevention Team (SWPPT) Members: The SWPPP must identify key personnel who are responsible for implementing the Best Management Practice, conducting the training and maintaining the records. Personnel responsible for BMP installation, inspection, maintenance, and repair must receive training by a Qualified SWPPP Developer.
 - c. The SWPPP may utilize plans, details, notes, and other information provided in the construction documents; however, such information

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shall not, in itself, be construed to meet the requirements of this section. Observe firsthand the conditions of the site and then provide additional detail to ensure that the SWPPP accurately reflects the Contractor's means and methods for construction, to include: construction sequencing, site layout, construction access, temporary facilities, specific sedimentation, erosion and runoff discharge controls, and project organization.

C. SWPPP Implementation:

1. Exercise every reasonable precaution, including temporary and permanent measures, throughout the duration of the project to control erosion, and the discharge of sediment and other pollutants associated with construction activity into the combined sewer system.
2. Temporary measures shall be coordinated with contract work to the extent practical to ensure economical, effective, and continuous erosion and siltation control and pollution prevention. Permanent pollution control measures and facilities as identified in the contract documents shall be installed as the work progresses.
3. Inspect erosion and siltation control devices and provide corrective measures for deficiencies 24 hours prior to a forecasted rain and immediately after each rainfall, and at least daily during prolonged rainfall. Deficiencies shall be corrected immediately. If the Contractor fails to correct or take appropriate actions to remedy the specified deficiencies, the City Representative will require Contractor to discontinue work in other areas and concentrate efforts toward rectifying the specified deficiencies. The City reserves the right to remedy the specified deficiencies and deduct the entire cost of such work from monies due Contractor.

D. SWPPP Best Management Practices (BMP):

1. The Contractor's SWPPP will identify Best Management Practices (BMPs) to prevent polluted runoff from entering the combined sewer system.
2. The Contractor BMPs shall at a minimum include:
 - a. Temporary sediment barriers such as silt fences, berms, dikes, fiber rolls, sandbags, gravel bags or straw bale barriers. These barriers shall be installed at the locations with potential erosion and to the limits shown on the approved SWPPP and as otherwise directed by the City Representative. They shall be relocated as necessary for construction operations, with prior approval from the City Representative. Remove the temporary barriers at the end of the project.
 - b. Dust Control: Employ construction methods and means that will keep airborne dust to the minimum.
 - c. Stockpile Management: Protection of Stockpiles is a year round requirement throughout the project duration. Locate stockpiles at minimum 0 yards away from concentrated flows of stormwater, drainage courses and inlets. All stockpiles should be completely covered and secured. They should be protected with a temporary

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linear sediment barrier prior to the onset of precipitation. During the rainy season, all stockpiles shall be protected from stormwater runoff by completely covering them and keeping the perimeter barriers around at all times.

- d. Provide for the continuous misting of water using hoses on the project, and on roads and other areas immediately adjacent to the project limits, wherever traffic or buildings that are occupied or in use, are affected by such dust caused by his hauling or other operations. The materials and methods used for water laying shall be subject to the approval of the City Representative. Provide for prompt and proper removal from existing roadways of all dirt and other materials that have been spilled, washed, tracked, or otherwise deposited thereon by Contractor's hauling and other operations.

E. The Contractor's SWPPP will also identify additional Best Management Practices (BMP) requirements as follows:

1. On-site vehicles must be monitored for leaks; inactive equipment must be stored with drip pans to contain any fluid leaks. Drip pans containing oil must be drained into waste oil drums on a regular basis.
2. Licensed waste material handlers must service portable sanitary facilities and trash dumpsters regularly.
3. All hazardous material stored on-site shall be stored in secondary containment to prevent spills and leaks. The containment must be covered with temporary tarps to prevent storm water contact.
4. A chain-link fence to prevent access by the public must enclose the site.
5. Silt dams shall be installed and maintained on public streets to prevent sediments from flowing into storm drain inlets and public streets. Storm drain inlets shall be protected surrounding the inlets with BMPs such as fiber rolls or filters media appropriate to type of traffic and as approved by the Minimize dust during demolition, grading, and construction by lightly spraying exposed soil on a regular basis.
6. Minimize wind and water erosion on temporary stockpiles by spraying with water during dry season and covering during the wet season. Cover inactive piles.
7. Minimize the area and length of time for clearing and grading.
8. Prevent release of construction pollutants, cement, mortar, paints, solvents, fuel, etc.
9. Install and maintain sediment traps in local storm water inlets.
10. Implement a hazardous material spill prevention, control, and cleanup program for the construction period.
11. Minimize the contact of construction materials, equipment, and maintenance supplies (e.g., fuels, lubricants, paints, solvents, adhesives) with storm water
12. Properly specify designed centralized storage areas that would keep construction materials and maintenance supplies out of the rain. Keep spill cleanup materials (e.g., rags, absorbent materials, appropriate container) at the work site when handling chemicals.

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13. Educate on-site personnel and maintain awareness of the importance of protecting storm water quality. Site supervisors or the site safety representative shall conduct regular tailgate meetings to discuss pollution prevention. The frequency of the meeting and the required personnel attendance list would be specified in the SWPPP. The Contractor shall furnish the City Representative with the attendance list and the subject notes of the meeting.
 14. Additional Erosion and Sediment Control Measures for the exposed soils and stockpiled soil are:
 - a. Erosion Control Blankets shall be used to control to stabilize disturbed and exposed soil, if weather warrants such blankets.
 - b. Silt fencing shall be installed at the foot of the slope around the entire perimeter of the stockpiled soil.
 - c. V-ditches and silt traps/sediment traps shall be installed at the perimeter of the stockpile to collect runoff where necessary to allow flow to continue to storm drain inlets.
 - d. Soil stabilization measures, placement of hay bales, and sediment basins shall be constructed to reduce erosion of exposed soils.
 - e. If grading must be conducted during the rainy season, prepare the primary BMPs on erosion control, by controlling the sources, that is by keeping sediments in place.
 - f. End-of pipe sediment control measures (e.g., basins and traps shall be used only as secondary measures.
 - g. Vehicle and equipment wash down facilities shall be designed to be accessible and functional during both dry and wet conditions.
- F. Prohibited Discharge: Discharge of other materials other than storm water and approved non-stormwater discharges to the combined sewer/storm system is prohibited unless a batch discharge permit is obtained from the PUC. Approved non-stormwater discharges include incidental discharges of potable water from irrigation of vegetative erosion control measures, and water from dust control applications. Non-storm water discharges requiring a batch discharge permit include groundwater from excavations, water from truck washing activities, and water from the cleaning or testing of pipes or tanks.
- G. Spill Prevention and Response:
1. The Contractor is responsible for minimizing the potential for spills of pollutants stored onsite. Leaks and spills shall be minimized and if observed, the Contractor shall clean it up immediately and institute preventive measures.
 - a. Be aware of potential spill areas and drainage routes in their work areas.
 - b. Containers must remain closed at all times except when transferring contents.
 - c. Do not attempt to carry or move heavy containers of oil or hazardous material without assistance or the use of a drum dolly.

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- d. Use funnels; pumps with closed hose systems, or other means to prevent spills while transferring material from large containers to small ones. Pumps in operation shall not be left on, unattended.
 - e. Hazardous materials will be stored in a designated area that is away from vehicle/traffic areas.
 - f. Immediately notify the supervisor of any spill occurring in the work area.
 - g. It is the responsibilities of the Contractor's designated Safety Officer to direct the cleanup activities and contact necessary regulatory agencies.
 - h. All necessary emergency telephone numbers shall be posted at the construction site at a location accessible to all personnel.
 - i. The Contractor shall know the proper methods to clean up small spills in their work areas, and how spent cleanup material shall be managed.
 - j. A SWPPT member is responsible for recording all steps taken to control spills in the field notes/daily log.
 - k. Spill cleanup equipment must be readily available on site. Emergency response equipment includes absorbent socks, over pack drums, personal protective equipment, shovel, labels, valves, valve charts, valve wrenches to shut off water supply, etc.
- H. General Inspection Procedures:
- 1. The person(s) conducting inspections for the Contractor must be trained by the qualified SWPPP Developer. The Contractor must inspect the following areas:
 - a. Disturbed areas
 - b. Material storage areas
 - c. Locations where vehicles enter and exit the site
 - d. All catch basins, storm drains and inlets. The contractor shall provide an inventory of the inlets existing conditions and their maintenance.
 - e. All areas where erosion and sediment control BMPs are used.
- I. Reporting and Retention of Records:
- 1. SWPPP inspection reports, compliance certification statements, training records, and correspondence must be maintained. The Contractor shall retain copies of the SWPPP, all reports required by the SWPPP, and records of all data including all logs and documentation described in this section for a period of at least three (3) years from the date the site is finally stabilized.
 - 2. Inspection and monitoring requirements and forms are contained in the California Regional Water Quality Control Board's - Erosion and Sediment Control Field Manual, pages 123 to 129.
 - 3. The Contractor will document with daily logs, and the inspection checklist the SWPPP measures inspected and implemented during the day. These records shall be kept at the job trailer so that during an inspection, it can be shown to the RWQCB, PUC and City representatives.

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4. Copies of the SWPPP inspection checklists shall be submitted monthly with progress payment request.
5. Progress payments shall be withheld if Contractor fails to submit the SWPPP inspection reports with payment request.
6. The SWPPP, all inspection forms, logs, training records and all amendments to the SWPPP shall be submitted to the City Representative.

END OF SECTION

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SECTION 03 11 00

CONCRETE FORMING

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:
 - 1. Formwork for cast-in-place concrete and shotcrete.
 - 2. Installation of cast-in anchors, sleeves and similar items furnished under other Sections.
- B. Related Sections include the following:
 - 1. Section 03 20 00: Concrete Reinforcing
 - 2. Section 03 30 00: Cast-in-Place Concrete
 - 3. Section 03 33 00: Architectural Concrete
 - 4. Section 32 13 13: Concrete Paving

1.3 REFERENCES

- A. Standards listed below apply where designation is cited in this Section. Where the applicable year of adoption or revision is not listed below, the latest edition applies.
- B. ASTM: Standards of the American Society for Testing and Materials (ASTM) apply where designated in this Section. Use applicable year of adoption or revision as published in the 2006 "Annual Book of ASTM Standards".
- C. American Concrete Institute's
 - 1. ACI 117 - Specifications for Tolerance for Concrete Construction, 2006.
 - 2. ACI 301 - Specifications for Structural Concrete for Buildings, 2005.
 - 3. ACI 347 - Guide to Formwork for Concrete, 2004.
- D. Product Standards
 - 1. PS1 - Construction and Industrial Plywood.

1.4 DEFINITIONS

- A. Architectural Concrete: Concrete surfaces that are shown in the Drawings. Refer to Specification Section 03 30 00: Cast-in-Place Concrete.

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- B. Exposed to View Concrete: Includes all exposed to view in finished condition concrete in the Drawings.

1.5 SUBMITTALS

- A. Submittal procedures and administrative provisions are established by Division 01 Section "Submittals".
- B. Product data for manufactured products, including forming accessories.
- C. Schedule showing Contractor's proposed location of construction joints not indicated on Drawings.
- D. Samples: As requested by Owner's Representative.

1.6 QUALITY ASSURANCE

- A. Standards: Comply with provisions of ACI 301 and ACI 347, except where more stringent requirements are shown or specified in this Section.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. General: Use materials suitable for exterior exposure and which have the strength to produce required tolerances. Material in contact with concrete shall not react with fresh concrete to cause loss of strength or durability. Form materials shall not stain concrete surfaces that are exposed to view.
- B. Form Facing Material: Wood, metal, plastic or other materials that do not exceed the roughness of dressed lumber.
 - 1. Smooth Form Finish: PS1 plywood intended for concrete formwork, edge sealed. Type B-B Plyform, MDO or HDO overlain plywood.
 - 2. Exposed to View Finish: Refer to specification section 03330.
- C. Forms for Cylindrical Columns: Metal, fiberglass, or spiral wound fiber tubes.
- D. Leave-in-Place Formwork: Provide only as designated on Drawings, except as approved by Owner's Representative.
 - 1. Ribbed Expanded Metal: Expanded mesh between solid V-ribs, ASTM A525 galvanized steel. Same as Stay-Form by Amico, or approved equal.

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2.2 FORM ACCESSORIES

- A. Form Ties: Snap off metal ties of fixed length with plastic cone, designed to prevent spalling of concrete upon removal. Provide units that will leave no metal within 1-inch of concrete surface, except as otherwise designated.
 - 1. Refer to specification Section 03 33 00: Cast-in-Place Concrete for form ties at exposed to view concrete.
- B. Chamfer and Rustication Strips: Plastic or polymer wood composite (P-W-F) strips fabricated to produce uniform smooth lines. At exposed conditions, provide in longest lengths practical.
- C. Form Release Agents: Commercial formulation compounds, that will not bond with or stain concrete surfaces and will not impair bonding of paint or other coatings intended for use.
 - 1. Use compounds specifically formulated for use on overlain plywood, where surfaces remain exposed to view.

PART 3 - EXECUTION

3.1 CONSTRUCTION

- A. Construct forms to sizes, shapes, lines and dimensions shown and to obtain accurate alignment, level and plumb work in finished structure. Finished work shall conform to tolerances of ACI 117.
 - 1. Tolerance for offsets at panel edges in as-cast condition shall conform to ACI 117, Class B for surfaces exposed to view, Class D for surfaces scheduled to receive rough formed finish, and Class C for all other surfaces.
 - 2. Refer to specification Section 03 33 00: Cast-in-Place Concrete for tolerances at exposed to view concrete.
- B. Select form-facing materials to obtain required finishes. Solidly butt and back joints to prevent leakage of cement paste.
- C. Provide, erect, support, brace and maintain formwork and shoring to safely support loads caused by concrete placement and other loads that might be applied, until such loads can be supported by hardened concrete in the completed structure.
- D. Earth Forms: Footing forms may be omitted and foundation concrete may be placed directly into neatly and accurately cut excavations, provided the excavation walls are stable.
 - 1. Form footings to minimum extent shown on Drawings, but not less than 12" below finish grade at surfaces areas exposed to view.

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- E. Make provisions in formwork for removal of debris from formed spaces. Locate temporary openings in inconspicuous locations at bottom of forms. Close ports with tight fitting panels, flush with inside face of forms.
- F. Plywood Forms at Exposed to View Surfaces:
 - 1. Keep number of panel joints to practical minimum.
 - 2. Ensure vertical joints are plumb and horizontal joints are level.
 - 3. Align form ties vertically and horizontally.
 - 4. Refer to specification Section 03 33 00: Cast-in-Place Concrete for further requirements.
- G. Shoring: Shores and struts shall be provided with positive means of vertical adjustment and corrections for formwork deflection and settlement shall be taken up during construction.
- H. Form Release Agent: Apply a coating of form release agent immediately prior to installation of reinforcing steel and embedded items.
 - 1. Coat steel surfaces with a nonstaining, rust preventative coating.
- I. Provision for Other Trades: Provide openings in formwork and sleeves to accommodate work of other trades. Determine size and location of openings and recesses from trades requiring them.

3.2 JOINTS

- A. Construction Joints:
 - 1. Provide where shown on the Drawings or as approved by the Owner's Representative.
 - 2. Provide 1-1/2" deep key indentations at formed joints in walls. Make key 1/3 of the wall thickness at widest portion of kerfed form.
 - 3. Provide rustication strips at exposed to view surfaces. Where no reveal remains in completed construction, install 3/4 inch x 1-1/2 inch kerfed strip centered on joint. Remove strip prior to making second pour.

3.3 EMBEDDED ITEMS

- A. Accurately place and securely support anchorage devices and other embedded items required for other work that is attached to cast in place concrete.
 - 1. Use setting templates, drawings, and instructions provided by supplier of items.
 - 2. Temporarily fill voids with readily removable material to prevent entry of concrete.
 - 3. Use only stainless steel fasteners for securing built in items to formwork, where end of fastener is exposed to view or weather in completed construction. Cut back and grind fasteners flush with concrete surface.
- B. Anchor rods (bolts) for steel columns shall be set to tolerances of Section 7.5.1 of AISC "Code of Standard Practice" (2005), which are more stringent than the requirements of ACI 117.

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- C. Aluminum Items: Aluminum surfaces in contact with concrete shall be painted with a bituminous paint complying with SSPC Paint 12, "Cold Applied Asphaltic Mastic", 1/8-inch minimum thickness; or other approved coating system.

3.4 FORM REMOVAL

- A. Do not remove forms and shores until concrete has hardened and attained sufficient strength to permit safe removal and adequate support of inherent and imposed loads.
- B. Carefully remove forms to avoid spalling concrete surfaces, in particular at corners and edges of exposed to view concrete. Prying against the face of concrete shall not be allowed.
- C. After concrete is placed, forms and shores shall remain in place for not less than the following period of time, subject to requirements for additional curing:
 - 1. Formwork not supporting the weight of concrete: For surfaces such as the sides of walls, columns, and beams, 24 hours at not less than 50 degrees F, except as otherwise noted.
 - 2. Where forms are removed in less than 7 days, continue curing in accordance with provisions of specification Section 03 30 00: Cast-in-Place Concrete.

3.5 REUSE OF FORMS

- A. The Owner's Representative will approve reuse of forms provided they are straight, clean, free from nails, dirt, hardened concrete, rust, and other injurious matter and edges and surfaces are in good condition.
- B. Clean and repair all damage caused by placing, removal, or storage. Reuse of formwork that would reduce quality of exposed-to-view concrete will not be permitted.

END OF SECTION

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SECTION 03 20 00

CONCRETE REINFORCING

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
 - 1. Reinforcement for cast-in-place concrete and shotcrete.
 - 2. Accessories as required to support and secure reinforcement.
 - 3. Couplers used to mechanically splice reinforcement.
- B. Related Sections
 - 1. Section 03 11 00: Concrete Forming
 - 2. Section 03 30 00: Cast-in-Place Concrete
 - 3. Section 03 33 00: Architectural Concrete
 - 4. Section 32 13 00: Concrete Paving

1.3 REFERENCES

- A. Standards listed below apply where designation is cited in this Section. Where the applicable year of adoption or revision is not listed below, the latest edition applies.
- B. ASTM: Standards of the American Society for Testing and Materials (ASTM) apply where designated in this Section. Use applicable year of adoption or revision as published in the 2009 "Annual Book of ASTM Standards".
- C. American Concrete Institute's
 - 1. ACI 301 - Specifications for Structural Concrete for Buildings, 2005.
 - 2. ACI 315 - Details and Detailing of Concrete Reinforcing.
 - 3. ACI 318 - Building Code Requirements for Structural Concrete, 2008.
- D. American Welding Society
 - 1. AWS D1.4 - Structural Welding Code - Reinforcing Steel, 2005.
- E. CBC - 2010 California Building Code.
- F. Concrete Reinforcing Steel Institute's
 - 1. CRSI Manual - "Manual of Standard Practice", 28th Edition.
- G. IAPMO Evaluation Service (IAPMO-ES)

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1. IAMPO-ES "Evaluation Reports" and "Acceptance Criteria" for proprietary products are available at www.iapmoes.org.
- H. ICC Evaluation Service (ICC-ES)
 1. ICC-ES "Evaluation Reports" and "Acceptance Criteria" for proprietary products are available at www.icc-es.org.

1.4 SUBMITTALS

- A. Submittal procedures and administrative provisions are established by Division 1 Specification Section 01 33 00: Submittal Procedures.
- B. Test Reports: Furnish test reports evidencing and certifying compliance with specified standards to Testing Laboratory for record purposes.
 1. Reinforcing steel.
- C. Product data for proprietary items, including bar couplers, headed bars, stud-rails, and welding electrodes.
 1. Furnish manufacturer's installation instructions and Evaluation Reports indicating quality control and special inspection requirements to Testing Laboratory for their information.
- D. Shop Drawings: Prepare placing drawings in accordance with ACI 315. Show size, shape and location of bars and wire fabric in structure. Show splice locations and lengths. Where details are not shown, conform to standards of practice indicated in ACI 315 and submit for approval.
 1. Bill reinforcing bars for walls on elevations. Bill reinforcing bars for slabs on plans. Plans and elevations need not be true views. When more than one wall or slab are identical, only one such wall or slab is required. Take sections to clarify the arrangement of reinforcement. Identify, but do not bill bars on sections.
 2. Unless the location of reinforcing is clear, give dimensions to some structural feature that will be readily distinguishable at time bars are placed.
 3. Make placing drawings complete, without reference to the design drawings.

1.5 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of ACI 301 and CRSI's "Manual of Standard Practice", except where more stringent requirements are shown or specified.
- B. Material Quality Assurance
 1. Reinforcing: Mill test reports including chemical analysis, tensile properties and bend test shall be examined for all reinforcing. Conform to one of the following:
 - a. Maintain positive identification of reinforcing by heat number. Provide certified mill test reports to Testing Laboratory.

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- b. Evidence that fabricator's quality assurance procedures ensure that certified mill test reports for each heat have been reviewed for compliance with requirements specified. Evidence shall be satisfactory to Testing Laboratory.
 - c. Where positive identification cannot be made and procedures are not deemed adequate to ensure compliance, Owner's Testing Laboratory will randomly sample and make one tensile and one bend test from each 2-1/2 tons or fraction thereof of each size of reinforcement. For bars to be welded, make chemical analysis. Contractor will bear the cost of testing.
- 2. Headed deformed bars:
 - a. Conform to quality assurance requirements of applicable ICC-ES or IAPMO-ES Evaluation Report.
 - b. At the start of fabrication, tension test 2 headed bar specimens for each bar size used in the work. Testing may be conducted by manufacturer's laboratory, subject to approval of Owner's Representative. Fabricator shall bear the cost of testing.
 - c. When number of headed bars of one size exceeds 200, tension test 1 additional specimen for each additional 200 heads or fraction thereof.
- 3. Mechanical bar couplers:
 - a. Conform to quality assurance requirements of applicable ICC-ES or IAPMO-ES Evaluation Report.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Store reinforcement in a manner that will prevent excessive rusting or fouling with grease, oil, dirt, and other bond weakening materials.
- B. Store in a manner to maintain identification of bars after bundles are broken.

1.7 SOURCE QUALITY CONTROL

- A. Testing Laboratory will:
 - 1. Review plant quality assurance procedures for fabrication of end headed bars, stud-rails and mechanical couplers for conformance with requirements of applicable ICC-ES or IAPMO-ES evaluation report. Special inspect fabrication as required by evaluation report.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Bar reinforcement: ASTM A615, Grade 60, or ASTM A706 deformed bars, except as otherwise designated.
 - 1. Furnish only ASTM A706, where designated on drawings.

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- B. Headed bar reinforcement: Deformed bar reinforcement (#11 and smaller) with forged, welded, or mechanically attached heads conforming to the requirements of ACI 318-08, Sections 3.5.9 and 12.6. Acceptable systems shall have an active ICC-ES or IAPMO-ES Evaluation Report evidencing compliance with specified criteria and establishing quality assurance and special inspection requirements. Subject to compliance with requirements, provide one of the following, or approved equal:
 - 1. HRC 555 Headed Bar, by Headed Reinforcement Corp. (ICC ESR 2935)
 - 2. Bartech Mechanical Anchor, by Dextra Manufacturing Co. (ICC ESR-2166)
 - 3. Lenton Terminator D16 (taper threaded); by Erico (IAPMO ESR-0129)
- C. Bar couplers: Capable of producing Type 1 or Type 2 mechanical splice in accordance with Section 21.1.6 of ACI 318-08, as specified herein. Select coupler type considering conditions of installation and space limitations; maintain specified cover and reinforcement position acceptable to Owner's Representative. Acceptable coupler systems shall have an active ICC-ES or IAPMO-ES Evaluation Report evidencing compliance with the specified criteria and establishing quality assurance and special inspection requirements.
 - 1. Type 2 couplers.
 - 2. Subject to compliance with requirements, provide one of the following mechanical splice systems:
 - a. Lenton, Erico Inc. (IAPMO ESR-0129)
 - b. Bartec, Dextra America, Inc. (ICC ESR-1705)
 - c. Taperlock, Dayton Superior (ICC ESR-2481)
 - d. HRC 500/510, Headed Reinforcement Corp (ICC ESR-2764)
 - e. Bar-Lock, Dayton Superior (ICC ESR-2495)
- D. Bar Supports:
 - 1. Supports placed against ground or atop vapor retarder shall be precast concrete blocks with base not less than 3 inches square.
 - 2. CRSI Class 1 plastic or plastic protected supports shall be used at surfaces exposed to view or weather in completed construction. Select support type to provide minimum surface contact. Refer to specification Section 03 33 00: Architectural Concrete for further requirements.
 - 3. CRSI Class 2 wire supports and precast bar supports shall be acceptable at other surfaces not exposed to view in completed construction.
 - 4. CRSI Class 3 wire supports shall be acceptable where support is no closer than 1/2 inch to surface or where support is placed atop steel deck.
 - 5. Supports and tie wire for coated bars shall be plastic or coated with epoxy or other polymer, and shall be of configuration approved by Owner's Representative.

2.2 FABRICATION

- A. Shop fabricate reinforcement to standard fabrication tolerances indicated in ACI 315.

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- B. Spirals: Provide 1 finishing turn with 90-degree hook at each end unless otherwise noted on structural drawings. At splices provide 80 bar diameter lap splice with 90-degree hooks at ends.
- C. Headed bars: Headed bars will be allowed to be substituted for 90 deg hooked bars, subject to meeting the requirements specified herein.
 - 1. Bars are designated to be ASTM A615, Gr. 60 or ASTM A706.
 - 2. Clearance between headed bars shall be at least 4 bar diameters in accordance with ACI 318, Section 12.6.
 - 3. A minimum cover of 2 bar diameters, 1-1/2 inches minimum, shall be provided to all faces of head.
 - 4. Headed bars shall not be substituted for stirrups and ties that serve to confine beam and column reinforcing.
 - 5. No additional cost to Owner.
 - 6. Contractor shall pay the cost of any additional testing and inspection associated with use of headed bars.

2.3 SOURCE QUALITY CONTROL

- A. Inspection and testing will be performed in accordance with procedures and administrative requirements of Division 01 Section "Quality Requirements".
- B. Owner's Testing Laboratory will:
 - 1. Review Quality Assurance procedures for maintaining identification of steel.
 - 2. Review Quality Assurance procedures for fabrication of proprietary items, including headed bars and couplers. Perform special inspection as required by applicable Evaluation Report.
 - 3. Review equipment and Quality Assurance procedures for cage pre-assembly using welded holding wires. Perform or witness specified sampling and testing.
 - 4. Test mechanical splices used for #6 bars and larger. When less than 100 couplers of any bar size are used in the work, tension test 2 specimens of the largest bar size used in the work. When more than 100 couplers of an individual bar size are used, test 2 specimens of that bar size. Randomly sample bars and couplers prior to installation in the work.
- C. Contractor shall:
 - 1. Furnish specimens required for testing. Assemble specimens of mechanically spliced bars using components sampled by Testing Laboratory.

PART 3 - EXECUTION

3.1 PLACEMENT

- A. Place and maintain bars at locations shown on Drawings to the tolerances of ACI 117, including but not limited to the following:
 - 1. Clear distance to formed surfaces: Plus or minus 1/4 inch.

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2. Top bars in slabs 8 inches deep or less: Plus or minus 1/4 inch.
 3. Top bars in foundations, beams and slabs over 8 inches deep: Plus 1/2 inch and minus 1/2 inch.
- B. Maintain minimum coverage as indicated for concrete protection. Conform to requirements of ACI 301 where not indicated.
1. Cover shall not be reduced at mechanical couplers and headed reinforcing.
- C. Place reinforcement with 1-1/2 bar diameters minimum clear distance between bars, but not less than 1-1/2 inches. Where specified clearance cannot be achieved, bundle bars.
1. Conform to additional requirements for spacing of headed bars.
- D. Support and securely fasten bars with chairs, spacers and ties to prevent displacement by construction loads or placement of concrete beyond the tolerances specified. Conform to CRSI "Manual" as a minimum standard.
- E. Take precautions to protect vapor retarder beneath slab-on-ground from damage during installation of reinforcement.
- F. Lap splices:
1. Contact splice: Lapped bars shall be placed in contact and securely tied. Lap shall be oriented to maintain bars in their designated layer, except where offset bent bars are used at splices. Stagger lap splices where necessary to maintain minimum 1 bar diameter and 1 inch clearance between bars at splice.
 2. Noncontact splice: Lapped bars shall be spaced apart a minimum of 1 bar diameter and 1 inch minimum to permit the encasement of the entire surface of the bar in concrete. Bars shall not be spaced farther apart than one-fifth of the lap and 6 inches maximum. Whenever practical, use noncontact splices, with 4 inch minimum clear spacing between bars, for shotcrete construction.
 3. Wire Fabric: Overlap outermost cross wires of each piece one wire space plus 2 inches. Wire or clip together at maximum 3-foot spacing. Stagger splices in one direction.
- G. Welding:
1. Welding is not permitted unless specifically detailed on plans or approved by Architect.
- H. Reinforcement shall be free of mud, oil or other materials that may reduce bond at the time concrete is placed. Reinforcement with tightly adhered rust or mill scale will be accepted without cleaning provided that rusting has not reduced dimensions and weights below applicable standards. Remove loose rust.
- I. Field straightening: Bar reinforcement shall not be field bent after being embedded in hardened concrete. Reinforcement that is accidentally bent, up to a 1:2 bend (30 deg) and not severely kinked, will be permitted to be straightened subject to the approval of the

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Owner's Representative. #7 and smaller bars may be straightened cold. Larger bars shall be preheated prior to bending in accordance with the provisions of ACI 301.

3.2 FIELD QUALITY CONTROL

- A. Inspection and testing will be performed in accordance with procedures and administrative requirements of Division 1 Section "Quality Requirements".
- B. Testing Laboratory will:
 - 1. Special Inspect placement of reinforcement for conformance with the Contract Documents, as required by CBC Table 1704.4.
 - 2. Special Inspect installation of mechanical couplers in accordance with requirements of applicable Evaluation Report.
 - 3. Special Inspect welding as required by CBC Table 1704.4, for compliance with AWS D1.4; including checking materials, equipment, procedure and welder qualification as well as the welds. Inspector will use nondestructive testing or any other aid to visual inspection that he deems necessary to assure the adequacy of the weld.
 - 4. Observe the straightening of bent reinforcing. Inspect preheat for bars larger than #7 for conformance with ACI 301. Where warranted by severity of bend, Inspector will use dye penetrant or any other aid to visual inspection deemed necessary to assure the affected area is free of cracks.

END OF SECTION

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SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- A. Standard Specifications of the City and County of San Francisco, Department of Public Works, Bureau of Engineering (SSDPWSF), Latest Edition. Also referred to as "City Standard Specifications."
- B. Standard Plans of the City and County of San Francisco, Department of Public Works, Bureau of Engineering (SPDPWSF), Latest Edition. Also referred to as "City Standard Plans."
- C. Department of Public Works (DPW) Order No. 187005 "Regulations for Excavating and Restoring Streets in San Francisco", approved February 6, 2018.
- D. Geotechnical Report: "Geotechnical Investigation Mission Rock Development Streets", Langan Engineering and Environmental Services, Inc (dated December 18, 2018)
- E. Standard Specifications, State of California Department of Transportation, 2015 or Latest Edition. Also referred to as "Caltrans Standard Specifications".

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, and finishes.
- B. Included Work:
 - 1. All Concrete shall conform to this specification except where concrete items are specified by City Standard Specifications, Section 800, unless otherwise indicated below.
 - 2. Concrete for Pole Foundations
 - 3. Concrete Curbs shall conform to Section 202 of the City Standard Specification, except as modified by these Construction Documents.
 - 4. Combined Concrete Curb and Gutter shall conform to Section 203 of the City Standard Specification, except as modified by these Construction Documents.
 - 5. Concrete Sidewalk shall conform to Section 204 of the City Standard Specification, except as modified by these Construction Documents.
 - 6. Concrete Driveways shall conform to Section 210 of the City Standard Specification, except as modified by these Construction Documents.
 - 7. Concrete Structures shall conform to Section 411 of the City Standard Specification, except as modified by these Construction Documents.
 - 8. Integrally colored finish for outfall structure.

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- C. Related Sections include the following:
 - 1. Section 31 20 00, "Earth Moving".
 - 2. Section 31 21 00, "Utility Trenching and Backfill".
 - 3. Section 32 13 13, "Concrete Pavement".
 - 4. Section 32 13 18, "Cement and Concrete for Exterior Improvements".
 - 5. Section 33 30 00, "Sanitary Sewer System"
 - 6. Section 33 40 00, "Storm Drainage Utilities"

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.4 SUBMITTALS

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Indicate amounts of mix water to be withheld for later addition at Project site.
- D. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.
- E. Formwork Shop Drawings shall be prepared by or under the supervision of a qualified Professional Engineer and shall detail fabrication, assembly, and support of formwork.
- F. Shoring and Re-shoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing re-shoring.
- G. Welding Certificates: Copies of certificates for welding procedures and personnel.
- H. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials.
- I. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:
 - 1. Cementitious materials and aggregates.
 - 2. Form materials and form-release agents.
 - 3. Steel reinforcement and reinforcement accessories.

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4. Admixtures.
 5. Curing materials.
 6. Bonding agents.
 7. Adhesives.
 8. Vapor retarders.
 9. Epoxy joint filler.
 10. Joint-filler strips.
- J. Mock-ups
1. Submit two full-scale mock-up (minimum 4' by 4') sample panels of all concrete finishes, colors and coatings. The samples shall include curing compound if any is to be used, and include an expansion joint and a score joint, as indicated on the Drawings. Approved samples shall be kept at the job site to serve as a prerequisite for all finishes until acceptance of the Work.
- K. Color Additive Samples for Verification: Submit sample chip of specified concrete colors indicating Davis color name.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed concrete work 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.
- B. The Contractor shall be responsible for quality of concrete in place and shall bear burden of proof that concrete meets minimum requirements. Contractor shall confirm that site soils do not contain elevated levels of sulfate that would require sulfate resistant concrete as outlined in Table 4.3.1 of the ACI 318 Building Code or Table 19B-A-3 of the Uniform Building Code. If the site soils contain elevated levels of sulfate, it is the Contractor's responsibility to request mixes that meet the aforementioned requirements.
- C. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
1. Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities. Submit Certifications to Owner's Agent
- D. Testing Agency Qualifications: An independent testing agency, acceptable to the Owner, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

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- E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.
- F. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- G. ACI Publications: Comply with the following, unless more stringent provisions are indicated:
 - 1. ACI 301, "Specification for Structural Concrete."
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- H. Formwork Design Criteria: Formwork shall conform to ACI 318, Section 6.1 and CBC Section 1906A.
 - 1. Formwork:
 - a. Shall prevent leakage or washing out of cement mortar.
 - b. Shall resist spread, shifting, and settling.
 - c. Shall reproduce accurately required lines, grades and surfaces within tolerances specified.
 - 2. Safety: The Contractor shall be responsible for adequate strength and safety of all formwork including falsework and shoring.
 - 3. Formwork allowable tolerances: Formwork shall produce concrete within tolerance limits recommended in ACI 318, Section 6.1, unless otherwise noted.
- I. Stipulations
 - 1. Finish Surface Tolerance: 1/4-inch maximum variation in 10 feet.
 - 2. At no point shall paving surface fail to drain.
 - 3. Finish Concrete Surface Slip Resistance: Shall have a minimum slip resistance coefficient of 0.65 on concrete pavement with less than 5% slope and 0.8 on concrete pavement with more than 5% slope.
 - 4. Walls retaining soil that retain 30 inches or more of soil shall include a subsurface drain behind wall per Section 68 of the Caltrans Standard Specifications and as accepted by the Owner's Agent. Drain line shall be connected to storm drain system as accepted by Owner's Agent.
 - 5. Walls retaining soil that retain 18 inches or more of soil shall receive Dampproofing per Caltrans Standard Specifications, Section 54.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Supply ready mixed concrete throughout. Batch, mix and transport in accordance with ASTM C-94, "Specifications for Ready Mixed Concrete."
- B. Mix and deliver concrete in quantities that will permit immediate use only.
- C. Indiscriminate addition of water for any reason will be cause for rejection of the load.

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- D. Deliver, store, and handle steel reinforcement to prevent bending and damage.
 - 1. Avoid damaging coatings on steel reinforcement.
 - 2. Repair damaged epoxy coatings on steel reinforcement according to ASTM D 3963.
- E. Color Additive: Deliver, store, and handle in accordance with manufacturer's instructions.

1.7 COORDINATION

- A. Coordinate items of other trades. Contractor shall be responsible for the proper installation of all accessories embedded in the concrete and for the provision of holes, openings, etc., necessary to the execution of the work of the trades.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1, or better.
 - b. Medium-density overlay, Class 1, or better, mill-release agent treated and edge sealed.
 - c. Structural 1, B-B, or better, mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1, or better, mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

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1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of the exposed concrete surface.
2. Furnish ties that, when removed, will leave holes not larger than 1 inch (25 mm) in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615, Grade 60 (Grade 420), deformed.
- B. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
- C. Deformed-Steel Welded Wire Fabric: ASTM A 497, flat sheet.
- D. All reinforcing steel, bolts anchors, sleeves, etc. shall be securely anchored in place before concrete is placed. All reinforcing details, fabrication and installation shall conform to ACI Standard 315, latest edition, except as noted. Stagger all splices where practical and not otherwise detailed. Minimum concrete protection for reinforcement shall be as follows unless otherwise noted:
 1. 3" clearance where concrete is placed against the earth.
 2. 2" clearance where concrete is exposed to earth but placed in forms.

2.3 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to (CRSI) "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.
 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymercoated wire bar supports.
 3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
- B. Joint Dowel Bars: Plain-steel bars, ASTM A 615, Grade 60 (Grade 420). Cut bars true to length with ends square and free of burrs.
- C. Epoxy-Coated Joint Dowel Bars: ASTM A 775; with ASTM A 615, Grade 60 (Grade 420), plain-steel bars.

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2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type II Modified
- B. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:
 - 1. Class: Moderate weathering region, but not less than 3M.
 - 2. Combined Aggregate Gradation: Well graded from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 (0.3-mm) sieve, and less than 8 percent may be retained on sieves finer than No. 50 (0.3 mm).
 - 3. Aggregate: In accordance with the requirements of Sections 800.03, 800.04, 800.05, and 800.06 of SSDPWSF, the Contractor shall substitute recycled concrete for a portion of the virgin aggregate in an amount no less than 15% of the total dry aggregate mass. The recycled concrete material shall meet or exceed the specified requirements. When recycled material is used for concrete base, exposed concrete applications, such as, sidewalk, curb, gutter, parking strip, pavement, and curb ramp, the Sodium Sulfate Soundness test (ASTM C88) is waived. Recycled concrete material will not be allowed in structural concrete or decorative concrete with an exposed aggregate finish."
- C. Water: Potable and complying with ASTM C 94.
- D. Fly ash: ASTM C618 for Class F fly ash.

2.5 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.
- B. Air-Entraining Admixture: ASTM C 260.
- C. Water-Reducing Admixture: ASTM C 494, Type A.

2.6 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

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- D. Water: Potable.
- E. Clear, Solvent-Borne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

2.7 RELATED MATERIALS

- A. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.
- B. Reglets: Fabricate reglets of not less than 0.0217-inch thick galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- C. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336-inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.
- D. Concrete Test Cylinders: The Contractor shall supply four (4) standard concrete test cylinders per 100 cubic yards or fraction thereof for every concrete pour.
- E. Aggregate Base: Crushed aggregate, R-78 minimum, 3/4-inch maximum, conforming to Caltrans Standard Specifications 26.1.02A, Class 2.
- F. Expansion Joint Material
 - 1. Fiber Expansion Joint: A non-extruding resilient filler, saturated with high quality bituminous materials having preserving characteristics. Conform to ASTM-D1751-04.
- G. Dampproofing: Per Caltrans Standard Specifications, Section 52.
- H. Grout: Premixed high strength non-shrink grout requiring only addition of water at the site. Burke's "Non-Ferrous, Non-Shrink Grout"; Master Builders "Masterflow 928 Grout", or equal.
- I. Patching Mortar: Mix in proportions by volume of one part cement to two parts fine sand. Provide integrally colored patching mortar as required to match color and finish of colored concrete surfaces.

2.8 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:
- B. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.

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- C. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.
- D. Proportion normal-weight concrete mix as follows:
 - 1. Compressive Strength (28 Days, psi):
 - a. Road Base – Class 5.5–3000–1 1/2"
 - b. Curb/Gutter – Class 6-3000-3/4"
 - c. Sidewalk – Class 5.5-3000-3/4"
 - d. Concrete Structures:
 - i. Conform to Caltrans Standard Specifications Section 90
 - ii. Minimum Amount of Cementations Material: 675 lbs. /CY of concrete
 - iii. Minimum Fly-ash Content: 15%
 - iv. Maximum Aggregate Size: 3/4"
 - v. Minimum Compressive Strength: 4500 psi
 - vi. Maximum Water Cement Ratio: 0.45
 - e. Cast-in-Drilled-Hole Concrete Piles:
 - i. Conform to Caltrans Standard Specifications Section 90
 - ii. Minimum Amount of Cementations Material: 675 lbs. /CY of concrete
 - iii. Minimum Fly-ash Content: 15%
 - iv. Maximum Aggregate Size: 1/2" or 3/8"
 - v. Minimum Compressive Strength: 4500 psi
 - vi. Slump: Equal to or greater than 7"
 - f. Other – Class 6-3000-3/4"
 - 2. Maximum Slump: 4 inches, except Class 5.5-3000-1 1/2" which shall be 3 inches.
- E. Cementitious Materials, Exposed to Deicers: For concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than Portland cement according to ACI 301 requirements.
- F. Cementitious Materials, General: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:
 - 1. Fly Ash: 25 percent.
 - 2. Combined Fly Ash and Pozzolan: 25 percent.
 - 3. Ground Granulated Blast-Furnace Slag: 50 percent.
 - 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent Portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
 - 5. Silica Fume: 10 percent.
 - 6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
 - 7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent Portland cement minimum, with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

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- G. Maximum Water-Cementitious Materials Ratio, Severe Sulfate Exposure: 0.45 for concrete subject to severe sulfate exposure.
- H. Air Content, General: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content stated below.
- I. Air Content, 1-inch Aggregate: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus 1 or minus 1.5 percent, unless otherwise indicated:
 - 1. Air Content: 6 percent for 1-inch- (25-mm-) nominal maximum aggregate size.
- J. Do not air entrain concrete to trowel-finished interior floors and suspended slabs. Do not allow entrapped air content to exceed 3 percent for those applications.
- K. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- L. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) 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.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 - 4. Use corrosion-inhibiting admixture in concrete mixes where indicated.
- M. Concrete Test Cylinder: The Contractor shall provide one set of four (4) concrete test cylinders per 100 cubic yards of concrete or portions thereof for every concrete pour.
- N. Lampblack: As supplied by batch plant for plain non-colored concrete work. Concrete for non-colored pavements shall be darkened by the addition of lampblack at the mixer. The proportion of lampblack or other approved colorant shall be that required to properly darken the concrete to reduce glare, and shall be subject to the approval of the Owner's Agent. Provide $\frac{3}{4}$ pound of lampblack per cubic yard of concrete unless required otherwise.
- O. Color Additives: Mix in accordance with manufacturer's instructions. Mix until color additives are uniformly dispersed throughout mixture and disintegrating bags, if used, have disintegrated.

2.9 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI "Manual of Standard Practice."

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2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116. Furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least one and one-half minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing times by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

2.11 EPOXY

- A. Where metal items, such as architectural vault covers (AVC's), are placed on precast or cast-in-place concrete, provide epoxy bond.
 - 1. Two-component, "CIA-GEL 7000" by Covert Operation, Long Beach, CA or accepted equal.

2.12 COLOR ADDITIVES (FOR OUTFALL STRUCTURE)

- A. Manufacturer: Davis Colors
 - 1. Contact Information:
 - a. Phone: 800-356-4848 or 323-269-7311
 - b. E-mail: info@daviscolors.com.
 - c. Web Site: www.daviscolors.com
- B. Type:
 - 1. Concentrated pigments specially processed for mixing into concrete and complying with ASTM C979.
 - 2. Color additives containing carbon black are not acceptable.
- C. Color Additive Delivery:
 - 1. Automated Dispensing: Meter and dispense colors using computer-controlled automated color weighing and dispensing system. Use Davis Colors Chameleon liquid metering system and Hydrotint liquid color additives.

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2. Manual Dispensing: Use Davis Colors Mix-Ready powdered color additives in pre-measured disintegrating bags.
- D. Concrete Color:
 1. Graphite (Iron Oxide), #860

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Install all concrete work true to line and grade as indicated on the drawings.
- B. Correct irregularities to the satisfaction of the Owner's Agent.
- C. Plain non-colored, exposed concrete shall contain lampblack, approximately 3/4 pound of lampblack per cubic yard, as accepted by Owner's Agent.
- D. The intent of the Grading Drawings is to provide positive drainage and to maintain slopes on walkways as required by the Americans with Disabilities act and California Title 24 throughout the project site. Notify the Owner's Agent immediately of any discrepancies between the Drawings and actual field conditions and/or conflicts between the design and Code requirements.

3.2 PREPARATION

- A. Examine subgrades and installation conditions. Do not start concrete work until unsatisfactory conditions are corrected.
- B. Provide subgrade preparation and the base material installation complete, including clearing, grading, excavation, filling and dewatering. Take every precaution to obtain a subgrade of uniform bearing power compacted to a minimum of 95% relative compaction as determined by the ASTM D1557 laboratory test procedure and in Sections 19 and 20 of the Caltrans Standard Specifications.
- C. Subgrade shall be kept moist and shall not be allowed to dry out before placement of concrete. Place no material on muddy subgrade. Remove un-compactable material and replace with clean fill and compact as required.
- D. Aggregate base, where indicated, shall be placed and compacted in conformance with Caltrans Standard Specifications 26-1.04 and 26-1.05.
- E. Obtain approval of subgrade from Owner's Agent prior to placing steel and concrete.

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3.3 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117. Curbs, gutters and sidewalks shall be set within 0.03' of designated grades.
- C. Construct forms tight enough to prevent loss of concrete mortar.
- D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
 - 1. Do not use rust-stained steel form-facing material.
- E. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- G. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- H. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- I. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- J. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement or pouring concrete.
- K. Forms for exposed surfaces shall be constructed to protect intended finish. Deflection of facing material between studs shall not exceed 0.0025 of the span. Facing material and pattern of joints shall be as approved by the Owner's Agent.
- L. For vertical surface of wall footings below grade, clean cut trench may be used in lieu of form if character of soil will permit installation without sluffing and width of concrete

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is increased at least 1 inch beyond indicated dimension of each face poured against earth.

- M. Curb and pavement edge forms shall extend full depth of concrete and shall be coordinated with installation of planting root barriers where required. Curves shall be formed with flexible metal or wood made up of thin laminations. Curve forms shall extend one stake space straight beyond tangent point. Where curbs and pavement are adjacent to areas to receive root barriers, provide smooth uniform edges. Remove any excess concrete as required to allow installation of root barriers without gaps between curbs and/or pavement and barriers.
- N. Maintain forms within the following tolerances.
 - 1. Top of Form: Plus or minus 1/8 inch in 10 feet and no abrupt variations; at required elevation to plus 3/8 inch.
 - 2. Face of Form: Plus or minus 1/4 inch in 10 feet longitudinal and no abrupt variations; perpendicular to surface plus or minus 1/8 inch.
- O. After concrete is placed, the following minimum times shall elapse before removal of forms.
 - 1. Walls: 48 hours.
 - 2. Footing sides: 24 hours.

3.4 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor bolts, accurately located, to elevations required.
 - 2. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 3. Install dovetail anchor slots in concrete structures as indicated.

3.5 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.
- B. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of 28- day design compressive strength. Determine compressive strength of in-place concrete by testing representative field- or laboratory-cured test specimens according

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to ACI 301. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

- C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Owner's Agent.

3.6 STEEL REINFORCEMENT

- A. General: Comply with CRSI "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Shop- or field-weld reinforcement according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing.
- F. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete. Where new pavements join existing, joints shall align.
- B. General: For concrete base in roadways. Contractor to document location of score joints in the as-builts.
- C. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Owner's Agent.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.

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- D. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.
 - 1. Use dowel sleeves, lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Tooled Joints / Score Joints
 - 1. Form joints in fresh concrete using a jointer to cut the groove so that a smooth, uniform impression is obtained to 1/4 depth of pavement unless shown otherwise.
 - 2. All joints shall be struck before and after brooming. Tool concrete both sides of joint.
 - 3. If joint pattern is not shown, provide joints not exceeding 6 feet in either direction and located to conform to column centerlines, wall corners, etc. as accepted by Owner's Agent.

3.8 CONCRETE PLACEMENT

- A. Mixed concrete shall be discharged within 1-1/2 hours or before the mixer drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates. When the concrete temperature exceeds 30 degrees C, 85 degrees F, the time shall be reduced to 45 minutes. Concrete shall be placed within 15 minutes after it has been discharged from the transporting unit. Concrete shall be handled from mixer or transporting unit to forms in a continuous manner until the approved unit of operation is completed. Adequate scaffolding, ramps and walkways shall be provided so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper consolidation, finishing and curing. Sufficient placing capacity shall be provided so that concrete can be kept free of cold joints.
- B. Before placing concrete, verify and obtain approval of Owner's Agent that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- C. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by Owner's Agent.
- D. Before placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mix.
- E. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of

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weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.

- F. Deposit concrete in forms in horizontal layers no deeper than 24 inches (600 mm) and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.
 - 1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended in ACI 309R.
 - 2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.
- G. Cold-Weather Placement: Comply with ACI 306.1 and as follows:
 - 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 2. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
 - 3. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 4. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
- H. Hot-Weather Placement: When hot-weather conditions exist, place concrete according to recommendations in ACI 305R and as follows:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option, at no additional cost to Owner.
 - 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.
- I. Concrete Placement When Water Is Present:

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1. Concrete shall be deposited either by a tremie or concrete pump. The methods and equipment used shall be subject to approval. Concrete buckets shall not be used for underwater placement of concrete except to deliver concrete to the tremie. The tremie shall be watertight and sufficiently large to permit a free flow of concrete. The concrete shall be deposited so that it enters the mass of the previously placed concrete from within, displacing water with a minimum disturbance to the surface of the concrete. The discharge end of the pump line or tremie shaft shall be kept continuously submerged in the concrete. The underwater seal at start of placing shall not produce undue turbulence in the water. The tremie shaft shall be kept full of concrete to a point well above the water surface. Placement shall proceed without interruption until the concrete has been brought to the required height. The tremie shall not be moved horizontally during a placing operation, and a sufficient number of tremies shall be provided so that the maximum horizontal flow of concrete will be limited to 0.15 feet. Concrete shall not be deposited in running water or in water with a temperature below 35 degrees F.
- J. Mixes for integrally colored concrete shall have pigment added early enough to ensure complete dispersal and uniform color, but not less than 15 minutes before placing. Comply with color admixture manufacturer's recommendations unless otherwise specified in this Section

3.9 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch (3 mm) in height.
 1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.
 2. Do not apply rubbed finish to smooth-formed finish.

3.10 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb./sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written

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instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the methods indicated under 3.8D.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with one of the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.
 - 3. 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.
 - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a 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. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.11 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least six months. Do not fill joints until construction traffic has permanently ceased.

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- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semi-rigid epoxy joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.12 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Owner's Agent. Remove and replace concrete that cannot be repaired and patched to Owner's Agent's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 (1.2-mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface.
 - 2. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 3. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 4. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Owner's Agent.

3.13 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

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1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 100 cu. yd. (38 cu. m) or fraction thereof.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mix, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4.4 deg C) and below or when 80 deg F (27 deg C) and above, and one test for each composite sample.
 5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 6. Compression Test Specimens: ASTM C 31; cast and laboratory cure one set of four standard cylinder specimens for each composite sample. Cast and field cure one set of four standard cylinder specimens for each composite sample.
 7. Compressive-Strength Tests: ASTM C 39; test two laboratory-cured specimens at 7 days and two at 28 days.
 - a. Test two field-cured specimens at 7 days and two at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at age indicated.
- C. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
- D. Strength of each concrete mix will be satisfactory if every 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 (3.4 MPa).
- E. Test results shall be reported in writing to Owner's Agent, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall 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 mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.

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- F. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Owner's Agent but will not be used as sole basis for approval or rejection of concrete.
- G. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as determined by Owner's Agent. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as determined by Owner's Agent.
- H. Pole Foundation Construction will be inspected by Owner's Agent for conformance with Contract Documents.

3.14 POLE FOUNDATIONS

- A. Construct all concrete foundations in accordance with the tolerances specified in ACI 117.
- B. Locate each foundation within one inch of its planned location, as indicated on the Project Drawings or as approved by the Owner's Agent.
- C. Axis of the foundations shall not be out of plumb more than one percent of its excavated depth.
- D. Install each foundation with the correct diameter and length indicated on the Project Drawings. If it is greater in size, avoid interference with utilities or other work and obtain approval from Owner's Agent.
- E. Install each anchor bolt within the tolerances indicated herein.
- F. Locate the anchor bolt assembly within its correct offset dimension and vertical position, as indicated in the Project Drawings. Determine anchor bolt positions relative to the offset dimensions from the vertical and horizontal base lines, or track center line.
- G. Locate each anchor bolt assembly within two degrees of its correct orientation, as indicated on the Project Drawings.
- H. The top of concrete of each pole foundation shall be within one-half inch of its correct elevation, as indicated on the Project Drawings.
- I. Steel trowel all exposed, rough concrete surface to produce a smooth, dense surface. Finish foundation top with 1% slope, unless otherwise indicated on the Project Drawings.
- J. Replace non-compliant or out-of-tolerance foundations at no additional cost to Owner.

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- K. Protect projecting and exposed surfaces from injury during entire construction period.
- L. Protect anchor bolts and embedded items with tape and cap of weak grout after steel template is removed. Remove grout just prior to pole installation.

3.15 DAMPPROOFING

- A. Mop apply one heavy coat of asphalt dampproofing to soil side of retaining walls and planter walls from top of wall footing to a minus 2 inches below finished soil grade.

3.16 CLEANING (OUTFALL STRUCTURE)

- A. Efflorescence: Remove efflorescence (white powdery soluble salts deposited on concrete surface) as soon as practical after it appears and as part of final cleaning.
- B. Use least aggressive cleaning techniques possible. If proprietary cleaning agents are used, pre-wet surface, test cleaning agent on small, inconspicuous area, and check effects prior to proceeding. At walls, begin cleaning at top and work down. Thoroughly rinse surface afterwards with clean water. Follow cleaner manufacturer's instructions.
- C. Do not use muriatic or hydrochloric acid on integrally colored concrete.

END OF SECTION

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SECTION 05 52 00

METAL FABRICATIONS

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

- B. This Section includes the following:
 - 1. Metal Framing.
 - 2. Metal Fasteners, Anchors and Supports.
 - 3. General Site Metal Fabrications.
- C. Related Sections include:
 - 1. Section 03 30 00 "Cast in Place Concrete" and related sections for formwork, reinforcing, and curing.

1.3 SUBMITTALS

- D. Product Data: For the following:
 - 1. Non-Shrink Grout.
 - 2. Galvanizing.
 - 3. Specialty Hardware.
- E. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage, specialty hardware and accessory items.
 - 1. Provide templates for anchors and bolts specified for installation under other Sections.
- F. Welding Certificates: Copies of certificates for welding procedures and personnel.

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- G. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of University's Representative, and other information specified.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing metal fabrications 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.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 4. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.5 WARRANTY

- A. Warranty: Manufacturer's standard warranty in which manufacturer agrees to replace painted surfaces that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 15 years from date of Substantial Completion.

1.6 PROJECT CONDITIONS

- A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. 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.
- B. Paint Coordination:
 - 1. Provide finish coats which are compatible with prime paint used. Review other sections of these specifications in which prime paint are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information in characteristics of finish materials proposed for use, to ensure compatible prime coats are used.

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2. Provide barrier coats over incompatible primers or remove and re-prime as required. Notify Architect in writing of any anticipated problems using specified coating systems with substrates primed by others.
3. The warranty shall be set up prior to the purchase of any coating material. Contact the coatings representative to establish a specific warranty for this project.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.
- C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304. Satin #4 Brush Finish. Provide sample of finished material.
- D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- E. Rolled-Stainless-Steel Floor Plate: ASTM A 793.
- F. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.
- G. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.
- I. Cast-in-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
 1. Threaded or wedge type; galvanized ferrous castings, either **ASTM A 47** (**ASTM A 47M**) malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.
- J. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

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2.3 FASTENERS

- C. General: Provide Type 304 or 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.
- D. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- E. Anchor Bolts: ASTM F 1554, Grade 36.
- F. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).
- G. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- H. Wood Screws: Flat head, carbon steel, ASME B18.6.1.
- I. Plain Washers: Round, carbon steel, ASME B18.22.1 (ASME B18.22M).
- J. Lock Washers: Helical, spring type, carbon steel, ASME B18.21.1 (ASME B18.21.2M).
- K. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5. Subparagraph above and below are examples only. Above protects against corrosion in an indoor atmosphere. Revise to suit other conditions after verifying availability of thicker coatings.
 - 2. Material: Alloy Group 1 or 2 stainless-steel bolts complying with ASTM F 593 (ASTM F 738M) and nuts complying with ASTM F 594 (ASTM F 836M).
- J. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as needed.

2.4 HARDWARE FOR METAL FABRICATIONS

- A. Specialty manufactured products according to approved product data submittals and shop drawings.

2.5 GROUT

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- A. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for exterior applications.

2.6 CONCRETE FILL

- A. Concrete Materials and Properties: Comply with requirements in Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.

2.7 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Shear and punch metals cleanly and accurately. Remove burrs.
- C. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Weld corners and seams continuously to comply 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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- G. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.
- H. Paragraph below is for exterior metalwork. Revise to suit Project conditions and metalwork exposure.
- I. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening up of joints, overstressing of components,

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failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- J. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- K. Remove sharp or rough areas on exposed traffic surfaces.
- L. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

2.8 FINISHES, GENERAL

- b. Finish metal fabrications after assembly.

2.9 STEEL AND IRON FINISHES

- c. Stainless Steel: Satin Brush #4 Finish
- d. Galvanizing: Hot-dip galvanize items after fabrication as indicated to comply with applicable standard listed below:
 1. ASTM A 123, for galvanizing steel and iron products.
 2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.
 3. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

2.10 PAINTED FINISHES:

- A. As indicated in Drawings. Conform to Manufacturer's written specifications. Refer to Section 09 90 00: Painting and Coating for additional requirements not referenced in this Section.
- B. Surface treatments and finishes to be as indicated in Drawings.
- B. Color Pigments:
 1. Pure, non-fading, application types to suit substrates and service indicated.
 2. No lead content in pigment allowed.

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PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. Field Welding: Comply with the following requirements:
 - 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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 SETTING BEARING AND LEVELING PLATES

- e. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- f. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

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1. Use non-shrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use non-shrink, nonmetallic grout in exposed locations, unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 INSTALLING SITE METAL FABRICATIONS

- a. Install as indicated in Drawings.

3.4 ADJUSTING AND CLEANING

- b. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas as specified in Section 099100 "Painting"
- c. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

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SECTION 09 90 00

PAINTING AND COATING

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: Surface preparation, painting and finishing of exposed exterior items and surfaces for opaque and transparent painting.

1.3 DEFINITIONS

- a) "Paint": As used herein, means coating systems materials including primers, emulsions, epoxy, enamels, sealers, fillers, and other applied materials whether used as prime, intermediate or finish coats.

1.4 SYSTEM DESCRIPTION

- a) Performance Requirements
 - i) Paint exposed surfaces except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces.
 - ii) Painting is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts and labels.

1.5 SUBMITTALS

- a) Product Data: Submit manufacturer's product data for each paint system specified, including block fillers and primers.
 - i) Provide manufacturer's technical information including label analysis and instructions for handling, storage and application of each material proposed for use.
 - ii) List each material and cross reference the specific coating, finish system and application. Identify each material by the manufacturer's catalog number and general classification.
- b) Samples: Following the selection of colors and glosses by the Architect, submit samples for the Architect's review.
 - i) Provide 3 samples of each color and each gloss for each material on which the finish is specified to be applied.

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- ii) Except as otherwise directed by the Architect, make samples approximately 8 inches by 10 inches in size.
- iii) Do not commence finish painting until approved samples are on file at the Project Site.
- c) Quality Control Submittals: Provide certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).

1.6 EXTRA MATERIAL

- a) Provide (1) gallon of each type of approved primer and finish coatings to Owner for use in touch-up. Clearly label cans with all batch mixture numbers required to duplicate finishes.

1.7 QUALITY ASSURANCE

- a) Provide primers and undercoat paint produced by the same manufacturer as finish coats.
 - i) Review other Sections of these Specifications as required, verifying the prime coats to be used and assuring compatibility of the total coating system for the various substrates.
 - ii) Upon request, furnish information on the characteristics of the specific finish materials to assure that compatible prime coats are used.
 - iii) Provide barrier coats over non-compatible primers, or remove the primer and re-prime as required.
 - iv) Notify the Architect in writing of anticipated problems in using the specified coating systems over prime coatings supplied under other Sections.
- b) Qualifications
 - 1. Applicator: Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- c) Provide field mockups for final paint color and texture approval in the form of actual application of the materials on actual surfaces to be painted for approval by the Architect.
 - 1. Field mockups, when approved, will become standards of color and finish for accepting or rejecting the work of this Section.
- D. CalGreen Requirements: As indicated on the Drawings, Section 01 35 20, and the following.
 - 1. Use low VOC coatings that meet SCAQMD Rule 1113.

1.8 DELIVERY, STORAGE, AND HANDLING

- a) Acceptance at Site: Deliver materials to the job site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
 - i) Product name or title of material.
 - ii) Product description (generic classification or binder type).

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- iii) Manufacturer's stock number and date of manufacture.
 - iv) Contents by volume for pigment and vehicle constituents.
 - v) Thinning instructions.
 - vi) Application instructions.
 - vii) Color name and number.
- b) Storage and Protection
- i) Store materials not in use in tightly covered containers in well ventilated area at minimum ambient temperature of 45 degrees Fahrenheit. Maintain containers used in storage in clean condition, free of foreign materials and residue.
 - ii) Protect from freezing. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.9 PROJECT CONDITIONS

- a) Environmental Requirements
- i) Apply water based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 degrees Fahrenheit, unless otherwise permitted by the manufacturers' printed instructions as approved by the Architect.
 - ii) Do not apply solvent-thinned paints when the temperature of surfaces to be painted and the surrounding air temperatures are below 45 degrees Fahrenheit, unless otherwise permitted by the manufacturers' printed instructions as approved by the Architect.
 - iii) Do not apply paint in rain, fog or mist; or when the relative humidity exceeds 85 percent. Do not apply paint to damp or wet surfaces, unless otherwise permitted by the manufacturers' printed instructions as approved by the Architect.

PART 2 - PRODUCTS

2.1) MANUFACTURERS

- a) Acceptable Manufacturers: Tnemec; Rustoleum; C.I.M. Industries, Inc., or equal.

2.2) PAINT MATERIALS

- a) Paint Materials, General: Provide block fillers, primers, finish coat materials, and related materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by the manufacturer, based on testing and field experience.
- 1. Provide paint containers labeled on top and side of the containers

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- b) Material Quality: Provide manufacturer's best quality trade sale paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.
- c) Chemical Components of Field-Applied Paints and Coatings: Comply with GreenPoint Rated Requirements as specified in Section 01 35 20.
- d) Colors: As selected by the Architect.

2.3) APPLICATION EQUIPMENT

- a) For application of the approved paint, use only such equipment as is recommended for application of the particular paint by the manufacturer of the particular paint, and as approved by the Architect.
- b) Prior to use of application equipment, verify that the proposed equipment is actually compatible with the material to be applied, and that integrity of the finish will not be jeopardized by use of the proposed equipment.

2.4) OTHER MATERIALS

- a) Provide other materials not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect.

PART 3 - EXECUTION

3.1) EXAMINATION

- a) Examine the areas and surface conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work.
- b) Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

- a) General
 - i) Mix and prepare paint materials in strict accordance with the manufacturers' recommendations as approved by the Architect.
 - ii) When materials are not in use, store in tightly covered containers.
 - iii) Maintain containers used in storage, mixing and application of paint in a clean condition, free from foreign materials and residue.
- b) Stirring
 - i) Stir materials before application, producing a mixture of uniform density.

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- ii) Do not stir into the material any film which may form on the surface, but remove the film and, if necessary, strain the material before using.
- c) Surface Preparation
 - i) Perform preparation and cleaning procedures in strict accordance with the paint manufacturers' recommendations as approved by the Architect.
 - ii) Remove removable items which are in place and are not scheduled to receive paint finish; or provide surface applied protection prior to surface preparation and painting operations.
 - iii) Following completion of painting in each space or area, reinstall the removed items by using workmen who are skilled in the necessary trades.
 - iv) Clean each surface to be painted prior to applying paint or surface treatment.
 - v) Remove oil and grease with clean cloths and cleaning solvent of low toxicity and flash point in excess of 200 degrees Fahrenheit prior to start of mechanical cleaning.
 - vi) Schedule the cleaning and painting so that dust and other contaminants from the cleaning process will not fall onto wet newly painted surfaces.
 - vii) Provide barrier coats over incompatible primers or remove and reprime.
- d) Ferrous Metals: Clean ungalvanized ferrous metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC recommendations.
 - i) Blast steel surfaces clean as recommended by paint system manufacturer and according to requirements of SSPC SP 10.
 - ii) Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - iii) Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
- e) Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

3.3 PAINT APPLICATION

- a) General:
 - i) Touch-up shop-applied prime coats which have been damaged, and touch-up bare areas prior to start of finish coats application.
 - ii) Slightly vary the color of succeeding coats.
 - (1) Do not apply additional coats until the completed coat has been inspected and approved.
 - (2) Only the inspected and approved coats of paint will be considered in determining the number of coats applied.
 - iii) Sand and dust between coats to remove defects visible to the unaided eye from a distance of 5 feet.

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- b) Drying
 - i) Allow sufficient drying time between coats, modifying the period as recommended by the material manufacturer to suite adverse weather conditions.
 - ii) Consider oil base and oleo-resinous solvent-type paint as dry for re-coating when the paint feels firm; does not deform or feel sticky under moderate pressure of the thumb, and when the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.
- c) Brush Applications
 - i) Brush out and work the brush coats onto the surface in an even film.
 - ii) Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness and other surface imperfections will not be acceptable.
- d) Spray Application
 - 1. Where spray application is used, apply each coat to provide the hiding equivalent of brush coats.
 - 2. Do not double back with spray equipment to build up film thickness of 2 coats in 1 pass.
 - 3. Protect all adjacent buildings, cars, plants, floors, etc., from over spray.
- e) For completed work, match the approved samples as to texture, color and coverage. Remove, refinish or repaint work not in compliance with the specified requirements.
- f) Miscellaneous Surfaces and Procedures
 - i) Exposed Mechanical Items
 - (1) Finish electric panels, conduits, pipes, and items of similar nature to match the adjacent surfaces, or as directed.
 - (2) Wash metal with solvent and prime.
 - ii) Hardware
 - (1) Except for stainless steel bolts and nuts, paint prime coated hardware to match adjacent surfaces.

3.4 EXTERIOR PAINT SCHEDULE

- A. Exterior Ferrous Metals
 - i) Primer is not required on shop-primed items.
 - ii) Semigloss, Acrylic-Enamel Finish - Option 1: 2 finish coats over aromatic urethane, zinc-rich primer.
 - (1) Prime Coat: 2 component moisture cured, zinc rich primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of 2.5 mils to 3.5 mils.
 - (a) Product: Tnemec, "90-97 Tneme-Zinc", or equal.
 - (2) Intermediate Coat: Satin, polyamidoamine epoxy applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of 2.0 mils to 10 mils per coat.

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- (a) Product: Tnemec, "L69 Epoxoline", or equal.
 - (3) Finish Coat: Satin, low VOC fluoropolymer coating applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of 2.0 mils to 3.0 mils.
 - (a) Product: Tnemec, "1072V Fluoronar", or equal.
- iii) Semigloss, Acrylic-Enamel Finish - Option 2: 2 finish coats over aromatic urethane, zinc-rich primer.
 - (1) Prime Coat: 2 component moisture cured, zinc rich primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of 2.5 mils to 3.5 mils.
 - (a) Product: Tnemec, "90-97 Tneme-Zinc", or equal.
 - (2) Intermediate Coat: Satin, polyamidoamine epoxy applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of 2.0 mils to 10 mils per coat.
 - (a) Product: Tnemec, "L69 Epoxoline", or equal.
 - (3) Finish Coat: Gloss, low VOC fluoropolymer coating applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of 2.0 mils to 3.0 mils.
 - (a) Product: Tnemec, "1070V", or equal.
- B. Exterior Areas Where Indicated on the Drawings to Protect Surfaces from Dog Urine
 - 1. Paint corrosion protection sleeve.
 - 2. Paint Manufacturer: CIM Industries, Inc., "CIM 1000 High Performance Coatings and Linings" at a dry film thickness as recommended by the manufacturer to cover concrete, steel, and wood surfaces.
 - 3. Color: Black.

END OF SECTION

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SECTION 12 93 50

SITE FURNISHINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following site furnishings:

1. Manufactured Benches.
2. Trash and Recycling Receptacles.
3. Bicycle Rack.
4. Bronze Jurisdictional Marker
5. Tree Grates
6. Manufactured Planters
7. Stair Tread Warning Strips.
8. Skate Deterrent Discs.
9. Trench Drain Grating.

B. Work Specified Elsewhere:

Section 03 30 00: "Cast-In-Place Concrete, (Site)".

Section 05 52 50: "Metal Fabrications

1.2 SUBMITTALS

A. Product Data: For each product indicated. Include shop drawings, construction details, material descriptions, dimensions of individual components and profiles, finishes, colors, field-assembly requirements, and installation details.

B. Material Certificates:

1. Wood Preservative Treatment: Include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
2. Sustainably Harvested Wood: Include certification by manufacturer and from sources that participate in sustained yield programs.

C. Samples: For Custom Monterey Pine Benches:

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1. 2-inch by 4-inch by 24-inch sample of each specified bench type for wood finishes, wood preservative treatments, and stain finishes as indicated on the Drawings.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of site furnishing through one source from a single manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated; free from surface blemishes and complying with the following:
 1. Rolled or Cold-Finished Bars, Rods, and Wire: **ASTM B 211**
 2. Extruded Bars, Rods, Wire, Profiles, and Tubes: ASTM B 221
 3. Structural Pipe and Tube: ASTM B 429.
 4. Sheet and Plate: ASTM B 209
- B. Steel: Free from surface blemishes and complying with the following:
 1. Plates, Shapes, and Bars: ASTM A 36/A 36M.
 2. Steel Pipe: Standard-weight steel pipe complying with ASTM A 53, or electric-resistance-welded pipe complying with ASTM A 135.
 3. Tubing: Cold-formed steel tubing complying with ASTM A 500.
 4. Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A 513, or steel tubing fabricated from steel complying with ASTM A 569/A 569M and complying with dimensional tolerances in ASTM A 500; zinc coated internally and externally.
 5. Sheet: Commercial steel sheet complying with ASTM A 569/A 569M.
- C. Stainless Steel: Free from surface blemishes and complying with the following:
 1. Marine grade and appropriate to assure no rusting or staining. Contractor is responsible to ensure material is suitable for project environment.
 2. Sheet, Strip, Plate, and Flat Bars: ASTM A 666.
 3. Pipe: Schedule 40 steel pipe complying with ASTM A 312/A 312 M.
 4. Tubing: ASTM A 554.
- D. Anchors, Fasteners, Fittings, and Hardware: Stainless steel, Galvanized steel, and Manufacturer's standard, corrosion-resistant-coated or non-corrodible materials; commercial quality; tamperproof, vandal and theft resistant, concealed. Provide as required for site furnishings' assembly, mounting, and secure attachment, and as per drawings.

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- E. Wood Sealants: Contractor shall recommend sealants as per manufacturer for pre-fabricated furnishings or as appropriate for custom furnishings. Ensure sealants are compatible with micro climate of project location. Include data regarding weathering, maintenance and reapplication schedule.
- F. Non-shrink, Nonmetallic Grout: Premixed, factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.
- G. Galvanizing: Where indicated for steel components, provide the following protective zinc coating applied to components after fabrication:
 - 1. Hot-Dip Galvanizing: According to ASTM A 123/A 123M, ASTM A 153/A 153M, or ASTM A 924/A 924M.

2.2 MANUFACTURED WOOD BENCHES

- A. Neoliviano Bench
 - 1. Manufacturer: Landscape Forms, Inc., www.landscapeforms.com, (800) 521-2546, or equal.
 - 2. Model: 69-inch Neoliviano Wood Bench for exterior use, backed with arms.
 - 3. Materials:
 - a. Wood: Seat and back panels: Black locust premium grade-plus heartwood. Seat and back panels, board thickness of 1-2/16 inches.
 - b. Cast Supports: A514 aluminum, anodized finish.
 - c. Center Strap: 5/32 inch by 1-inch stainless steel.
 - 4. Mounting:
 - a. Embedded units supplied with two 10mm by 120mm threaded rods for each support casting.
 - b. Anchor Bolts: Corrosion resistant, not supplied by Manufacturer.

2.3 TRASH AND RECYCLING RECEPTACLES

- A. Trash and Recycling Receptacles
 - 1. Chase Park Litter Receptacle
 - 2. Landscape Forms, Inc., www.landscapeforms.com, (800) 521-2546
 - 3. Material: Powder Coated Metal
 - 4. Color: Silver
 - 5. Opening: Side Open
 - 6. Signage for Trash: Sign 17 "landfill"
 - 7. Signage for Recycling: Sign 10 "recyclable"

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8. Surface mount per manufacturer's recommendation

2.4 BICYCLE RACK

- A. Manufacturer: Palmer Group LLC, www.bikeparking.com 1(888) 764-2453, or equal.
- B. Model: WCR02-SQ-IG-G, Square Tubing Welle Circular Rack, in-ground.
- C. Material: 2-inch (0.188 inch wall) square structural and mechanical tubing, regular steel.
- D. Finish: Hot-dip Galvanized.
- E. Surface mount.

2.6 BRONZE JURISDICTIONAL MARKER

- A. Manufacturer: Bernsten International, Inc. www.bernsten.com, 1(800)518-0934, or equal.
- B. Model: CD2B – 2-inch diameter by 2-1/4-inch long domed concrete marker/bronze with embedment flange.
- C. Custom inscription as indicated on Drawings.

2.7 TREE GRATES

- A. Manufacturer: Urban Accessories, www.urbanaccessories.com as represented by Recreation Republic, 1(510) 470-1673
- B. Tree Grate: "L4"
 1. Dimensions and anchorage as indicated in the Drawings.
 2. Rectangular Jamison Tree Grate with 24" Square opening
 3. Material: Ductile Iron
 4. Finish: Rust Conditioner
 4. Conform to Drawings, Submittal and Shop Drawing requirements.
- C. Tree Grate: "L5"
 1. Dimensions and anchorage as indicated in the Drawings.
 2. Circular Jamison Tree Grate with 18" Diameter opening
 3. Material: Ductile Iron
 4. Finish: Rust Conditionaer
 5. Conform to Drawings, Submittal and Shop Drawing requirements.

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2.8 MANUFACTURED PLANTERS

Manufacturer Planterworx, <https://www.planterworx.com/contract-collection>

- A. Size: 6" Diameter round X 48" H.
- B. Model: Cylinder Planter / Planterworx Contract
- C. Material/Finish: Aluminum with Marine grade powder coat finish
- D. Color: Provide Standard Color list with submittal

2.8 STAIR TREAD WARNING STRIPS

Manufacturer: American Safety Tread, www.americansafetytread.com 1(800) 245-4881, or equal:

- A. Structural tread, Style No. 800 cast in Feracast, with embedment anchors, with No. 24 virgin grain Silicon Carbide granules embedded into the walking surface.
- B. Furnish with one coat of shop applied black paint.
- C. Width as indicated on Drawings. Thickness 7/16 inches.

2.8 SKATE DETERRENT DISC

- A. Manufacturer: SkateStopTM, www.skatestop.com.au, sales.usa@skatestop.co or equal.
- B. Model: Disc SSD 3020 SkateStop.
 - 1. Materials: Marine grade stainless steel.

2.7 TRENCH DRAIN GRATING

- A. Manufacturer: Urban Accessories, Inc., www.urbanaccessories.com, 1 (877) 487 0488
- B. Trench Grate Model: 12" Jamison Trench Grate. Ductile Iron. Raw Natural Finish.
- C. Trench Grate Frame Model: For 12" grate. H20 Duty. Mild Steel

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 PREPARATION

- A. Concrete Pads and Footings:
 - 1. Layout: Accurately lay out all pads and footings as called for in the Drawings.
 - 2. Installation: Excavate form as required and fill for pads and footings as specified in Section 03300 Cast in Place Concrete.

3.3 INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions, 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 and positioned at locations indicated on Drawings.

3.4 CLEANING

- A. After completing site and street furnishing installation, inspect components. Remove spots, dirt, and debris. Repair damaged finishes to match original finish or replace component.

END OF SECTION 12 93 50

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SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Exterior luminaires.
- B. Lamps.
- C. Poles and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Materials and installation requirements for concrete bases for poles.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 37 - Boxes.

1.03 REFERENCE STANDARDS

- A. AASHTO LTS - Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals; American Association of State Highway and Transportation Officials; 6th Edition, with 2015 Interim Revisions
- B. IEEE C2 - National Electrical Safety Code; Institute of Electrical and Electronic Engineers; 2012.
- C. IESNA LM-63 - ANSI Approved Standard File Format for Electronic Transfer of Photometric Data and Related Information; Illuminating Engineering Society; 2002 (Reaffirmed 2008).
- D. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; Illuminating Engineering Society; 2008.
- E. IES LM-80 - Approved Method: Measuring Lumen Maintenance of LED Light Sources; Illuminating Engineering Society; 2008.
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- G. NECA/IESNA 501 - Recommended Practice for Installing Exterior Lighting Systems; National Electrical Contractors Association; 2006.
- H. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- J. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

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1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
 - 2. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
 - 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
 - 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 - 2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IESNA LM-63 standard format upon request.
 - 3. Lamps: Include rated life and initial and mean lumen output.
 - 4. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.
- D. Certificates for Poles and Accessories: Manufacturer's documentation that products are suitable for the luminaires to be installed and comply with designated structural design criteria.
- E. Field Quality Control Reports.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- G. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
- I. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

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1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

PART 2 – PRODUCTS

2.01 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.02 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.
- H. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.
- I. Exposed Hardware: Matching Stainless steel.

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2.03 LAMPS

- A. Manufacturers:
 - 1. General Electric Company/GE Lighting; _____: www.gelighting.com.
 - 2. Osram Sylvania; _____: www.sylvania.com.
 - 3. Philips Lighting Company; _____: www.lighting.philips.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
 - 5. Manufacturer Limitations: Where possible, provide lamps produced by a single manufacturer.
 - 6. Where a specific manufacturer or model is indicated elsewhere in the luminaire schedule or on the drawings, substitutions are not permitted unless explicitly indicated.
- B. Lamps - General Requirements:
 - 1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
 - 2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
 - 3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
 - 4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect to be inconsistent in perceived color temperature.

2.04 POLES

- A. All Poles:
 - 1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.
 - 2. Structural Design Criteria:
 - a. Comply with AASHTO LTS.
 - b. Wind Load: Include effective projected area (EPA) of luminaire(s) and associated supports and accessories to be installed.
 - 1) Design Wind Speed: 85 miles per hour, with gust factor of 1.3.
 - c. Dead Load: Include weight of proposed luminaire(s) and associated supports and accessories.
 - d. Include structural calculations demonstrating compliance with submittals.
 - 3. Mounting: Install on concrete foundation, height as indicated on the drawings, unless otherwise indicated.
 - 4. Unless otherwise indicated, provide with the following features/accessories:
 - a. Top cap.
 - b. Handhole, 11" x 17" size.
 - c. Anchor bolts with leveling nuts or leveling shims.
 - d. Anchor base cover.
- B. Metal Poles: Provide ground lug, accessible from handhole.

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PART 3 – EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 05 37 as required for installation of luminaires provided under this section.
- B. Install products according to manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship) and NECA/IESNA 501 (exterior lighting).
- D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- E. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- F. Pole-Mounted Luminaires:
 - 1. Maintain the following minimum clearances:
 - a. Comply with IEEE C2.
 - b. Comply with utility company requirements.
 - 2. Foundation-Mounted Poles:
 - a. Provide cast-in-place concrete foundations for poles as indicated, in accordance with Section 03 3000.
 - 1) Install anchor bolts plumb per template furnished by pole manufacturer.
 - 2) Position conduits to enter pole shaft.
 - b. Install foundations plumb.
 - c. Install poles plumb, using leveling nuts or shims as required to adjust to plumb.
 - d. Tighten anchor bolt nuts to manufacturer's recommended torque.
 - e. Install non-shrink grout between pole anchor base and concrete foundation, leaving small channel for condensation drainage.

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- f. Install anchor base covers or anchor bolt covers as indicated.
- 3. Grounding:
 - a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.
 - b. Provide supplementary ground rod electrode as specified in Section 26 0526 at each pole bonded to grounding system as indicated.
- 4. Install separate service conductors, size as indicated on drawings, from each luminaire down to handhole for connection to branch circuit conductors.
- G. Install accessories furnished with each luminaire.
- H. Bond products and metal accessories to branch circuit equipment grounding conductor.
- I. Install lamps in each luminaire.

3.04 FIELD QUALITY CONTROL

- A. Inspect each product for damage and defects.
- B. Operate each luminaire after installation and connection to verify proper operation.
- C. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.05 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
- B. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by Architect.

3.06 CLEANING

- A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07 CLOSEOUT ACTIVITIES

- A. Just prior to Substantial Completion, replace all lamps that have failed.

3.08 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

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SECTION 31 20 00

EARTH MOVING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Excavation and/or embankment from existing ground to subgrade, including soil sterilant, for roadways, driveways, parking areas, building pads, walks, paths, or trails and any other site improvements called for on the Plans.

1.2 SECTION EXCLUDES

- A. Earthwork related to underground utility installation shall be performed in accordance with Sections 31 21 00, Utility Trenching and Backfill.

1.3 RELATED SECTIONS

- A. Section 01 10 00, Supplemental General Requirements
- B. Section 01 50 50, Erosion Control
- C. Section 31 10 00, Site Clearing
- D. Section 31 23 19, Dewatering

1.4 RELATED DOCUMENTS

- A. Geotechnical Report: "Geotechnical Investigation Mission Rock Development Streets", Langan Engineering and Environmental Services, Inc (dated December 18, 2018)
- B. ASTM
 - 1. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort
 - 2. D1586, Method for Penetration Tests and Split-Barrel Sampling of Soils
 - 3. D2487, Classification of Soils for Engineering Purposes
 - 4. D3740, Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
 - 5. D4318, Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils
 - 6. E329, Specification for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
 - 7. E548, Guide for General Criteria Used for Evaluating Laboratory Competence
- C. California Building Code, California Code of Regulations, Title 24, Part 2, Chapter 18, Soils and Foundations, and Chapter 33, Safeguards During Construction

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- D. Caltrans Standard Specifications, 2015
 - 1. Section 17, General
 - 2. Section 19, Earthwork
- E. CAL/OSHA, Title 8.

1.5 DEFINITIONS

- A. Borrow: Approved soil material imported from off-site for use as Fill or Backfill.
- B. Excavation: Removal of material encountered above subgrade elevations.
 - 1. Authorized Over-Excavation: Excavation below subgrade elevations or beyond indicated horizontal dimensions as shown on plans or authorized by the Geotechnical Engineer.
 - 2. Unauthorized Over-Excavation: Excavation below subgrade elevations or beyond indicated horizontal dimensions without authorization by the Geotechnical Engineer. Unauthorized excavation shall be without additional compensation.
- C. Geotechnical Testing Agency: An independent testing agency qualified according to ASTM E329 to conduct soil materials and rock definition testing, as documented according to ASTM D3740 and ASTM E548.
- D. Backfill: Soil materials approved by the Geotechnical Engineer and used to fill excavations resulting from removal of existing below grade facilities, including trees.
- E. Fill: Soil materials approved by the Geotechnical Engineer and used to raise existing grades.
- F. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material $\frac{3}{4}$ cubic yards or more in volume that when tested by an independent geotechnical testing agency, according to ASTM D1586, exceeds a standard penetration resistance of 100 blows/2 inches.
- G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man made stationary features constructed above or below grade.
- H. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, base or topsoil materials.
- I. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of weeds, roots, and other deleterious materials.

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- J. Unsuitable Material: Any soil material that is not suitable for a specific use on the Project. The Geotechnical Engineer will determine if a soil material is unsuitable.
- K. Relative Compaction: In-place dry density of soil expressed as percentage of maximum dry density of same materials, as determined by laboratory test procedure ASTM D1557.
- L. Utilities: onsite underground pipes, conduits, ducts and cables.

1.6 SUBMITTALS

- A. Follow submittal procedure outlined in Section 01 10 00, Supplemental General Requirements.
- B. Samples:
 - 1. If required by the Geotechnical Engineer, provide 20 pound samples, sealed in airtight containers, tagged with source locations and suppliers of each proposed soil material from on-site or borrow sources, 72 hours prior to use. Do not import materials to the Project without written approval of the Geotechnical Engineer.
 - 2. Provide materials from same source throughout work. Change of source requires approval of the Geotechnical Engineer.
- C. Material Test Reports: Provide, from a qualified testing agency, the following test results showing compliance with the project requirements:
- D. Classification according to ASTM D2487 of each onsite or borrow soil material proposed for fill and backfill.
 - 1. Laboratory compaction curve in conformance with ASTM D1557 for each onsite or borrow soil material proposed for fill and backfill.

1.7 QUALITY ASSURANCE

- A. Contractor shall verify shrinkage characteristics of all soils to be used on the site as engineered fill. The Developer will not be responsible for additional costs associated with variations in shrinkage or bulking factors and related earthwork quantities.
- B. All testing required by this Section and other Sections of these Specifications shall be performed by an independent, qualified Testing Company as approved by the. Retesting required as a result of failed tests shall be at the Contractor's expense.
- C. Codes and Standards: Perform earthwork complying with the requirements of Design Geotechnical Report.
- D. Testing and Inspection Service: The Developer will employ a qualified independent geotechnical engineering testing agency to classify proposed on-site and borrow soils to check that the soils are suitable for use as engineered fill and to perform required

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field and laboratory testing to check required compaction and moisture requirements. Samples of proposed engineered fill shall be provided to the geotechnical engineer at least 72 hours prior to its use. It shall not be used as fill or backfill until it is approved.

- E. Contractor shall submit laboratory certification that any manufactured material to be used complies with the requirements given in the specifications.
- F. The geotechnical engineer may request or collect samples of material to check conformance during construction.
- G. Contractor shall employ a surveyor to confirm dimensions, locations, and elevations.
- H. A corrosion consultant has been retained by the Developer or the Developer's Agent to evaluate the corrosivity of the soil and recommend appropriate mitigation measures.
- I. Earthwork shall be constructed within a vertical tolerance of +/-0.1 foot, unless otherwise shown. Grading shall be executed to maintain slopes and drainage as indicated. Variations within the specified tolerance shall be compensated so that the average grade and cross section specified are met.

1.8 PROJECT CONDITIONS

- A. The Contractor shall visit the site to determine if the existing conditions, nature of materials to be encountered, and all other facts concerning or affecting the work.
- B. The contractor should submit in writing, any questions or comments regarding discrepancy or constructability between the specs, the plans and existing conditions before bidding.
- C. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by the Owner and then only after acceptable temporary utility services have been provided.
 - 1. Provide a minimum 72-hours notice to the Owner and receive written notice to proceed before interrupting any utility.
- D. Any water and debris which would interfere with construction shall be removed from excavated areas. Excavations shall be free from loose material and water while forms are being set and concrete placed. During rainy weather, maintain excavations free of water by pumping and other appropriate means. Pumping from excavations shall be performed in such a manner as to preclude the possibility of any portion of the concrete being carried away. All water resulting from dewatering operations shall be disposed of in accordance with the requirements of the City and County of San Francisco and/or the San Francisco Bay Regional Water Quality Control Board.
- E. Throughout the entire construction period, keep dust down within the working area along roads used in the operations and all involved portions of site by intermittent

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watering and sprinkling. In accordance with Bay Area Air Quality Management District (BAAQMD) guidelines, unpaved access roads should be watered three times daily and other active construction areas twice daily. If necessary, all areas should be watered more frequently to prevent visible dust plumes from migrating outside of the development parcel.

- F. Contractor shall keep his work area clean, and in a safe and workmanlike condition so that rubbish, waste and debris do not interfere with the work of other trades.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Imported fill shall conform to Lightweight Cellular Concrete per Geotechnical recommendation and approved specification by SFPUC.

2.2 SOIL STERILANT

- A. Commercial chemical for weed control, registered by EPA. Provide granular, liquid or wet-able powder form.

PART 3 - EXECUTION

3.1 GENERAL

- A. Material Handling
 1. Strip and stockpile topsoil in accordance with Section 31 10 00.
 2. Excavated soil shall be stockpiled at a site within Mission Rock designated by the Developer's Agent.
 3. Material determined to be unsuitable material by the Developer's Agent shall be stockpiled separately from suitable material.
 4. At such time as earthwork (and trenching) operations are substantially complete and it is determined that there is excess suitable material, the excess suitable material shall be added to the stockpile of unsuitable material. The unsuitable material stockpile will then be tested by the Developer's Agent to determine the classification for off haul purposes. Once the stockpile is tested, no new material shall be added to, or removed from, the stockpile. If the suitable or unsuitable material is to remain on a Mission Rock parcel for more than 30 days, Contractor is required to cover the stockpile.
 5. Contractor shall be responsible for off-site disposal of all excess material and shall, for bidding purposes, assume all excess material to be Class II materials. Developer's Agent will direct the Contractor where the excess material is to be shipped/disposed based on the results of the testing conducted in (6). Contractor is responsible for preparing and managing any necessary shipping and disposal documents (bills of lading, non-hazardous waste manifests, hazardous waste manifests, weight tags from the landfill, etc.). All shipping and

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disposal documents are to be delivered to Developer or the Developer's Agent at the conclusion of shipping and disposal efforts.

6. Materials determined to be non-Class II materials shall be disposed of accordingly and changes in cost will be negotiated with the Contractor. Imported sand for the purpose of mixing with suitable materials will be excluded from the negotiated cost. The Contractor shall be responsible for the cost of disposal of any imported sand.

- B. Provide 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. Comply with Section 01 50 50, Erosion Control.

3.2 CONTROL OF WATER AND DEWATERING

- A. Comply with Section 31 23 19, Dewatering, if dewatering is necessary.
- B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding the site and surrounding area. Provide dewatering equipment necessary to drain and keep excavations and site free from water.
- C. Dewater during backfilling operation so that groundwater is maintained a least 1 foot below level of compaction effort.
- D. Obtain the Geotechnical Engineer's approval for proposed control of water and dewatering methods.
- E. Protect subgrades from softening, undermining, washout and damage by rain or water accumulation.
- F. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations.
- G. Maintain dewatering system in place until dewatering is no longer required.

3.3 WET WEATHER CONDITIONS

- A. Do not prepare subgrade, place or compact soil materials if subgrade or materials are above optimum moisture content.
- B. If the Geotechnical Engineer allows work to continue during wet weather conditions, conform to supplemental recommendations provided by the Geotechnical Engineer.

3.4 BRACING AND SHORING

- A. For all excavation greater than five (5) feet in depth, Contractor shall design, maintain and install sheeting, shoring and/or bracing, Sheeting, shoring and/or bracing plan

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shall be designed by a California Registered Engineer and installed per regulatory requirements of Cal/OSHA, California State Labor Code and CBC. Design shall take into account Project soils, seismic requirements and other constraints.

3.5 EXCAVATION

- A. Explosives: Do not use explosives.
- B. Unclassified Excavation: Excavation is unclassified and includes excavation to required sub grade elevations regardless of the character of materials and obstruction encountered.
- C. Soft or wet materials encountered at excavation subgrade shall be removed and replaced with lean concrete, engineered fill, crushed rock, stabilization material, or cement-treated soil, as approved by the Developer's Agent (Representative of Geotechnical Engineer) to provide non-yielding subgrade. In soft soil conditions, a stabilization reinforcement fabric may be placed as needed prior to placement of these materials. Where open-graded crushed rock or stabilization material is used, it shall be covered entirely by filter fabric.

3.6 GRADING

- A. Work to be performed shall be relative to finished grades shown on the Drawings. Earthwork beneath proposed paved areas is to be constructed to pavement subgrade (finished pavement surface grade minus the thickness of the proposed structural section).
- B. If site grading occurs when onsite soils are above the optimum moisture content, aeration, blending, or chemical treatment with lime and/or cement may be used to reduce the moisture content to within specified limits.

3.7 SUBGRADE PREPARATION

- A. Under pavements and walks, place subbase course material on prepared subgrades.
- B. Place base course material over subbases to pavements. Both the subbase and base materials shall be placed and compacted to a minimum 95 percent relative compaction as defined by ASTM D1557. Where sidewalk occurs over a planting trench, refer to Specification Section 32 11 00 for compaction requirements.

3.8 LOT FINISH GRADING

- A. Blade finish lots to lines and grades indicated on the Drawings.

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3.9 FILL PLACEMENT AND COMPACTION

The following compaction recommendations should be used for the placement and compaction of engineered fills:

- A. Relative compaction refers to in-place dry density of the fill material expressed as a percentage of the maximum dry density as determined by ASTM D-1557-91. Optimum moisture is the moisture content corresponding to the maximum dry density.
- B. Under city streets, from back of curb to back of curb, compact the subgrade soil within the upper 36 inches of finished roadway surface to 95 percent relative compaction.
- C. Under city sidewalks, which are not otherwise referred to as specialty sidewalks, compact fill to 90 percent relative compaction, compact the upper 6 inches of subgrade to minimum 95 percent relative compaction. Where sidewalk occurs over a planting trench, refer to Specification Section 32 11 00, Pavement Base Course for compaction requirements.
 - 1. Jetting shall not be permitted.
- D. Vibratory equipment shall not be used where shallow groundwater is present that when vibrated will adversely affect compaction efforts. The contractor shall repair any subgrade/fill damaged by the use of vibratory equipment at no cost to the Developer.
- E. Where lightweight fill material is used, cover lightweight fill material with stabilization reinforcement fabric. Stabilization reinforcement material fabric such as Mirafi 600X or approved equal shall also be placed between lightweight fill and aggregate base or aggregate subbase.
- F. Lightweight Fill Requirements:
 - 1. Lightweight fill (cellular concrete) shall be placed in lifts of less than 3 feet. Subsequent lifts shall be placed once the initial lift has cured as directed by the manufacturer.
- G. The subgrade beneath pavements and sidewalks shall be compacted to provide a smooth non-yielding surface. Subgrade shall be proof-rolled under the observation of the geotechnical engineer.

3.10 DISPOSAL

- A. Lawfully dispose of all unsuitable and excess or surplus material off-site at no cost to the Developer.

END OF SECTION

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SECTION 31 21 00

UTILITY TRENCHING AND BACKFILL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Excavation, bedding, and backfill for underground storm drain, sanitary sewer, and water piping, underground HVAC piping, electrical conduit, telephone conduit, gas piping, cable TV conduit, etc., and associated structures.
- B. Provide labor, material, equipment, and services necessary to complete the backfilling and compacting as necessary for this project. Section includes, but is not limited to:
 - 1. Select Backfill Material
 - 2. Aggregate Base
 - 3. Detectable Tape
 - 4. Trench Excavation
 - 5. Pipe Bedding
 - 6. Trench Backfill
 - 7. Trench Surfacing
- C. This section excludes drainage fill material and placement around subdrains.

1.2 RELATED SECTIONS

- A. Section 31 10 00 – Site Clearing
- B. Section 31 20 00 – Earthwork Moving
- C. Section 31 23 00 – Excavation and Fill
- D. Section 31 23 19 - Dewatering
- E. Section 33 10 00 – Water System
- F. Section 33 10 10 – Auxiliary Water Supply System
- G. Section 33 20 00 – Recycled Water System
- H. Section 33 30 00 – Sanitary Sewer System
- I. Section 33 34 00 – Sanitary Sewer Force Main

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1.3 RELATED DOCUMENTS

- A. Geotechnical Report: "Geotechnical Investigation Mission Rock Development Streets", Langan Engineering and Environmental Services, Inc (dated December 18, 2018)
- B. ASTM
 - 1. D1557, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.
 - 2. D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewer and Other Gravity-Flow Applications.
- C. California Administrative Code, Title 24, Part 2 - Basic Building Regulations, Chapter 24, Excavations, Foundations, and Retaining Walls.
- D. Caltrans Standard Specifications, 2015
 - 1. Section 19, Earthwork
 - 2. Section 26, Aggregate Bases
 - 3. Section 68, Subsurface Drains
 - 4. Section 96, Geosynthetics
- E. CAL/OSHA, Title 8

1.4 DEFINITIONS

- A. AC: Asphalt Concrete
- B. ASTM: American Society for Testing and Materials
- C. Base: The layer placed between the subgrade and surface pavement in a paving system.
- D. Bedding: Material from bottom of trench to bottom of pipe
- E. CDF: Controlled Density Fill
- F. DIP: Ductile Iron Pipe
- G. Engineered Fill:
 - 1. Soil or soil-rock material approved by the Developer and transported to the site by the Contractor in order to raise grades or to backfill excavations.
 - 2. Contractor shall provide sufficient tests, and a written statement that all materials brought onto the project site comply with specification requirements.
- H. Excavation: Consists of the removal of material encountered to subgrade elevations
- I. Initial Backfill: Material from bottom of pipe to 12 inches above top of pipe

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- J. LCC: Lightweight cellular concrete
- K. PCC: Portland Cement Concrete
- L. RCP: Reinforced Concrete Pipe
- M. Relative Compaction: In-place dry density of soil expressed as percentage of maximum dry density of same materials, as determined by laboratory test procedure ASTM D1557.
- N. Springline of Pipe: Imaginary line on surface of pipe at a vertical distance of $\frac{1}{2}$ the outside diameter measured from the top or bottom of the pipe.
- O. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below base.
- P. Subsequent Backfill: Material from 12 inches above top of pipe to subgrade of surface material or subgrade of surface facility or to finish grade.
- Q. Trench Excavation: Removal of material encountered above subgrade elevations and within horizontal trench dimensions.
 - 1. Authorized Trench Over-Excavation: Excavation below trench subgrade elevations or beyond indicated horizontal trench dimensions as shown on plans or authorized by the Geotechnical Engineer.
 - 2. Unauthorized Trench Over-Excavation: Excavation below trench subgrade elevations or beyond indicated horizontal trench dimensions without authorization by the Geotechnical Engineer. Unauthorized excavation shall be without additional compensation.
- R. Utility Structures:
 - 1. Storm drainage manholes, catch basins, drop inlets, curb inlets, vaults, etc.
 - 2. Sanitary sewer manholes, vaults, etc.
 - 3. Water vaults, etc.

1.5 SUBMITTALS

- A. Follow submittal procedures outlined in Section 01 10 00 – Supplemental General Requirements.
- B. Test Reports: Submit the following report for import material directly to the Developer from the Contractor's testing services:
 - 1. Compaction test reports for aggregate base.
- C. Samples:
 - 1. If required by the Geotechnical Engineer, provide 20-pound samples of all imported trench bedding and backfill material sealed in airtight containers, tagged with source locations and suppliers of each proposed material. Do not

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import materials to Project without written approval of the Geotechnical Engineer and the Developer.

2. Provide materials from same source throughout work. Change of source requires approval of the Geotechnical Engineer and the Developer.

1.6 QUALITY ASSURANCE

- A. Contractor shall verify shrinkage characteristics of all soils to be used on the site as engineered fill. The Developer will not be responsible for additional costs associated with variations in shrinkage or bulking factors and related earthwork quantities.
- B. Samples of proposed fill shall be provided to the Geotechnical Engineer at least 72 hours prior to its use. It shall not be used as fill or backfill until it is approved.
- C. All testing required by this Section and other Sections of these Specifications shall be performed by an independent, qualified Testing Company as approved by the Developer. Retesting required as a result of failed tests shall be at the Contractor's expense.
- D. Codes and Standards: Perform earthwork complying with requirements of Design Geotechnical Report: "Geotechnical Investigation Mission Rock Development Streets", Langan Engineering and Environmental Services, Inc (dated December 18, 2018).
- E. Testing and Inspection Service: The Developer will employ a qualified independent geotechnical engineering testing agency to classify proposed on-site and borrow soils to verify that soils comply with specified requirements and to perform required field and laboratory testing.
- F. Contractor shall employ surveyor to confirm dimensions, locations, and elevations.

1.7 PROJECT CONDITIONS

- A. The Contractor shall visit the site to determine if the existing conditions, nature of materials to be encountered, and all other facts concerning or affecting the work.
- B. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Port of San Francisco or others except when permitted in writing by the Owner and then only after acceptable temporary utility services have been provided.
- C. Provide a minimum 72-hours' notice to the Owner and receive written notice to proceed before interrupting any utility.
- D. Any water and debris, which would interfere with construction shall be removed from excavated areas. During rainy weather, maintain excavations free of water by pumping and other appropriate means. Excavations shall be free from loose material and free water while forms are being set and concrete is being placed. Pumping from excavations shall be performed in manner as to preclude the possibility of any portion

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of the concrete being carried away. All water resulting from dewatering operations shall be disposed of in accordance with the requirements of the City and County of San Francisco and/or the San Francisco Bay Regional Water Quality Control Board.

- E. Throughout the entire construction period, keep dust down within the working area along roads used in the operations and all involved portions of site by intermittent watering and sprinkling. In accordance with Bay Area Air Quality Management District (BAAQMD) guidelines, unpaved access roads should be watered three times daily and other active construction areas twice daily. If necessary, all areas should be watered more frequently to prevent visible dust plumes from migrating outside of the development parcel.
- F. Contractor shall keep his work area clean, and in a safe and workmanlike condition so that rubbish, waste and debris do not interfere with the work of other trades.

1.8 EXISTING UTILITIES

- A. Locate existing underground utilities in the areas of work. For utilities that are to remain in place, provide adequate means of protection during excavation operations.
 - 1. Locating of existing underground utilities shall include but not be limited to pot-holing prior to the start of construction.
- B. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult the Developer, utility agency, and owner immediately for directions.
 - 1. Cooperate with the Developer and public and private utility companies in keeping their respective services and facilities in operation.
 - 2. Repair damaged utilities to the satisfaction of the agency with jurisdiction.
- C. Do not interrupt existing utilities serving facilities occupied and used by the Owner or others, except when permitted in writing by the Owner, and then only after acceptable temporary utility services have been provided.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Import materials will be subject to approval of the Geotechnical Engineer.
- B. For approval of imported fill material, notify the Developer at least 7 days in advance of intention to import material.

2.2 PIPE BEDDING AND INITIAL BACKFILL

- A. Bedding and Cover Material: Where not specified in these specifications, bedding and cover material shall conform to SSDPWSF, Section 703 Trench Backfill of City Standard Specifications.
 - 1. Storm Drain and Sanitary Sewer Pipelines:

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- a. RCP: shall be an evenly graded mixture of crushed stone or crushed gravel with 100 percent passing a 1-inch sieve, 90 to 100 percent passing a $\frac{3}{4}$ inch sieve, and not more than 5% passing the No. 4 Sieve. Recycled Material shall not be allowed.
 - b. HDPE: shall be $\frac{3}{4}$ inch crushed stone or crushed gravel. Recycled Material shall not be allowed.
2. Low Pressure Water and Reclaimed Water Pipelines: shall consist of dune sand or equivalent, free from rock, concrete, organic material and other objectionable material and shall have 100% passing the $\frac{3}{8}$ " sieve, 93% to 100% passing the No. 4 sieve and 0% to 10% passing the No. 200 sieve.

2.3 SELECT BACKFILL

- A. Select backfill material shall be Class IV or greater LCC per Geotechnical recommendation and approved specification by SFPUC.

2.4 WARNING TAPE

- A. Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 6 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.
 1. Warning Tape Color Codes
 - a. Red: Electric
 - b. Yellow: Gas, Oil; Dangerous Materials
 - c. Orange: Telephone and Other Communications
 - d. Blue: Water Systems
 - e. Green: Sewer Systems
 - f. White: Steam Systems
 - g. Gray: Compressed Air
 2. Warning Tape for Metallic Piping: Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.
 3. Detectable Warning Tape for Non-Metallic Piping: Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase

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metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.5 DETECTION WIRE FOR NON-METALLIC PIPING

- A. Detection wire shall be insulated single strand, solid copper with a minimum of 12 AWG.

2.6 SUBSEQUENT BACKFILL

- A. Conform to on-site or imported backfill in Section 31 20 00, Earth Moving.

2.7 CONCRETE STRUCTURE BEDDING AND BACKFILL

- A. Precast Structures: Same materials to the same heights as specified for pipe bedding and backfill, or other material approved by the Geotechnical Engineer.
- B. Poured-in-Place Structures:
 - 1. Bedding: Bedding shall meet the approval of the Geotechnical Engineer. In general, bedding is not required, pour bases against undisturbed native earth in cut areas and against engineered fill compacted to 90% relative compaction in embankment areas.
 - 2. Side Backfill: On-site or imported fill meeting the requirements given in Section 31 20 00, Earth Moving.

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with the recommendations of the Geotechnical Engineer.
- B. Protect existing trees to remain. No grading is permitted under the drip line of protected trees.
- C. Excavations for appurtenant structures, such as, but not limited to, manholes, transition structures, junction structure, vaults, valve boxes, catch basins, thrust blocks, and boring pits, shall be deemed to be in the category of trench excavation.
- D. Unless otherwise indicated in the Plans, all excavation for pipelines shall be open cut.
- E. Prior to commencement of work, become thoroughly familiar with site conditions.
- F. In the event discrepancies are found, immediately notify the Developer in writing, indicating the nature and extent of differing conditions.
- G. Backfill excavations as promptly as work permits.

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- H. Do not place engineered fill or backfill until rubbish and deleterious materials have been removed and areas have been approved by the Developer or Developer's Representative.
- I. Place acceptable soil material in layers to required subgrade elevations, for each area classification listed below.
- J. In excavations, use satisfactory excavated or borrow material.
- K. Under grassed areas, use satisfactory excavated or borrow material.

3.2 SITE PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, which are to remain, from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Protect existing storm drainage system from silt and debris resulting from construction activities. If contamination occurs, remove contamination at no cost to the Developer.

3.3 EXISTING UTILITIES

- A. Identify the location of existing utilities.
 - 1. Prior to trenching, the Contractor shall excavate at locations specifically indicated on the Plans, if any, and where new lines cross other utilities of uncertain depth and determine the elevation of the utility in question to ensure that the new line will clear the potential obstruction.
 - 2. The Contractor shall contact Underground Service Alert (USA) at 1-800-227-2600 for assistance in locating existing utilities.
 - 3. If, after the excavation, a crossing utility does present an obstruction, then the line and grade of the new line will be adjusted as directed by the Developer to clear the utility.
- B. Protect all existing utilities that are to remain in operation.
- C. Movement of construction machinery and equipment over existing pipes and utilities during construction shall be at Contractor's risk.
- D. Excavation made with power-driven equipment is not permitted within 2 feet of any known utility or subsurface structure.
 - 1. Use hand or light equipment for excavating immediately adjacent to known utilities or for excavations exposing a utility or buried structure.
 - 2. Start hand or light equipment excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured.
 - 3. Support uncovered lines or other existing work affected by excavation until approval for backfill is obtained.

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4. Report damage of utility line or subsurface structures immediately to the Developer.
- E. Backfill trenches resulting from utility removal in lifts of 8 inches maximum.

3.4 TRENCH EXCAVATION

- A. All Trench Excavation shall be performed in accordance with Section 702 'Trench Excavation' of the City Standard Specifications, DPW Order No. 178,940, unless otherwise specified herein.
- B. In accordance with rules and regulations adopted by DPW, the trench length of all street openings shall not exceed the length of one block in any three-block section without special permission from the SFMTA. The amount of excavated trench in excess of pipe laid therein shall not exceed 200 linear feet at the end of each working day.
 1. The depth of the trench cited shall be from a point below the gutter grade. The gutter grade shall be defined as the existing gutter grade or six inches below the official grade (grade at top of curb as established by the San Francisco Board of Supervisors) whichever is lower. The section of trench above the gutter grade shall be included in the cost of the excavation per linear foot of trench and no additional payment will be allowed for that section of trench cut from the present ground surface to the gutter grade. Where the existing pavement elevation is below the gutter grade, the depth of the trench shall be measured from the existing pavement grade.
 2. The trench shall be excavated in a manner to avoid existing structures, property, and other obstructions encountered during the progress of the work. The Contractor shall support, protect, maintain, and provide for the safe operation and use of all such structures and property so encountered. Should the Contractor damage any structure or property during the progress of the work, he shall immediately notify the proper owners or authorities and shall arrange repair of the same at his expense.
- C. All excavations in Bay Mud shall be shored.
- D. When Bay Mud or soft, wet soil is encountered at the trench bottom, a stabilization reinforcement fabric shall be placed and overlain by at least 12 inches of stabilization material as needed to provide a non-yielding subgrade and covered entirely by filter fabric (Mirafi 140 NC), unless greater measures are specified in the plans or as directed by the Developer's Agent (Representative of Geotechnical Engineer).
- E. Explosives: Do not use explosives.
- F. Unclassified Excavation: Excavation is unclassified and includes excavation to required subgrade elevations regardless of the character of materials and obstructions encountered.

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- G. Comply with the geotechnical report, local codes, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations.
- H. Excavations shall be sloped, or supported and braced to prevent movement of the adjacent soil. Shoring and bracing systems shall be designed by a Civil Engineer registered in the State of California. Drawings and Calculations for shoring shall be submitted for review by the Developer's Agent.
- I. Submittals should include plans and calculations for a shoring system to be submitted for review and approval prior to trench excavation.

3.5 CONTROL OF WATER AND DEWATERING

- A. Contractor attention is directed to Section 31 23 19, Dewatering.
- B. Be solely responsible for dewatering trenches and excavations and subsequent control of ground and surface water. Provide and maintain such pumps or other equipment as may be necessary to control ground water and seepage to the satisfaction of the Geotechnical Engineer and the Developer until backfilling is completed.
- C. Dewater during backfilling operation so that groundwater is maintained a least one foot below level of compaction effort.
- D. Obtain the Geotechnical Engineer's approval for proposed control of water and dewatering methods.
- E. Reroute surface water runoff away from open trenches and excavations. Do not allow water to accumulate in trenches and excavations.
- F. Maintain dewatering system in place until dewatering is no longer required.

3.6 PIPE BEDDING

- A. Obtain approval of bedding material from the Geotechnical Engineer.
- B. Accurately shape bedding material to the line and grade called for on the Plans. Carefully place and compact bedding material to the elevation of the bottom of the pipe in layers not exceeding 8 inches in loose thickness. Compact bedding material at optimum water content to 90% relative compaction unless specified otherwise on the Plans or by the Geotechnical Engineer. Compact by pneumatic tampers or other mechanical means approved by the Geotechnical Engineer. Jetting or ponding of bedding material will not be permitted.
- C. Stabilization of Trench Bottom: When the trench bottom is unstable due to wet or spongy foundation, trench bottom shall be stabilized with gravel or crushed rock. The Geotechnical Engineer will determine the suitability of the trench bottom and the

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amount of gravel or crushed rock needed to stabilize a soft foundation. Soft material shall be removed and replaced with gravel or crushed rock as necessary.

- D. Placement of Bedding Material: The trench bottom shall be cleaned to remove all loose native material prior to placing select backfill material. Sufficient select backfill material shall be placed in trench and tamped to bring trench bottom up to grade of the bottom of pipe. The relative compaction of tamped material shall be not less than 90 percent. It is the intention of these requirements to provide uniform bearing under the full length of pipe to a minimum width of 60 percent of the external diameter.

3.7 BACKFILLING

- A. Initial Backfill:
1. Obtain approval of backfill material from Geotechnical Engineer.
 2. Bring initial backfill up simultaneously on both sides of the pipe, so as to prevent any displacement of the pipe from its true alignment. Carefully place and compact initial backfill material to an elevation of 12 inches above the top of the pipe in layers not exceeding 8 inches in loose thickness. Compact bedding material at optimum water content to 90% relative compaction unless specified otherwise on the Plans or by the Geotechnical Engineer. Compact by pneumatic tampers or other mechanical means approved by the Geotechnical Engineer. Jetting or ponding of initial backfill material will not be permitted.
- B. Pipe Detection: In trenches containing pressurized plastic pipes, tracer wire shall be placed directly above the pipe and shall be connected to all valves, existing exposed tracer wires, and other appurtenances as appropriate.
- C. Subsequent Backfill:
1. Above the level of initial backfill, the trench shall be backfilled with LCC per Geotechnical recommendation and approved specification by SFPUC..
 2. Bring subsequent backfill to subgrade or finish grade as indicated. Carefully place and compact subsequent backfill material to the proper elevation in layers not exceeding 8 inches in loose thickness. Compact bedding material at optimum water content to 90% relative compaction, except that the upper 36 inches in areas subject to vehicular traffic shall be compacted to at least 95% relative compaction, unless specified otherwise on the Plans or by the Geotechnical Engineer. Compact by pneumatic tampers or other mechanical means approved by the Geotechnical Engineer. Jetting or ponding of subsequent backfill material will not be permitted.
- D. Do not use compaction equipment or methods that produce horizontal or vertical earth pressures that may cause excessive pipe displacement or damage the pipe. Jetting of trench backfill is not permitted.
- E. Utility backfill shall be inspected and tested by the Geotechnical Engineer during placement. Cooperate with the Geotechnical Engineer and provide working space for

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such tests in operations. Backfill not compacted in accordance with these specifications shall be re-compacted or removed as necessary and replaced to meet the specified requirements, to the satisfaction of the Geotechnical Engineer and the Developer prior to proceeding with the Project.

- F. Compaction testing shall be in accordance with California Test Method ASTM D1556 or D1557.

3.8 CLEANUP

- A. Upon completion of utility earthwork all lines, manholes catch basins, inlets, water meter boxes and other structures shall be thoroughly cleaned of dirt, rubbish, debris and obstructions of any kind to the satisfaction of the Developer.

END OF SECTION

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SECTION 31 23 00

EXCAVATION AND FILL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section 31 23 00 includes specifications for placing cellular concrete lightweight embankment material to the lines, grades and dimensions shown.
- B. Cellular concrete is designated as Class I through Class VI as shown in the following table:

Cellular Concrete Class	Max Density pcf	Minimum Compressive Strength psi
I	24	10
II	30	40
III	36	80
IV	42	120
V	50	160
VI	80	300

1.2 SUBMITTALS

- A. Mix Design
 - 1. Submit a mix design that will produce a cast density at point of placement and a minimum compressive strength for the class described. Include laboratory data using the mix design verifying mass and strength requirements
- B. Work Plan
 - 1. Submit the work plan before placement of embankment material. The plan includes:
 - a. Proposed construction sequence and schedule
 - b. Type of equipment and tools to be used.
 - c. Material list of items and manufacturer's specifications

PART 2 - MATERIALS

2.1 ADMIXTURES

- A. Admixtures for accelerating the set time may be used under the manufacturer's recommendations. A foaming agent must be used and testing in accordance with ASTM C 796.

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2.2 WATER

- A. Mixing water shall be potable and free of deleterious amounts of acids, alkali, salts, oils, and organic materials which would adversely affect the setting or strength of the cellular concrete.

2.3 PORTLAND CEMENT

- A. Portland cement must comply with ASTM C 150, Types II, or VI. Pozzolans and other cementitious materials may be used when approved by the manufacturer of the foaming agent. Fly ash and natural pozzolans must comply with ASTM C 618. Ground granulated blast furnace slag must comply with ASTM C 989, grade 100 or 120.

2.4 PRIME COAT

- A. Prime coat must comply with section 93 or 94.

2.5 CONSTRUCTION

- A. Subgrade to receive embankment material must be free of all loose and extraneous material. Subgrade must be uniformly moist, and any excess water standing on the surface must be removed before placing embankment material.
- B. A minimum 12 hour curing period between lifts is required. If ambient temperatures are anticipated to be below 40 degrees F within 24 hours after placement, the mixing water must be heated when approved by the manufacturer of the foaming agent or placement must be prohibited. Placement must not be allowed on frozen ground.
- C. Cellular concrete must be job site batched, mixed with the foaming agent and placed with specialized equipment certified by the manufacturer of the cellular concrete lightweight material. Cement and water may be premixed and delivered to the job site and foaming agent added on site.
- D. At the point of placement, the density must comply with the specified cast density. A single cast density test must represent the lesser of 300 cy or 1 day's production.
- E. The compressive strength must be tested under ASTM C 485 except as follows:
 - 1. Unless otherwise approved, the specimens must be 3 x 6 inch cylinders. During molding, place the concrete in 2 equal layers and raise and drop the cylinders 1 inch, 3 times on a hard surface or lightly tap the side or bottom of the cylinder to close any accidental entrained air. No rodding is allowed.
 - 2. Specimens must be covered and protected immediately after casting to prevent damage and loss of moisture. Specimens must be moist cured in the molds for 7 days and air dry a minimum of 24 hours and maximum of 72 hours before the 28 day compressive strength test. Specimens must not be oven dried.

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3. Lift thickness must not exceed 3 feet. After curing for 12 hours, any crumbling area on the surface must be removed and scarified before the next layer is placed. Surface stepping to achieve grade and super elevation must not be less than 6 inches in thickness. Grades of up to 5 percent may be made by adding a thickening agent to the mix in conformance with the manufacturer's recommendation.

END OF SECTION

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SECTION 31 23 19

DEWATERING

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall provide all labor, materials, and equipment necessary to dewater trench and structure excavations, in accordance with the requirements of the Contract Documents. The Contractor shall secure all necessary permits to complete the requirements of this section. The Contractor shall refer to Section 01 50 50, Erosion Control, 31 20 00, Earth Moving, and 31 21 00, Utility Trenching and Backfill for other dewatering requirements.

1.2 RELATED SECTIONS

- A. Section 01 50 50, Erosion Control
- B. Section 31 20 00, Earth Moving
- C. Section 31 20 00, Utility Trenching and Backfill

1.3 CONTRACTOR SUBMITTALS

- A. Follow submittal procedure outlined in Section 01 10 00, Supplemental General Requirements.
- B. Prior to commencement of excavation, the Contractor shall submit a detailed plan and operation schedule for dewatering of excavations. The Contractor may be required to demonstrate the system proposed and to verify that adequate equipment, personnel and materials are provided to dewater the excavations at all locations and times. The Contractor's dewatering plan is subject to review by the Port of San Francisco's Representative.

1.4 QUALITY CONTROL

- A. If wells are used, obtain a drilling permit from the City of San Francisco (SFPUC).
- B. Obtain permit from the SFPUC and/or Regional Water Quality Control Board (RWQCB) for extracted groundwater discharge to the sewer system or percolation basin. Comply with all sampling, testing and analysis, discharge flow and daily volume requirements. No dewatering discharge to the storm sewer without review and approval by the SFPUC-WWE.

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- C. Perform Work in accordance with State, City, RWQCB, and the California Building Code Requirements.
- D. Maintain on copy of the permit document on-site.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Select dewatering equipment to meet specified performance requirements.
 - 1. The equipment shall include but not limited to: extraction pumps and backups, storage/surge tank, transfer pump, particulate/sediment filter housing and replacement filters, flow totalizer, miscellaneous hoses, fittings and connectors to hook up, operate and maintain the dewatering process.
- B. Flow Measurement: Furnish devices as follows:
 - 1. Install and monitor a flow totalizer for the discharged volume and rate of flow to the SFPUC sewer system.
 - 2. Monitor the flow rate and pressure within the particulate/sediment filter, replace filters as necessary to maintain a sediment free flow.
 - 3. Install and monitor the groundwater to maintain water free work conditions.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Valves and Fittings: Furnish valves, fittings and backflow prevention to isolate each extraction well from header pipe that discharges to the storage tank and to prevent loss of pump prime. Provide valves, fitting and backflow prevention devices for the discharging of extracted groundwater to the sewer system.
- B. Contact SFPUC not less than seven working days before any discharge of groundwater to the sanitary sewer.
 - 1. Conduct all groundwater discharge work, testing and analysis in accordance with SFPUC and/or RWQCB requirements and as specified in the permit.
- C. Provide necessary protection from any damage caused by dewatering operations in the event of a system failure.
- D. The system shall be designed to coexist with the excavation activities. The sidewalls of the excavations shall be shored. The dewatering system will be required to remove all groundwater from the planned excavations to enable the planned work to be completed.
- E. Install dewatering system in accordance with the approved dewatering system design.

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- F. Locate system components to allow continuous dewatering operations without interfering with the excavation Work and existing public rights-of-way, sidewalks and improvements.
- G. Install the dewatering system in accordance with State, SFPUC, and RWQCB standards and requirements.
- H. Contain all extracted groundwater in temporary storage tank(s) prior to discharge to the separated sewer.
- I. Control the flow rate of discharged groundwater to the sewer manhole, maintaining the particulate/sediment filter and monitoring the totalizer to record the flow rate and volume.
- J. Control and remove all unanticipated water seepage into excavation.
- K. All pumps, piping, hoses and storage tanks shall be correctly designed so that no releases of extracted groundwater will occur during the dewatering and construction activities.
- L. Operate dewatering system continuously until all structures are installed and until backfilling has progressed to a significant height to anchor the work against possible floatation or leakage. It is anticipated due to shallow groundwater that the dewatering activities will continue until all of the backfill has been placed.
- M. Provide supervision of dewatering system by personnel skilled in operation, maintenance, and replacement of system components.

END OF SECTION

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SECTION 32 01 90

LANDSCAPE MAINTENANCE

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. Work Included: Provide continuous Landscape Maintenance, complete as specified during progress of the work, after installation, and for a minimum period of 120 days after Preliminary Acceptance, and as required by warranty and Article 3.09, Termination of the Maintenance Period.
- B. Related Sections include:
 - 1. Section 329119 "Landscape Grading"
 - 2. Section 328000 "Irrigation"
 - 3. Section 329113 "Soil Preparation"
 - 4. Section 329000 "Planting"

1.3 SUBMITTALS

- A. Quality Control Submittals:
 - 1. Schedule of maintenance operations and monthly status report including list of equipment, materials proposed for the job.
 - 2. Licenses, permits and insurances required by City, County, State or Federal government pertaining to maintenance work.
 - 3. Monthly record of all herbicides, insecticides and disease control chemicals used for the project.
 - 4. Written application recommendation by a licensed agricultural pest control advisor for all weed, pest and disease controls restricted by the Director of Agriculture proposed for this work.
 - 5. Schedule of recommended annual fertilizer and soil conditioning program provided by Soils Testing Lab based on plant schedule.
- B. Project Close-out Submittal: Include in a single, 3-ring binder a landscape maintenance manual containing an indexed collection of all schedules, records and permits listed above, as well as a documentation of accepted condition of planting and irrigation at Final Acceptance.

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1.3 QUALITY ASSURANCE

A. Qualifications:

1. Experience: The landscape contractor or maintenance subcontractor shall have a full-time employee assigned to the job as foreman for the duration of the contract. He/she shall have a minimum of four (4) years experience in landscape maintenance supervision, with experience or training in turf management, entomology, pest control, soils, fertilizers and plant identification.
2. Labor Force: The landscape maintenance labor force shall be thoroughly familiar with, and trained in, the work to be accomplished and shall perform the task in a competent, efficient manner acceptable to the Owner.

B. Requirements:

1. Supervision: The foreman shall directly supervise the work force at all times. Notify Owner of all changes in supervision.
2. Identification: Provide proper identification at all times for landscape maintenance firm's vehicles and labor force. Be uniformly dressed in a manner satisfactory to the Owner.

1.4 PROJECT/SITE CONDITIONS

- A. Site Visit: At beginning of maintenance period, visit and walk the site with the Landscape Architect to clarify scope of work and understand existing project/site conditions.
- B. Documentation of Conditions: Document general condition of existing trees, shrubs, vines and groundcovers recording all plant materials which are healthy, thriving, damaged, dead or dying.
- C. Irrigation System: Document general condition of existing irrigation system, making sure that faulty electrical controllers, broken or inoperable sprinkler heads or emitters are reported.

1.5 SEQUENCING AND SCHEDULING

- A. Perform all maintenance during hours mutually agreed upon between Owner and Contractor.
- B. Work force shall be present at the project site at least once a week and as often as necessary to perform specified maintenance in accordance with the approved maintenance schedule.

PART 2 - PRODUCTS

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2.1 MATERIALS

- A. General: All materials and equipment, shall be provided by the Contractor, except as specified below.
- B. Water: Clean, potable and fresh, as available from Owner
- C. Fertilizers:
 - 1. Tightly-compressed, slow-release and long-lasting complete fertilizer tablets bearing manufacturer's label of guaranteed analysis of chemicals present.
 - 2. Balanced, once-a-season application, controlled-release fertilizers with a blend of coated pills which supply controlled-release nitrogen, phosphorus and potassium, and uncoated, rapidly soluble pills containing nitrogen and phosphorus.
- D. Herbicides, Insecticides, and Fungicides:
 - 1. Best quality materials with original manufacturers' containers, properly labeled with guaranteed analysis.
 - 2. Use non-staining materials.
- E. Perennials/groundcovers: Nursery-grown in 4 in. pots, full, healthy plants just ready to bloom.
- F. Replacement Tree Stakes and Ties: Match originally accepted existing materials on the site.

2.2 EQUIPMENT

- A. General: Use only the proper tool for each job. Maintain all tools in sharp, properly-functioning condition. Clean and sterilize pruning tools prior to usage.
- B. Insect/Disease Prevention: Take all acceptable measures to prevent introduction of insect or disease-laden materials onto the site.

PART 3 - EXECUTION

3.1 ESTABLISHING THE MAINTENANCE PERIOD

- A. Preliminary Review: As soon as planting is substantially completed per documents, hold a preliminary review to determine the condition of the work.

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- B. Date of Review: Notify Landscape Architect at least five (5) working days prior to anticipated date of review.
- C. Beginning of the Maintenance Period: The date on which the Landscape Architect issues a letter of Preliminary Acceptance to the Contractor.
- D. Ending of the Maintenance Period: The date on which the Landscape Architect issues a letter of Final Acceptance to the Contractor.

3.2 PREPARATION

- A. Protection:
 - 1. Protect all new planting areas from damage of all kinds from beginning of work until sufficiently established or until Final Acceptance.
 - 2. Provide temporary protection fences, barriers and signs as required for protection.
- B. Replacements:
 - 1. Immediately treat or replace all plants, which become damaged or injured as a result of Contractor's operations or negligence, as, directed by Landscape Architect, at no cost to Owner.
 - 2. Replacement plants shall match size, condition and variety of plants replaced.

3.3 PLANTING

- A. Watering Basins:
 - 1. For supplemental hand watering of watering basins, use a water wand to break the water force. Do not permit use of "jet" type watering equipment. Do not permit crown roots to become exposed to air through dislodging of soil and mulch.
 - 2. Maintain originally called for depth of mulch to reduce evaporation and frequency of watering.
 - 3. In rainy season, open basins to allow surface drainage away from the root crown where excess water may accumulate. Restore watering basins at end of rainy season.
- B. Resetting: Reset plants to proper grades and upright position.
- C. Weed Control:
 - 1. All areas between plants, including watering basins, shall be weed free at all times.
 - 2. Use only recommended and legally approved herbicides to control weed growth.

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3. Avoid frequent soil cultivation that destroys shallow roots and breaks the seal of pre-emergent herbicides.

D. Pruning:

1. Prune trees to select and develop permanent scaffold branches that are smaller in diameter than the trunk or branch to which they are attached, and which have vertical spacing of 18 in. to 48 in. and radial orientation so as not to overlay one another.
2. Prune trees to eliminate diseased or damaged growth, and narrow V-shaped branch forks that lack strength. Reduce toppling and wind damage by thinning out crowns.
3. Prune trees to maintain growth within space limitations, maintaining a natural appearance and balancing crown with roots.
4. No stripping of lower branches ("raising up") of young trees will be permitted.
5. Retain lower branches in a "tipped back" or pinched condition to promote caliper trunk growth (tapered trunk). Do not cut back to fewer than six buds or leaves on such branches. Only cut lower branches flush with the trunk after the tree is able to stand erect without staking or other support.
6. Thin out and shape evergreen trees when necessary to prevent wind and storm damage. Do primary pruning of deciduous trees during the dormant season. Do not permit any pruning of trees prone to excessive "bleeding" during growth season.
7. Prune damaged trees or those that constitute health or safety hazards at any time of year as required.
8. Make all cuts clean and close to the trunk, without cutting into the branch collar. "Stubbing" will not be permitted. Cut smaller branches flush with trunk or lateral branch. Make larger cuts (1 in. in diameter or larger) parallel to shoulder rings, with the top edge of the cut at the trunk or lateral branch.
9. Branches too heavy to handle shall be precut in three stages to prevent splitting or peeling of bark. Make the first two cuts 18 in. or more from the trunk to remove the branch. Make the third cut at the trunk to remove the resulting stub.
10. Do not prune or clip shrubs into balled or boxed forms unless specifically called for by design.
11. Take extreme care to avoid transmitting disease from one infected plant to another. Properly sterilize pruning tools before going from one infected plant to all other plants.
12. Pruning Season: Prune tree's during dormant season consistent with arboricultural standards for species to be pruned.

- E. Staking and Guying of Trees: Inspect stakes at least once a month to check for rubbing that causes bark wounds.

3.4 GROUNDCOVERS

A. Watering:

1. Check for moisture penetration throughout the root zone at least twice a month.

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2. Water as frequently as necessary to maintain healthy growth of groundcovers.
- B. Weed Control:
1. Control weeds, preferably with pre-emergent herbicides and with selective systemic herbicides.
 2. Minimize hoeing of weeds in order to avoid plant damage.
- C. Fertilization:
1. Verify specific plant requirements, if any.
 2. Recently installed plant materials: Verify with Owner actual completion date of planting installation and rate of prior application of fertilizers.
 3. New plant materials: Place one (1) 5-gram tablets (20-10-5; N-P-K) beside the root ball about an inch from root tips.
 4. Established Plant Materials: Do not use complete fertilizers unless soil test shows specific nutrient deficiencies.
- D. Edging:
1. Edge groundcovers to keep in bounds. Trim top growth as necessary to achieve an overall even appearance.
 2. Groundcovers, which lend themselves to mowing, shall be mowed to specified height above finished grade in order to renew growth, improve density and attractiveness.
- E. Replace dead and missing plants after obtaining Owner's agreement to pay for replacement. Damages due to Contractor's negligence shall be paid for without charge to Owner.

3.5 ANNUALS, PERENNIALS AND SUCCULENTS

- A. Watering:
1. Species, sizes of plants, container sizes and orientation shall dictate frequency of watering. Submit to Owner a watering schedule for different seasonal requirements.
- B. Weed Control: All planters with annuals and perennials shall be weed-free at all times.
- C. Pruning:
1. Limit pruning to removal of damaged or dead twigs and foliage.
 2. Remove spent flowers on a weekly basis.
- E. Fertilization: Incorporate slow release fertilizers per manufacturer's current specifications, and rake smooth.

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3.6 INSECTS, PESTS, AND DISEASE CONTROL

- A. Inspection: Inspect all plant materials for signs of stress, damage and potential trouble from the following:
 - 1. Presence of insects, moles, gophers, ground squirrels, snails and slugs in planting areas.
 - 2. Discolored or blotching leaves or needles.
 - 3. Unusually light green or yellowish green color inconsistent with normal green color of leaves.
- B. Personnel: Only licensed, qualified, trained personnel shall perform spraying for insect, pest and disease control
- C. Application: Spray with extreme care to avoid all hazards to any person or pet in the area or adjacent areas.

3.7 IRRIGATION SYSTEM

- A. General:
 - 1. Repair without additional charge to Owner all damages to system caused by Contractor's operations. Perform all repairs within one (1) watering period.
 - 2. Report promptly to Owner all accidental damage not resulting from Contractor's negligence or operations.
 - 3. Set and program automatic controllers for seasonal water requirements.
 - 4. Twice a month, use a probe or other acceptable tool to check the rootball moisture of representative plants as well as the surrounding soil.
- B. Cleaning and Monitoring the System:
 - 1. Continually monitor the irrigation systems to verify that they are functioning properly as designed. Make program adjustments required by changing field conditions.
 - 2. Clear irrigation systems once a year and as often as necessary to keep the irrigation systems free of sand and other debris.
 - 3. Prevent spraying on windows, building walls, (game courts) by balancing the throttle control on the remote control valves and the adjustment screws on the sprinkler heads. Do not allow water to atomize and drift.

3.8 TERMINATION OF THE MAINTENANCE PERIOD

- A. Final Acceptance Procedure:

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1. Work will be accepted by the Landscape Architect upon satisfactory completion of all work, including maintenance period, but exclusive of replacement of materials under the Warranty Period.
 2. Submit a written request to Landscape Architect for review for Final Acceptance at least five (5) working days prior to anticipated Final Review date, which is at the end of the Maintenance Period.
 3. Submit maintenance operations manual to Owner.
- B. Corrective Work:
1. Work requiring corrective action or replacement shall be performed within ten (10) calendar days after the Final Review.
 2. Perform corrective work and materials replacement in accordance with the Drawings and Specifications, and shall be made by the Contractor at no cost to the Owner.
 3. After corrective work is completed, the Contractor shall again request a Final Review for Final Acceptance as outlined above.
 4. Continue maintenance of all landscaped areas until such time as all corrective measures have been completed and accepted.
- C. Conditions for Acceptance of Work at End of Maintenance Period:
1. Each plant shall be alive and thriving, showing signs of growth and no signs of stress, disease, or any other weaknesses.
 2. Replace all plants not meeting these conditions. An additional Warranty Period equal in length to the original shall be commenced for all such plants and planted areas.
- D. Final Acceptance Date: The date on which the Landscape Architect issues a Letter of Final Acceptance. Upon Final Acceptance, the Owner will assume responsibility for maintenance of the work.

3.9 CLEANING

- A. Dispose of all pruned materials, clippings and leaves, sweep all walkways and rake smooth all mulched areas.
- B. Remove from the site all containers and evidence of maintenance activities.

3.10 CLOSE OUT

- A. Landscape Maintenance and Operations Manual: Submit binder to Owner with all documentation and records required and utilized during the maintenance period with recommended operations and maintenance procedures and schedules.

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- B. Keys and Identification: Return all keys and identification materials supplied by Owner for the purpose of site access.

END OF SECTION

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SECTION 32 11 00

PAVEMENT BASE COURSE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Aggregate subbase
- B. Aggregate base
- C. Lime stabilization

1.2 RELATED SECTIONS

- A. Section 01 10 00, Supplemental General Requirements
- B. Section 01 50 50, Erosion Control
- C. Section 31 20 00, Earth Moving

1.3 RELATED DOCUMENTS

- A. Geotechnical Report: "Geotechnical Investigation Mission Rock Development Streets", Langan Engineering and Environmental Services, Inc (dated December 18, 2018).
- B. ASTM:
 - 1. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort
 - 2. D3740, Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
 - 3. E329, Specification for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
 - 4. E548, Guide for General Criteria Used for Evaluating Laboratory Competence
- C. Caltrans Standard Specifications, 2015
 - 1. Section 24, Stabilized Soils
 - 2. Section 25, Aggregate Subbases
 - 3. Section 26, Aggregate Bases
 - 4. Section 27, Cement Treated Bases

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1.4 DEFINITIONS

- A. Geotechnical Testing Agency: An independent testing agency qualified according to ASTM E329 to conduct soil materials and rock definition testing, as documented according to ASTM D3740 and ASTM E548.
- B. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material $\frac{3}{4}$ cubic yards or more in volume that when tested by an independent geotechnical testing agency, according to ASTM D1586, exceeds a standard penetration resistance of 100 blows/2 inches.
- C. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man made stationary features constructed above or below grade.
- D. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, base or topsoil materials. Perform work in accordance with Section 31 20 00, Earth Moving.

1.5 SUBMITTALS

- A. Follow submittal procedure outlined in Section 01 10 00, Supplemental General Requirements.
- B. Submit material certificates signed by the material producer and the Contractor, certifying that that each material item complies with, or exceeds the specified requirements.

1.6 QUALITY ASSURANCE

- A. Conform all work and materials to the recommendations or requirements of the Geotechnical Report and meet the approval of the Geotechnical Engineer.
- B. Percentage of compaction specified shall be the minimum acceptable. The percentage represents the ratio of the dry density of the compacted material to the maximum dry density of the material as determined by the procedure set forth in ASTM D1557.
- C. Perform installation of base materials under the observation of the Geotechnical Engineer. Materials placed without approval of the Geotechnical Engineer will be presumed to be defective and, at the discretion of the Geotechnical Engineer, shall be removed and replaced at no cost to the Developer. Notify the Geotechnical Engineer at least 24 hours prior to commencement of base material installation and at least 48 hours prior to testing.
- D. Do not mix or place cement treated base when the temperature is below 36 degrees F or when the ground is frozen.

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- E. Finish surface of material to be stabilized prior to lime treatment shall be in accordance with Caltrans Standard Specification Section 24, Stabilized Soils.
- F. Finish surface of the stabilized material after lime treatment shall be in accordance with Caltrans Standard Specifications Section 24, Stabilized Soils.
- G. Finish surface of cement treated base shall be in accordance with Caltrans Standard Specification Section 27, Cement Treated Bases.
- H. Do not project the finish surface of aggregate subbase above the design subgrade.
- I. Finish grade tolerance at completion of base installation: +0.05 feet

1.7 PROJECT CONDITIONS

- A. Protect open excavations, trenches, and the like with fences, covers and railings to maintain safe pedestrian and vehicular traffic passage.
- B. Temporarily stockpile material in an orderly and safe manner and in a location approved by the Developer.
- C. Provide dust and noise control in accordance with Section 01 10 00, Supplemental General Requirements.

PART 2 - PRODUCTS

2.1 AGGREGATE SUBBASE

- A. Material: Class 2 in accordance with Caltrans Standard Specification Section 25, Aggregate Subbases.

2.2 AGGREGATE BASE

- A. Material: Class 2, 1½ inch or ¾ inch maximum in accordance with Caltrans Standard Specification Section 26, Aggregate Bases.

PART 3 - EXECUTION

3.1 GENERAL

- A. Placement and compaction of material by flooding, ponding, or jetting will not be permitted.

3.2 WET WEATHER CONDITIONS

- A. Do not place or compact subgrade if above optimum moisture content.

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- B. If the Geotechnical Engineer allows work to continue during wet weather conditions, conform to supplemental recommendations provided by the Geotechnical Engineer.

3.3 AGGREGATE SUBBASE

- A. Spreading and Compacting: In accordance with City of San Francisco Standard Specification Section 205.04, Spreading and 205.05, Compacting.

3.4 AGGREGATE BASE

- A. Watering, Spreading and Compacting: In accordance with City of San Francisco Specification Section 205.04, Spreading and 205.05, Compacting.

3.5 DISPOSAL

- A. Lawfully dispose of all unsuitable and excess or surplus material off-site at no cost to the Developer.

END OF SECTION

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SECTION 32 12 16

ASPHALT PAVING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Hot Mix Asphalt
- B. Tack coat
- C. Hot Mix Asphalt paving
- D. Hot Mix Asphalt overlay
- E. Speed bumps
- F. Asphalt curbs
- G. Pavement grinding
- H. Adjusting manholes, valves, monument covers and other structures to grade

1.2 RELATED SECTIONS

- A. Section 01 10 00, Supplemental General Requirements
- B. Section 31 20 00, Earth Moving
- C. Section 32 11 00, Pavement Base Course

1.3 RELATED DOCUMENTS

- A. Geotechnical Report: "Geotechnical Investigation Mission Rock Development Streets", Langan Engineering and Environmental Services, Inc (dated December 18, 2018).
- B. ASTM
 - 1. D979: Standard Practice for Sampling Bituminous Paving Mixtures
 - 2. D1188: Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples
 - 3. D2041: Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
 - 4. D2726: Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
 - 5. D2950: Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods

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- 6. D3549: Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens.
- C. Caltrans Standard Specifications, 2015
 - 1. Section 20: Landscape
 - 2. Section 39: Asphalt Concrete
 - 3. Section 88: Engineering Fabrics
 - 4. Section 92: Asphalt Binder
 - 5. Section 94: Asphaltic Emulsions
 - 6. Section 96: Geosynthetics

1.4 DEFINITIONS

- A. ASTM: American Society for Testing Materials.
- B. Caltrans: State of California, Department of Transportation

1.5 QUALITY ASSURANCE

- A. Testing Agency: Developer's Representative will engage a qualified independent testing agency to perform field inspections and tests and to prepare test reports.
 - 1. Testing agency will conduct and interpret tests and state in each report whether tested work complies with or deviates from specified requirements.
- B. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.
- C. Thickness of hot mix asphalt: In-place compacted thickness of asphalt courses will be determined according to ASTM D3549.
- D. Surface Smoothness: Finished surface of each asphalt course will be tested for compliance with smoothness tolerances.
- E. In-Place Density: Samples of uncompacted paving mixtures and compacted pavement will be secured by testing agency according to ASTM D979.
 - 1. Reference maximum theoretical density will be determined by averaging results from 4 samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D2041, and compacted according to job-mix specifications.
 - 2. In-place density of compacted pavement may be determined by testing core samples according to ASTM D1188 or ASTM D2726.
 - a. One core sample may be taken for every 1000 square yard or less of installed pavement, but in no case will fewer than 3 cores be taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D2950 and correlated with ASTM D1188 or ASTM D2726.

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1.6 SUBMITTALS

- A. Follow submittal procedure outlined in Section 01 10 00, Supplemental General Requirements.
- B. Job-Mix Designs: Certificates signed by manufacturers certifying that each hot mix asphalt mix complies with requirements.
- C. Material Certificates: Certificates signed by manufacturers certifying that each material complies with requirements.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Tack Coat: Minimum surface temperature of 60 F at application.
 - 2. Asphalt Base Course: Minimum surface temperature of 40 F and rising at application.
 - 3. Asphalt Surface Course: Minimum surface temperature of 60 F at application.

PART 2 - PRODUCTS

2.1 HOT MIX ASPHALT

- A. Type A In accordance with the City of San Francisco Standard Specifications Section 208.02, Asphalt.
- B. Hot Mix Asphalt Materials:
 - 1. Asphalt Binder: Grade PG 64-10 in accordance with Caltrans Standard Specification Section 92, Asphalt Binders.
 - 2. Tack Coat: Grade SS1 in accordance with Caltrans Standard Specification Section 94, Asphaltic Emulsions.
- C. Aggregates: 1 ½" inch or ¾ inch max gradation for virgin aggregate and recycled asphalt pavement (RAP) in accordance with the City of San Francisco Standard Specifications Section 205.02.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.
- B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.

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- C. If necessary, perform subgrade preparation or remediation in accordance with Section 31 20 00, Earth Moving.
- D. Notify The Developer in writing of any unsatisfactory conditions. Do not begin paving until these conditions have been satisfactorily corrected.
- E. Subgrade preparation in accordance with Geotechnical Report.

3.2 SURFACE PREPARATION FOR AGGREGATE BASE MATERIALS

- A. General: Immediately before placing asphalt materials remove loose and deleterious material from substrate surfaces and ensure that prepared subgrade is ready to receive paving in accordance with Caltrans Standard Specification Section 39-2.01C(3)(b) and in accordance with Section 32 11 00, Pavement Base Course.
- B. Tack Coat: Apply uniformly and at specified rates between HMA layers, to vertical surfaces of curbs, gutters and construction joints, and to existing pavement, including planed surfaces, in accordance with Caltrans Standard Specification Section 39-2.01C(3)(f).
 - 1. Allow tack coat to cure undisturbed before paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.3 HOT MIX ASPHALT SPREADING AND COMPACTING EQUIPMENT

- A. Provide spreading and compacting equipment in accordance with the City of San Francisco Standard Specifications Section 208.07.

3.4 HOT MIX ASPHALT PLACEMENT

- A. Place, spread and compact hot mix asphalt to required grade, cross section, and thickness in accordance with the City of San Francisco Standard Specifications Sections 208.07 and 208.08.
- B. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.5 JOINTS

- A. Construct joints to ensure continuous bond between adjoining paving sections in accordance with Caltrans Standard Specification Sections 39-2.01C(4)
 - 1. Construct joints free of depressions with same texture and smoothness as other sections of asphalt course.
 - 2. Clean contact surfaces and apply tack coat.
 - 3. Offset longitudinal joints in successive courses a minimum of 6 inches.
 - 4. Offset transverse joints in successive courses a minimum of 24 inches.

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5. Compact joints as soon as hot mix asphalt will bear roller weight without excessive displacement.

3.6 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact in accordance with the City of San Francisco Standard Specifications Section 208.08.
- B. Compaction Requirements: Compact subgrade and fill per Geotechnical Report.
- C. Finish Rolling: Finish roll paved surfaces to remove roller marks while asphalt is still warm.
- D. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while still hot, with back of rake or smooth iron. Compact thoroughly using tamper or other satisfactory method.
- E. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh asphalt. Compact by rolling to specified density and surface smoothness.
- F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.7 ADJUSTING MANHOLES, VALVES, MONUMENT COVERS AND OTHER STRUCTURES TO GRADE

- A. Remove pavement, using vertical cuts, as needed to remove frame and provide for concrete collar. Do not damage adjacent pavement.
 1. Circular Covers: Cut circle with radius 6 inches larger than cover and concentric with cover.
 2. Rectangular Covers: Cut rectangle 6 inches larger than cover on all sides.
- B. Install grade rings or blocking as needed to raise cover to finish grade.
- C. Pour concrete collar:
 1. Bottom of Collar: Top of existing collar or 6 inches below top of proposed collar, whichever is at a higher elevation.
 2. Top of Collar: Bottom of existing asphalt pavement.
 3. Apply tack coat to all exposed surfaces.
 4. Fill excavation with hot mix asphalt and, while still hot, compact flush with adjacent surface.

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3.8 INSTALLATION TOLERANCES

- A. Hot Mix Asphalt Pavement:
 - 1. Course thickness and surface smoothness shall be in accordance with Caltrans Standard Specification Section 39-2.01A(4)(i)(iii)
 - 2. Total Thickness: Not less than indicated.
- B. Trench Patch:
 - 1. Compacted surface: Within 0.01 foot of adjacent pavement.
 - 2. Do not create ponding.
- C. Adjust Covers:
 - 1. Compacted surface: Up to 0.01 foot higher, and no lower, than adjacent pavement.
 - 2. Do not create ponding.

END OF SECTION

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SECTION 32 13 13

CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section includes (but is not necessarily limited to) the furnishing of all materials and equipment and performing all operations necessary for the following, additional information for sidewalks and exposed roadway concrete can be found in Section 32 13 16.
 - 1. Curb/gutter and concrete base under asphalt/pavers.
 - 2. Furnishing, placing, spreading, compacting and shaping portland cement concrete pavement with undoweled transverse weakened plane joints, for vehicular traffic.
 - 3. Form construction and use in placing portland cement concrete pavement.
 - 4. Joints for portland cement concrete pavement.
 - 5. Finishing portland cement concrete pavement.
 - 6. Curing and protecting portland cement concrete pavement.

1.2 RELATED SECTIONS

- A. 01 10 00, Supplemental General Requirements
- B. 31 20 00, Earth Moving
- C. 32 11 00, Pavement Base Course
- D. 32 13 18, Cement and Concrete for Exterior Improvements
- E. 32 13 16, Exterior Landscape Concrete

1.3 RELATED DOCUMENTS

- A. Geotechnical Report: "Geotechnical Investigation Mission Rock Development Streets", Langan Engineering and Environmental Services, Inc (dated December 18, 2018).
- B. AASHTO Standard Specifications
 - 1. T132: Standard Method of Test for Tensile Strength of Hydraulic Cement Mortars
- C. ASTM Standards
 - 1. D36: Standard Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)

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2. A615: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 3. A706: Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
 4. A775: Standard Specification for Epoxy Coated Steel Reinforcing Bars.
 5. A934: Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
 6. A996: Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
 7. C94: Standard Specification for Ready-Mixed Concrete
 8. C603: Standard Test Method for Extrusion Rate and Application Life of Elastomeric Sealants
 9. C639: Standard Test Method for Rheological (Flow) Properties of Elastomeric Sealants
 10. C661: Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer
 11. C679: ASTM C679-15 Standard Test Method for Tack-Free Time of Elastomeric Sealants
 12. C719: Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)
 13. C793: Standard Test Method for Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants
 14. C881: Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
 15. D412: Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
 16. D1640: Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings
 17. D2628: Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
 18. D2835: Standard Specification for Lubricant for Installation of Preformed Compression Seals in Concrete Pavements.
 19. D3963: Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars.
 20. D6690: Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
- D. Caltrans Standard Specifications, 2015
1. Section 10, General
 2. Section 40, Concrete Pavement
 3. Section 52, Reinforcement
 4. Section 95, Epoxy
- E. Caltrans Standard Plans:
1. Plan P1: Jointed Plan Concrete Pavement – New Construction
 2. Plan P10: Concrete Pavement Dowel Bar Details

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1.4 DEFINITIONS

- A. AASHTO: American Association of State Highway and Transportation Officials
- B. ASTM: American Society for Testing and Materials
- C. Caltrans: State of California, Department of Transportation

1.5 QUALITY ASSURANCE

- A. Testing Agency: Developer's Representative will engage a qualified independent testing agency to perform field inspections and tests and to prepare test reports.
 - 1. Testing agency will conduct and interpret tests and state in each report whether tested work complies with or deviates from specified requirements.
- B. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.
- C. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C94 requirements for production facilities and equipment.
- D. Installer Qualification: An experienced installer who has completed pavement work 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.
- E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.

1.6 SUBMITTALS

- A. Follow submittal procedure outlined in Section 01 10 00, Supplemental General Requirements.
- B. Design Mixes: For each concrete pavement mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results or other circumstances warrant adjustments.
- C. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements.
 - 1. Cementitious materials and aggregates
 - 2. Steel reinforcement and reinforcement accessories
 - 3. Admixtures
 - 4. Curing compound
 - 5. Applied finish material
 - 6. Bonding agent or adhesive
 - 7. Joint filler
 - 8. Joint Sealant

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- 9. Tie Bars
- 10. Epoxy
- 11. Backer Rods

PART 2 - PRODUCTS

2.1 PORTLAND CEMENT CONCRETE

- A. In accordance with Section 32 13 18, Cement and Concrete for Exterior Improvements.

2.2 BASE MATERIAL

- A. In accordance with Section 32 11 00, Pavement Base Course.

2.3 TIE BARS

- A. Deformed reinforcing steel bars conforming to the requirements of ASTM Designation A615, Grade 40 or 60
- B. Epoxy-coat in accordance with Caltrans Standard Specification Section 52-2.02, Epoxy-Coated Reinforcement, except bars must comply with ASTM A706; ASTM A996; or ASTM A615, Grade 40 or 60.
- C. Do not bend tie bars.

2.4 EPOXY

- A. Bond tie bars to existing concrete with epoxy resin in accordance with Caltrans Standard Specification Section 95-1.02D, Epoxy Adhesive for Bonding Freshly Mixed Concrete to Hardened Concrete.

2.5 SILICONE JOINT SEALANT

- A. Furnish low modulus silicone joint sealant in a one-part silicone formulation. Do not use acid cure sealants. Compound to be compatible with the surface to which it is applied and conform to the following requirements:

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Specification	Test Method	Requirement
Tensile stress, 150% elongation, 7-day cure at 77° ± 1°F and 45% to 55% Relative Humidity	ASTM D412 (Die C)	45 psi max.
Flow at 77° ± 1°F	ASTM C639 ^a	Shall not flow from channel
Extrusion Rate at 77° ± 1°F	ASTM C603 ^b	75-250 g per min.
Specific Gravity	ASTM D792 Method A	1.01 to 1.51
Durometer Hardness, at 0°F, Shore A, cured 7 days at 77° ± 1°F	ASTM C661	10 to 25
Ozone and Ultraviolet Resistance, after 5000 hours	ASTM C793	No chalking, cracking or bond loss
Tack free at 77° ± 1°F and 45% to 55% Relative Humidity	ASTM C679	Less than 75 minutes
Elongation, 7 day cure at 77° ± 1°F and 45% to 55% Relative Humidity	ASTM D412 (Die C)	500 percent min.
Set to Touch, at 77° ± 1°F and 45% to 55% Relative Humidity	ASTM D1640	Less than 75 minutes
Shelf Life, from date of shipment	—	6 months min.
Bond, to concrete mortar-concrete briquets, air cured 7 days at 77° ± 1°F	AASHTO T132 ^c	50 psi min.
Movement Capability and Adhesion, 100% extension at 0°F after air cured 7 days at 77° ± 1°F, and followed by 7 days in water at 77° ± 1°F	ASTM C719 ^d	No adhesive or cohesive failure after 5 cycles

Notes:

- a. ASTM Designation: C639 Modified (15 percent slope channel A).
 - b. ASTM Designation: C603, through 1/8 inches opening at 50 psi.
 - c. Mold briquets in conformance with the requirements in AASHTO Designation: T132, sawed in half and bonded with a 1/16 inches maximum thickness of sealant and tested in conformance with the requirements in AASHTO Designation: T132. Briquets shall be dried to constant mass at 212 ± 10°F.
 - d. Movement Capability and Adhesion: Prepare 12 inch x 1 inch x 3 inch concrete blocks in conformance with the requirements in ASTM Designation: C719. A sawed face shall be used for bond surface. Seal 2 inch of block leaving 1/2 inches on each end of specimen unsealed. The depth of sealant shall be 3/8 inches and the width 1/2 inches.
- B. Formulate the silicon joint sealant to cure rapidly enough to prevent flow after application on grades of up to 15 percent.
- C. Furnish to the Developer's Representative a Certificate of Compliance. Accompany certificate with a certified test report of the results of the required tests performed on the sealant material within the previous 12 months prior to proposed use. Provide the certificate and accompanying test report for each lot of silicone joint sealant prior to use on the project.

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2.6 ASPHALT RUBBER JOINT SEALANT

- A. Conform to the requirements of ASTM Designation: D6690 as modified herein or to the following:
 - 1. Provide a mixture of paving asphalt and ground rubber. Ground rubber to be vulcanized or a combination of vulcanized and de-vulcanized materials ground so that 100 percent will pass a No. 08 sieve and contain not less than 22 percent ground rubber, by mass. Modifiers may be used to facilitate blending.
 - 2. The Ring and Ball softening point shall be 135°F minimum, when tested in conformance with the requirements in ASTM D36.
 - 3. Provide asphalt rubber sealant material capable of being melted and applied to cracks and joints at temperatures below 400°F.
- B. The penetration requirements of Section 4.2 of ASTM Designation: D6690 do not apply. The required penetration at 77°F, 5 oz, 5s, shall not exceed 120.
- C. The resilience requirements of Section 4.5 of ASTM Designation: D6690 do not apply. The required resilience, when tested at 77°F, shall have a minimum of 50 percent recovery.
- D. Accompany each lot of asphalt rubber joint sealant shipped to the job site, whether as specified herein or conforming to the requirements of ASTM Designation D6690, as modified herein, by a Certificate of Compliance, storage and heating instructions and precautionary instructions for use.
- E. Heat and place in conformance with the manufacturer's written instructions and the details shown on the Plans. Provide manufacturer's instructions to the Developer's Representative. Do not place when the pavement surface temperature is below 50 °F.

2.7 PREFORMED COMPRESSION JOINT SEALANT

- A. Material: ASTM Designation: D2628.
 - 1. Number of cells: 5 or 6.
 - 2. Lubricant Adhesive: ASTM Designation D2835.
 - 3. Install compression seals along with lubricant adhesive according to the manufacturer's recommendations. Submit manufacturer's recommendations to the Developer's Representative.
- B. Accompany each lot of compression seal and lubricant adhesive by a Certificate of Compliance, storage instructions and precautionary instructions for use. Also submit the manufacturer's data sheet with installation instructions and recommended model or type of preformed compression seal for the joint size and depth as shown on the Plans. Show evidence that the selected seal is being compressed at level between 20 and 50 percent at all times for the joint width and depth shown on the Plans.

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2.8 BACKER RODS

- A. Provide backer rods that have a diameter prior to placement at least 25 percent greater than the width of the saw cut after sawing and are expanded, crosslinked, closed-cell polyethylene foam that is compatible with the joint sealant so that no bond, adverse reaction occurs between the rod and sealant. In no case use a hot pour sealant that will melt the backer rod. Submit a manufacturer's data sheet verifying that the backer rod is compatible with the sealant to be used.

2.9 SLIP RESISTIVE AGGREGATE FINISH

- A. Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

PART 3 - EXECUTION

3.1 WATER SUPPLY

- A. Provide water supply in accordance with Caltrans Standard Specification Section 10-6, Watering.

3.2 SUBGRADE

- A. Prepare subgrade in accordance with Caltrans Standard Specification Section 40-1.03F, Placing Concrete.

3.3 SOIL STERILANT

- A. Furnish and apply to areas indicated in accordance with Section 31 20 00, Earth Moving.

3.4 PLACING

- A. Prepare concrete in accordance with Caltrans Standard Specification Section 40-1.03F, Placing Concrete.

3.5 SPREADING COMPACTING AND SHAPING

- A. Conform to the following:
 - 1. Stationary Side Form Construction: In accordance with Caltrans Standard Specification Section 40-1.03F(4), Stationary Side-Form Construction.
 - 2. Slip Form Construction: In accordance with Caltrans Standard Specification Section 40-1.03F(4), Slip Form Construction.

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3.6 INSTALLING TIE BARS

- A. Install at longitudinal contact joints, longitudinal weakened plane joints, and transverse contact joints as shown on the Plans. In no case, shall any consecutive width of new portland cement concrete pavement tied together with tie bars exceed 50 feet. In no case shall tie bars be used at a joint where portland cement concrete and asphalt concrete pavements abut.

- B. Tie bars shall be installed at longitudinal joints by one of the 3 following methods:
1. Drilling and bonding in conformance with the details shown on the Plans. Provide a two-component, epoxy-resin, conforming to the requirements of ASTM Designation: C881, Type V. Grade 3 (Non-Sagging), Class shall be as follows:

<u>Temperature of Concrete</u>	<u>Required Class of Epoxy Resin</u>
Lower than 40° F	A
40° F through 60° F	B
Above 60° F	C

2. Provide, at least 7 days prior to start of work, a Certificate of compliance and a copy of the manufacturer's recommended installation procedure. The drilled holes shall be cleaned in accordance with the epoxy manufacturer's instructions and shall be dry at the time of placing the epoxy and tie bars. Immediately after inserting the tie bars into the epoxy, the tie bars shall be supported as necessary to prevent movement during the curing and shall remain undisturbed until the epoxy has cured a minimum time as specified by the manufacturer. Tie bars that are improperly bonded, as determined by the Developer's Representative, will be rejected. If rejected, adjacent new holes shall be drilled, as directed by the Developer's Representative, and new tie bars shall be placed and securely bonded to the concrete. All work necessary to correct improperly bonded tie bars shall be performed at the Contractor's expense.
3. Insert the tie bars into the plastic slip-formed concrete before finishing the concrete. Inserted tie bars shall have full contact between the bar and the concrete. When tie bars are inserted through the pavement surface, the concrete over the tie bars shall be reworked and refinished to such an extent that there is no evidence on the surface of the completed pavement that there has been any insertion performed. Any loose tie bars shall be replaced by drilling and grouting into place with epoxy as described in method 1 above at the Contractor's expense.
4. By using threaded dowel splice couplers fabricated from deformed bar reinforcement material, free of external welding or machining. Threaded dowel splice couplers shall be accompanied by a Certificate of Compliance and installation instructions. Installation of threaded dowel splice couplers shall conform to the requirements of the manufacturer's recommendations.

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3.7 JOINTS

- A. Construct joints in accordance with Caltrans Standard Specification Section 40-1.03B, Joints, except that tie bars shall be as specified under Part 1, Materials.
 - 1. Construction Joints: In accordance with Caltrans Standard Specification Section 40-1.03B(2), Construction Joints.
 - a. Construct a construction joint at the end of each day's work, or where concrete placement is interrupted for more than 30 minutes, to coincide with the next weakened plane joint location.
 - b. If sufficient concrete has not been mixed to form a slab to match the next contraction joint, when an interruption occurs, the excess concrete shall be removed and disposed of back to the last preceding joint. The cost of removing and disposing of any excess concrete shall be at the Contractor's expense. Any excess material shall become the property of the Contractor and shall be properly disposed of.
 - c. A metal or wooden bulkhead (header) shall be used to form the joint. The bulkhead shall be designed to accommodate the installation of tie bars.
 - 2. Contraction Joints: In accordance with Caltrans Standard Specification Section 40-1.03B (3), Contraction Joints, except that the insert method of forming joints in pavement shall not be used.

3.8 FINISHING

- A. Finish concrete in accordance with Caltrans Standard Specification Section 40-1.03H, Finishing, and the City of San Francisco Standard Specification Sections 202.02 Finishing (Sidewalk C&G) and 201.06 Concrete Pavement.

3.9 CURING

- A. Cure concrete in accordance with Caltrans Standard Specification Section 40-1.03I, Curing.

3.10 SEALING JOINTS

- A. Liquid Joint Sealant Installation.
 - 1. The joint sealant detail for transverse and longitudinal joints, as shown on the Plans, shall apply only to weakened plane joints. Construct weakened plane joints by the sawing method. Should grinding or grooving be required over or adjacent to any joint after sealant has been placed, completely remove the joint material and disposed of, and replace at the Contractor's expense. Recess sealant below the final finished surface as shown on the Plans.
 - 2. At the Contractor's option, transverse weakened plane joints shall be either Type DSC or Type SSC as shown on the Plans. Longitudinal weakened plane joints shall be Type SSC only as shown on the Plans.

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3. Seven days after the concrete pavement placement and not more than 4 hours before placing backer rods and joint sealant materials, clean the joint walls by the dry sand blast method and other means as necessary to completely remove from the joint all objectionable material such as soil, asphalt, curing compound, paint and rust. After cleaning the joint, remove all traces of sand, dust and loose material from and near the joint for a distance along the pavement surfaces of at least 2 inch on each side of the joint by the use of a vacuum device. Remove surface moisture at the joints by means of compressed air or moderate hot compressed air or other means approved means. Do not use drying procedures that leave a residue or film on the joint wall. Sandblasting equipment shall have a maximum nozzle diameter size of $1/4 \pm 1/32$ inches and a minimum pressure of 90-psi.
 4. Install backer rod as shown on the Plans. Provide an expanded, closed-cell polyethylene foam backer rod that is compatible with the joint sealant so that no bond or adverse reaction occurs between the rod and sealant. Install backer rod when the temperature of the portland cement concrete pavement is above the dew point of the air and when the air temperature is 40°F or above. Install backer rod when the joints to be sealed have been properly patched, cleaned and dried. Do not use a method of placing backer rod that leave a residue or film on the joint walls.
 5. Immediately after placement of the backer rod, place the joint sealant in the clean, dry, prepared joints as shown on the Plans. Apply the joint sealant by a mechanical device with a nozzle shaped to fit inside the joint to introduce the sealant from inside the joint. Apply adequate pressure to the sealant to ensure that the sealant material is extruded evenly and that full continuous contact is made with the joint walls. After application of the sealant recess the surface of the sealant as shown on the Plans.
 6. Any failure of the joint material in either adhesion or cohesion of the material will be cause for rejection of the joint. Conform the finished surface of joint sealant to the dimensions and allowable tolerances shown on the Plans. Rejected joint materials or joint material whose finished surface does not conform to the dimensions shown on the Plans shall be repaired or replaced, at the Contractor's expense, with joint material that conforms to the requirements.
 7. After each joint is sealed, remove all surplus joint sealer on the pavement surface. Traffic shall not be permitted over the sealed joints until the sealant is tack free and set sufficiently to prevent embedment of roadway debris into the sealant.
- B. Preformed Compression Joint Seal Installation
1. The compression seal alternative joint detail for transverse and longitudinal joints, as shown on the Plans, shall apply only to weakened plane joints. Construct weakened plane joints by the sawing method. Should grinding or grooving be required over or adjacent to any joint after the compression seal has been placed, completely remove the joint materials and disposed of, and

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- replace at the Contractor's expense. Compression seal shall be recessed below the final finished surface as shown on the Plans.
2. At the Contractor's option, transverse weakened plane joints shall be either Type DSC or Type SSC as shown on the Plans. Longitudinal weakened plane joints shall be Type SSC only as shown on the Plans.
 3. Seven days after the concrete pavement placement and not more than 4 hours before placing preformed compression joint seals, clean the joint walls by the dry sand blast method and other means as necessary to completely remove from the joint all objectionable material such as soil, asphalt, curing compound, paint and rust. After cleaning the joint, remove all traces of sand, dust and loose material from and near the joint for a distance along the pavement surfaces of at least 50 mm on each side of the joint by the use of a vacuum device. Remove surface moisture at the joints by means of compressed air or moderate hot compressed air or other means. Do not use drying procedures that leave a residue or film on the joint wall. Sandblasting equipment shall have a maximum nozzle diameter size of $1/4 \pm 1/32$ inches and a minimum pressure of 90 psi.

3.11 PROTECTING CONCRETE PAVEMENT

- A. Protect pavement in accordance with Caltrans Standard Specification Section 40-1.03J Protecting Concrete Pavement.

END OF SECTION

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SECTION 32 13 18

CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Materials for portland cement concrete
- B. Aggregate and aggregate grading for portland cement concrete
- C. Water for portland cement concrete
- D. Admixtures for portland cement concrete
- E. Proportioning for portland cement concrete
- F. Mixing and transporting portland cement concrete
- G. Formwork for cast in place portland cement concrete
- H. Embedded materials for portland cement concrete
- I. Steel reinforcement for portland cement concrete
- J. Placing and finishing portland cement concrete
- K. Curing portland cement concrete
- L. Protecting portland cement concrete

1.2 RELATED SECTIONS

- A. Section 31 20 00, Earth Moving
- B. Section 32 12 16, Asphalt Paving
- C. Section 32 13 13, Concrete Pavement

1.3 RELATED DOCUMENTS

- A. Geotechnical Report: "Geotechnical Investigation Mission Rock Development Streets", Langan Engineering and Environmental Services, Inc (dated December 18, 2018).
- B. ASTM Standards

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1. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 2. A1064, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
 3. C94, Standard Specification for Ready-mixed Concrete
 4. C150, Standard Specification for Portland Cement
 5. C260, Standard Specification for Air-Entraining Admixtures for Concrete
 6. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 7. C494, Standard Specification for Chemical Admixtures for Concrete.
 8. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use in Portland Cement
 9. C1017, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
 10. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
 11. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
- C. Caltrans Standard Specifications, 2015
1. Section 51: Concrete Structures
 2. Section 73: Concrete Curbs and Sidewalks
 3. Section 90: Concrete

1.4 DEFINITIONS

- A. ASTM: American Society for Testing and Materials

1.5 SUBMITTALS

- A. Follow submittal procedures outlined in Section 01 10 00, Supplemental General Requirements.
- B. Concrete Mix Design: Have all concrete mixes designed by a testing laboratory and approved by the Consulting Engineer. Conform all mixes to the applicable building code requirement, regardless of other minimum requirements listed herein or on the Plans. Submit mix designs for review before use. Show proportions and specific gravities of cement, fine and coarse aggregate, and water and gradation of combined aggregates.
- C. Reinforcing Steel Shop-Drawings

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1.6 QUALITY ASSURANCE

- A. Concrete shall be subject to quality assurance in accordance with Section 90 of the Caltrans Standard Specifications.
 - 1. Slump tests: Have available, at job site, equipment required to perform slump tests. Make one slump test for each cylinder sample, from same concrete batch. Allowable maximum slump shall be 4 inches for walls and 3 inches for slabs on grade and other work.
- B. Certifications:
 - 1. Provide Developer's Representative at the time of delivery with certificates of compliance signed by both Contractor and Supplier containing the following statements:
 - a. Materials contained comply with the requirements of the Contract Documents in all respects.
 - b. Proportions and mixing comply with the design mix approved by the Consulting Engineer. Design mix shall have been field tested in accordance with the herein requirements of the Caltrans Standard Specifications and produces the required compressive strength under like conditions.
 - c. Statement of type and amount of any admixtures.
 - 2. Provide Owner's Representative, at time of delivery, with certified delivery ticket stating volume of concrete delivered and time of mixing, or time of load-out in case of transit mixers.

1.7 DESIGNATION

- A. General: Whenever the 28 day compressive strength is designated herein or on the Plans is 3,600 psi or greater, the concrete shall be considered to be designated by compressive strength. The 28 day compressive strength shown herein or on the Drawings which are less than 3,600 psi are shown for design information only and are not considered a requirement for acceptance of the concrete. Whenever the concrete is designated by class or as minor concrete herein or on the Plans, the concrete shall contain the cement per cubic yard shown in Section 90-2 of the Caltrans Standard Specifications.
- B. Unless specified otherwise herein or on the Plans, portland cement concrete for curbs, gutters, sidewalks and their appurtenances such as island paving, curb ramps and driveways, shall be minor concrete as specified in Section 73 of the Caltrans Standard Specifications.

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PART 2 - PRODUCTS

2.1 PORTLAND CEMENT

- A. General: Type II or Type V cement conforming to the requirements of ASTM C150. Contractor may substitute pozzolan for portland cement in amounts up to 15% of the required mix unless high early strength concrete is specified. Pozzolan shall consist of Class F Fly Ash meeting the requirements of ASTM C618.
- B. Color: Provide a coloring per City of San Francisco Standard Specification Section 204.01 General
 - 1. Lampback in dry form, in accordance with the requirements of ASTM "Standard Specifications for Lampback," designation D209, in proportion from $\frac{1}{2}$ to $\frac{3}{4}$ pound per cubic yard of concrete; or
 - 2. An approved liquid or semi-paste black colorant intended for use integrally in concrete mixes. The proportion required, generally from 10 to 40 ounces liquid measure per cubic yard of concrete, may be affected by the colorant used. Curing in this case shall be by the pigmented curing compound method.

2.2 AGGREGATE AND AGGREGATE GRADATION

- A. General: Fine and coarse aggregates shall be $\frac{3}{4}$ inch maximum size; clean and crushed aggregate free of materials which may cause staining. Aggregates shall conform to the requirements of section 90-1.02C of the Caltrans Standard Specifications.
- B. Aggregate Size and Gradation: Conform to the requirements of section 90-1.02C(4)(d) of the Caltrans Standard Specifications for 1 inch maximum combined aggregate.

2.3 WATER

- A. General: Water shall be clean, free from injurious amounts of oil, alkali, organic matter, or other deleterious material, and not detrimental to concrete per ASTM C94. Water shall conform to the requirements of section 90-1.02D of the Caltrans Standard Specifications, for mixing and curing portland cement concrete and for washing aggregates.

2.4 CHEMICAL ADMIXTURES

- A. Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious material. Admixtures shall conform to the requirements of section 90-1.02E of the Caltrans Standard Specifications and as noted herein or on the Plans.
 - 1. Air-Entraining Admixture: ASTM C260/C260M
 - 2. Water-Reducing Admixture: ASTM C494/C494M, Type A
 - 3. Retarding Admixture: ASTM C494/C494M, Type B

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4. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D
5. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F
6. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G
7. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II

2.5 CLASSIFICATION OF PORTLAND CEMENT CONCRETE

- A. Unless specified otherwise herein or on the Plans, portland cement concrete for the following items shall be designated as follows:
 1. Curbs, Gutters, and Sidewalks: Minor concrete.
 2. Cast in Place Concrete Pipe: The concrete shall consist of a minimum of 564 pounds of portland cement per cubic yard of concrete.
 3. Thrust Blocks: The concrete shall have a minimum compressive strength of 3,000 psi.
 4. Sign and Fence Footings: The concrete shall consist of a minimum of 376 pounds of portland cement per cubic yard of concrete.
 5. Water, Storm, and Sanitary Structures: The concrete shall consist of a minimum of 564 pounds of portland cement per cubic yard of concrete.

2.6 EXPANSION JOINT MATERIAL

- A. Material for expansion joints in portland cement concrete improvements shall be premolded expansion joint fillers conforming to the requirements of ASTM D1751. Expansion joint material shall be shaped to fit the cross section of the concrete prior to being placed. Suppliers certificates showing conformance with this specification shall be delivered with each shipment of materials delivered to the job site. Unless specified otherwise herein or on the Plans, expansion joint thickness shall be as follows:
 1. Concrete Slope Protection, Gutter Lining, Ditch Lining and Channel Lining: $\frac{1}{2}$ inch
 2. Structures: As indicated

2.7 REINFORCEMENT AND DOWELS

- A. Bar reinforcement for concrete improvements shall be deformed steel bars of the size or sizes called for on the Drawings conforming to the requirements of ASTM A615 for Grade 60 bars. Size and shape for bar reinforcement shall conform to the details shown or called for on the Plans. Substitution of wire mesh reinforcement for reinforcing bars will not be allowed.
- B. Slip dowels, where noted or called for on the Plans or detail drawings shall be smooth billet-steel bars as designated and conforming to the requirements of ASTM A615 for Grade 60 bars. Ends of bars inserted in new work shall be covered with a cardboard tube sealed with cork; no grease or oil shall be used.

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- C. Mesh for reinforcement for concrete improvements shall be cold drawn steel wire mesh of the size and spacing called for on the Drawings conforming to the requirements of ASTM A1064. Size and extent of mesh reinforcement shall conform to the details shown or called for on the Drawings.
- D. Tie wire for reinforcement shall be eighteen (18) gauge or heavier, black, annealed conforming to the requirements of ASTM A1064.
- E. Suppliers certificates showing conformance with this specification shall be delivered with each shipment of materials delivered to the job site.

2.8 CURING AND SEALING MATERIALS

- A. Curing Compounds:
 - 1. Concrete surface repellent-vertical and/or flatwork: Repello surface treatment, invisible chemical treatment barrier system.
 - 2. Curing and sealing-exterior: Colorcure concrete cureseal manufactured by L.M. Scofield Company or approved equal. Color-matched, water-based curing and sealing compound that complies with ASTM C309.
 - 3. See City of San Francisco Standard Specification Section 800.16 for further curing compound methods and requirements.

2.9 FORMS

- A. Conform to the requirements of Section 73-1.03C and Section 90-1.03B(5) of the Caltrans Standard Specifications.
- B. Tolerance: Not to deviate more than ¼ inch in 10 feet in grade and alignment.

2.10 PRECAST CONCRETE STRUCTURES

- A. Conform to the following Sections of Caltrans Standard Specifications:
 - 1. 51-7, Minor Structures
 - 2. 70-5.02, Flared End Sections

2.11 CONCRETE VEHICULAR PAVEMENT

- A. General: See Section 32 13 13, Concrete Pavement.

PART 3 - EXECUTION

3.1 STRUCTURAL EXCAVATION

- A. Structural excavation may be either by hand, or by machine and shall be neat to the line and dimension shown or called for on the Drawings. Excavation shall be sufficient width to provide adequate space for working therein, and comply with CAL-OSHA requirements.

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- B. Where an excavation has been constructed below the design grade, refill the excavation to the bottom of the excavation grade with approved material and compact in place to 95% of the maximum dry density as determined by ASTM D1557.
- C. Remove surplus excavation material remaining upon completion of the work from the job site, or condition it to optimum moisture content and compact it as fill or backfill on the site.

3.2 BRACING AND SHORING

- A. Conform to California and Federal OSHA requirements.
- B. Place and maintain such bracing and shoring as may be required to support the sides of the excavations for the proper protection of workmen; to facilitate the work; to prevent damage to the facility being constructed; and to prevent damage to adjacent structures or facilities. Remove all bracing and shoring upon completion of the work.
- C. Be solely responsible for all bracing and shoring and, if requested by the Developer's Representative, submit details and calculations to the Developer's Representative. The Developer's Representative may forward the submittal to the Consulting Engineer for their review. The Contractor's submittal shall include the basic design, assumed soils conditions and estimation of forces to be resisted, together with plans and specifications of the materials and methods to be used, and shall be prepared by a civil engineer or structural engineer registered in California. No excavations related to the proposed facility shall precede a response to the submittal by the Developer's Representative.
- D. Be solely responsible for installing and extracting the sheathing in a manner which will not disturb the position or operation of the facility being constructed or adjacent utilities and facilities.

3.3 PLACING CONCRETE FORMS

- A. Form concrete improvements with a smooth and true upper edge. Side of the form with a smooth finish shall be placed next to concrete. Construct forms rigid enough to withstand the pressure of the fresh concrete to be placed without any distortion.
- B. Thoroughly clean all forms prior to placement and coat forms with an approved form oil in sufficient quantity to prevent adherence of concrete prior to placing concrete.
- C. Carefully set forms to the alignment and grade established and conform to the required dimensions. Rigidly hold forms in place by stakes set at satisfactory intervals. Provide sufficient clamps, spreaders and braces to insure the rigidity of the forms.
- D. Provide forms for back and face of curbs, lip of gutters and edge of walks, valley gutters or other surface slabs that are equal to the full depth of the concrete as shown, noted

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or called for on the Plans. On curves and curb returns provide composite forms made from benders or thin planks of sufficient ply to ensure rigidity of the form.

3.4 PLACING STEEL REINFORCEMENT

- A. Bars shall be free of mortar, oil, dirt, excessive mill scale and scabby rust and other coatings of any character that would destroy or reduce the bond. All bending shall be done cold, to the shapes shown on the Drawings. The length of lapped splices shall be as follows:
 - 1. Reinforcing bars No. 8, or smaller, shall be lapped at least 45 bar diameters of the smaller bar joined, and reinforced bars Nos. 9, 10, and 11 shall be lapped at least 60 bar diameters of the smaller bars joined, except when otherwise shown on the Drawings.
 - 2. Splice locations shall be made as indicated on the Drawings.
- B. Accurately place reinforcement as shown on the Drawings and hold firmly and securely in position by wiring at intersections and splices, and by providing precast mortar blocks or ferrous metal chairs, spacers, metal hangers, supporting wires, and other approved devices of sufficient strength to resist crushing under applied loads. Provide supports and ties of such strength and density to permit walking on reinforcing without undue displacement.
- C. Place reinforcing to provide the following minimum concrete cover:
 - 1. Surfaces exposed to water: 4 inches.
 - 2. Surfaces poured against earth: 3 inches.
 - 3. Formed surfaces exposed to earth or weather: 2 inches.
 - 4. Slabs, walls, not exposed to weather or earth: 1 inch.
- D. Minimum spacing, center of parallel bars shall be two and one half ($2\frac{1}{2}$) times the diameter of the larger sized bar. Accurately tie reinforcing securely in place prior to pouring concrete. Placing of dowels or other reinforcing in the wet concrete is not permitted.

3.5 MIXING AND TRANSPORTING PORTLAND CEMENT CONCRETE

- A. Transit mix concrete in accordance with the requirements of ASTM Designation C94. Transit mix for not less than ten (10) minutes total, not less than three (3) minutes of which shall be on the site just prior to pouring. Mix continuous with no interruptions from the time the truck is filled until the time it is emptied. Place concrete within one hour of the time water is first added unless authorized otherwise by the Developer's Representative.
- B. Do not hand mix concrete for use in concrete structures.

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3.6 PLACING PORTLAND CEMENT CONCRETE

- A. Thoroughly wet subgrade when concrete is placed directly on soil. Remove all standing water prior to placing concrete.
- B. Do not place concrete until the subgrade and the forms have been approved.
- C. Convey concrete from mixer to final location as rapidly as possible by methods that prevent separation of the ingredients. Deposit concrete as nearly as possible in final position to avoid re-handling.
- D. Place and solidify concrete in forms without segregation by means of mechanical vibration or by other means as approved by the Developer's Representative. Continue vibration until the material is sufficiently consolidated and absent of all voids without causing segregation of material. The use of vibrators for extensive shifting of fresh concrete will not be permitted.
- E. Concrete in certain locations may be pumped into place upon prior approval by the Developer's Representative. When this procedure requires redesign of the mix, such redesign shall be submitted for approval in the same manner as herein specified for approval of design mixes.

3.7 PLACING ACCESSORY MATERIALS

- A. Place water stops and other items required to be embedded in of portland cement concrete structures at locations shown or required in accordance with Section 51-2.04 of the Caltrans Standard Specifications unless otherwise specifically noted or called for on the Plans.
- B. Curing Compounds:
 - 1. Regular Portland Cement Concrete: 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.

3.8 FORM REMOVAL

- A. Remove forms without damage to the concrete. Remove all shores and braces below the ground surface, before backfilling.
- B. Do not backfill against concrete until the concrete has developed sufficient strength to prevent damage.
- C. Leave forms for cast-in-place walls in place at least 72 hours after pouring.
- D. Leave edge forms in place at least 24 hours after pouring.

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3.9 FIELD QUALITY CONTROL

- A. Finish subgrade for concrete improvements shall be subject to approval prior to placement of forms.
- B. No concrete shall be placed prior to approval of forms.
- C. Concrete improvements constructed shall not contain "bird baths" or pond water and shall be smooth and ridge free.
- D. Conform the finish grade and cross section of concrete improvements to the design grades and cross sections.
- E. Variation of concrete improvements from design grade and cross section as shown or called for on the Drawings shall not exceed the tolerances ACI 117 and as follows:
 - 1. Elevation: $\frac{1}{4}$ inch.
 - 2. Thickness: Plus $\frac{3}{8}$ inch, minus $\frac{1}{4}$ inch.
 - 3. Surface: Gap below 10 foot long, unlevelled straightedge not to exceed $\frac{1}{4}$ inch.
 - 4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
 - 5. Vertical Alignment of Tie Bars and Dowels: $\frac{1}{4}$ inch.
 - 6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: $\frac{1}{2}$ inch.
 - 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel $\frac{1}{4}$ inch per 12 inches.
 - 8. Joint Spacing: 3 inches, unless otherwise indicated.
 - 9. Contraction Joint Depth: Plus $\frac{1}{4}$ inch, no minus.
 - 10. Joint Width: Plus $\frac{1}{8}$ inch, no minus.

3.10 RESTORATION OF EXISTING IMPROVEMENTS

- A. Replace in kind all pavement or other improvements removed or damaged due to the installation of concrete improvements.
- B. Remove, landscaping or plantings damaged or disturbed due to the installation of concrete improvements. Replace in kind.

END OF SECTION

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SECTION 32 13 75

CONCRETE CURBS AND GUTTERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Portland cement concrete curbs and gutters, sidewalk, curb ramps and driveways.

1.2 RELATED SECTIONS

- A. Section 31 20 00, Earth Moving
- B. Section 32 11 00, Pavement Base Course
- C. Section 32 13 13, Concrete Pavement
- D. Section 32 13 18, Cement and Concrete for Exterior Improvements

1.3 RELATED DOCUMENTS

- A. Geotechnical Report: "Geotechnical Investigation Mission Rock Development Streets", Langan Engineering and Environmental Services, Inc (dated December 18, 2018).
- B. American society for Testing and Materials (ASTM)
 - 1. A1064 – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
 - 2. D1751 – Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
- C. Caltrans Standard Specifications, 2015
 - 1. Section 51: Concrete Structures
 - 2. Section 72: Slope Protection
 - 3. Section 73: Concrete Curbs and Sidewalks
 - 4. Section 90: Concrete

1.4 DEFINITIONS

- A. ASTM: American Society for Testing Materials
- B. ACI: American Concrete Institute

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1.5 SUBMITTALS

- A. Submittal procedures shall be as outlined in Section 01 10 00 – Supplemental General Requirements.
- B. Concrete Mix Design: Have all concrete mixes designed by a testing laboratory and approved by the Developer. Conform all mixes to the applicable building code requirement, regardless of other minimum requirements listed herein or on the drawings. Submit mix designs for review before use. Show proportions and specific gravities of cement, fine and coarse aggregate, and water and gradation of combined aggregates.

1.6 QUALITY ASSURANCE

- A. Concrete shall be subject to quality assurance in accordance with Section 90 of the Caltrans Standard Specifications.
- B. Certifications:
 - 1. Provide the Developer at the time of delivery with certificates of compliance signed by both Contractor and Supplier containing the following statements:
 - a. Materials contained comply with the requirements of the Contract Documents in all respects.
 - b. Proportions and mixing comply with the design mix approved by the Consulting Engineer. Design mix shall have been field tested in accordance with the herein requirements of the Caltrans Standard Specifications and produces the required compressive strength under like conditions.
 - 2. Settlement of type and amount of any admixtures.
 - 3. Provide the Developer, at time of delivery, with certified delivery ticket stating volume of concrete delivered and time of mixing, or time of load-out in case of transit mixers.
- C. Conform to the applicable provisions of Sections 51, 73 and 90 of the Caltrans Standard Specification and these Technical Specifications.
 - 1. Conform construction of portland cement concrete surface improvements (including curbs, gutters, medians, valley gutters, walks) to the requirements of Section 73 of the Caltrans Standard Specifications unless otherwise required in these Technical Specifications or shown on the Drawings.
 - 2. Construct "V" ditches in accordance with Section 72-5 of the Caltrans Standard Specifications; except that finishing shall be in accordance with Standard Specification Section 73, or as otherwise required in these Technical Specifications or shown on the Drawings.

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1.7 DESIGNATION

- A. General: Whenever the 28 day compressive strength is designated herein or on the Drawings is 3,600 psi or greater, the concrete shall be considered to be designated by compressive strength. The 28 day compressive strength shown herein or on the Drawings which are less than 3,600 psi are shown for design information only and are not considered a requirement for acceptance of the concrete. Whenever the concrete is designated by class or as minor concrete herein or on the Drawings, the concrete shall contain the cement per cubic yard shown in Section 90-2 of the Caltrans Standard Specifications.
- B. Unless specified otherwise herein or on the Drawings, portland cement concrete for curbs, gutters, sidewalks and their appurtenances such as island paving, curb ramps and driveways, shall be minor concrete as specified in Section 90-2 of the Caltrans Standard Specifications.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Comply with requirements of Section 32 13 18, Cement and Concrete for Exterior Improvements.

2.2 PORTLAND CEMENT CONCRETE

- A. Unless specified otherwise herein or on the Drawings, portland cement concrete for items in this section shall be Minor Concrete as specified in Section 73 of the Caltrans Standard Specifications.
- B. Design mix to produce normal-weight concrete consisting of portland cement, aggregate, water-reducing or high-range water-reducing admixture (superplasticizer), air-entraining admixture, and water to produce the following properties:
 - 1. Compressive Strength:
 - a. Typical: 3000 psi, minimum at 28 days, unless otherwise indicated.
 - b. Curbs & Gutters: 3500 psi, minimum at 28 days.
 - 2. Slump Limit: 8 inches minimum for concrete containing high-range water-reducing admixture (superplasticizer, limited to flatwork only); 4 inches for other concrete.
 - 3. Water/Cement Ratio: 0.5

2.3 CURBS AND GUTTERS FORMS

- A. Use flexible spring-steel forms or laminated boards to form radius bends. Tolerance: Not to deviate more than 1/4 inch in 10 feet in grade and alignment.

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2.4 EXPANSION JOINT MATERIAL

- A. Material for expansion joints in portland cement concrete improvements shall be premolded expansion joint fillers conforming to the requirements of ASTM Designation D1751. Expansion joint material shall be shaped to fit the cross section of the concrete prior to being placed. Suppliers certificates showing conformance with this specification shall be delivered with each shipment of materials delivered to the job site.
- B. Unless noted otherwise herein or on the Drawings expansion joint thickness shall be as follows:
 - 1. Curbs, Curb Ramps, Island Paving, Driveways and Gutter Depressions: ¼ inch

2.5 REINFORCEMENT AND DOWELS

- A. Comply with requirements of Section 32 13 18, Cement and Concrete for Exterior Improvements.

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with requirements of Section 32 13 18, Cement and Concrete for Exterior Improvements.
- B. Form, place and finish concrete curbs, gutters, walkways, island paving, valley gutters and driveway approaches in conformance with the applicable requirements of Section 73 of the Caltrans Standard Specifications as modified herein.
- C. Construct new concrete curb, curb and gutter and valley gutters against existing asphalt concrete by removing a minimum of 12 inches of the asphalt concrete to allow placement of curb or gutter forms. Patch pavement with a 6 inch deep lift of asphalt concrete after gutter form is removed.

3.2 SUBGRADE

- A. Conform City of San Francisco Standard Specifications Section 204.02 Subgrade.

3.3 SOIL STERILANT

- A. Furnish and apply an oxidation granular preemergent soil sterilant to prepared subgrade or after installation of rock or aggregate base uniformly at the rate recommended by the manufacturer.

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3.4 PLACING CONCRETE FORMS

- A. Form concrete improvements with a smooth and true upper edge. Side of the form with a smooth finish shall be placed next to concrete. Construct forms rigid enough to withstand the pressure of the fresh concrete to be placed without any distortion.
- B. Thoroughly clean all forms prior to placement and coat forms with an approved form oil in sufficient quantity to prevent adherence of concrete prior to placing concrete.
- C. Carefully set forms to the alignment and grade established and conform to the required dimensions. Rigidly hold forms in place by stakes set at satisfactory intervals. Provide sufficient clamps, spreaders and braces to insure the rigidity of the forms.
- D. Provide forms for back and face of curbs, lip of gutters and edge of walks, valley gutters or other surface slabs that are equal to the full depth of the concrete as shown, noted or called for on the Drawings. On curves and curb returns provide composite forms made from benders or thin planks of sufficient ply to ensure rigidity of the form.

3.5 PLACING STEEL REINFORCEMENT

- A. Bars shall be free of mortar, oil, dirt, excessive mill scale and scabby rust and other coatings of any character that would destroy or reduce the bond. All bending shall be done cold, to the shapes shown on the Drawings. The length of lapped splices shall be as follows:
 - 1. Reinforcing bars No. 8, or smaller, shall be lapped at least 45 bar diameters of the smaller bar joined, and reinforced bars Nos. 9, 10, and 11 shall be lapped at least 60 bar diameters of the smaller bars joined, except when otherwise shown on the Drawings.
 - 2. Splice locations shall be made as indicated on the Drawings.
- B. Accurately place reinforcement as shown on the Drawings and hold firmly and securely in position by wiring at intersections and splices, and by providing precast mortar blocks or ferrous metal chairs, spacers, metal hangers, supporting wires, and other approved devices of sufficient strength to resist crushing under applied loads. Provide supports and ties of such strength and density to permit walking on reinforcing without undue displacement.
- C. Place reinforcing to provide the following minimum concrete cover:
 - 1. Surfaces exposed to water: 4 inches
 - 2. Surfaces poured against earth: 3 inches
 - 3. Formed surfaces exposed to earth or weather: 2 inches
 - 4. Slabs, walls, not exposed to weather or earth: 1 inch
- D. Minimum spacing, center of parallel bars shall be two and one half (2 ½) times the diameter of the larger sized bar. Accurately tie reinforcing securely in place prior to

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pouring concrete. Placing of dowels or other reinforcing in the wet concrete is not permitted.

3.6 PLACING PORTLAND CEMENT CONCRETE

- A. Thoroughly wet subgrade when concrete is placed directly on soil. Remove all standing water prior to placing concrete.
- B. Do not place concrete until the subgrade and the forms have been approved.
- C. Convey concrete from mixer to final location as rapidly as possible by methods that prevent separation of the ingredients. Deposit concrete as nearly as possible in final position to avoid re-handling.
- D. Place and solidify concrete in forms without segregation by means of mechanical vibration or by other means as approved by the Developer. Continue vibration until the material is sufficiently consolidated and absent of all voids without causing segregation of material. The use of vibrators for extensive shifting of fresh concrete will not be permitted.
- E. Concrete in certain locations may be pumped into place upon prior approval by the Developer. When this procedure requires redesign of the mix, such redesign shall be submitted for approval in the same manner as herein specified for approval of design mixes.

3.7 EXPANSION JOINTS

- A. Construct expansion joints incorporating premolded joint fillers at twenty (20) foot intervals in all concrete curbs, gutters, median/island paving, valley gutters, driveway approaches and at the ends of all returns. At each expansion joint install one-half inch by twelve inch smooth slip dowels in the positions shown or noted on the detail drawings.
- B. Orient slip dowels at right angles to the expansion joint and hold firmly in place during the construction process by means of appropriate chairs.
- C. See City of San Francisco Standard Specification Section 204.07 Joints for City requirements.

3.8 WEAKENED PLANE JOINTS

- A. Construct weakened plane joints in concrete curbs, gutters, median/island paving and valley gutters between expansion joints at ten (10) foot intervals throughout, or as otherwise indicated. Depth of joint score depth to be one-fourth (25%) the thickness of the concrete.

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- B. Orient slip dowels at right angles to the expansion joint and hold firmly in place during the construction process by means of appropriate chairs.
- C. Grooved Joints: Form weakened plane joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of weakened plane joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

3.9 FINISHING CONCRETE

- A. Finish curb and gutter in conformance with the applicable requirements of Section 73 of the Caltrans Standard Specifications as modified herein.
- B. Where monolithic curb, gutter and sidewalk is specified, separate concrete pours will not be allowed.
- C. Provide a broom finish to all horizontal surfaces perpendicular to the path of travel on surfaces used by pedestrians:
 - 1. Sloped Less than 6%: Provide a medium salt (medium broom) finish by drawing a soft bristle broom across concrete surface, perpendicular to line of traffic, to provide a uniform fine line texture.
 - 2. Surfaces Sloped Greater than 6%: Provide a slip resistant (heavy broom finish) by striating surface 1/16 inch to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.10 FORM REMOVAL

- A. Remove forms without damage to the concrete. Remove all shores and braces below the ground surface, before backfilling.
- B. Do not backfill against concrete until the concrete has developed sufficient strength to prevent damage.
- C. Leave edge forms in place at least 24 hours after pouring.

3.11 CONNECTING TO EXISTING CONCRETE IMPROVEMENTS

- A. New curb or gutter is to connect to existing improvements to remain by saw cutting to existing sound concrete at the nearest score line, expansion joint or control joint. Drill and insert ½ inch diameter by 12 inch long dowels at 24 inches on center into existing improvements. Install pre-molded expansion joint filler at the matching joint.
- B. A cold joint to the existing curb is not acceptable.

3.12 FIELD QUALITY CONTROL

- A. Conform the finish grade at top of curb, flow line of gutter, and the finish cross section of concrete improvements to the design grades and cross sections.

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- B. Variation of concrete improvements from design grade and cross section as shown or called for on the Drawings shall not exceed the tolerances established in Section 73 of the Caltrans Standard Specifications.

3.13 RESTORATION OF EXISTING IMPROVEMENTS

- A. Replace in kind all pavement or other improvements removed or damaged due to the installation of concrete improvements.
- B. Remove, landscaping or plantings damaged or disturbed due to the installation of concrete improvements. Replace in kind.

END OF SECTION

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CONCRETE UNIT PAVING

PART 1 CONCRETE UNIT PAVERS — 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. Precast concrete pavers.
- B. Related Sections:
 - Section 32 13 13: Concrete Paving
 - Section 05 50 00: Metal Fabrications

1.3 REFERENCES

- A. ASTM — ASTM International:
 - 1. C 33 - Specification for Concrete Aggregates
 - 2. C 39 - Concrete Compressive Strength
 - 3. C 150 - Specification for Portland Cement
 - 4. C170 – Test Method for Compressive Strength of Natural Building Stone
 - 5. C241 – Test
 - 6. C 642 - Water Absorption, Density, Voids in Hardened Concrete
 - 7. C 666 - Rapid Freeze/Thaw Resistance of Concrete
 - 8. C 979 - Pigments for Integrally Colored Concrete
 - 9. C 1028 - Coefficient of Friction
 - 10. C1242 – Guide for Design, Selection, and Installation of Exterior Dimension Stone Anchors and Anchoring Systems
 - 11. D 1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort

1.4 DEFINITIONS

- A. Acceptance, Acceptable, or Accepted: Acceptance by the Landscape Architect in writing.
- B. Excessive Compaction: Planting area soil or soil mix compaction greater than 75 percent of maximum dry density as determined by ASTM D 1557.

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- C. Landscape Architect: Landscape Architect employed by the Owner to provide professional landscape architectural services for the Project.

1.5 SUBMITTALS

- A. Product Data:
 - 1. Paving Units.
 - 2. Stabilized Joint Sand.
- B. Samples:
 - 1. Paving Units - Three full size pavers of each color, representing size, color, and finish.
 - 2. Joint Sand -1-pound plastic bag or approved substitute
- C. Test Reports: Setting Bed Material Sieve Analysis with Test Date less than 8 Weeks old.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Successfully installed unit paving similar to the quality specified and in the quantity shown for a period of not less than 5 years.
 - 2. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.
- B. Regulatory Requirements: Meet requirements of applicable laws, codes, and regulations required by authorities having jurisdiction over such Work.
- A. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution for each paver type and pattern.
 - 1. Construct a 10'x10' area minimum of all different unit pavers as directed by Owner's Representative. Include all unique conditions (curves, turns, joints, etc.)
 - 2. Include a 9" nominal size steel pipe to demonstrate cutting of pavers abutting hydrants and other round objects.
 - 3. Compact pavers on sand or bituminous setting bed, fill joints with stabilized joint sand, and wet.
 - 4. Construct as many samples as necessary to achieve an accepted mock-up.
 - 5. Mock-ups which are partially constructed or finished incorrectly will be rejected.
 - 6. Do not remove mock-ups from site until directed by Owner
 - 7. Place accepted mock-ups in a location where samples can be referenced.
 - 8. Accepted mock-up panels shall become the project standard for tolerances and appearance.

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- C. Pre-installation Meeting: Prior to commencement of paver installation, schedule and conduct an on-site meeting with the Landscape Architect and the paver and stabilized joint sand manufacturer's representatives.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Loading and Shipment:
 - 1. Carefully pack the unit pavers for shipment free from stains, saw mud, and other deleterious material.
 - 2. Exercise precautions against damage in transit.
- B. Storage:
 - 1. Store pavers on non-staining wood skids or pallets at least 4 inches above grade.
 - 2. Place and stack skids and unit pavers to distribute weight evenly and to prevent breakage or cracking of pavers.
 - 3. Store and protect unit pavers from weather and soiling with waterproof non-staining covers or enclosure, but allow air to circulate around unit pavers.
- C. Handling:
 - 1. Handle unit pavers to prevent chipping, breakage, soiling or other damage.
 - 2. Do not use pinch or wrecking bars without protecting edges of unit pavers with wood or other rigid materials.
 - 3. Do not use wire rope or ropes containing tar or other substances which might cause staining.

1.8 SITE CONDITIONS

- A. Environmental Requirements: Meet requirements of joint sand manufacturer's current printed instructions.
- B. Dust Nuisance: Assume full responsibility for alleviation or prevention of dust as a result of Work.

1.9 WARRANTY

- A. General Description: In addition to manufacturer's warranties, warrant Work for a period of one year from the date of Final Acceptance against defects in materials and workmanship.
- B. Additional Items Covered: Warranty shall also cover repair of damage to other materials and workmanship resulting from defects in materials and workmanship.
- C. Exceptions: Contractor shall not be held responsible for failures due to normal wear, neglect by Owner, vandalism, and other causes outside Contractors control.

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PART 2 — PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND SUPPLIERS

- A. Unit Pavers: Refer to Drawings.
- B. Modified Asphalt Mastic: Hanover Architectural Products or approved equal
- C. Joint Sand: Techniseal Inc.; Jeff Bal (909) 320-9088; Jeff.Bal@oldcastle.com
- D. Joint Spacers (if needed per details): Paverhelp.com, San Jose, CA; (408) 266-4176; www.paverhelp.com.
- E. Paver Retention Angle: galvanized steel, coat fresh cuts with brush-on cold galvanizing compound 95% zinc minimum.

2.2 MATERIALS

- A. Precast Concrete Unit Pavers: Refer to Drawings.
- B. Modified Asphalt Mastic: Hanover Paver Mastic
- C. Sand for Setting Bed: ASTM C 33, naturally occurring angular silica sand.
- D. Stabilized Joint Sand: Techniseal HP Polymeric Sand, Sierra Grey color.
- E. Water: Clean, potable.
- F. Joint Spacers: Paverhelp Mortarless Spacers, size as recommended by spacer manufacturer for joint width size and paver size.
- G. Paver Retention Angle: Galvanized steel, dimensions per drawings. Coat cut ends with brush-on cold galvanizing compound. Compound to have 95% Zinc content minimum.
- H. Bituminous Setting Bed
 - 1. Asphalt Cement:
 - a. Asphalt cement to be used in the bituminous setting bed shall conform to ASTM Designation D-946-69A with a penetration at 77 degrees F. 100G., 5 sec of minimum 85 millimeters and a maximum of 100 millimeters.
 - 2. Fine Aggregate:
 - a. It shall be clean, hard sand with durable particles and free from adherent coatings, lumps of clay, alkali salts and organic matters.
 - b. It shall be uniformly graded from "coarse" to "fine" and all passing the No. 4 sieve and meet with gradation requirements when tested in

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accordance with the standard method of test for sieve and screen analysis for fine and coarse aggregates ASTM Designation C-136-67.

3. Mixture:
 - a. The dried fine aggregates shall be combined with hot asphalt cement, and the mix shall be heated to approximately 300 degrees F. at asphalt plant.
 - b. The appropriate proportion of materials shall be seven (7) percent asphalt cement and ninety-three (93) percent sand by weight in the approximate ratio of 145 pounds asphalt to 1,855 pounds of sand. The contractor shall determine the exact proportions to produce the best possible mixture for construction of the bituminous setting bed to meet construction requirements.

PART 3— EXECUTION

3.1 EXAMINATION

- A. General: Examine site and verify that conditions are suitable to receive Work and that no defects or errors are present which would cause defective installation of products or cause latent defects in workmanship and function.
- B. Notification of Unsuitable Conditions: Before proceeding with Work, notify Owner in writing of unsuitable conditions.

3.2 PREPARATION

- A. Protection:
 1. Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, plant materials and walks on or adjacent to the site of the Work.
 2. Provide barricades, fences or other barriers as necessary to protect existing conditions to remain from damage during construction.
 3. Use every possible precaution to prevent excessive compaction of planting area soil or soil mixes within or adjacent to the areas of Work.
 4. Do not store materials or equipment, permit burning, or operate or park equipment under the branches of existing plants to remain.
 5. Submit written notification of damaged plants and structures to the Owner immediately.
- B. Surface Preparation: Remove plaster, cement powder, gravel and other materials from concrete subslab surface which conflict with the sand bed thickness and compaction.

3.3 PAVER INSTALLATION

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- A. SAND SET: Spreading Sand Setting Bed
1. Making allowances for compaction, screed un-compacted bedding sand to a consistent thickness which will bring the finish surface of the pavers to the elevations indicated on the Drawings.
 2. Check and verify effect of bed compaction in a sample panel to determine the screeded bed thickness.
 3. Do not use bedding sand for leveling.
 4. Maintain bedding in a loose condition and protected against pre-compaction both prior to and following screeding.
 5. Screed bedding slightly ahead of the laying of unit pavers.
 6. Under no circumstances shall the bedding be screeded in advance of the laying face to an extent to which paving will not be completed that day.
 7. Protect screeded bedding fully against accidental pre-compaction including compaction by rain or dew.
- B. BITUMINOUS SET: Placing of the Setting Bed
1. Install the setting bed directly over a prepared concrete sub-base. Place two screed rails at desired width to serve as guides for the striking board. The screed rails should be carefully set to ensure proper setting bed depth and finished paver grade. If necessary, adjustments can be made under the screed rails with wood chucks or shims; typical setting bed depth is 3/4". Place the bituminous material between the parallel screed rails. Position striking board perpendicularly over the screed rails and pull smooth. Repeat several times showering low porous spots with fresh bituminous material to yield a smooth, firm and even setting bed. As soon as this initial panel is completed advance the first bar to the next position in readiness for striking the next panel. Carefully fill any depressions that remain after removing the screed rails and wood chucks. The bed depth shall be adjusted to ensure the top surface of the placed pavers will be at the required finished grade.
 2. The setting bed shall be screeded and rolled with a power roller while hot, to a nominal 3/4" depth. The thickness of the bed shall be adjusted so that when the pavers are placed, the top surface of the paver will be at the required finished grade.
 3. Modified Asphalt Mastic
 - a. To be applied as a 1' band around the perimeter of the paver installation
 - b. Surface must be free of all foreign matter.
 - c. Apply as a skim coat to a 1/16" maximum with a straight edge trowel or squeegee. Allow mastic to flash off but not dry before embedding pavers.
 - d. This material may bleed or seep through block joints if the mastic is applied too heavily.
 - e. For best results, the temperature is recommended to be above 70°F, although mastic can be applied at any temperature. Cold Weather Application: Cold temperatures will increase the viscosity of the mastic.

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- f. Care must be taken in troweling the product to make sure a paper thin 1/16" skim coat is maintained. This may require the product be brought to a more ambient temperature, making the mastic more pliable.
 - g. At all costs, a 1/16" maximum thickness must be satisfied.
 - h. Install per manufacturer specifications
- C. Laying Paver Units:
 - 1. Place pavers on the un-compacted bedding to the specified laying pattern.
 - 2. Place pavers so that joints are aligned and installed in the pattern as shown on the Drawings.
 - 3. Install joint spacers at each paver corner to help maintain joint widths and paver alignments.
 - 4. Use string lines to hold pattern lines and elevations true.
 - 5. Lay rows of full units first.
 - 6. Cut off and fit closure units subsequently.
 - 7. Cut paver units with power diamond blade masonry saw where partial pavers abut straight surfaces. Install factory edge side of cut paver along paver retention angles, rectangular utility boxes, concrete collars, SFDPW concrete bands, curb ramps, etc. Install cut side of paver facing paver field.
 - 8. Cut radial paver edges with a diamond-blade masonry saw by kerfing and grinding, or other accepted method, where pavers abut round elements such as manholes, curvilinear utility lids, footings, etc to achieve smoothly curved edges parallel with the abutting surfaces with 1/4-inch wide joints.
 - 9. Do not allow other construction traffic on pavement during the paver installation until pavers have been compacted.
- D. Compaction of Pavers:
 - 1. Achieve consolidation of the sand bedding and bring paver surfaces to design levels by using beating block and rubber mallet.
 - 2. Continue beating and leveling until lippage has been eliminated and pavers are at proper elevations.
 - 3. Immediately remove and replace pavers which are damaged during installation.
- E. Filling Sand Joints:
 - 1. Install joint sand in accordance with the joint sand manufacturer's current printed instructions.
 - 2. Wet joint sand in accordance with the joint sand manufacturer's current printed instructions.
 - 3. After edge pavers are installed and there is a completed surface or before surface is exposed to rain.
 - 4. Before ending each day's work, fully compact installed concrete pavers to within 36 inches (900 mm) of the laying face. Cover pavers that have not been compacted, and leveling course on which pavers have not been placed, with nonstaining plastic sheets to protect them from rain.

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5. The resanding as necessary of paver joints shall be accomplished by contractor for a period of 90 days after completion of work.
 6. Sweep off excess sand when the job is complete
 - 7.
- F. The finish surface elevation of pavers shall be flush with adjacent concrete finish paving surfaces.
- G. Activation of Bonding
1. Carefully sweep entire pavement clean to remove sand mixture from the paver surfaces, including chamfered areas. Power brooms or blowers are recommended for large areas. Excess material remaining on surface after the mixture has been activated is difficult to remove.
 2. The paved area, including joints, should be saturated with water to activate Sandlock. Care must be taken to avoid washing sand from the joints. **DO NOT USE HIGH PRESSURE SPRAY FOR SATURATING SURFACE.** After flooding, surface area should be allowed to dry, prior to permitting traffic. Drying typically occurs within 2 to 6 hours, depending upon weather conditions.

3.4 TOLERANCES

- A. Paver Finished Surface: Do not permit finished paving surfaces to vary more than 1/8-inch measured with a 10-foot long metal straightedge, except at grade changes.
- B. Lippage Between Adjacent Pavers: 1/16-inch maximum.
- C. Sand Joints Indicated on Drawings as 1/8-inch Wide: 1/8-inch average; 1/16-inch minimum; 3/16-inch maximum.
- D. Sand Joints Indicated on Drawings as 1/16-inch Wide: 1/16-inch minimum, 1/8-inch maximum.

3.5 CLEANING

- A. Paving Units:
1. Clean stained or dirty paving units with clean water and stiff bristle brush.
 2. Remove and replace permanently stained pavers.
 3. Add additional sand to joints where cleaning has dislodged sand and re-wet joints.

3.6 PROTECTION

- A. Damage and Defacement: Protect paving units against damage and defacement during subsequent construction operations until date of Final Completion by covering paving with 3/4-inch thick exterior grade plywood where subject to traffic damage.

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END OF SECTION

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SECTION 32 14 45

STONE PAVERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: Perform all paving work and related items as indicated on the Drawings and/or as specified herein including, but not limited to the following:
 - 1. Dimension Stone Paving.
 - 2. Granite Cobble Paving.
 - 3. Splash Block Stone Units.
- B. Related Sections include:
 - 1. Section 03 30 10 "Cast-in-Place Concrete (Site)", for concrete sub-slabs at Dimension Stone Paving.
 - 2. Section 32 11 23 "Aggregate Base".
 - 3. Section 32 13 13 "Landscape Concrete Paving".
 - 4. Section 32 91 23 "Structural Soil", for granite cobble set over structural soil.

1.2 DEFINITIONS

- A. The following related items are included herein and shall mean:
 - 1. AASHTO: American Association of State Highway and Transportation Officials.
 - 2. NBGQA Standards: Recommended Standards of the National Building Stone Quarries Associations, Inc.

1.3 REFERENCES

- A. American Society of Testing and Materials (ASTM):
 - 1. ASTM C170 Test Method for Compressive Strength of Natural Building Stone.
 - 2. ASTM C241 Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic.
 - 3. ASTM C1242 Guide for Design, Selection, and Installation of Exterior Dimension Stone Anchors and Anchoring Systems.

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1.4 SUBMITTALS

A. Shop Drawings

1. Provide shop drawings for special details noting accommodation for reinforcement bars for concrete footings per details as required.
2. Clearly indicate adjacent work, provided by other trades.
3. Submit procedures for the repair and/or replacement of stones before and after installation.

B. Samples

1. Stone: Submit full size samples sets of dimension stone pavers and cobble stone pavers to indicate color and finish selections. Provide the number and size necessary to show full range of color, texture, finish, and kind and distribution of characteristic markings. Minimum submission: Two sets of three samples of 4" x 8" cobble stone and splash block stone, and three sets of three samples of dimension stone hex pavers. Each set shall show extremes and middle of the range of appearance variations of stone proposed for the project.

1.5 QUALITY ASSURANCE

- A. Subcontract fabrication stone paver work to a firm or firms which have successfully fabricated work of a similar quality and schedule requirements, and in the quantity shown, for a period of not less than 3 years.
- B. Coordination of Fabrication:
 1. Field check and confirm dimensions shown on Contract Drawings at the site by using surveying equipment as necessary or accurate field measurements before final submittal of shop drawings and before final fabrication of stone work. Coordinate installation tolerances to insure proper fit of final stone work.
- C. Construction Tolerances for Stone Work: This will apply to exposed surfaces of the work that is installed.
 1. Variation from Level: For grades shown and other conspicuous lines, do not exceed 1/8 inch for individual grades or 1/8 inch in 10 feet for level line.
- D. MOCK-UPS:
 1. Construct mock up paving panels as per Drawings to include dimension stone hex pavers and cobble paving. Construct at least one month before start of stone work.

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2. The mock up area will be used to determine joint sizes, lines, laying pattern(s), color(s), and texture of the job. This area shall be the standard from which the work will be judged.
3. Preserve mock- up until after the actual work has been accepted.
4. The quality of workmanship, joint treatment, and cleanliness of stone after installation must be approved by University's Representative before permanent paving is started. If the original sample is not approved, the Contractor shall provide additional samples, as required, at no cost to the Owner until an approved sample is obtained. The approved sample shall become the standard for paving for the entire job. Panel may be constructed on a location becoming part of the final pavement and shall remain undisturbed until all paving is completed unless authorized otherwise by University's Representative.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver stone pavers to the site in steel banded, plastic banded, or plastic wrapped cubes capable of transfer by fork lift or clamp lift. Unload pavers at job site in such a manner that no damage occurs to the product.
- B. Do not install stone when soil conditions are wet.

1.7 REPAIR AND REPLACEMENT

- A. The intent of this Section is to provide for the repair of defects in stone in such a way as to produce a structurally sound and aesthetically pleasing stone regardless of whether the defects are naturally existing in the stone or were produced or exacerbated during quarrying, fabrication, handling, or erection.
- B. Repair and replacement procedures must be approved in writing by the University's Representative before being used.
- C. At job site on arrival: Defects may be repaired, provided that the repaired material neither impairs the structural integrity nor degrades the aesthetic qualities of the stone. Repairable defects include cracks less than 0.010 inch in width and less than 12 inches in length or less than 1/2 the stone width, whichever is smaller. Stones with scratched or abraded surfaces or with breaks extending from edge to edge shall be replaced.

1.8 GUARANTEE

- A. All workmanship and materials shall be guaranteed for a period of not less than one year from the date of acceptance.

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PART 2 - PRODUCTS

2.1 GENERAL

A. General Requirements

1. Stone shall be sound stock of uniform texture; free from holes, seams, shakes, clay pockets, spalls, stains, starts, and other defects that impair strength or durability or appearance. It shall have required mechanical and physical properties. Appearance shall be within the range illustrated by each set of accepted samples.
2. Each type of stone shall be from a single quarry.
3. No substitutions accepted for color, product, finish and dimensions.
4. Physical Properties:
 - a. Bulk Density ASTM C97 182.6 pcf average.
 - b. Absorption Rate ASTM C97 0.12 percent average.
 - c. Modulus of Rupture ASTM C99 2,385 psi average.
 - d. Compressive Strength ASTM C170 29,000 psi average.
 - e. Coefficient of Friction ASTM C1028 not less than 0.5.

B. Stone

1. Dimension Stone Pavers (Textured Paving - P11):
 - a. Supplier: Lyngso Garden Materials Tel. 650.364.1730, www.lyngsogarden.com =
 - b. Color/Product: Brown Limestone.
 - c. Finish: Point Stalk Top (4pt), Sawn Edges
 - d. Sizes: As indicated on the Drawings.
2. Granite Cobble Paving:
 - a. Manufacturer: Cold Spring Granite Corp., 1977 Sage Ave., Corona, CA, Tel. (951) 549-9042. (Mission Bay Standard, no known equal).
 - b. Color /Product: 'Academy Black' Granite.
 - c. Finish: Split-4

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- d. Size: 4 inches x 4 inches x 3 inches thick.
- e. Joint Size: As shown in the Drawings.

2.2 AGGREGATE BASE

- A. Conform to requirements in Section 32 11 23 "Aggregate Base".

2.3 SETTING BED SAND FOR COBBLE PAVERS

- A. 100 percent washed plaster or concrete sand.
- B. Chemical Properties:
 - 1. Salinity: The saturation extract conductivity shall not exceed 3.0 millimhos/cm at 2.25 degrees C.
 - 2. Boron: The concentration in the saturation extract shall not exceed 1.0 ppm.
 - 3. Sodium: The sodium absorption ration (SAR) as calculated from analysis of saturation extract shall not exceed 6.0.

2.4 SETTING BED MORTAR FOR DIMENSION STONE PAVERS – WET AND DRY LOCATIONS

- A. Mortar: non-staining, cement/lime mortar, complying with ASTM C270, using specified materials. Mortar shall be Type S. Color of mortar shall match stone and be approved by the Landscape Architect.
- B. Cement: Provide white cement as follows:
- C. Portland cement: ASTM C 150, complying with the staining requirements of ASTM C 91 for not more than 0.03% water soluble alkali. Furnish Type 1, except Type III may be used for setting stonework in cold weather.
- D. Masonry cement: ASTM C 91, non-staining.
- E. Hydrated lime: ASTM C 207, Type S.
- F. Sand: ASTM C 144, clean, sharp, washed mason's sand. Sand must be dry or free-flowing so that its use with the latex emulsion will not produce a very wet, unstable material.

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- G. Mortar setting and spots: Mason sand conforming to ASTM C 144 for mortar bed and ASTM C 33 concrete sand bagged 30-60 mesh silica for slurry bond coat.
- H. Coloring Agent: Non-fading, lime proof, carbon black or mineral oxide.
- I. Water: Clean, potable, and free from injurious amounts of acids, alkalis, organic materials or other harmful substances.
- J. Liquid admixture for setting bed and joints: Liquid latex mortar additive with a compression strength of 4000 psi, bond strength of 500 psi, and a water absorption of 4% maximum. Subject to compliance with requirements, provide Laticrete 3701, manufactured by Laticrete International, Inc., or approved equal. Admixture to be styrene-butadiene; polyvinyl acetate is not to be substituted.
- K. Bond coat mortar admixture: High strength liquid latex mortar additive with a compressive strength of 5000 psi, bond strength of 500 psi, tensile strength of 500 psi, and water absorption of 4% maximum. Subject to compliance with requirements, provide Laticrete 4237, manufactured by Laticrete International, Inc., or approved equal.

2.5 GROUT MATERIALS FOR DIMENSION STONE PAVING

- A. Latex-Portland Cement Grout: ANSI A118.6, Composition as follows:
- B. Prepackaged dry mortar mix composed of Portland cement, graded aggregate, and ethylene vinyl acetate in the form of a re-emulsifiable powder to which only water is added at job site.
- C. Latex additive (water emulsion) serving as replacement for part or all of gauging water, combined at job site with dry grout mixture, with latex and dry grout mixture as follows:
 - 1. Latex Additive: Styrene butadiene rubber.
 - 2. Latex Additive: Acrylic resin.
 - 3. Dry Grout Mixture: Commercial Portland cement grout complying with ANSI A118.6 and specified or supplied by latex manufacturer, in color indicated.
- D. Dry Grout Mixture: Dry-set grout complying with ANSI A118.6 and specified or supplied by latex manufacturer, in color indicated. Use latex additive without retarder with dry-set grout.
- E. Portland Cement: ASTM C 150, Type I or II, of natural color or white as required to produce color indicated.
- F. Aggregate: ASTM C 144, graded to comply with latex additive manufacturer's requirements.

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- G. White Aggregate: Natural white sand or ground white stone.
- H. Colored Aggregate: ground marble, granite, or other sound stone; selected as required to produce mortar color matching the Owner's Authorized Agent's sample.
- I. Colored Mortar Pigments for Grout: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar and grout mixes. Use only pigments that have proven through testing and experience to be satisfactory for use in Portland cement grout.
- J. Water: Clean, free of materials detrimental to strength or bond of grout.

2.6 MORTAR AND GROUT MIXES FOR DIMENSION STONE PAVERS

- A. General: Mix mortars and grouts to comply with latex additive manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, pot life and other procedures needed to produce mortar and grout of uniform quality and with optimum performance characteristics.
 - 1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, anti-freeze compounds, or other admixtures, unless otherwise indicated. Do not use calcium chloride.
- B. Latex additives: Adjust liquid quantity for proper consistency per manufacturer's written recommendations; do not add water unless specifically recommended by additive manufacturer. Setting mortar shall be of the following proportions:
 - 1. One part Portland Cement
 - 2. Three cubic feet of coarse aggregate sand
 - 3. 5 gallon latex additive. Adjust quantity of liquid to obtain proper consistency.

2.7 JOINT FILLER FOR COBBLE PAVERS

- A. Polymeric Sand: Super Sand, as manufactured by Alliance Designer Products, Inc. www.supersandbond.com, or equal, no known equal (Mission Bay Standard Specifications).
 - 1. Color: Gray.

2.8 GEOTEXTILE FABRIC

- A. Mirafi 140NC, as manufactured by Mirafi, Inc., Pendergrass, GA (706) 693-2226, or equal, no known equal (Mission Bay Standard Specification).

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PART 3 – EXECUTION

3.1 GENERAL

A. Preparation

1. Protect stone during storage and construction against moisture, soiling, staining, and physical damage.
2. Before commencing work, thoroughly clean surfaces to be covered with stone of all dust, dirt, and foreign matter.
3. Beginning of mortar bed and paver installation means acceptance of subgrade and base preparation.
4. Contractor shall examine the concrete base to determine its adequacy to receive stone pavers. Evidence of inadequate base shall be brought to the immediate attention of the University's Representative.

3.2 AGGREGATE BASE

- #### **A. Install as specified in Section 32 11 23 "Aggregate Base".**

3.3 GEOTEXTILE INSTALLATION

- #### **A. Lay Fabric smooth, and free of tension, stress, folds, wrinkles or creases. Do not allow traffic on unprotected fabric.**
- #### **B. Provide at least 18 inches of overlap at each joint.**

3.4 SAND SETTING BED INSTALLATION FOR COBBLE PAVERS

- #### **A. Place control bars directly over the geotextile fabric to bring pavers, when set, to proper grade. Thickness of the finished setting bed shall be no more than one inch and no less than 1/2 inch.**
- #### **B. Roll setting bed with a power roller to a nominal depth of 3/4 inch. Do not exceed one inch depth.**
- #### **C. Adjust bed thickness so that when pavers are placed. The top surface of the cobbles shall be at the required finish grade after placement.**

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3.5 STONE PAVER AND COBBLE PLACEMENT

- A. Prior to installation of cobbles at tree wells, trees should be watered-in and given time to settle to final grade.
- B. Place stone pavers and cobbles true to grade and uniform in slope. Set as shown in the Drawings with uniform spacing and minimum joints of 1/8 inch in accordance with the Drawings.
- C. Place each paver with finish face upward, onto the setting bed and rap or beat with a small beating block or rawhide mallet to a full and solid bearing.
- D. Equalize bed and joint openings to eliminate need for redressing of exposed surfaces. Do not disturb pavers in areas where pavers are already set for purposes of realigning finished surfaces or adjusting joints.
- E. Install edge restraints in accordance with Manufacturer's written instructions and as indicated on Drawings.

3.6 JOINT FILLER FOR COBBLE PAVERS

- A. Install in accordance with manufacturer's written instructions.
- B. Maximum joint width as indicate on the Drawings.
- C. Cure joints for at least 7 days after installing by covering with curing paper or other non-staining material as approved by the owner.

3.7 INSTALLATION, DIMENSION STONE PAVER SET ON MORTAR BED

- A. Prepare concrete subbase and slab in accordance with Section 03 30 01, "Cast in Place Concrete".
- B. Saturate concrete slab with clean water several hours before placing setting bed. Remove surface water about 1 hour before placing setting bed.
- C. Apply cement paste slush coat over surface of concrete slab about 15 minutes prior to placing setting bed. Limit area of slush coat to avoid its drying out prior to placing the setting bed. Do not exceed 1/16" thickness for cement slush coat.

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- D. The prepared mortar shall be spread to desired thickness. The mortar shall be rodded and compacted with a steel trowel. Apply mortar setting bed over cement paste slush coat immediately after latter has been applied. Spread and screed setting bed to uniform thickness at subgrade elevations required for accurate setting of paver to finished grades indicated.
- E. Mix and place only that amount of mortar setting bed that can be covered with paver prior to initial set. Cut back, bevel edge remove, and discard setting bed material that has reached initial set prior to placing paver.
- F. Place reinforcing wire fabric over membrane, lapped at joints by at least one full mesh at joints and supported so that it becomes embedded in the middle of setting bed. Do not butt edges against vertical surfaces.
- G. Before placing the paver on a wet screed bed, a slurry bond coat shall be applied to the mortar bed or to the back of the paver using a flat trowel. Thickness of the bond coat shall be approximately 1/16".
- H. Paver shall be placed in the wet slurry coat before the surface dries.
- I. After each paver is laid, tamp each paver with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Do not return to areas already set and disturb bricks for purposes of realigning finished surfaces or adjoining joints.
- J. Grout joints as soon as possible after initial set of setting bed. Force gout into joints. Taking care not to smear grout on adjoining pavers and other surfaces.
- K. After initial set of grout, finish joints by tooling to produce a very slightly concave polished joint, free from drying cracks. Mix grout color to match paver.
- L. Cure grout by maintaining in a damp condition for 7 days except as otherwise recommended by latex additive manufacturer.

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3.8 EXPANSION JOINTS FOR DIMENSION STONE PAVERS

- A. Provide joints at locations and intervals shown on the Drawings or as specified herein.
- B. All expansion joint filler strips shall be installed vertically, and extend to the full depth and width of the work in which they are installed, and be constructed perpendicular to straight curb or radially to the line of the curb constructed on a curve. During placing and tamping of the concrete, the expansion joint shall be held rigidly and securely in proper position.
- C. After curing period, carefully clean expansion joints and fill with joint compound as shown on the Drawings.
- D. Do not permit spillage on paved surfaces or overflow from the joint.

3.9 PROTECTION

- A. Contractor shall implement all necessary procedures required to protect completed stonework from damage prior to final acceptance.

3.10 REPAIR AND CLEANING

- A. Remove and replace stone units which are broken, chipped, stained, or otherwise damaged. Where directed, remove and replace units which do not match adjoining stonework. Provide new matching units, install as specified, and point-up joints to eliminate evidence of replacement. Repoint defective and unsatisfactory joints to provide a neat, uniform appearance.
- B. All stone masonry work shall be cleaned thoroughly to remove stains, excess mortar, sealant, dirt and other discoloration, or blemishes.

END OF SECTION 32 14 45

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SECTION 32 17 23

PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Removal of existing traffic stripes and pavement markers
- B. Removal of existing signs
- C. Cleaning and sweeping of streets before application of traffic stripes and pavement markings
- D. Materials and application for traffic stripes and pavement markings
- E. Materials and application for pavement markers
- F. Traffic control signs and street name signs
- G. Object markers
- H. Survey monuments

1.2 RELATED SECTIONS

- A. Section 01 10 00, Supplemental General Requirements
- B. Section 32 13 18, Cement and Concrete for Exterior Improvements

1.3 RELATED DOCUMENTS

- A. Caltrans Standard Specifications, 2015
 - 1. Section 78, Incidental Construction
 - 2. Section 81, Miscellaneous Traffic Control Devices
 - 3. Section 82, Signs and Markers
 - 4. Section 84, Markings
- B. Caltrans Standard Plans, 2015
 - 1. Plan A20A through A20D: Pavement Markers and Traffic Lines, Typical Details
 - 2. Plan A24A and A24B: Pavement Markings Arrows
 - 3. Plan A24C: Pavement Markings, Symbols and Numerals
 - 4. Plan A24D: Pavement Markings, Words
 - 5. Plan A24E: Pavement Markings, Words, Limit and Yield Lines
 - 6. Plan A24F: Pavement Markings, Crosswalks
 - 7. Plan A73A: Object Markers

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8. Plan A73B: Markers
 9. Plan A73C: Delineators, Channelizers and Barricades
 10. Plan A74: Survey Monuments
 11. Plan RS1: Roadside Sign, Typical Installation Details No. 1
 12. Plan RS2: Roadside Sign, Wood Post - Typical Installation Details No. 2
 13. Plan RS3: Roadside Sign, Laminated Wood Box Post - Typical Installation Details No. 3
 14. Plan RS4: Roadside Sign, Typical Installation Details No. 4
- C. The State of California Traffic Manual, 2014
- D. The regulations, standards, and tests of the State of California Department of Transportation Materials and Research Division, edition in effect at time of date on Plans.
- E. Professional Land Surveyor's Act, Business and Professions Code §§ 8700 – 8805

1.4 SUBMITTALS

- A. Submit product data for each of the following in accordance with Section 01 10 00, Supplemental General Requirements:
1. Traffic paint
 2. Pavement markers and adhesives
 3. Reflectorized markers and posts

1.5 QUALITY ASSURANCE

- A. Deliver certificates showing conformance with this specification to the Owners Representative with each shipment of materials and equipment to the Project site.
- B. Provide proper facilities for handling and storage of products to prevent damage. Where necessary, stack products off ground on level platform, fully protected from weather.

1.6 PROJECT CONDITIONS

- A. Do not apply traffic striping or pavement markings to the pavement until after approval to proceed has been given by the Owners Representative.
- B. Thoroughly cure new asphalt concrete and portland cement concrete before application of stripes, markings or markers.

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PART 2 - PRODUCTS

2.1 THERMOPLASTIC STRIPES AND MARKING

- A. Thermoplastic striping and marking materials shall be in accordance with Caltrans Standard Specifications Sections 84-2.02 and 84-2.02B, unless noted otherwise herein or on the Drawings.
- B. Glass Beads shall be in accordance with Caltrans Standard Specification Section 84-2.02D, Glass Beads, unless noted otherwise herein or on the Drawings.
- C. Thermoplastic stripes and markings shall have a minimum skid friction value of BPN 35.

2.2 PAINTED STRIPES AND MARKINGS

- A. Painted striping and marking materials shall be in accordance with Caltrans Standard Specifications Sections 84-2.02 and 84-2.02C, unless noted otherwise herein or on the Drawings.
- B. Glass Beads shall be in accordance with Caltrans Standard Specification Section 84-2.02D, Glass Beads, unless noted otherwise herein or on the Drawings.

2.3 PAVEMENT MARKERS

- A. Pavement Markers shall be in accordance with Caltrans Standard Specification Section 81-3, Pavement Markers, and as indicated on the Drawings.
- B. Material
 - 1. Non-reflective Material shall be in accordance with Caltrans Standard Specification Section 81-3.02B, Non-Reflective Pavement Markers.
 - 2. Retroreflective Material shall be in accordance with Caltrans Standard Specification Section 81-3.02C, Retroreflective Pavement Markers.
- C. Adhesive:
 - 1. Adhesive Material shall be in accordance with Caltrans Standard Specification Section 81-3.02D, Hot Melt Bituminous Adhesive.

2.4 TRAFFIC CONTROL SIGNS

- A. General: Traffic control signs shall be in accordance with Caltrans Standard Specification Section 82-1, Signs and Markers.
- B. Sign Panels shall be in accordance with Caltrans Standard Specification Section 82-2, Sign Panels. Conform type (regulatory or warning), size, shape and pattern to the State of California, Department of Transportation, Traffic Manual, edition in effect at the date of the Drawings.

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- C. Posts:
 - 1. Metal Posts shall be in accordance with Caltrans Standard Specification Section 82-3.02B, Metal Posts.
 - 2. Wood Posts shall be in accordance with Caltrans Standard Specification Section 82-3.02C, Wood Posts.
- D. Mounting Hardware shall be in accordance with Caltrans Standard Specification 82-3.02E, Sign Panel Fastening and Mounting Hardware, unless otherwise specified.
- E. Post Foundations: Conform to Caltrans Standard Plans.

2.5 STREET NAME SIGNS

- A. Conform to manufacturer, style, size, and shape shown on the Drawings.
- B. Posts: 2 inch inside diameter steel pipe unless noted otherwise on the Drawings. Posts shall be in accordance with Caltrans Standard Specification Section 82-3.02B, Metal Posts.
- C. Post Foundations: Portland cement concrete in accordance with Section 32 13 18, Cement and Concrete for Exterior Improvements.

2.6 REFLECTORIZED OBJECT MARKERS

- A. ReflectORIZED Metal Object Markers: In accordance with Caltrans Standard Specification Section 82-5, Markers, for target plates and reflectors, and Caltrans Standard Plans A73A through A73C. Marker type shall be as shown on Plans.
- B. Posts: Metal posts shall be in accordance with Caltrans Standard Specification Section 82-5.02C, Metal Posts, and Caltrans Standard Plan A73B.
- C. Mounting Hardware: In accordance with Caltrans Standard Specification Section 82-5.02G, Hardware.

2.7 STREET SURVEY MONUMENTS

- A. General: In accordance with Caltrans Standard Specification Section 78-2, Survey Monuments, except that the marker disk will not be furnished. Marker disk shall be 2 inch diameter solid brass with a 2 ¾ inch shaft, "Lietz No. 525" or approved equal.
 - 1. Portland Cement Concrete: In accordance with Section 32 13 18, Cement and Concrete for Exterior Improvements.

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PART 3 - EXECUTION

3.1 REMOVAL OF TRAFFIC STRIPES, PAVEMENT MARKINGS AND PAVEMENT MARKERS

- A. Where blast cleaning is used for the removal of painted traffic stripes and pavement markings, or for removal of objectionable material, remove the residue, including dust and water, immediately after contact with the surface being treated. Remove by a vacuum attachment operating concurrently with the blast cleaning operation.
- B. Where grinding is used for the removal of thermoplastic traffic stripes and pavement markings; remove the residue by means of a vacuum attachment to the grinding machine. Do not allow the residue to flow across or be left on, the pavement.
- C. Where markings are to be removed by blast cleaning or by grinding, the removed area shall be approximately rectangular so that no imprint of the removed marking remains on the pavement.
- D. Waste from removal of yellow painted traffic stripe may contain lead chromate. Residue produced when yellow paint is removed may contain heavy metals in concentrations that exceed thresholds established by the California Health and Safety Code and may produce toxic fumes when heated. As such, when grinding or other methods approved by the Owner's Representative are used to remove yellow painted traffic stripes, the removed residue, including dust, shall be collected and contained immediately. The Contractor shall submit a written work plan for the removal, storage, and disposal of yellow painted traffic stripe to the Owner's Representative for approval not less than fifteen (15) days prior to the start of the removal operations. Removal operations shall not be started until the Owner's Representative has approved the work plan.
- E. Contractor will be responsible for repairing any damage to the pavement during removal of pavement markers. Damage to the pavement, resulting from removal of pavement markers, shall be considered as any depression more than 1/4-inch deep.

3.2 TEMPORARY PAVEMENT MARKERS

- A. If permanent pavement markers cannot be installed immediately, and the street or road is to be placed in service, install short term, temporary pavement markers on the new pavement prior to opening the street or road to traffic.
- B. Place markers, at a minimum, of 24 feet on centers, or as required by the governmental agency having jurisdiction, in the appropriate colors to delineate centerlines and travel lanes on multi-lane roadways.

3.3 THERMOPLASTIC TRAFFIC STRIPES AND PAVEMENT MARKINGS

- A. Apply in conformance with the manufacturer's instructions and the applicable requirements Caltrans Standard Specification Section 84-2.03, Construction, and Caltrans Standard Plans A20A through A20D, and A24A through A24E.

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3.4 PAINTED TRAFFIC STRIPES AND PAVEMENT MARKINGS

- A. Apply in conformance with the manufacturer's instructions and the applicable requirements of Caltrans Standard Specification Section 84-3.03, 3.04 and 3.05 and Caltrans Standard Plans A20A through A20D, and A24A through A24F.

3.5 PAVEMENT MARKERS

- A. Place in accordance with Caltrans Standard Specification Section 81-3.03, Construction.
- B. Pavement recesses are not required. Markers shall be installed accurately to the line established by the Owner's Representative. No markers shall be installed until the surface has been approved by the Owner's Representative.

3.6 TRAFFIC CONTROL SIGNS

- A. Install in accordance with Caltrans Standard Specification Sections 82-2.03 and 82-3.03, Caltrans Standard Plan RS1, the applicable requirements of the State of California Department of Transportation Maintenance Manual and the details shown on the Drawings. The horizontal locations shown on Caltrans Standard Plan RS1 shall not be applicable, the horizontal location shall be as shown on the Drawings.
- B. Portland cement concrete for post foundations shall be of the configuration shown on the Drawings.
- C. After erection, damage to traffic sign faces shall be touched up or the sign replaced.

3.7 STREET NAME SIGNS

- A. Install in accordance with the manufacturer's instructions and as shown on the Drawings.
- B. Horizontal location shall be as shown on the Drawings.
- C. Portland cement concrete for post foundations shall be of the configuration shown on the Drawings.

3.8 REFLECTORIZED OBJECT MARKERS.

- A. Install in accordance with Caltrans Standard Specification Section 82-5.03, Construction, except that the metal marker posts shall not be driven in place without prior approval of the Owner's Representative.
- B. Install at locations shown on the Drawings.

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3.9 STREET SURVEY MONUMENTS

- A. Install Survey Monuments in accordance with Caltrans Standard Specification Section 78-2.03, Construction and Caltrans Standard Plan A74, except that the marker disk will not be furnished. Exact point in marker to be determined by an accurate survey and placed by a California Licensed Land Surveyors in accordance with the Professional Land Surveyors' Act.

3.10 PROTECTION

- A. Protect the newly installed traffic stripes and pavement markings from damage until the material has cured.
- B. Replace any traffic stripes or pavement markings or markers broken, misaligned or otherwise disturbed prior to opening roadway to traffic.

3.11 RESTORATION OF EXISTING IMPROVEMENTS

- A. Existing signs striping or other markings removed or damaged due to the installation of new facilities shall be replaced in kind.
- B. Existing landscaping or planting removed, damaged or disturbed due to the installation of traffic control signs or street name signs shall be replaced in kind.

END OF SECTION

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SECTION 32 17 26

DETECTABLE WARNING PAVERS

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 the following:
 - 1. Detectable Warning Pavers
- B. Related Sections include the following:
 - 1. Division 01 for LEED and Sustainable Design requirements.
 - 2. Division 31 "Earthwork" for subgrade preparation and aggregate base.
 - 3. Section 321314 "Cement Concrete Pavement" for cast-in-place concrete serving as edge restraint for unit pavers.

1.3 DEFINITIONS

- C. Lippage: Condition where edges of pavers are not at the same plane with each other.

SUBMITTALS

- A. Submit product drawings and data for pavers and setting bed.
- B. Submit one full size sample of concrete paving unit to indicate color and dimensions.
- C. Submit test results from an independent testing laboratory for compliance of paving unit requirements to ASTM C 936.
- D. Shop Drawings:
 - 1. Show paver pattern curved pavement runs indicating all cut units.
 - 2. Show widths, details, and locations of expansion, contraction, control, and isolation joints in paver substrates and finished paver surfaces.
- E. LEED Submittals:
 - 1. Submit applicable LEED Submittal Form for each different product, showing recycled content and geographic source of products.

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2. Submit applicable LEED Submittal Form for each different product or component which contains recycled content.
3. Submit applicable LEED Submittal Form for each different product or component which has been extracted, recovered, or manufactured within 500 miles of the project site.

1.5 QUALITY ASSURANCE

- A. Delete paragraph and subparagraph below if latex additives are not specified or if testing is considered unnecessary.
- B. Delete paragraph and subparagraph below if not required. If retained, indicate location, size, and other details of mockups on Drawings or by inserts. Revise wording if only one mockup is required.
- C. Manufacturer: Company specializing in the manufacture of precast concrete pavers meeting for a minimum of three (3) years. Retain subparagraph below if mockups are erected as part of building rather than separately and the intention is to make an exception to the default requirement in Division 1 Section "Quality Requirements" for demolishing and removing mockups when directed, unless otherwise indicated.
- D. Manufacturer: Company specializing in the manufacture of precast concrete pavers meeting for a minimum of (3) years.
- E. Mock-ups for Tactile Paver Work:
 1. After all samples and product data are approved, construct mock-up in location and configuration as directed by the Landscape architect.
 2. Mock-up shall consist of the following:
 - a. Once panel: 4 foot wide by 3 foot long including all typical joints and paving adjacencies.
 3. If Mockup is not approved by the Landscape architect, remove and replace with others and no additional cost to the Owner.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver concrete pavers to the site in steel banded, plastic banded, or plastic wrapped cubes capable of transfer by fork lift or clamp lift. Unload pavers at job site in such a manner that no damage occurs to the product.
- B. Sand shall be covered with waterproof covering to prevent exposure to rainfall or removal by wind. The covering shall be secured in place.

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- C. Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving.

1.7 WARRANTY

- D. Warranty: Manufacturer's standard warranty in which manufacturer agrees to replace tactile warning surfacing pavers that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 5 years from date of Substantial Completion

PART 2 – PRODUCTS

2.1 DETECTABLE WARNING PAVERS

- A. Product: Hannover Prest Detectable Warning Paver; www.hanoverpavers.com; (800) 426-4242
- B. Composition: Polymer concrete mix with blended aggregates.
 - 1. Compressive Strength: Greater than 16,300 psi; ASTM C 39.
 - 2. Tensile Strength: Greater than 2,650 psi; ASTM C 496.
 - 3. Flexural Strength: ASTM C 947.
 - a. Top Surface in Tension:
 - 1) Ultimate Strength: Greater than 2,550 psi.
 - b. Molded Surface in Tension:
 - 1) Ultimate Strength: Greater than 2,550 psi.
 - 4. Water Absorption: Less than 0.25 percent; ASTM C 140.
 - 5. Abrasion Resistance: Less than 0.03 cm³/cm²; ASTM C 418.
 - 6. Freeze-Thaw Durability: No change; ASTM C 1262.
 - 7. Slip Resistance: >1.15 (Dry), >0.90 (Wet); ASTM C 1028
- C. Paver Size: Provide the following sizes with dimensional tolerance of plus or minus 0.065 inches in accordance with ASTM C 936.
 - 1. 12 by 12 inches, nominal.
- D. Truncated Dome Spacing: 2.35 inches.
- E. Thickness: In accordance with ASTM C 936.
- F. Substitutions: Not permitted.
- G. Color: Custom Enhanced Charcoal by special request.

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2.2 SETTING MORTAR MATERIALS

- A. Medium-Bed, Polymer-Modified, Single-Component Mortar: Provide materials composed as follows, with physical properties equaling or exceeding those required for thin-set mortars based on testing of medium-bed specimens according to ANSI A118.4:
 - 1. Pre-packaged dry-mortar mix combined with acrylic resin liquid-latex additive.
 - a. Products:
 - 1) Mortar: Kerabond, Mapei Corporation
 - 2) Latex Additive: Keralastic, Mapei Corporation.
 - 2. Prepackaged rapid-setting mortar mix containing hydraulic cement.
 - a. Product: Granirapid System, Mapei Corporation.
- B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction.
- C. Aggregate: Washed natural sand conforming to ASTM C 144.
- D. Water: Potable.

2.3 ELASTOMERIC SEALANTS

- A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements in Section 07 92 00 "Joint Sealants."
- B. Color: Provide color of sealant to match color of tactile warning surfacing pavers adjoining sealed joints.

2.4 MORTAR MIXES

- A. Mortar for Thin-Set Installation: Mix to comply with ANSI A118.4 and mortar manufacturer's written instructions.
- B. Mortar for Wet Installation: Mix 3:1:1 ratio of portland cement, aggregate, and water.
- C. Use equipment and procedures that produce mortar of uniform consistency and quality.

2.5 EXPANSION JOINTS

- A. Refer to section 321313 "Cement Concrete Paving".

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Coordinate conditions required by Work of this Section with requirements in Section where substrate is specified. Delete this Article if aggregate setting-bed method is used.
- B. Verify that aggregate base materials and concrete paving thickness, compaction, surface tolerances, and elevations have been completed according to plans and specifications.
- C. Verify that base is dry, uniform, even, and ready to support, pavers, and imposed loads.

3.2 INSTALLATION, GENERAL

- D. Lay out tactile warning surfacing pavers centered in the work area in both directions so that perimeter pavers are more than 1/2 of paver width.
- E. Cut pavers using a concrete saw with a diamond blade. Provide clean, sharp, unchipped edges on cut pavers. Where cuts are made through domes, grind the remaining dome flush with paver surface.
- F. Joint Width:
 - 1. Perimeter: 1/8 inch.
 - 2. Between Pavers: 1/16 inch.
- G. Brush back of tactile warning surfacing pavers with a stiff, moist brush to remove loose aggregate.
- H. Set paver surface (base of domes) flush with the adjacent surfaces and other tactile warning paver surfaces.
- I. Set pavers so that domes align between pavers in both directions.
- J. Tolerances: Compared to level, or indicated slope, for finished tactile warning surfacing.
 - 1. Lippage: Not to exceed 1/16 inch paver-to-paver offset from flush.
 - 2. Overall: Not to exceed 1/8 inch in 24 inches and 1/4 inch in 10 feet.

3.2 THIN-SET INSTALLATION

- A. Saturate concrete substrate with clean water several hours before placing mortar setting bed. Remove standing surface water about one hour before placing mortar setting bed.
- B. Lightly dampen back of pavers using a brush.

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- C. Apply setting mortar material to entire back of pavers in thicknesses indicated below and set pavers firmly with a light twisting motion to ensure good contact.
 - 1. Full Size Pavers: 1/8 inch.
 - 2. Cut Pavers: 3/8 inch.
- D. Tamp or beat each paver with beating block and a rubber mallet to ensure paver is embedded into mortar setting bed. Set each paver in a single operation before initial set of mortar.

3.3 SEALANT INSTALLATION

- A. After tactile warning surfacing pavers have set, fill perimeter joint and joints between pavers with elastomeric sealant in accordance with Section 07 92 00 "Joint Sealants."
- B. After tactile warning surfacing pavers have set, fill perimeter joint and joints between pavers with elastomeric sealant.
- C. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

3.4 CLEANING AND PROTECTION

- A. Remove protective covering from pavers immediately upon completion of installation.
- B. Cleaning: Remove excess mortar and sealant from exposed paver surfaces; wash and scrub clean.
- C. Protection: Keep pedestrian and vehicular traffic off tactile warning surfacing until mortar and sealants have set. Follow the setting mortar material and sealant manufacturers' instructions.

3.5 FIELD QUALITY CONTROL

- A. After removal of excess grout and cleaning, check final elevations for conformance to the drawings. Delete subparagraph below if not applicable for brick pavers.

END OF SECTION

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SECTION 32 84 00

LANDSCAPE IRRIGATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: All labor, materials, supplies, tools and transportation to perform all operations in connection with and reasonably incidental to the complete installation of the automatic sprinkler irrigation systems as shown on the Drawings.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 RELATED SECTIONS:

- A. Final Acceptance for Work of this Section is contingent on completion of Work of Section 32 90 00.
- B. Division 26 - Electrical power to controller for 24 volt wiring.
- C. Division 32 – Exterior Improvements: Irrigation sleeving under paving.
- D. Division 33 – Utilities: Water meter and stub-out installation.

1.3 REFERENCES

- A. ASTM – American Society for Testing and Materials
 - 1. A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 2. D1785 – Standard Specification for Poly Vinyl Chloride (PVC) Plastic Pipe, Schedules 40 and 80 and Classes 200 and 315.
- B. ICC – International Code Council
- C. NEC – National Electric Code
- D. State of California, Division of Industrial Safety
 - 1. Electrical Safety Orders
- E. UPC – Uniform Plumbing Code

1.4 QUALITY ASSURANCE

- A. OSHA Compliance:

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1. All articles and services covered by this Specification shall meet or exceed the safety standards established under the Federal Occupational Safety and Health Act of 1970, together with all amendments in effect as of the date of this Specification.
 2. The subcontractor shall erect and maintain barricades, guards, warning signs, and lights as necessary or required by OSHA regulations for the protection of the public or workmen.
- B. Regulatory requirements: In addition to complying with all pertinent codes and regulations, comply with the latest rules of NEC and the Electrical Safety Orders of the State of California, Division of Industrial Safety, for all electrical work and materials. The materials and methods to be used in constructing the irrigation system shall conform to the applicable provisions of the UPC.
- C. When the Specifications call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, the provision of the Specifications shall take precedence over the requirements of the said rules and regulations.
- D. The subcontractor shall furnish without any extra charge any additional material and labor when required by the compliance with these rules and regulations, though the work be not mentioned in these particular Specifications or shown on the Drawings.
- E. Any existing buildings, equipment, piping, pipe covering sewers, sidewalks, landscaping, etc., damaged by the subcontractor during the course of his work shall be replaced or repaired by the subcontractor in a manner satisfactory to the Owner's Agent and at subcontractor's own expense, and before the final payment is made. The subcontractor shall be responsible for damage caused by leaks in the piping systems being installed by him. He shall repair, at his own expense, all damage so caused, in a manner satisfactory to the Owner's Agent.
- F. The subcontractor, personally or through an authorized and competent representative, shall supervise the work constantly, and shall as far as possible keep the same foreman and workmen on the job from commencement to completion. The workmanship of the entire job must in every way be first class, and only experienced and competent workmen will be allowed on the job.
- G. The subcontractor shall pay for all permits, licenses, and fees required.
- H. Pre-construction conference: Contractor shall schedule and conduct a conference to review in detail quality control and construction requirements for equipment, materials, and systems used to perform the work. The conference shall be scheduled not less than 10 days prior to commencement of work. All parties required to be in attendance shall be notified no later than 7 days prior to date of conference.

1.5 SUBMITTALS

- A. Materials List: Within 15 days after award of contract and prior to installation, submit six copies of materials list. Include manufacturer, model number, and description of all materials and equipment. Include sealants, cements, lubricants and other proprietary items.

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- B. Substitutions: Submit six copies of catalog information on materials which are to be submitted for substitution. No substitution will be permitted without prior written approval by the Architect. A complete material list shall be submitted prior to performing any work.
- C. Record Drawings:
 - 1. The subcontractor shall maintain in good order, in the field office, one complete set of bond prints of all irrigation drawings which form a part of the Contract, showing all water lines, sprinklers, valves, controllers and stub-outs. Any work not installed as indicated on the Drawings, shall be recorded and dimensioned accurately from the building walls on these prints. All as-built markups shall be indicated in red.
 - 2. All underground stub-outs for future connections and valves shall be located and dimensioned accurately from building walls on these record drawings.
 - 3. Upon completion of the work, obtain reproducible prints from Architect and neatly correct the prints to show the as-built conditions.
- D. Controller Charts:
 - 1. Record Drawings shall be accepted by Architect before controller charts are prepared.
 - 2. Provide one controller chart for each controller supplied.
 - 3. Charts shall be the maximum size that the controller door will allow, showing areas covered by each controller. Chart shall be an electrostatic copy and a different color shall be used to indicate area of coverage for each station. Enlarge valve sequence to be readable when drawing is reduced.
 - 4. After being completed and accepted, seal by plastic laminating. Laminating sheets shall be a minimum of 10 mil thick.
- E. Operations and maintenance manuals:
 - 1. Deliver to owner at least 10 days prior to completion of construction, 2 complete sets of the following data. Data shall be on 8 1/2 inch by 11 inch sheets, in a 3-ring binder.
 - a. Index sheet stating Contractor's address and telephone number and list of equipment with name and addresses of local manufacturer's representatives.
 - b. Catalog and parts sheets on all material and equipment installed under this Section.
 - c. Complete operating and maintenance instructions for all equipment.
 - d. Complete and dated manufacturer's warranties for all materials used.
 - 2. Irrigation Maintenance Schedule to include, but not be limited to, routine inspection, adjustment, and repair of the irrigation system and its components.

1.6 LAYOUT OF WORK

- A. The irrigation contractor shall stake out the irrigation system as shown on the Drawings. Stakes shall be approved by Landscape Architect before construction is started. Any changes, deletions or additions shall be determined at this check.

1.7 INSTRUCTION

- A. After the system has been installed and approved, subcontractor shall instruct the Owner's representative in complete operation and maintenance of the irrigation system.

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1.8 WARRANTY

- A. Provide 1 year guarantee for Work of this Section in accordance with Section 1700.
- B. Provide supplemental guarantee, on Contractor's letterhead:
 - 1. Warrant that irrigation system has been installed according to Drawings and Specifications, and that system will be free of defects in products and installation for 1 year from Substantial Completion. Manufacturer's warranties shall only supplement special warranty.
 - 2. Agree to repair or replace defective Work, or adjacent work which is damaged by such defects, with the exception of ordinary wear and tear, abuse or neglect. This includes damage to site improvements caused by settlement of improperly compacted trench backfill.
 - 3. Owner reserves the right to make temporary repairs as required.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. Main lines (constant pressure); 1 to 2 inch shall be 1120 Purple Schedule 40 polyvinyl chloride (PVC) solvent weld pipe, Type 1, and shall conform to ASTM D1785. Use Schedule 40 and Schedule 80 PVC solvent weld fittings.
- B. Lateral lines (non pressure) shall be 1120- Schedule 40 Purple polyvinyl chloride (PVC) plastic pipe Type 1, and shall conform to ASTM D1785. Use Schedule 40 PVC solvent weld fittings.
- C. Metal Pipe:
 - 1. Steel pipe shall be Schedule 40 galvanized steel conforming to ASTM 53B. Metal pipe shall be wrapped in 2 inch wide, 20 mil thick, black PVC all weather corrosion-resistant tape with high tack adhesive. Use threaded galvanized steel fittings.
 - 2. Provide dielectric fittings where dissimilar metals come into contact.
- D. Fittings:
 - 1. Solvent Weld socket fittings: Schedule 40, Type 1, Grade 1, PVC and shall conform to ASTM D2466. Schedule 80, Type 1, Grade 1 PVC and shall conform to ASTM D2467. Solvent cement and primer for PVC solvent-weld pipe and fittings shall be of type recommended by pipe manufacturer.
- E. Connections between main lines and remote control valves shall be of Schedule 80 PVC (threaded both ends) nipples and fittings.
- F. Risers shall be as follows: Schedule 80 PVC threaded nipples and Schedule 80 PVC ells as shown on the construction details.
- G. Detectable marking tape shall be 3 inch wide and consist of a minimum 5.0 mil overall thickness. The tape shall have a 20 gauge solid aluminum foil core, encapsulated within 2.55 mil polyethylene backing. Tape color shall be purple for recycled water or blue for potable

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water.

2.2 QUICK COUPLING VALVES

- A. Quick Coupling valves shall be brass construction, 3/4 inch connection, two-piece body, locking purple vinyl top, single slot and lug. Provide one 3/4-inch single lug key and 3/4 -inch hose swivel for every 5-6 quick couplers.
- B. Quick Coupling valves shall be restrained with cast iron restrainers that attach securely to the base of the valve. Restrainers shall make contact with the hex flats of the valve and be secured by a single bolt.

2.3 GATE VALVES

- A. 2½ inch and smaller shall be brass construction conforming to ASTM B 62 with screw-in bonnet, non-rising stem, operating wheel and threaded connections.

2.4 BALL VALVES

2.5

- A. Ball valves shall be Schedule 80 PVC full port design. PVC ball valves to be installed upstream of each remote control valve.

2.6 REMOTE CONTROL VALVES

- A. Remote control valves shall be globe pattern constructed of heavy duty glass-filled nylon and stainless steel with internal and external bleed. Operating pressure shall be 20 to 150 psi and flow range shall be .25-15 gpm. All internal parts shall be removable from the top.
- B. Each valve shall have a plastic tag denoting its controller and station number.

2.7 MASTER REMOTE CONTROL VALVE

- A. Master remote control valve shall be constructed of heavy duty cast iron, bronze, stainless steel, and copper with metering pin and manual flow stem to adjust closing speed. Operating pressure shall be 3 to 300 psi and flow range shall be .01 to 3000 gpm.
- B. Master Valve shall be normally open.

2.8 FLOW SENSOR

- A. Flow sensors shall be capable of sensing programmed water flows during the operation of the irrigation system and shall be capable of detecting excess or inadequate water flows as per the operator entered parameters.
- B. The flow sensors shall be compatible with the irrigation controller and shall be capable of transmitting water flow information to the irrigation controller.

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- C. The flow sensor shall meet the following requirements:
 - 1. Tee shall be PVC with sensor pre-installed.
 - 2. Insertion type with a non magnetic, spinning impeller as the only moving part.
 - 3. Rated for a maximum line pressure of 240 psi and a maximum liquid temperature of 140 degrees F.
 - 4. Accuracy of plus or minus 1 percent of full scale, linearity of plus or minus 1 percent, repeatability of plus or minus 1 percent, and a flow range of .25 to 15 feet per second.

2.9 CONTROLLERS

- A. Controllers shall be as listed on the Drawings and shall have the following features:
 - 1. Utilize either evapotranspiration or soil moisture data for irrigation scheduling.
 - 2. UL listed, solid state, capable of automatic or manual operation.
 - 3. Non-volatile memory.
 - 4. Scheduling with 365 day calendar, odd/even watering, and rain delay of 1-14 days.
 - 5. Cycle and soak feature.
 - 6. Compatible with master valve and flow sensor.
 - 7. Hand held remote ready.
- B. Controller enclosure shall be stainless steel and as listed on the Drawings.
- C. Hand held remote shall be compatible with controller.

2.10 CONTROL WIRE

- A. Copper with UL approval for direct burial in ground, size #12-1 for common wire and size #14-1 for control wire. Common ground wire shall have white insulating jacket; control wire shall have insulating jacket of color other than white. Provide a separate ground wire for each controller.
- B. Splices shall be made with 3M DBR/Y-6 connectors.

2.11 VALVE BOXES

- A. High density polyethylene construction with UV inhibitors. Lid shall be purple in color and have stainless steel bolt-down mechanism. Boxes, lids, and bolts shall be from the same manufacturer. Plastic valve boxes shall be by Carson, NDS Pro Series, or equal.
- B. High density reinforced concrete with non-settling shoulders. Etched polyethylene face with UV inhibitor. Conforms to ASTM D1693 standard. Reinforced concrete lid or Cast iron lid with lock. Boxes and lids shall be from the same manufacturer. Concrete valve boxes shall be by Christy or equal.
- C. The lid shall be marked as follows:
 - 1. Remote Control Valves – "Irrigation Control Valve" or "ICV" with the station number in one inch (1") high white enamel or heat branded numbers and letters.
 - 2. All other valves - "Irrigation Control Valve" or "ICV".

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- D. Valve box sizes are noted on drawing details.

2.12 TREE WATER INSPECTION TUBES

- A. The tree root aeration and nutrient delivery device shall be manufactured specifically for this purpose. It shall:
 - 1. Be constructed of a single tubular high-density polypropylene polymer.
 - 2. Contain sidewall openings in a horizontal and vertical pattern, equally spaced, that span the entire length and circumference in a uniform manner.
 - 3. Be capable of having the sidewall shape distorted without damage to the device.
 - 4. The top and bottom end caps shall be constructed of a high-density styrene polymer. The top end cap also contains the air convection insert device which shall have a flexible central tube that extends from the top cap into the tube's interior 5". The flexible tube shall have an outside sidewall dimension of .3125 ", and an internal diameter of .25 ". The top cap has additional ¼" openings to promote the convection of internal air currents for fresh air transition for increased Oxygen and Nitrogen content.
 - 5. Be manufactured by Rootwell Products, Inc.

2.13 SUBSURFACE IRRIGATION

- A. Dripline tubing and pressure compensating emitters shall be extruded from linear low-density polyethylene. Each dripper to have a check valve that holds back 8.5' of water. Tubing shall have a minimum nominal diameter of ½ inch with a minimum wall thickness of 0.050. Dripline shall be purple in color.
- B. Dripline is infused with Cupron copper oxide to prevent root intrusion.
- C. No line flushing valves are required. No Air/Vacuum relief valves are required.
- D. CV Mister fogger to emit a moisture zone to indicate operation. Opens at 14.5 psi line pressure.

2.14 BACKFLOW PREVENTION DEVICE

- A. Backflow prevention device shall be the reduced pressure type with gate valves, check valves, test cocks, reduced pressure chamber, and air vent.
- B. Backflow preventer enclosure shall be marine grade aluminum alloy with stainless steel hardware. Enclosure shall be removable from base without use of tools. Enclosure shall be sized to fit backflow prevention device.
- C. Insulated blanket shall be constructed of polymeric resin coated polyester fabric with R-30 fiberglass insulation. Blanket shall be sized to fit backflow prevention device.

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2.15 STRAINER

- A. Bronze body with 20 mesh stainless steel screen and blow off port.
- B. Install upstream of backflow preventer.

2.16 WEATHER SENSOR

- A. UV resistant, polymer housing with weatherproof switch mechanism and mounting bracket.
- B. The system shall consist of a remote weather sensor / transmitter that wirelessly communicates weather information to a receiver module which shall be connected to the irrigation controller.
- C. The weather sensor shall have the capability of:
 - 1. Detecting rainfall amount set by the user, which will shut down the irrigation
 - 2. Monitor solar exposure
 - 3. Monitor air temperature
- D. The module shall utilize local 10 year average weather information and shall be capable of adjusting the controller's water budget percentage based on the average weather information and the information from the sensor.
- E. The weather sensor shall be wireless with a catalog 1000 foot transmission range. Install no further than 500' from the controller.

2.17 MISCELLANEOUS INSTALLATION MATERIALS

- A. Solvent cement and primer for solvent weld joints shall be of make and type approved by manufacturer(s) of pipe and fittings. Cement shall be maintained at proper consistency throughout use.
- B. Pipe joint compound shall be non-hardening, non-toxic materials designed specifically for use on threaded connections in water carrying pipe. Performance shall be same as Rector Seal 100 W.
- C. Drain rock: 3/4 inch washed pea gravel.
- D. Recycled water identification tags and stickers must be purple background with permanent black lettering stating "Warning: Recycled Water – Do Not Drink" in English and Spanish. Potable water identification tags and labels must be blue background with permanent black lettering stating "Potable Water" in English and Spanish.

2.18 MISCELLANEOUS EQUIPMENT

- A. Provide all equipment called for by the Drawings.

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- B. Provide to the Owner, at completion of the Maintenance Period, three (3) each of all operating and servicing keys and wrenches required for complete maintenance and operation of all heads and valves. Include all wrenches necessary for complete disassembly of all heads and valves.
- C. Provide two (2) each of quick coupler keys and hose swivels and three (3) sets of keys to both controller cabinets and enclosures.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Schedule and coordinate placement of materials and equipment in a manner to effect the earliest completion of work in conformance with construction and progress schedule.
- B. Contractor shall field verify the static water pressure at the project site prior to commencing work or ordering irrigation materials. If contractor fails to verify static water pressure prior to commencing work, contractor shall assume responsibility for all costs required to make system operational.
- C. Examine areas and conditions under which work of this section is to be performed. Do not proceed with work until necessary conditions have been corrected.

3.2 HANDLING AND STORAGE

- A. Protect work and materials from damage during construction and storage as directed by Architect.
- B. Handle plastic pipe carefully; especially protecting it from prolonged exposure to sunlight.
- C. Store sub-surface dripline and polyethylene tubing in cool dry place out of sunlight during installation.

3.3 LAYOUT

- A. Layout work as accurately as possible in accordance with diagrammatic drawings.
- B. Where site conditions do not permit location of piping, valves and heads where shown, notify Architect immediately and determine relocation in a joint conference.
- C. Run pipelines and automatic control wiring in common trenches whenever practical.

3.4 EXCAVATING AND TRENCHING

- A. Excavation shall be in all cases ample in size to permit the pipes to be laid at the elevations intended and to permit ample space for joining.

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- B. Depth of trenches shall be enough to provide minimum cover from finish grade to top of pipe in trenches, as follows:
1. 18 inch minimum cover over main lines to the control valves and quick coupling valves.
 2. 18 inch minimum cover over direct burial control wires from controller to valves.
 3. 12 inch minimum cover over the valve controlled lines to sprinkler heads.
 4. 24 inch minimum cover over sleeves.
- C. Restore surfaces, existing underground installations, etc., damaged or cut as a result of excavations, to original conditions in a manner approved by the Architect.
- D. Where other utilities interfere with irrigation trenching and pipe work, adjust the trench depth as instructed by Architect.

3.5 ASSEMBLING PIPELINES

- A. All pipes shall be assembled free from dirt and pipe scale. Field cut ends shall be reamed only to full pipe diameter with rough edges and burrs removed.
- B. Thrust Blocking:
1. Provide thrust blocks at all changes in size or direction. Bends, reducers, plugs, and the opposite side of tee branches all require thrust blocks.
 2. The size of the thrust block is determined by the working pressure, the size and type of fitting and the soil conditions at the job site. To calculate the area of contact with the soil, follow these steps:

Calculate the total thrust by selecting thrust/100 by size and type of fitting from Table 1 and multiplying thrust/100 by system pressure divided by 100.

Divide the total thrust by the bearing capacity of the soil in excavation (from Table 2) to determine the area (in square feet) of thrust block required to be in contact with the undisturbed soil.

TABLE 1 THRUST/100 TABLE (POUNDS PER 100 PSI)

SIZE	TEES PLUGS	90° BENDS	45° BENDS	22° BENDS
2	363	513	259	141
2 ½	531	751	379	207
3	788	1114	562	207
4	1302	1841	928	307
6	2822	3990	2012	1101

TABLE 2 SOIL BEARING CAPACITY

SOIL TYPE	SAFE BEARING LOAD LBS PER SQ FT
Soft Clay	1,000

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Sand	2,000
Sand and Gravel	3,000
Sand and Gravel cemented w/ Clay	4,000
Hard Pan	10,000

The engineer is responsible for determining safe bearing loads. When doubt exists, soil bearing tests should be specified.

C. Solvent Weld Joint:

1. Prepare joint by first making sure the pipe end is square, then deburring the pipe end and cleaning the pipe and fitting of dirt.
2. Dry-insert pipe into fitting to check for missizing. Pipe should enter fitting 1/3 to 2/3 depth of socket.
3. Coat the inside socket surface of the fitting and the external surface of the male end of the pipe with P-70 primer (manufactured by Weld-On), immediately followed by Weld-On 711 cement liberally applied to the male end of the pipe and lightly applied to the inside of the socket. Then, apply a second coat of cement to the pipe end.
4. Insert pipe immediately into fitting and turn it 90° to distribute cement and remove air bubbles. The pipe must seat to the bottom of the socket and fitting. Check alignment of the fitting. Pipe and fitting shall be aligned properly without strain to either.
5. Hold joint still for approximately thirty (30) seconds and then wipe the excess cement from the pipe and fitting.
6. Cure joint a minimum of thirty (30) minutes before handling and at least six (6) hours before allowing water in the pipe.

D. Threaded Joint:

1. Field threading of plastic pipe or fittings is not permitted. Factory-formed threads only will be permitted.
2. Factory-made nipples shall be used wherever possible. Field-cut threads in metallic pipe will be permitted only where absolutely necessary. When field threading, cut threads accurately on the axis with sharp dies.
3. All threaded joints shall be made up with pipe joint compound. Apply compound to male threads only.
4. Where assembling metallic pipe to metallic fitting or valve, no more than three (3) full threads shall show when joint is made up.
5. Where assembling to threaded plastic fitting, take up joint no more than one full turn beyond hand tightening.
6. Where assembling soft metal (brass or copper) or plastic pipe, use a strap type friction wrench only; do not use a metal-jawed wrench.

E. Cap or plug openings as pipeline is assembled to prevent entrance of dirt or obstruction. Remove caps or plugs only when necessary to continue assembly.

F. Where pipes or control wires pass through sleeves, provide a removable non-decaying plug at ends of sleeve to prevent entrance of earth.

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3.6 REMOTE CONTROL VALVES

- A. Install where shown on Drawings and group together where practical. Limit one remote control valve per box with no exceptions.
- B. Locate valve boxes 12 inches from and perpendicular to walk edges, buildings and walls. Provide 12 inches between valve boxes where valves are grouped together.
- C. Thoroughly flush main line before installing the valve.
- D. Install in shrub or ground cover areas where possible.
- E. Label control line wire at each valve with a 2 1/4" x 2 3/4" polyurethane I.D. tag, indicating identification number of the valve (controller and station number). Tag shall be purple for recycled water. Attach a label to control wire.

3.7 QUICK COUPLING VALVES

- A. Install quick coupling valves on double swing-joint assemblies of Schedule 80 PVC risers and fittings.
- B. Thoroughly flush main line before installing the valve.
- C. Install 12 inch from hardscape areas.

3.8 VALVE BOXES

- A. Install one valve box for each type of valve unless otherwise noted.
- B. Install boxes 12 inches from walk or header and 12 inches apart. Short side of rectangular boxes shall be parallel to walk or header. Install 2 inches above finish grade in groundcover areas and flush with grade in lawn areas.
- C. Install common bricks as shown and as required to keep box stable. Install gravel sump after compaction of all trenches.
- D. Gopher Wire: Install 1/2 inch wire mesh at base of all irrigation boxes. Wrap wire mesh tightly up all sides of box for sufficient seal.

3.9 FLOW SENSOR

- A. Install flow sensor a minimum of 10 times pipe diameter upstream and 5 times pipe diameter downstream of any valves, fittings, pipe bends, etc.
- B. Use only sensor cable approved by the controller manufacturer. Install cable in a separate 1 inch conduit routed to controller. Leave enough flexibility in the cable to allow for future

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service of sensor.

3.10 SUB-SURFACE IRRIGATION

- A. Install per manufacturer's instructions.
- B. Install dripline as shown on plans 2 inch below finish grade in planted areas and in clean crushed rock strata in the structured soil for the trees.
- C. No air/vacuum relief valve is required.
- D. No automatic flush valve is required.

3.11 AUTOMATIC CONTROL WIRING

- A. Run lines along mains where practical. Tie wires in bundles with pipe wrapping tape at 10' intervals and allow slack for contraction between strappings.
- B. Loop a minimum of three (3) feet of extra wire in each valve box; both control wire and ground wire.
- C. Connections shall be made as shown on plans.
- D. Splicing will be permitted only on runs exceeding 2500'. Locate all splices at valve locations within valve boxes.
- E. Where control lines pass under paving, they shall pass through Schedule 40 electrical PVC conduit.
- F. Common wire and control wires shall be tagged with 1/4" wide embossed plastic labeling tape, showing controller and station number designation.
- G. Locate all splices at valve locations within valve boxes.
- H. Where control lines pass under paving, they shall pass through Schedule 40 electrical PVC conduit.

3.12 AUTOMATIC CONTROLLER

- A. Provide and install automatic irrigation controller in approximate locations shown on Drawings. The exact location will be determined on the site by Architect. Provide conduit and wire and connect to 120 volt switch accessible to controller for ease of maintenance.
- B. Connect control lines to controller in sequential arrangement according to assigned identification number of the valve. Each control line wire shall be labeled at controller with a permanent non-fading label indicating station number of the valve controlled. Attach label to control wire.

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- C. Contractor is responsible for programming the controller. Provide optimum amounts of water for each plant type to maintain plants in vigorous healthy condition. Reprogram as required at end of maintenance period.

3.13 BACKFLOW PREVENTION ASSEMBLY

- A. Local codes shall govern installation requirements.
- B. Install a minimum of 12 inches and a maximum of 30 inches above grade.
- C. Install enclosure on concrete pad as shown on drawings.

3.14 BACKFILLING

- A. Backfill only after piping has been tested, inspected and approved.
- B. Backfill material shall be the earth excavated from the trenches, free from rocks, concrete chunks, and other foreign or coarse materials. Carefully select backfill that is to be placed next to plastic pipe to avoid any sharp objects which may damage the pipe.
- C. All pipe under asphalt paving shall be backfilled with 4 inches of clean sand on all sides of pipe.
- D. Place backfill materials in 6 inch layers and compact by jetting or tamping to a minimum compaction of 90 percent of original soil density.
- E. Dress off areas to finish grades and remove excess soil, rocks or debris remaining after backfill is completed.
- F. If settlement occurs along trenches, and adjustments in pipes, valves and sprinkler heads, soil, sod or paving are necessary to bring the system, soil, sod, or paving to the proper level or the permanent grade, subcontractor, as part of the work under this Contract, shall make all adjustments without extra cost to the Owner.

3.15 PIPE TESTS

- A. Notify Architect at least three (3) days in advance of testing.
- B. Perform testing at his own expense
- C. Center load piping with a small amount of backfill to prevent arching or slipping under pressure. No fitting shall be covered.
- D. Apply the following tests after weld plastic pipe joints have cured at least 24 hours.
 - 1. Test live (constant pressure) and quick coupling valve lines hydrostatically at 125 PSI minimum. Lines shall be filled with water and pressure gauge connected to the pipe line. After lines have reached the 125 PSI, (use hydraulic pump or other safe method – do not

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- use an air compressor) cut off the source of pressure. Lines will be approved if test pressure (with an allowable drop of 2 PSI) is maintained for two (2) hours. Should leaks develop during the test period, they shall be located and repaired and retested in the same method. The subcontractor shall make tests and repairs as necessary until test conditions are met.
2. Test remote control valve controlled lines with water at line pressure and visually inspect for leaks. Retest after correcting defects.
 3. Test remote control valve controlled lines with water at line pressure and visually inspect for leaks. Retest after correcting defects.

E. Remake faulty joints with new materials. Do not use cement or caulking to seal leaks.

3.16 SYSTEM ADJUSTMENT

- A. Adjust pressure regulating modules to proper and similar pressure to provide optimum and efficient coverage.
- B. Drip System Check
 1. Immediately after installation, flush lateral line piping by removing automatic flush valve, figure 8 fitting, or by opening the shut-off flush valve.
 2. Clean filter screens. Open filter flush valve for at least 10 seconds. Clean or replace clogged elements
 3. Adjust pressure regulator to system design pressure.
 4. Verify that emitters are producing specified water output. If not, replace emitters, check filter element, check pressure at emitters, and review system for clogs and leaks. Correct deficiencies.

3.17 GUARANTEE

- A. It shall be the responsibility of subcontractor to fill and repair all depressions and replace all necessary lawn and planting due to the settlement of irrigation trenches for one year following completion and acceptance of the job.
- B. The subcontractor shall also guarantee all materials, equipment and workmanship furnished by him to be free of all defects of workmanship and materials, and shall agree to replace at his expense, at any time within one year after installation is accepted, any and all defective parts that may be found.

3.18 CLEANUP

- A. When work of this section has been completed, and at such other times as may be directed, remove all trash, debris, surplus materials and equipment from the site.

END OF SECTION

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A. SECTION 32 90 00

PLANTING

PART 2 - GENERAL

2.1 SUMMARY

- A. Work Included: Provide planting complete, as shown and as specified.
 - 1. Trees
 - 2. Shrubs
 - 3. Groundcover
 - 4. Tree stakes
 - 5. Mulches
 - 6. Stone mulch
- B. Work Specified Elsewhere:
 - 1. Section 02200: Earthwork
 - 2. Section 02935: Landscape Maintenance
 - 3. Section 02953: Lawns, Grasses and Hydroseed
 - 4. Section 02810: Irrigation
 - 5. Section 02921-01: Soil Preparation
 - 6. Section 02921-02: Soil Preparation – Bioretention Soil
 - 7. Section 02310: Finish Grading

2.2 REFERENCES

- A. "An Annotated Checklist of Woody Ornamental Plants of California, Oregon and Washington, (Number 4091)", McClintock and Leiser, Division of Agricultural Sciences, University of California, 1979.
- B. "American Standard for Nursery Stock", 2014 Edition, American Association of Nurserymen, Inc.
- C. "Hortus III", 1976 Edition, Bailey Hortorium, Cornell University.

2.3 DEFINITIONS

- A. General Nomenclature: as suggested by ANSI Z60.1
- B. Container-Grown Stock: Healthy, vigorous, well-rooted trees grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container.

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- C. Crown Spread or Diameter: the average diameter of the widest portion of the crown and that diameter perpendicular to it.
- D. Root Ball Diameter: The average diameter of the widest portion of the root ball and that diameter measured perpendicular to it.
- E. Finish Grade: Elevation of finished surface of planting soil.

2.4 MEASUREMENT & GRADING

- A. Time: The specified sizes and grades shall be at the time of delivery to site. Any assessment or measurement before this time can only be based on the plant characteristics at that time and not any future or predicted growth potential of the plant.
- B. Size: The measurements specified or referenced shall be the minimum sizes acceptable after any necessary pruning and with branches, trunks or canes in their normal position. Plants that meet measurements specified but do not possess a normal balance between height and spread shall be rejected. Plants larger than specified may be used if approved by the Landscape Architect. Use of such plants shall not increase the Contract price. If larger plants are approved, increase the root ball size in proportion to the size of the plant.

2.5 SUBMITTALS

- A. Product Data: Manufacturer's current catalog cuts and specifications of the following:
 - 1. Mulch
 - 2. Stone (gravel) mulch
 - 3. Fertilizer tablets.
 - 4. Tree stakes, metal
 - 5. Anti-desiccant.
 - 6. Erosion Control Fabric and
- B. Samples:
 - 1. Mulch: One (1) quart, each type.
 - 2. Gravel mulch: ½ Gal. bag per color and size.
 - 3. Tree tie
- C. Certificates of Inspection: As required by law for transportation of each shipment of plants along with invoice.
- D. Supply Problems & Substitutions: Submit immediate notice of any supply difficulties and substantiate if any material specified is not obtainable including copies of supplier's correspondence. Submit in writing to the Owner's Representative no later than twenty-one days after the Notice to Proceed any proposed plant alternatives or substitutions of equivalent size and/or variety with corresponding adjustment of Contract Price. Alternatives shall not be considered after this time.

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- E. Nursery Reviews: Submit written requests for review of plants at the nursery/plantation. Give a minimum of twenty-one days notice of review. State the names and addresses of the nursery/plantation and quantity of plants to be reviewed.
- F. Photographs: Submit a representative example image within fourteen days of proposed field inspections of all shrub, groundcover, and tree species of each size clearly showing the full range of variations.
 - 1. Format: PDF made from digital high resolution jpeg file.
 - 2. Scale: Include a yardstick in each photograph to provide scale.
 - 3. Background: Ensure form and condition of plant is clear from background.
 - 4. Identification:
 - a. Name of Project & Owner.
 - b. Name & address of grower.
 - c. Date photograph was taken.
 - d. Species name.

2.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of exterior plants.
 - 1. Sourcing: Require an experienced plant finder whose work has resulted in successful sourcing, selection and delivery of quality plants. Hire a plant broker if necessary.
 - 2. Tree Tagging: All trees shall be selected by Contractor at the Nursery for review by Owners Representative prior to delivery. Provide two weeks advanced notification for review. Alternative material shall be available at Nursery for review and substitution at the discretion of Owners Representative. Trees which have been approved shall be delivered to site within two weeks of tagging and shall be inspected for any decline in health and damage in travel prior to planting.
 - 3. Delivery Supervision: Require an experienced person who can assess the condition of the plants at the time of loading and unloading and who can resolve any disputes on site.
 - 4. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when exterior planting is in progress.
- B. Observation: Plants may be subject to review both at the nursery/plantation and at the delivery site for conformity. Such acceptance shall not impair the right of review and rejection during progress of the Work. Owner's Representative reserves the right to refuse the review if, in the Landscape Architect's opinion, a sufficient quantity of plants are not available.
 - 1. Notify Landscape Architect of sources of plants fourteen days in advance of delivery to site.
 - 2. Notify Landscape Architect when lay out of plants is ready for review fourteen days in advance of delivery to site.

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- C. Ordering: Be responsible for searching, locating and ordering natural materials with long lead times and/or seasonal dependencies. No extensions of time or variations shall be considered if supply is compromised by late sourcing and/or ordering.
- D. Allowance for losses: Grow additional plants to ensure that the contract quantities shall be achieved after normal production losses from natural causes, breakage, natural random non-conformities, transplant shock and/or delivery damage. Replace any plants that are damaged, fail or are rejected.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

2.7 SOURCE QUALITY CONTROL

- A. Transportation: Contractor shall accompany Landscape Architect to all review(s) of plant materials at the nursery. Landscape Architect will review and tag plants at place of growth and upon delivery for conformity to specifications
- B. Unavailable Material: If proof is submitted that a specified plant is not obtainable, a proposal will be considered for use of the nearest equivalent size or variety with corresponding adjustment of Contract price. Substantiate such proof in writing no later than 30 days after award of contract.
- C. Special Conditions: The above provisions shall not relieve Contractor of the responsibility of obtaining specified materials in advance if special growing conditions or other arrangements must be made in order to supply specified materials.

2.8 PROJECT/SITE CONDITIONS

- A. Refer to Drawings, and Sections 02921-01 Soil Preparation and 02920 Structural Soil for Landscape.

2.9 SEQUENCING AND SCHEDULING

- A. Acceptance: Do not install plant materials prior to acceptance of finish grades and main line trenching/installation of irrigation system.
- B. Coordination: Coordinate with work of other sections to insure the following sequence of events:
 - 1. General: Sprinkler system to be installed and operable prior to installation of plant materials. Schedule hand watering of all plant materials installed prior to sprinkler irrigation system.
 - 2. Specimen tree relocation: As directed by owners representative
 - 3. Trees in Cobble paving: Install prior to installation of paving under another section. See Drawings.
 - 4. Pruning: Do not prune plant material prior to installation and acceptance. Request review by Owners representative prior to pruning.

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5. Drainage: Drain pipes and equipment to be installed and operable prior to installation of plant materials.

2.10 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Do not deliver disease-infected plant materials to the site.
 1. Notification: Notify Owner at least two (2) weeks in advance of date when plants will be picked up and transported to the place of installation.
 2. Inspection: Inspect plants prior to acceptance and notify Landscape Architect of all unacceptable plants. Pick up of plants shall constitute acceptance for the purpose of warranties.
- B. Fertilizers and Soil Amendments: Store in a dry place and protect from intrusion of moisture.
- C. Labeling: Furnish standard products in manufacturer's standard containers bearing original labels legibly showing quantity, analysis, genus/species and name of manufacturer/grower.
- D. Storage: Protect metal containers from sun during summer months with temperatures above 80 degrees F. Keep plants that cannot be planted immediately upon delivery in the shade, well-protected and well-watered.
- E. Handling:
 1. Protect plant material at all times during handling, storage and planting from extreme weather conditions, wind, drying roots and rootballs and injury.
 2. Support root system of container plant material when lifting and moving to minimize injury to the root system. Do not lift or handle plants by tops, stems or trunks at any time. Do not bind or handle plants with wire or rope at any time.
 3. Plant material showing damage from shipping, while in storage or during planting may be rejected by the Owners Representative. Rejected plant material shall be replaced at the contractor at his own expense.
- F. Anti-Desiccant: At Contractor's option, immediately before transporting, spray deciduous plant materials in full leaf or evergreens with anti-desiccant. Apply an adequate film over trunks, branches, twigs and foliage.

2.11 WARRANTY

- A. Warrant that all plants planted under this Contract will be healthy and in flourishing condition of active growth one (1) year from date of Final Acceptance.
- B. Replace, in accordance with the Drawings and Specifications.
- C. Correct Species: Warrant that all plant materials are true to species and variety.

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- D. Delays: Delays caused by the Contractor in completing planting operations, which extend the planting into more than one planting season, shall extend the Warranty Period correspondingly.
- E. Condition of Plants: At the end of the Warranty Period plants shall be free of dead or dying branches and branch tips, with foliage of normal density, size and color.
- F. Replacements: As soon as weather conditions permit, replace, without cost to Owner all dead plants and all plants not in a vigorous, thriving condition, as determined by Landscape Architect during and at the end of Warranty Period.
- G. Exclusions: Contractor shall not be held responsible for failures due to neglect by Owner, vandalism, and acts of Nature, during Warranty Period. Report such conditions.

2.12 SUBSTANTIAL COMPLETION, MAINTENANCE PERIOD AND FINAL ACCEPTANCE

- A. See Section 02935 - Landscape Maintenance

2.13 REPLACEMENTS

- A. Failed Materials:
 - 1. Repair and/or replace at no cost to the Owner all plant materials exhibiting conditions which are determined as unacceptable due to workmanship by the Contractor or supplier.
 - 2. Closely match replacements to adjacent specimens of the same species. Apply requirements of this Specification to replacements.
- B. Incorrect Materials:
 - 1. During Warranty Period, replace at no cost to Owner plants revealed as being untrue to name and species.
 - 2. Provide replacements of a size and quality to match the planted materials at the time the mistake is discovered.
- C. General Replacements: Any species replacement must be reviewed with the Landscape Architect.

PART 3 - PRODUCTS

3.1 PLANTS

- A. Plant Materials: Verify that all container stock (excluding annuals) has been grown in the containers in which delivered for at least one growing season, but not over two (2) years.
 - 1. Growing Conditions: Plants shall be nursery-grown in accordance with good horticultural practices under climatic conditions similar to those of the project for at least two years unless otherwise specifically authorized.

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2. Appearance: Trees shall be exceptionally heavy, symmetrical, tightly knit, and so trained or favored in development and appearance as to be superior in form for their species, with regard to number of branches, compactness and symmetry.
 3. Vigor: Plants shall be sound, healthy and vigorous, well branched and densely foliated when in leaf. They shall be free of disease, insect pests, eggs, or larvae. They shall have healthy, well-developed root systems. Plants shall be free from physical damage or adverse conditions that would prevent thriving growth.
- B. Requirements: Requirements: Provide quality, size, genus, species, variety and sex of plants indicated conforming with the Plant Schedule and which;
1. Are fit for purpose.
 2. Are acclimated to the proposed site conditions.
 3. Have an optimum habit and sound, healthy, vigorous growth without excessive succulence.
 4. Comply with the requirements of ANSI Z60.1.
 5. Have a normal amount of flowers, fruit, cones, and seeds.
 6. Sturdy root ball when trunk bends along its vertical length and no pivoting at the base or moving the root ball.
 7. A symmetrical/radial pattern of well-branched fibrous roots without crushed/torn ends.
 8. Have no weeds.
- C. Condition of Root System: Samples must prove to be completely free of circling, kinked or girdling trunk surface and center roots and show no evidence of a pot-bound condition. Upon inspection by Landscape Architect at the job site, if five (5) percent or more of the plants of each species are found to contain kinked, circling or girdling roots, all plants of that species will be rejected.
- D. Measurements:
1. General: Plant material shall be classified and measured according to ANSI Z60.1 standards for each type or grade of plant and stock i.e. containers, boxes, B&B. All tree, shrubs and groundcover shall conform to the latest edition of the California Association of Nurseryman specifications and the latest guideline Specifications for Nursery Tree quality published by the Urban Farmer Tree Foundation and California Department of Forestry.
 2. Size Range: Caliper, height, spread, branch height, shall meet ANSI standard for container or box size. If a range of size is given, do not use plant materials less than the minimum size. The measurements specified are the minimum size acceptable and are the measurements after pruning, where pruning is required. Plants that meet the measurements specified, but do not possess a normal balance between height and spread shall be rejected.
 3. Substitutions: Substituted plants shall be true to species and variety and shall conform to measurements specified except that plants larger than specified may be used if accepted. Use of such plants shall not increase Contract price. If larger plants are accepted, increase the ball of earth in proportion to the size of the plant. Plants overgrown for their container size will be rejected.

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4. Unacceptable Trees: All trees must have a straight and defined central leader, with good taper and caliper. Trees, which have damaged or crooked leaders, will be rejected. Trees having a main leader shall not have been headed back. Trees with abrasions of the bark, sunscalds, disfiguring knots, or fresh cuts of limbs over 3/4 in. which have not completely callused, will be rejected.
 5. Pruning: Do not prune plants before delivery. Consult Owner's Representative for pruning after installation.
 6. Field Dug Stock: Prior to digging of field grown plant materials, insure that excess loose fill resulting from cultivation around stems and over roots be removed down to natural finish grade at crown of plant materials. During digging, verify that size of tree spade or other equipment is adequate to encompass the actively-growing root zone of all plants. Plants, which, after digging, show mostly large fleshy roots and few fibrous roots, will be rejected.
- E. Substitutions: Substituted plants shall be true to species and variety and shall conform to measurements specified except that plants larger than specified may be used if accepted. Use of such plants shall not increase Contract price. If larger plants are accepted, increase the ball of earth in proportion to the size of the plant. Plants overgrown for their container size will be rejected.

3.2 DEEP POTS

- A. Container grown plant must be nursery propagated in 2 3/8" square by 3 3/4" deep open-bottomed pots and meet the requirements for plant materials specified above.

3.3 PLANTING SOIL MIXES

- A. Tree, Palm and Shrub Planting Topsoil and Backfill Mix: See Section 3291 13-01 - Soil Preparation.
- B. Biofiltration Planter Soil Mix: See Section 3291 13-02 - Soil Preparation

3.4 MISCELLANEOUS PRODUCTS

- A. Tree Stakes:
1. "Mega Grate Stake" by Reddy Stake for tree installed in tree grates as manufactured and distributed by J.R. Partners (888) 333-3090, Install 2 per tree. <http://www.jrpartnersco.com>.
 2. Lodgepole Stakes: 3" diameter, 12 ft. length.
 3. Install per details and manufacturers recommendation. For street trees install parallel to street curb.
- B. Tree ties: Per Drawings or approved equal.
- C. Commercial Fertilizers:
1. Slow release Fertilizer Tablets " Agriform" 21 gram tablets with 20 -20-25 (N-P-K) by Sierra Chemical Co. (408) 263- 8080 or approved equal.

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- D. Mulch:
1. Crushed Rock Mulch: See plans for material. If none listed assume ½" size with no fines, American Soil Products, 2121 San Joaquin, Richmond, CA. 510.292.3000 or Lyngso Garden Supply (650) 364-1730 or equal. Color to be selected by Landscape Architect.
 2. Bark Mulch:
 - a. Bark Mulch on less than 3:1 slope:
 - 1) Type: Small Fir Bark, free of dirt and other debris; as supplied by Lyngso Garden Materials, Inc., (650) 364.1730. Or Approved Equivalent.
 - 2) Size: medium chip 1/2 inch to 1 inch in size.
 - b. Bark Mulch on 3:1 or steeper slope:
 - 1) Type: Ground Redwood Bark, free of dirt and other debris; as supplied by Lyngso Garden Materials, Inc., (650) 364.1730. Or Approved Equivalent.
 - 2) Consult with Landscape Architect to determine extent of mulch at transition areas.
- E. Steel Header:
1. 3/16" x 4" Steel
 2. Powdercoat: Black, unless otherwise noted.
 3. JD Russell DURAEDGE Heavy Duty or approved equal.
- F. Water:
1. Clean, fresh and potable.
 2. Transport as required.
- G. Anti-Desiccant/transpirant:
1. Type: Sprayable, water-soluble pine oil complex that will produce a moisture-retarding barrier not removable by rain (or snow).
 2. Product: "Wilt-Pruf" by Wilt-Pruf Products, Inc., Greenwich, CT.

PART 4 - EXECUTION

4.1 EXAMINATION

- A. Verification of Conditions:
1. Finish Grades: Finish grades for planting areas shall have been established in another Section. Verify that all grades are within 1 in. plus or minus of required finish grade.

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2. Confirm that all specimen tree relocation work being done by others is coordinated with work under this section. Verify in writing that the locations and requirements for such work are understood and pose no conflicts.
3. Soil Preparation: Do not commence planting work prior to completion and acceptance of soil preparation.
4. Irrigation: Verify that irrigation system has been installed and accepted.

4.2 PREPARATION

- A. Layout and Staking: Lay out plants at locations shown on Drawings. Use 3 -ft. lath, color-coded for each species of plant material. Stake each tree, not specifically located by dimension or alignment. Outline shrub and groundcover beds with lime.
- B. Review: Locations of plants will be checked in the field and will be adjusted to exact position before planting begins. Right is reserved to refuse review at this time if, in the Landscape Architect's opinion, an insufficient quantity of plants is available.
- C. Digging Plant Pits: Dig tree pits and scarify all sides of the tree pit after excavation - see below. Do not use an auger or tree spade.
- D. Containerized Plant Pits: Excavate planting holes per details to dimensions dictated by the rootball dimensions.

4.3 DRAINAGE TEST OF PLANT PITS/OBSTRUCTIONS

- A. Drainage Testing: Immediately after completion of excavation, test drainage of plant pits by filling with water twice in succession. Give written notification of conditions permitting the retention of water in plant pits for more than twenty-four (24) hours.
- B. Drainage Correction: To improve drainage install underdrains as per planting details. Submit for acceptance a written proposal and cost estimate for the correction of poor drainage conditions before proceeding with planting.
- C. Obstructions: If rock, underground construction work, tree roots or other obstructions are encountered and cannot be removed in the excavation of plant pits, acceptable alternate locations may be used with approval of Landscape Architect.
- D. Percolation Test Pit:
 1. Location: At four (4) locations as determined by the Landscape Architect on site.
 2. Restrictions: Do not perform test on a rainy day. Repeat all tests interrupted by rain or cold.
 3. Procedure:
 - a. Dig test pit of a size specified for the tree pits, a minimum of 4 ft. deep. Legibly calibrate a stake at 1 in. intervals and drive it firmly into the undisturbed soil at the bottom of the pit.
 - b. Fill test pit with water to within 1 ft. of the finish grade. Immediately record water level on the stake.

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- c. After 3 hours, record water level again. Repeat recording of water level once each hour for the succeeding five hours.
4. Documentation: Submit written documentation of all test pit results, dated and signed by the tester.

4.4 TREE AND SHRUB PLANTING

- A. Handling and De-potting of Plant Materials:
 1. Damage: Avoid damage to containers and rootballs. If rootball is cracked or broken during handling and de-potting, plant will be rejected. Do not remove plant from container prior to completion of plant pit preparation.
 2. Container Trees and Shrubs: Metal Containers: Cut can on two sides with accepted cutting tool. Do not use spade. Plastic Containers: Tip container to horizontal orientation and shake carefully to remove shrub. Support rootball during installation to prevent cracking or shedding of soil.
 3. Boxed Trees: Lift from bottom with forklift or from sides with 2 in. x 4 in. rails nailed to each side of box. Do not remove box prior to settling tree in plant pit. Remove sides of box after acceptance by Owner's Representative and prior to backfilling. Bottom of box may be left in place.
- B. Installation:
 1. Scarification:
 - a. Plant Rootball: After removing plant from container, scarify the sides of the rootball to a depth of 1 in. at four to six equally-spaced locations around the perimeter of the ball or at 12 in. intervals on sides of boxed materials. Cut and remove circling roots over 3/8 in. diameter.
 - b.
 - c. Plant Pit: Scarify sides of plant pit, thoroughly breaking up surfaces and eliminating "glazed" areas.
 2. For tree plantings install drainage as per details.
 3. Positioning: Backfill plant pit to allow setting crown of tree 2 in. above new finish grade and crown of shrub 1 in. above finish grade. Thoroughly foot tamp all backfill. Position plant in planting pit, maintaining plumb condition. Maintain throughout all planting operations.
 4. Backfilling:
 - a. Use backfill mix to backfill plant pits as shown on Drawings. Brace each plant plumb and rigidly in position until planting soil has been tamped solidly around the ball and roots.
 - b. When plant pits have been backfilled approximately 2/3 full, water thoroughly and saturate rootball, before installing remainder of the backfill mix to top of pit, eliminating all air pockets.
 5. Staking: When required, stake or guy as specified below.

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- C. Watering Basin: Form saucer with 3 in. high berm centered around tree and shrub pits 12 in. wider than ball diameter. Do not form saucer around trees in lawn areas.
- D. Watering: Immediately water all plants after completion of planting operations.
- E. Fertilization:
 - 1. Slow-release Fertilizer Tablets: Place evenly distributed in plant pits when backfilled 2/3 according to the following schedule or per Manufacturer's latest specifications.
 - 2. Container Stock:
 - a. 1 gallon can - 2 tablets
 - b. 5 gallon can - 4 tablets
 - c. 15 gallon can - 6 tablets
 - d. 24 in. box - 8 tablets
 - e. 36 in. box - 10 tablets
 - f. 48 in box - 12 tablets

4.5 STAKING

- A. General:
 - 1. Located stakes as detailed in the Drawings, and per manufacturer's specifications. Install stake perpendicular to prevailing wind and as close to the main trunk as is practical, avoiding root injury. Install street tree stakes parallel to the curb. Drive stakes at least 36 in. into firm ground.
 - 2. Remove nursery-supplied stake and tie to new stakes using two tree ties. Find proper height for point of tree ties and attach as follows:
 - a. Hold trunk in one hand, pull top to one side and release. The Base Height is the height at which the trunk snaps back to an upright position while hand-held. Attach tree ties to trunk 6 in. above Base Height.

4.6 HEADERS

- A. Layout locations of headers for review before final installation. Install per details in DRAWINGS true to line and grade.

4.7 PRUNING

- A. See Section 02935 - Landscape Maintenance.

4.8 GROUNDCOVER/SHRUB PLANTING

- A. Space planting in even triangular spacing pattern at spacing indicated in plant schedule.
- B. Top-dress Fertilizer: Apply at the rate of 5 pounds per 1,000 square feet immediately after completion of planting.
- C. Watering: Immediately water groundcover areas after fertilizer application to wash fertilizers from leaves of plants.

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4.9 FINISH GRADING

- A. Refer to Section 02310 Finish Grading.

4.10 EROSION CONTROL FABRIC

1. In areas with slopes less than 2:1, apply 5' width of erosion control fabric on the uphill side of all paths that don't have a swale.
2. Consult with Landscape Architect regarding extent prior to installation.
3. In areas with slopes 2:1 or greater, refer to the Erosion Control Plan notes.
4. Install before mulching.
5. Install 6"x6" key trenches per CADOT standard details

4.11 MULCHING

- A. Install a 2 inch layer of mulch over all shrub areas including tree and shrub watering basins.
- B. Do not mulch lawn areas.
- C. Pre-mix Bark Mulch and Site Chipped Mulch (if available at the time of planting) to create a standardized mixture to be used throughout project.

4.12 CLEANUP AND PROTECTION

- A. Keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect plants from damage due to landscape operations, operations by others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plants

4.13 DISPOSAL

- A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

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SECTION 32 91 13-01

SOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Work Included: Provide all soil, soil mixes, and soil amendment products, including all imported topsoil as required to make up deficiencies in quantity of suitable soil available on site. Execute all labor to achieve soil preparation, complete, as shown and as specified.
- B. Work Specified Elsewhere:
 - 1. Section 31 20 00 "Earth Moving"
 - 2. Section 31 22 19 "Finish Grading"
 - 3. Section 32 80 00 "Irrigation System"
 - 4. Section 32 91 14 "Bioretention Soil"
 - 5. Section 32 91 23 "Structural Soil"
 - 6. Section 32 93 00 "Trees, Shrubs, Ornamental Grasses and Ground Cover"

1.2 DEFINITIONS

- A. Existing Soil: Area of undisturbed native soil where no rough grading is to be done. No topsoil is to be placed. Only surface cultivation and soil amending are included in this Section. See Drawings.
- B. Subgrade: Soil level resulting from the rough grading work under another Section. Cultivation of all subgrade areas prior to amending is included in this section.
- C. Finish Grade: Elevation of finished surface of planting soil.
- D. Bio-retention Area Soil Mix: Soil mix comprised of sandy loam topsoil, sand and compost for use as planting medium over drain rock courses in Bio-retention Areas shown on Drawings and included in another Section.
- E. Topsoil: Suitable soil protected and stockpiled for spreading over prepared subgrade.
- F. Stockpiled Native Topsoil: Topsoil stripped from the site above the subsoil layer prior to rough grading work under another Section, to be spread and amended as work under this Section.
- G. Imported Topsoil: Off-site suitable topsoil imported and stockpiled under this Section, to be spread and amended also as work under this Section.

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1.3 SUBMITTALS

- A. Product Data: Manufacturer's current catalog cuts and specifications of the following:
 - 1. Fertilizer.
 - 2. Herbicide.
- B. Quality Control Submittals:
 - 1. Testing Laboratory Qualifications: Wallace Laboratories, LLC, 365 Coral Circle, El Segundo, CA 90245, www.wlabs.com Tel. (310) 615-0116, or equal.
 - 2. Test Reports:
 - a. Existing Topsoils: Provide testing, analysis and amendment recommendations from sample locations as directed by the University's Representative. Testing analysis shall include pH, salinity, fertility, sodium hazard, boron hazard, lime content, organic matter content, soil texture and 12 non-essential minerals. Recommendations shall be provided for each type of planting area as designated on the planting plans. Submit planting plans and landscape soil specifications with soil samples to lab. Laboratory to make recommendations based on an organic approach to soil and landscape management. Provide tests as needed to verify material meets requirements of this section. Provide a minimum of 3 tests from the top 12 inches and 3 tests from between 1 and 3 feet.
 - b. Imported Topsoil: Provide testing, analysis, and amendment recommendations of imported topsoil. Testing and analysis shall include pH, salinity, fertility, sodium hazard, boron hazard, lime content, organic matter, soil texture and 12 non-essential minerals. Recommendations shall be provided for each type of planting area as designated on the planting plans. Submit planting plans and landscape soil specifications with soil samples to lab. Laboratory to make recommendations based on an organic approach to soil and landscape management. Provide tests as needed to verify material meets requirements of this section. Provide a minimum of 3 tests.
 - c. Post-amendment testing: Provide tests as needed to verify that planting area amendments and soil mix amendments meet the requirements of this section. University's Representative to identify test locations following soil mix placement and topsoil placement and/or amendment.
 - 3. All testing will be at the expense of the Contractor. The University's Representative may request additional test on different mix component ratios in order to attain results that more closely meet the mix requirements as recommended by the testing lab or specified herein.
 - 4. Certificates: Certify strict compliance with accepted soil mixes and amendments, including rate of application.

1.4 FIELD QUALITY CONTROL

- A. Tests: Right is reserved to take samples of soil mixes and prepared and amended soil for testing for conformity to Specifications.

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- B. Rejected Materials: Remove off site at Contractor's cost. Pay cost of testing of materials, not meeting Specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

A. TOPSOIL AND IMPORTED TOPSOIL

1. General:
 - a. Quantity: Import topsoil in a sufficient quantity to provide 24 inches of topsoil for all landscape areas. Quantity of import topsoil to complete the work shall be calculated by the Contractor.
 - b. Samples: The Owner's Representative reserves the right to take samples of the imported topsoil delivered to the site for conformance to the Specifications.
 - c. Rejected Topsoil: Immediately remove rejected topsoil off the site at Contractor's expense.
 - d. Topsoil shall be free of roots, clods, stones larger than 1-inch in the greatest dimension, pockets of coarse sand, noxious weeds, sticks, lumber, brush and other litter. It shall not be infested with nematodes or other undesirable disease-causing organisms such as insects and plant pathogens.
 - e. Topsoil shall be friable and have sufficient structure in order to give good tilth and aeration to the soil.
2. Gradation limits: soil shall be a sandy loam. The definition of soil texture shall be the USDA classification scheme. Gravel over 2 millimeters in diameter shall be less than 20% by weight.
3. Permeability Rate: Hydraulic conductivity rate shall be not less than one inch per hour nor more than 20 inches per hour when tested in accordance with the USDA Handbook Number 60, method 34b or other approved methods.
4. Fertility: The range of the essential elemental concentration in soil shall be as follows:

Ammonium Bicarbonate/DTPA Extraction
parts per million (mg/kilogram)
dry weight basis

phosphorus	2 - 40
potassium	40 - 220
iron	2 - 35
manganese	0.3 - 6
zinc	0.6 - 8
copper	0.1 - 5
boron	0.2 - 1.0
magnesium	50 - 150
sodium	0 - 100

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sulfur	25 - 500
molybdenum	0.1 – 1.0

Soil may need to be amended and conditioned to optimize plant growth. The above listed fertility is for soil selection.

5. Concentration of nutrients for final acceptance

Ammonium Bicarbonate/DTPA Extraction
parts per million (mg/kilogram
dry weight basis

phosphorus	10 - 40
potassium	100 - 220
iron	5 - 35
manganese	0.6 - 6
zinc	1 - 8
copper	0.3 - 5
boron	0.2 – 1.0
magnesium	50 - 150
sodium	0 - 100
sulfur	25 - 500
molybdenum	0.1 – 1.0

6. Acidity: The soil pH range measured in the saturation extract (Method 21a, USDA Handbook Number 60) shall be 6.5 - 7.9.
7. Salinity: The salinity range measured in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 0.5 - 2.5 dS/m.
8. Chloride: The maximum concentration of soluble chloride in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 150 mg/l (parts per million).
9. Boron: The maximum concentration of soluble boron in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 1.0 mg/l (parts per million).
10. Sodium Adsorption Ratio (SAR): The maximum SAR shall be 3 measured per Method 20b, USDA Handbook Number 60.
11. Aluminum: Available aluminum measured with the Ammonium Bicarbonate/DTPA Extraction shall be less than 3 parts per million.
12. Soil Organic Matter Content - Sufficient soil organic matter shall be present to impart good physical soil properties but not be excessive to cause toxicity or cause excessive reduction in the volume of soil due to decomposition of organic matter. The desirable range is 3% to 6%. The carbon-to-nitrogen ratio should be about 10. A high carbon-to-nitrogen ratio can indicate the presence of hydrocarbons or non-humified organic matter.
13. Calcium Carbonate Content: Free calcium carbonate (limestone) shall not be present for acid-loving plants.

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14. Heavy Metals: The maximum permissible elemental concentration in the soil shall not exceed the following concentrations:

Ammonium Bicarbonate/DTPA Extraction
parts per million (mg/kilogram)
dry weight basis

arsenic	1
cadmium	1
chromium	10
cobalt	2
lead	30
mercury	1
nickel	5
selenium	3
silver	0.5
vanadium	3

15. If the soil pH is between 6 and 7, the maximum permissible elemental concentration shall be reduced 50%. If the soil pH is less than 6.0, the maximum permissible elemental concentration shall be reduced 75%. No more than three metals shall be present at 50% or more of the above values.
16. Phytotoxic constituent, herbicides, hydrocarbons etc. - Germination and growth of monocots and dicots shall not be restricted more than 10% compared to the reference soil. Total petroleum hydrocarbons shall not exceed 50 mg/kg dry soil measured per the modified EPA Method No. 8015. Total aromatic volatile organic hydrocarbons (benzene, toluene, xylene and ethyl benzene) shall not exceed 0.5 mg/kg dry soil measured per EPA Methods No. 8020.

2.2 TREE AND SHRUB PLANTING SOIL MIX

- A. Tree and Shrub Planting Pits below is for bidding purposes only. Final soil mixes shall be determined by the Soil Testing Laboratory:

Tree Backfill Mix

1 part	Existing Soils
3 parts	Imported Topsoil
1/2 part	Organic Compost

Uniformly blended with:

Amount/ Cu.Yd. of Backfill Mix for bid purposes only, adjust based on lab recommendations

1/2 pound	6-20-20 Complete Fertilizer
1/2 pound	Potassium sulfate (0-0-50)
1 pound	Soil Sulfur
3 pounds	Agricultural gypsum

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Amended soil shall contain between 3 percent and 7 percent soil organic matter on a dry weight basis. The top 12 inches of plant pits may be backfilled with approved, amended topsoil. Plant pit depths greater than 12 inches shall not contain organic amendment.

2.3 PRE-EMERGENCE WEED CONTROL

- A. Pre-emergence Weed Control: "Treflan 5G", by Elanco Products Co., (317) 261-3638, or (209) 486-3020 or "Enide 50W", by TUCO, (616) 385-6609, or equal.

2.4 WATER

- A. Water: Clean, fresh and potable, as available from University. Transport as required.

2.5 ORGANIC COMPOST

- A. The organic amendments, and fertilizer rates and quantities listed in Part Three are to be used for bid basis only. The contractor shall provide a copy of a lab analysis and recommendations performed by a certified US Composting Council Compost Analysis Program. Adjustments to project costs resulting from the soil report recommendation shall be submitted as a modification of the base bid.
- B. Compost Properties:
 - 1. Humus material shall have an acid-soluble ash content of no less than 6% and no more than 20%. The organic matter content shall be at least 50% on a dry weight basis.
 - 2. The pH of the material shall be between 6 and 7.5.
 - 3. The salt content shall be less than 10 millimho/cm @ 25° C. (ECe less than 10) in a saturated paste extract.
 - 4. Boron content of the saturated extract shall be less than 1.0 part per million.
 - 5. Silicon content (acid-insoluble ash) shall be less than 50%.
 - 6. Calcium carbonate shall not be present if to be applied on alkaline soils.
 - 7. Types of acceptable products are composts, manures, mushroom composts, straw, alfalfa, peat mosses etc. low in salts, low in heavy metals, free from weed seeds, free of pathogens and other deleterious materials.
 - 8. Composted wood products are conditionally acceptable [stable humus must be present]. Wood based products are not acceptable which are based on red wood or cedar.
 - 9. Sludge-based materials are not acceptable.
 - 10. Carbon:nitrogen ratio is less than 25:1.
 - 11. The compost shall be aerobic without malodorous presence of decomposition products.
 - 12. The maximum particle size shall be 0.5 inch, 80% or more shall pass a No. 4 screen.

Maximum total permissible pollutant concentrations in amendment in parts per million on a dry weight basis:

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arsenic	20	copper	150	selenium	30
cadmium	15	lead	100	silver	10
chromium	100	mercury	10	vanadium	200
cobalt	50	molybdenum	20	zinc	200
		nickel	100		

- C. Additional Amendments and/or fertilizers based on lab recommendations.

2.6 CHEMICAL COMPONENTS: The following additives may or may not be used depending on the outcome of the soils report.

- A. Gypsum: Agricultural grade product containing 80% minimum calcium sulfate.
- B. Potassium Sulfate: Agricultural grade (0-050) containing 50% to 53% of water-soluble potash.
- C. Soil Sulfur: Agricultural grade sulfur containing a minimum of 96% sulfur.

PART 3 - EXECUTION

3.1 SOIL MOISTURE CONTENT

- A. General: Do not work soil when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in air or that clods will not break readily. Apply water, if necessary, to bring soil to an optimum moisture content for tilling and planting.
- B. Range: Maintain within 2 percent above or below optimum moisture content at all times during the work.

3.2 SUBSOIL PREPARATION AND AMENDMENT

- A. Clearing: Clear all planting areas of stones 2 in. diameter and larger, weeds, debris and other extraneous materials prior to soil preparation work.
- B. Subgrade Preparation
 - 1. Verification:
 - a. Verify that subgrades for installation of topsoil have been established under rough grading. Do not spread topsoil prior to acceptance of subgrade work.
 - b. Depth: Verify that subgrades are 6 in. minimum below finished grades, plus or minus 2 inches. Report all variations.
 - 2. Cultivation: Rip or cultivate planting area subgrades to a depth of 8 in. immediately prior to applying soil amendments.

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3.3 SPREADING OF TOPSOIL

- A. General: Spread Stockpiled topsoil over accepted subgrade prior to incorporating amendments.
- B. Restrictions: Do not commence spreading of topsoil prior to acceptance of subsoil preparation and amendment above. Do not place topsoil under muddy conditions.
- C. Topsoil Depth: Minimum depth of 18 inches, or as shown on Drawings, after natural settlement and light rolling conforming to finished grades shown on Drawings.

3.4 TOPSOIL AMENDMENT

- A. Amend top soil according to the laboratory analysis and amendment recommendations. Evenly spread and thoroughly blend the amendment materials into the top 6 inches of subsoil to form a homogenous layer.
- B. Compost application rate: Submit compost test data with topsoil samples to testing agency. Testing agency to determine application rate to achieve 4 to 6 percent organic matter content (by dry weight) in topsoil.
- C. Compost application method: Apply compost according to supplier recommendations.

3.5 LAWN SOIL MIX AT AMPHITHEATER

- A. Test over-structure mix and adjust mix in conformance with soils lab's recommendations prior to transport and placement at amphitheater structure.
- B. Place soil mix carefully to avoid damage or displacement of other materials such as walls, paving, drainage components, filter fabric, or roofing membrane.
- C. Place soil mix to within 1 inch above the final grade indicated on the Drawings and compacted as described below. For final grades greater than 12- inches, place soil at no greater than 8- inch lifts and repeat procedure until soil has been compacted within 2- inches of final grade. The remaining soil should be loosely placed at 1- inch greater than final grade and water-jet settled.
- D. Compaction shall be performed with a 200-300 lb. landscape roller or lightly compacted with a hand held mechanical compactor to achieve about 50 – 60 percent compaction as determined by ASTM D1557.
- E. After compaction remaining soil shall be placed and thoroughly watered or jetted over entire area. Fill settled low areas with additional soil and re-wet to achieve uniform prescribed final grade.
- F. Layout and install plant materials in conformance with Section 32 93 00 "Trees, Shrubs, Ornamental Grasses and Ground Cover". Material shall have appropriate fertilizers and conditioners added as

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indicated in Soils Laboratory's recommendations and all plant material shall have an initial watering as part of the installation process.

END OF SECTION.

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SECTION 32 91 13 - 2

SOIL PREPARATION - BIORETENTION SOIL

PART 1 - GENERAL

1.1 SUMMARY

- A. BIORETENTION SOIL MIX
- B. AGGREGATE STORAGE
- C. MULCH
- D. WORK SPECIFIED ELSEWHERE:
- E. SECTION 02200: EARTHWORK
- F. SECTION 02950: LANDSCAPE MAINTENANCE
- G. SECTION 02953: LAWNS, GRASSES AND HYDROSEED
- H. SECTION 02810: IRRIGATION SYSTEM
- I. SECTION 02950: LANDSCAPE PLANTING
- J. SECTION 02310: FINISH GRADING

1.2 REFERENCED STANDARDS

- A. ASTM: AMERICAN SOCIETY FOR TESTING AND MATERIALS
 - 1. ASTM C136-84a - Method for Sieve Analysis of Fine and Course Aggregates.
 - 2. ASTM D422-63 (1972)- Method for Particle Size Analysis of Soils
 - 3. ASTM D2607-69- Classification of Peats, Mosses, Humus, and Related Products.
 - 4. ASTM D2974-84- Test Method for Moisture, Ash, and Organic Matter of Peat Materials.
 - 5. ASTM D2976-71 (1981) Test Method for pH of Peat Materials.
 - 6. ASTM D5268-92 - Standard Specification for Topsoil Used for Landscaping Purposes.
- B. USDA: UNITED STATES DEPARTMENT OF AGRICULTURE
 - 1. USDA Soil Particle Size & Texture Classes.
- C. AOAC: ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS STANDARDS.

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D. CALTRANS – STANDARD SPECIFICATIONS

E. SAN FRANCISCO DPW – ENGINEERING STANDARD SPECIFICATIONS

1.3 DEFINITIONS

A. FINISH GRADE: ELEVATION OF FINISHED SURFACE OF PLANTING SOIL.

B. EXISTING SOIL: AREA OF UNDISTURBED NATIVE SOIL WHERE NO ROUGH GRADING IS TO BE DONE. NO TOPSOIL IS TO BE PLACED. ONLY SURFACE CULTIVATION AND SOIL AMENDING ARE INCLUDED IN THIS SECTION. SEE DRAWINGS.

C. SUBSOIL: SOIL LEVEL RESULTING FROM THE ROUGH GRADING WORK UNDER ANOTHER SECTION. SUBSOIL FOR ALL PARK AREAS MUST BE SUITABLE FOR PLANT GROWTH. CULTIVATION OF SUBSOIL AREAS PRIOR TO AMENDING IS INCLUDED IN THIS SECTION.

D. NATIVE STOCKPILED TOPSOIL: NATIVE TOPSOIL STRIPPED AND STOCKPILED PRIOR TO ROUGH GRADING WORK IN ANOTHER SECTION TO BE AMENDED AND SPREAD OVER PREPARED SUBGRADE. NATIVE TOPSOIL MUST ALSO MEET THE REQUIREMENTS OF SECTION 2.1.A. STOCKPILED NATIVE TOPSOIL.

E. IMPORTED TOPSOIL: OFFSITE TOPSOIL IMPORTED AND STOCKPILED UNDER THIS SECTION, TO BE SPREAD AND AMENDED ALSO AS WORK UNDER THIS SECTION.

F. BIORETENTION SOIL MIX (BSM): A SOIL MIX THAT HAS BEEN SPECIALLY BLENDED AND TESTED FOR USE IN BIORETENTION FACILITIES WITH THE INTENT TO MEET THE FOLLOWING OBJECTIVES:

1. Infiltrate runoff at a minimum rate of 5 inches per hour throughout the life of the facility, and
2. By nature of its components be capable of the removal of certain suspended and dissolved stormwater pollutants, and
3. Have sufficient moisture retention and other agronomic properties to support healthy vegetation.

1.4 SUBMITTALS

A. PRE-INSTALLATION SUBMITTALS: THE CONTRACTOR SHALL SUBMIT TO THE ENGINEER/LANDSCAPE ARCHITECT THE FOLLOWING A MINIMUM OF 20 CALENDAR DAYS (OR AS DIRECTED BY THE ENGINEER/LANDSCAPE ARCHITECT) PRIOR TO THE CONSTRUCTION OF BIORETENTION FACILITIES:

1. BSM Submittals
 - a. Two one (1) gallon samples of the BSM.
 - b. Source certificates for all BSM materials.

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- c. Sieve analysis of BSM per ASTM D422 performed within two (2) months of product delivery to site
 - d. Certification from the soil supplier or an accredited testing agency that the BSM, including sand and compost components, conforms to all industry or technical society reference standards specified in Sections 2.01.A, 2.01.B, and 2.01.C.
 - e. A description of the equipment and methods used to mix the sand and compost to produce BSM.
 - f. Organic content test results of the BSM, performed in accordance with Testing Methods for the Examination of Compost and Composting (TMECC) 05.07A, "Loss-On-Ignition Organic Matter Method."
 - g. Permeability test results for BSM per ASTM D2434 (Modified). See SFPUC Modified ASTM D2434 Procedures for required modifications to test.
2. Sand Submittals
 - a. Sieve analysis of sand per ASTM D422 performed within two (2) months of product delivery to site.
3. Compost Submittals
 - a. Quality analysis results for compost performed in accordance with Seal of Testing Assurance (STA) standards, as specified in Section 2.01.C, and performed within two (2) months of product delivery to site.
 - b. Sieve analysis of compost per TMECC 02.02-B performed within two (2) months of product delivery to site.
4. Other Submittals
 - a. Cut sheets of any media or soil admixes to enhance moisture retention properties, if used.
 - b. Testing agency qualifications as specified in Section 1.06.B.
 - c. Aggregate Mulch

1.5 QUALITY CONTROL AND QUALITY ASSURANCE

A. GENERAL: TEST AND INSPECT BIORETENTION MATERIALS AND OPERATIONS AS WORK PROGRESSES AS DESCRIBED IN THIS SECTION. FAILURE TO DETECT DEFECTIVE WORK OR MATERIALS AT ANY TIME WILL NOT PREVENT REJECTION IF A DEFECT IS DISCOVERED AFTER INSTALLATION, NOR SHALL IT CONSTITUTE FINAL ACCEPTANCE.

1. Testing Agency Qualifications: Wallace Laboratories, 365 Corel Circle, El Segundo, CA 90245 (310) 615-0116. Or approved equivalent.
2. Compost: Laboratory that performs testing shall be independent, enrolled in the US Composting Council's (USCC) Compost Analysis Proficiency (CAP) program, and perform testing in accordance with USCC Test Method for The Examination of Composting and Compost (TMECC). The sample collection protocol can be obtained from the U.S. Composting Council, 4250 Veterans Memorial Highway, Suite 275, Holbrook, NY 11741, 631-737-4931, www.compostingcouncil.org.

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B. RESPONSIBILITIES OF CONTRACTOR

1. Submittals: Some of the tests required for this specification are unique, and BSM shall be considered a long-lead-time item. Under no circumstance shall failure to comply with all specification requirements be an excuse for a delay or for expedient substitution of unacceptable material(s). The requirements of Division 0 apply in their entirety.
2. Pre-Placement Conference: A mandatory pre-placement conference will take place, including at a minimum the Engineer/Landscape Architect, the Resident Engineer, the Owner/Client Representative, Installer, and general Contractor, to review schedule, products, soil testing, permeability testing, and installation. The Contractor shall notify the Engineer/Landscape Architect a minimum of 2 working days prior to conference.
3. Testing: All testing specified herein is the responsibility of the Contractor and shall be conducted by an independent testing agency, retained by the Contractor. The Owner reserves the right to conduct additional testing on all materials submitted, delivered, or in-place to ensure compliance with Specifications.

C. Bioretention Soil Testing Requirements:

1. Provide 1 soil test for every 500 cubic yards of soil.
2. Sieve analysis of BSM per ASTM D422 performed within two (2) months of product delivery to site
3. Organic content test results of the BSM, performed in accordance with Testing Methods for the Examination of Compost and Composting (TMECC) 05.07A, "Loss-On-Ignition Organic Matter Method."
4. Permeability test results for BSM per ASTM D2434 (Modified). See SFPUC Modified ASTM D2434 Procedures for required modifications to test.

D. Contractors Responsibility:

1. General: Coordinate quality control activities to avoid delay.
2. Contractor shall collect and deliver required samples to approved testing lab.
3. Notice: Furnish notice to Owner and/or Architect and testing and inspection agency not less than 48 hours prior to any time required for such services.
4. Rejected Materials: Remove off site at Contractor's cost. Pay cost of testing of materials, not meeting Specifications.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect the BSM and mulch from contamination and all sources of additional moisture at supplier site, during transport, and at the project site, until incorporated into the Work.

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- B. The Contractor is required to coordinate delivery of BSM and aggregates with bioretention facility excavation and soil installation. A written schedule shall be submitted for review as part of the submittal package. BSM should not be stockpiled onsite for any length of time. In no case shall BSM be stockpiled onsite for more than 24 hours without prior written approval by the Engineer/Landscape Architect. If stockpiling onsite for any length of time, BSM stockpiles shall meet the following requirements:
 - 1. Locate stockpiles away from drainage courses, inlets, sewer cleanout vents, and concentrated stormwater flows
 - 2. Place stockpiles on geotextile fabric
 - 3. Cover stockpiles with plastic or comparable material
 - 4. Contain stockpiles (and prevent contamination from adjacent stockpiles) with temporary perimeter barrier (e.g., sand bags, wattles, silt fence)
- C. Prevent spillage when hauling on or adjacent to any public street or highway. In the event that spillage occurs, remove all spillage and sweep, wash, or otherwise clean such streets or highways as required by local City, County and/or the State Authorities.
- D. Take precautions to prevent a dust nuisance to adjacent public or private properties and to prevent erosion and transportation of soil to downstream or adjacent properties due to work under this Contract. At project site exit, clean dirt from tires. Do not track dirt onto highways.
- E. Prior to delivery, propose suitable stockpile locations and required area for review and approval by Owner's Representative.
- F. Stockpile to a 6-foot high maximum and protect from traffic, wind and water erosion. Provide temporary seeding and/or erosion control measures as approved by Owner's Representative.
- G. Protect inorganic mulch from contamination by foreign materials. Isolate stockpiles to prevent mixing of different aggregate grades. Prevent contamination by organic materials.
- H. Before Landscape Soils are redistributed from stockpiles homogenize to make a uniform mix, free of lenses and other irregularities.

1.7 SEQUENCING AND SCHEDULING

- A. Soil testing of subsoil to be performed and amended per Soil test recommendations prior to placement of topsoil.

1.8 COORDINATION

- A. Coordinating stockpiles: Be responsible for any necessary temporary storage and staging of soil works including relocating stockpiles to accommodate the scheduling of other work. Coordinate soil placement with irrigation, and planting installation.

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PART 2 - PRODUCTS

2.1 BIORETENTION SOIL MIX (BSM)

- A. General: BSM shall be a well-blended mixture of sand and compost, shall have sufficient moisture retention to support healthy plant growth, and shall meet the following criteria:
1. Mixture proportions: 30 to 40 percent Compost by volume and 60 to 70 percent Sand by volume
 2. Organic matter content: 4 to 8 percent as determined by TMECC 05.07-A, Loss on Ignition Method.
 3. Extraneous materials: BSM shall be free of all roots, plants, weeds, sod, stones, clods, pockets of coarse sand, construction debris, or other extraneous materials harmful to plant growth.
 4. Permeability/Saturated Hydraulic Conductivity: 10 inches per hour (minimum) tested in accordance with ASTM D2434 (Modified). See SFPUC Modified ASTM D2434 Procedures for required modifications to test.
 5. Acceptance of BSM quality and performance may be based on samples taken from stockpiles at supplier's yard, submitted test results, and/or onsite and laboratory testing of installed material at the discretion of the Engineer/Landscape Architect. The point of acceptance will be determined in the field by the Engineer/Landscape Architect.
- B. Sand: Sand in the BSM shall conform to the requirements for Sand, Type specified herein, unless otherwise approved by the Engineer/Landscape Architect.
1. Sand shall be free of wood, waste, coating, or any other deleterious material.
 2. Sand material shall meet the following specifications for gradation.

Sieve Size ¹	Percent Passing by Weight	
	Type A ²	Type B (low fines) ³
3/8 inch	100	100
No. 4	90 to 100	90 to 100
No. 8	70 to 100	70 to 100
No. 16	40 to 95	40 to 85
No. 30	15 to 70	15 to 60
No. 50	5 to 55	8 to 15
No. 100	0 to 15	0 to 4
No. 200	0 to 5	0 to 2

¹ Sieve provided in nominal size square openings or United States Standard Sieve Series sizes.

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- ² Sand conforming to ASTM C33 for Fine Aggregate satisfies the requirements of this specification for Sand, Type A.
 - ³ Type B (low fines) sand gradation pending local availability.
3. Coefficient of Uniformity: $C_u = \frac{D_{60}}{D_{10}}$; 4 or less for Sand, Type B.
 4. Effective Particle Size (D10): 0.3 to 0.5 mm for Sand, Type B.
 5. All aggregate passing the No. 200 sieve shall be non-plastic.
 6. Acceptance of grading and quality of the sand may be based on samples taken from stockpiles at supplier's yard or a submitted gradation report at the discretion of the Engineer/Landscape Architect. The point of acceptance will be determined in the field by the Engineer/Landscape Architect.
- C. Compost: Compost in the BSM shall organic matter sourced from waste materials including yard debris, wood wastes or other organic materials, not including biosolids or manure feedstock. Compost shall conform to California Code of Regulations Title 14, Division 7, Chapter 3.1 requirements, be certified through the USCC Seal of Testing Assurance (STA) Program, and meeting the criteria specified herein be well decomposed, stable, weed free.
 1. Feedstock: Feedstock materials shall be specified and include one or more of the following: landscape/yard trimmings, grass clippings, food scraps, and agricultural crop residues. Feedstock shall not include biosolids or manure.
 2. Organic Matter Content: 35 to 75 percent by dry weight tested in accordance with TMECC 05.07-A (Loss on Ignition Organic Matter Method).
 3. Carbon to Nitrogen Ratio: C:N between 15:1 and 25:1 when tested in accordance with TMECC 05.02-A.
 4. Maturity/Stability: shall have a dark brown color and a soil-like odor. Compost exhibiting a sour or putrid smell, containing recognizable grass or leaves, or is hot (120°F) upon delivery or rewetting is not acceptable. In addition any one of the following is required to indicate stability:
 - a. Specific Oxygen Uptake Rate (SOUR): 1.5 milligrams O₂ per gram biodegradable volatile solids per hour (maximum) per TMECC 05.08-A.
 - b. Carbon Dioxide Evolution Rate: 8 milligrams CO₂ per gram volatile solids per day per TMECC 05.08-B.
 - c. Dewar Self Heating Test: 20°C temperature rise (maximum) per TMECC 05.08-D (Class IV or V).
 - d. Solvita®: Index value greater than 6 per TMECC 05.08-E.
 5. Toxicity: Seed Germination: greater than 80 percent of control AND Vigor: greater than 80 percent of control per TMECC 05.05-A.
 6. Nutrient Content: provide analysis detailing nutrient content including N-P-K, Ca, Na, Mg, S, and B.
 - a. Total Nitrogen: 0.9 percent (minimum).
 - b. Boron: Total shall be < 80 ppm
 7. Salinity/Electrical Conductivity: less than 6.0 deciSiemen per meter (dS/m or mmhos/cm) per TMECC 04.10-A (1:5 Slurry Method, Mass Basis).

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8. pH: 6.5 to 8 per TMECC 04.11-A (1:5 Slurry pH).
9. Gradation: Compost for BSM shall meet the following size gradation per TMECC 02.02-B (test shall be run on dry compost sample):

Sieve Size	Percent Passing by Weight	
	<i>Min</i>	<i>Max</i>
1 inch	99	100
1/2 inch	90	100
1/4 inch	40	90
No. 200	1	10

10. Bulk density: 500 to 1,100 dry pounds per cubic yard.
11. Moisture content: 30 to 55 percent of dry solids.
12. Inerts: compost shall be relatively free of inert ingredients, including glass, plastic and paper, less than 1 percent by weight or volume per TMECC 03.08A.
13. Weed seed/pathogen destruction: provide proof of process to further reduce pathogens (PFRP). For example, turned windrows must reach minimum 55°C for 15 days with at least 5 turnings during that period.
14. Select Pathogens
- a. Salmonella: less than 3 Most Probable Number per 4 grams of total solids, dry weight per TMECC 07.02.
 - b. Coliform Bacteria: fecal coliform less than 1,000 Most Probable Number per gram of total solids, dry weight per TMECC 07.01.
15. Trace Contaminants Metals (lead, mercury, etc.): Product must meet US EPA, 40 CFR 503 regulations.

D. Soil Admixtures: [Specify admixtures, if used]

2.2 AGGREGATE STORAGE

- A. Aggregate Storage shall consist of hard, durable, and clean, sand, gravel, or mechanically crushed stone, substantially free from adherent coatings. Materials shall be washed thoroughly to remove fines, organic matter, extraneous debris, or objectionable materials. Recycled materials are not permitted. The material shall be obtained only from a source(s) approved by the Engineer/Landscape Architect. Written requests for source approval shall be submitted to the Engineer/Landscape Architect not less than ten (10) working days prior to the intended use of the Material. Should the proposed source be one that the Engineer/Landscape Architect has no history of Material performance with, the Engineer/Landscape Architect reserves the right to take preliminary samples at the proposed source, and make preliminary tests, to first determine acceptability of the new source and then perform the applicable Material approval testing. Continued approval of a source is contingent upon the Materials from that source continuing to

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meet Contract requirements. Materials shall meet the Standard Specifications for grading and quality for use in the Work; however, allowable exceptions may be specified in the Contract.

B. Aggregate storage shall meet the following specifications for grading and quality.

1. Aggregate gradation testing in accordance with ASTM C136 at least once per 500 cubic yards.

Sieve ¹	Percent Passing by Weight		
	Choking Course ASTM No. 9 (Modified) ³	Reservoir Course ASTM No. 7 (Modified) ⁴	Caltrans Class 2 Permeable Aggregate (MS4 Areas Only)
1 inch	–	–	100
3/4 inch	–	100	90 to 100
1/2 inch	100	90 to 100	–
3/8 inch	100	40 to 70	40 to 100
No. 4	85 to 100	0 to 15	25 to 40
No. 8	10 to 40	0 to 5	18 to 33
No. 16	0 to 10	–	–
No. 30	–	–	5 to 15
No. 50	–	–	0 to 7
No. 200 ²	0 to 2	0 to 2	0 to 3

¹ Sieve provided in nominal size square openings or United States Standard Sieve Series sizes.

² Gradation modified from ASTM for portion passing the No. 200 sieve.

³ Materials likely to meet this specification are available locally as Graniterock 1/4" premium screenings (Wilson 1/4" x #10 Premium Screenings).

⁴ Materials likely to meet this specification are available locally as Graniterock 1/2" premium screenings (Wilson 1/2" x #4 Roofing Aggregate).

2. Crushed Particles: 90 percent (minimum) fractured faces tested in accordance with California Test 205. Do not use rounded river gravel.
3. L.A. Abrasion: 40 percent (maximum) tested in accordance with ASTM C 131.

2.3 MULCH

A. Aggregate Mulch :

1. See Materials Schedule for mulch color, finish and supplier.

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2. Mulch shall be free of dyes, recycled dimensional lumber, and bark. Materials selected shall be sufficiently permeable to allow water to pass through at a rate equal to or greater than the underlying BSM.

2.4 ACCESSORIES

- A. Herbicides and Pesticides: Products as approved by SFE Integrated Pest Management.
- B. Water: Clean, fresh and potable, as available from Owner. Transport as required.

PART 3 - EXECUTION

3.1 GENERAL

- A. Prevent runoff from adjacent pervious and impervious surfaces from entering the bioretention facility (e.g., sand bag inlet curb cuts, stabilize adjacent areas, flow diversion) until authorization is given by the Engineer/Landscape Architect. Refer to SFPUC Specification Section 01 57 29 Temporary Protection of Green Infrastructure Facilities.
- B. Exclude equipment from bioretention facilities. No equipment shall operate within the facility once bioretention facility excavation has begun, including during and after excavation, backfilling, mulching, or planting.
- C. Prevent foreign materials and substances, such as silt laden run-off, construction debris, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid from entering or being stored in the facility at any point during construction.

3.2 GRADING

- A. The Contractor shall not start bioretention facility grading until all areas draining to the facility are stabilized and authorization has been given by the Engineer/Landscape Architect.
- B. Construct bioretention facility subgrade to +/- 3/4 inch of the grades and slopes specified on the Plans.
- C. Excavation within 6 inches of final native soil grade shall not be permitted if facility soils have standing water, or have been subjected to more than 1/2 inch of precipitation within the previous 48 hours.

3.3 SUBGRADE PREPARATION AND PROTECTION

- A. Protect the bioretention excavation from over compaction and/or contamination.
- B. Areas which have been over compacted by equipment or vehicle traffic or by other means and which need to be ripped, over excavated, receive additional scarification, or other restorative

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means shall be done at the Contractor's expense and at the direction of the Engineer/Landscape Architect.

- C. Excavated areas contaminated by sediment laden runoff prior to placement of BSM or Aggregate Storage material shall be remediated at the Contractor's expense by removing the contaminated soil (top 3 inches minimum) and replacing with a suitable material, as determined by the Engineer/Landscape Architect.
- D. Remove all trash, debris, construction waste, cement dust and/or slurry, or any other materials that may impede infiltration into prepared subgrade.
- E. The subgrade shall be inspected and accepted by the Engineer/Landscape Architect prior to placement of any materials or final subgrade scarification.
- F. Scarify the surface of the subgrade to a minimum depth of 3 inches immediately prior to placement of BSM or aggregate storage material. Acceptable methods of scarification include use of excavator bucket teeth or a rototiller to loosen the surface of the subgrade.
- G. Place aggregate storage material, where shown on drawings with conveyor belt or with an excavator or loader from a height no higher than 6 feet unless otherwise approved by the Engineer/Landscape Architect (i.e., do not dump material directly from truck into cell).
- H. Aggregate Storage areas contaminated by sediment-laden runoff prior to placement of BSM shall be remediated at the Contractor's expense by removing the contaminated aggregate storage material (top 3 inches minimum or as directed by the Engineer/Landscape Architect) and replacing with clean aggregate storage material per Section 2.03, to the lines and grades on the Plans.
- I. Aggregate Storage material shall be inspected and accepted for placement and finish grade by the Engineer/Landscape Architect prior to the installation of BSM. Any material that does not conform to this Specification shall be removed and replaced with acceptable material or remediated to the satisfaction of the Engineer/Landscape Architect, at the Contractor's expense.

3.4 BIORETENTION SOIL MIX PLACEMENT

- A. The Contractor shall not place BSM until the Engineer/Landscape Architect has reviewed and confirmed the following:
 - 1. BSM delivery ticket(s): Delivery tickets shall show that the full delivered amount of BSM matches the product type, volume and manufacturer named in the submittals. Each delivered batch of BSM shall be accompanied by a certification letter from the supplier verifying that the material meets specifications and is supplied from the approved BSM stockpile.
 - 2. Visual match with submitted samples: Delivered product will be compared to the submitted 1-gallon sample, to verify that it matches the submitted sample. The Engineer/Landscape Architect may inspect any loads of BSM on delivery and stop

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- placement if the soil does not appear to match the submittals; and require sampling and testing of the delivered soil to determine if the soil meets the requirements of Section 2.01 before authorizing soil placement.
3. Inspection of the aggregate storage layer, underdrain, cleanout, and overflow structure installation, where included on the plans.
-
- B. BSM placement, grading and consolidation shall not occur when the BSM is excessively wet, or has been subjected to more than 1/2 inch of precipitation within 48 hours prior to placement. Excessively wet is defined as being at or above 22 percent soil moisture by a General Tools & Instruments DSMM500 Precision Digital Soil Moisture Meter with Probe (or equivalent). A minimum of three readings with the soil moisture probe will be used to determine the average percent soil moisture reading per each truck load. There should be no visible free water in the material.
 - C. The Contractor shall place BSM loosely with a conveyor belt or with an excavator or loader from a height no higher than 6 feet, unless otherwise approved by the Engineer/Landscape Architect (i.e., do not dump material directly from truck into cell). Soil shall be placed upon a prepared subgrade in accordance with these Specifications and in conformity with the lines, grades, depth, and typical cross-section shown in the Drawings or as established by the Engineer/Landscape Architect.
 - D. Excessively dry BSM may be lightly and uniformly moistened, as necessary, to facilitate placement and workability.
 - E. Compact BSM using non-mechanical compaction methods (e.g., boot packing, hand tamping, or water consolidation) to 83 percent (+/- 2 percent) of the maximum dry density per modified Proctor test (ASTM D1557), or as directed by the Geotechnical Engineer. Determination of in-place density shall be made using a nuclear gauge per ASTM D6938. Moisture content determination shall be conducted on a soil sample taken at the location of the nuclear gage reading per ASTM D2216.
 - F. Grade BSM to a smooth, uniform surface plane with loose, uniformly fine texture. Rake, remove ridges, and fill depressions to meet finish grades.
 - G. Final soil depth shall be measured and verified only after the soil has been compacted. If after consolidation, the soil is not within +/- 3/4 inch of the grades and slopes specified on the Plans, add material to bring it up to final grade and raked.
 - H. The BSM shall be inspected and accepted for placement and finish grade by the Engineer/Landscape Architect prior to the installation of planting and mulch. Any BSM that does not conform to this Specification shall be remediated to the satisfaction of the Engineer/Landscape Architect, or removed and replaced with acceptable BSM, at the Contractor's expense.

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3.5 PLANTING AND MULCHING

- A. Bioretention facilities shall be planted and mulched as shown on the Plans.
- B. Bioretention facilities shall not be planted or mulched when soils are excessively wet as defined in Section 3.04.
- C. Bioretention facility areas contaminated by sediment laden runoff prior to planting or placement of mulch shall be remediated at the Contractor's expense by removing the contaminated BSM (top 3 inches minimum) and replacing with BSM per Section 2.01, to the lines and grades on the Plans.
- D. All mulch shall be inspected and accepted by the Engineer/Landscape Architect to ensure appropriate depth and material prior to facility commissioning (e.g., unblocking of inlets).

3.6 FLOOD TESTING

- A. Inlets shall be constructed per the Plans and free from all obstructions prior to commencing flow testing.
- B. Testing shall be conducted at the conclusion of the 90-day plant grow-in period. Protection and flow diversion measures installed to comply with Section 01 57 29 Temp Protection of GI Facilities shall be removed in their entirety prior to commencing flow testing.
- C. Underdrains shall be plugged at the outlet structure to minimize water consumption during testing.
- D. Prior to testing, broom sweep gutter and other impervious surfaces within the test area to remove sediments and other objectionable materials.
- E. The Engineer/Landscape Architect shall be present during the demonstration. The Contractor shall notify the Engineer/Landscape Architect a minimum of 2 working days prior to testing.
- F. The Contractor shall water test each facility to demonstrate that all inlet curb openings are capturing and diverting all water in the gutter to the facility, outlet structures are engaging at the elevation specified, and the designed ponding depth is achieved. Testing shall include application of water from a hydrant or water truck per Section 00 73 73, Article 3.04 (Requirements for Using Water For Construction), at a minimum rate of 10 gallons per minute, into the gutter a minimum of 15 feet upstream of the inlet curb opening being tested. Each inlet shall be tested individually. If erosion occurs during testing, restore soils, plants, and other affected materials.
- G. Engineer/Landscape Architect will identify deficiencies and required corrections, including but not limited to relocating misplaced plants, adjusting streambed gravel, adjusting mulch, adjusting inlets, splash aprons, and forebays, removing and replacing inlets, and removing debris.

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- H. Once adjustments are made, the Contractor shall re-test to confirm all test water flows into the facility from the gutter and correct any remaining deficiencies identified by Engineer/Landscape Architect.
- I. Inlets, outlets, and other bioretention facility appurtenances shall not be accepted until testing and any required correction and retesting is complete and accepted by the Engineer/Landscape Architect.

END OF SECTION

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SECTION 32 91 13-03

SOIL PREPARATION - STRUCTURAL SOIL

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 the following:
 - 1. Structural Soil sub-base material and installation.
 - 2. Structural soil occurs at soils trenches as shown on plans
- B. Work specified elsewhere:
 - 1. Section: Earthwork:
 - 2. Section 32 91 19: Landscape Grading
 - 3. Section 32 90 00 Planting
 - 4. Section 12 93 50: Site Furnishings
 - 5. Section 03 30 00: Cast-in-Place Concrete
 - 6. Section 32 13 13: Concrete Paving

1.3 DEFINITIONS

- A. Backfill: Soil materials used to fill an excavation.
- B. Excavation: Removal of material encountered above subgrade elevations.
 - 1. Additional Excavation: Excavation below subgrade elevations as directed by Architect. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 - 2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

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- C. Fill: Soil materials used to raise existing grades.
- D. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- E. Subbase Course: Layer placed between the subgrade and base course for asphalt paving, or layer placed between the subgrade and unit paving or concrete pavement.
- F. Sub-grade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below sub-base, drainage fill, or topsoil materials.
- G. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

- A. Contractor Qualifications: Submit the Landscape or Pavement Contractor's qualifications outlining projects of similar quality, schedule requirements and construction detailing over the last five years. Qualifications shall include: the names of all similar projects, year completed, location, description of the scope of work including the types and quantities of planting mix/pavement material installed.
- B. Samples: Representative samples of the structural soil materials with documentation showing their conformance to the specifications including certified tests from the manufacturer.
 - 1. Submit two one half cubic foot samples each of the clay loam and the crushed rock to be used in the CU-Soil™ for testing, analysis and approval.
- C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated: (All testing and analysis shall be at the expense of the contractor)
 - 1. The clay loam soil will be tested for the following:
 - a. Physical properties and USDA Classification
 - b. PH
 - c. Percent organic matter by dry weight.
 - d. Nutrient levels by ppm
 - e. Toxic elements and compounds.
 - f. Soluble Salt (ECE)
 - g. Cation exchange capacity (CEC)

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- h. Carbon/Nitrogen ratio.
- 2. The crushed stone will be tested for the following:
 - a. Physical properties (Size)
 - b. Specific Gravity
- 3. A representative sample of the finished CU-Structural soil will be tested for the following:
 - a. California Bearing Ratio of 50 or greater.
 - b. Measured dry weight of stone in mixture.
 - c. The approved sample will be the standard for any further quality control testing as may be required by the engineer.

1.5 QUALITY ASSURANCE

- A. Structural Soil: The structural soil supplier must be a licensed producer of CU-Structural Soil™ from Amereq, Inc.
- B. Qualifications of Landscape or Pavement material Contractor: The work of this section shall be performed by a Contracting firm which has a minimum of five years experience successfully installing base material and/or planting mix of a similar quality, schedule requirement and construction detailing to this project.
- C. Soil Testing Agency Qualifications: An independent testing agency, acceptable to Architect, qualified to conduct soil materials testing as documented in applicable ASTM standards.
- D. Preinstallation Conference: Conduct conference at Project site prior to delivery and installation of materials to comply with requirements in Division 1.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver or place soils in frozen, wet, or muddy conditions. Material shall be delivered at or near optimum compaction moisture content as determined by AASHTO T99 (ASTM D 698). Do not deliver or place materials in an excessively moist condition (Beyond two percent above optimum compaction moisture content as determined by AASHTO T 99 (ASTM D 698).
- B. Protect soils and mixes from absorbing excess water and from erosion at all times. Do not store materials unprotected from large rainfall events. Do not allow excess water to enter site prior to compaction. If water is introduced into the material after grading, allow material to drain or aerate to optimum compaction moisture content.

PART 2 - PRODUCTS

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2.1 STRUCTURAL SOIL: CU-STRUCTURAL SOIL™ BY LICENSED SUPPLIER:

- A. Licensed supplier:
TMT Enterprises, Inc.
1996 Oakland Road
San Jose, CA 95131
Phone: 408-432-9040
Fax : 408-432-9429
- B. CU-Structural Soil™: A uniformly blended mixture of crushed Stone, Clay Loam and Hydrogel, mixed to the following proportion:

Crushed Stone	100 units
Clay Loam Soil	20 Units
Gelscape	.03 Units
Water	As needed for soil to adhere to stone.

2.2 CLAY LOAM

- A. General: Clay Loam shall be a "loam" based on the "USDA classification system" as determined by mechanical analysis (ASTM D-422) and it shall be of uniform composition, without admixture of subsoil.
- B. Mechanical Analysis of clay loam shall be as follows:
- | Textural Class | % of Total Weight |
|----------------|-------------------|
| Gravel | less than 1% |
| Sand | 20-50% |
| Silt | 20-50% |
| Clay | 20-40% |
- C. Chemical Analysis should meet or be amended to meet the following criteria:
1. pH 5.5-7.5
 2. Organic Matter, 2-5% by dry weight.
 3. Soluble Salt less than 1.0 Millimho per cm.
 4. Toxic elements and compounds below the United States Environmental Protection Agency Standards for Exceptional Quality sludge or local standard; whichever is more stringent.

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- D. Commercial fertilizers to be added will be of the type and application rates recommended by the soil-testing laboratory based on the type of plant material to be installed in the soil.

2.3 CRUSHED STONE

- A. Crushed Stone shall be ½" to 1 1/2" highly angular crushed granite with no more than 10% passing the ½" sieve meeting the following criteria:

2"	100% Passing	
1.5"	94%	"
1"	43%	"
.75"	12%	"
.50"	7%	"
.375"	4%	"
#4	2%	"

Specific Gravity=2.78

2.4 HYDROGEL: HYDROGEL SHALL BE GELSCAPE™ AS MANUFACTURED BY AMEREQ, INCORPORATED OF NEW CITY, NY. PHONE: 800-832-8788.

2.5 GEOTEXTILES

- A. Drainage Fabric: Non-woven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:
1. Grab Tensile Strength: 110 lbf; ASTM D 4632.
 2. Tear Strength: 40 lbf ; ASTM D 4533.
 3. Puncture Resistance: 50 lbf ; ASTM D 4833.
 4. Water Flow Rate: 150 gpm per sq. ft.; ASTM D 4491.
 5. Apparent Opening Size: No. 50 ; ASTM D 4751.

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- B. Separation Fabric: Woven geotextile, specifically manufactured for use as a separation geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:
 - 1. Grab Tensile Strength: 200 lbf ; ASTM D 4632.
 - 2. Tear Strength: 75 lbf ; ASTM D 4533.
 - 3. Puncture Resistance: 90 lbf ; ASTM D 4833.
 - 4. Water Flow Rate: 4 gpm per sq. ft.; ASTM D 4491.
 - 5. Apparent Opening Size: No. 30 ; ASTM D 4751.

PART 3 - EXECUTION

3.1 UNDERGROUND UTILITIES AND SUBSURFACE CONDITIONS

- A. Notify the Architect of any subsurface conditions, which will affect the Contractor's ability to complete the work.
- B. Locate and confirm the location of all underground utility lines and structures prior to the start of any excavation.

3.2 SITE PREPARATION

- A. Excavation: Excavation for structural soil areas shall be as per Section 2 "Earthwork". Excavate and compact the proposed subgrade to depths, slopes and widths as shown on the Drawings. Maintain all required angles of repose of the adjacent materials as shown on the drawings. Do not over excavate compacted subgrades of adjacent pavement or structures.
- B. Confirm that the subgrade is at the proper elevation and compacted as required. Subgrade elevations shall slope parallel to the finished grade and or toward the subsurface drain lines as shown on the drawings.
- C. Do not proceed with the installation of Structural Soil until all utility and irrigation system work in the area has been installed. All subsurface drainage systems shall be operational prior to installation of Structural Soils.

3.3 INSTALLATION OF STRUCTURAL SOIL MATERIAL

- A. Install separation fabric on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends. (As needed)
- B. Install Structural Soil in 6-inch lifts and compact each lift. Install to depth and width around tree as indicated on the Drawings.

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- C. Compact all materials to peak dry density from a standard AASHTO compaction curve (AASHTO T 99). No compaction shall occur when moisture content exceeds maximum as listed herein. Delay compaction 24 hours if moisture content exceeds maximum allowable.
 - 1. Underneath concrete paving, Structural Soil to be compacted to min. 95% relative compaction.
- D. Grading: Bring Structural Soils to finished grades as shown on the Drawings and according to "Earthwork" and "Finish Grading".
- E. The Landscape Architect may periodically check the material being delivered and installed at the site for color and texture consistency with the approved sample provided by the Contractor as part of the submittal for Structural Soil. In the event that the installed material varies significantly from the approved sample, the Landscape Architect may request that the Contractor test the installed Structural Soil. Any soil, which varies significantly from the approved testing results, as determined by the Landscape Architect, shall be removed and new Structural Soil installed that meets these specifications.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test structural soil backfill. Proceed with subsequent structural soil installation only after test results for previously completed work complies with requirements.
- C. Testing agency will test compaction of structural soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Tree Pits: At subgrade and at each compacted layer, at least one test for every tree pit.
- D. When testing agency reports that structural soils have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace structural soil to depth required; recompact and retest until specified compaction is obtained.

3.5 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, 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.

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1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION

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SECTION 32 91 19

LANDSCAPE GRADING

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. Work Included: Execute finish grades complete, as shown, and as specified.
- B. Related Sections:
 - 1. Section 31 23 33 - Trenching and Backfilling
 - 2. Section 32 80 00 - Irrigation
 - 3. Section 32 90 00 - Planting
 - 4. Section 32 91 13 - Soil Preparation

1.3 PROJECT/SITE CONDITIONS

- A. Dust Nuisance: Assume full responsibility for alleviation or prevention of dust as a result of grading work.

1.4 SEQUENCING AND SCHEDULING

- A. Complete all landscape finish grading prior to installation of sprinkler irrigation systems in each area graded.
- B. Re-grade as required to finish grades established in Drawings and as required by City Representative once the irrigation system has been installed.

PART 2 - PRODUCTS

- 2.1 NOT USED

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify that the following items have been completed prior to commencement of landscape finish grading:

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1. Rough Grading and subgrade soil amendments.
2. Installation of stockpiled and import topsoil as required and soil preparation including debris removal.
3. Approval of soil preparation.
4. Installation of drainage and subsurface drainage.

3.2 LAYOUT

- B. Lines and Elevations: The visual appearance and acceptable tolerances of the design is critically dependent upon the layout of the works. Include all costs and provide all instruments necessary to layout the works accurately. Establish lines and elevation markers by survey instrumentation for finish grades and locations.
- C. Include all costs and provide all calculations necessary to verify the subgrade, substrate and/or structural set-down elevations from the finish grades to earthwork grades. If any discrepancy is found notify the City Representative in writing prior to commencement of rough grading.
- D. Provide additional grade stakes and string lines as required to achieve grades and to enable field observations by the City Representative. Re-instate markers/stakes as required throughout the works. The City Representative may direct the layout of the more important landform elements and/or shall review the works when laid out and retains the right to adjust the layout.

3.3 LANDSCAPE FINISH GRADING

- E. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 1. Provide a smooth transition between adjacent existing grades and new grades.
 2. Grade with constant slope between points where elevations are given.
 3. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
 4. Slope grades to direct water away from buildings to drains or subdrains and to prevent ponding.
 5. Finish grade, as defined by top of soil, to meet drain grates, top of drain box concrete surrounds and other drain inlet structures flush.

3.4 TOLERANCES

- F. Comply with tolerances for lawn, grass and planting areas as follows:
 1. Elevation: 1/2 inch.
 2. Surface smoothness: Gap below ten (10) foot long straightedge not to exceed 1/2 inch in any direction.
 3. Slope: unless otherwise noted on the Drawings not less than one (1) percent fall.

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- G. Comply with tolerances for pavement and against building areas as follows:
 - 1. Elevation: 1/8 inch.
 - 2. Surface smoothness: Gap below ten (10) foot long straightedge not to exceed 1/8 inch in any direction.
 - 3. Slope: unless otherwise noted on the Drawings not less than one (1) percent fall.
 - 4. Hold finished grades below top of adjacent pavement, headers, curbs or walls as follows: 1 inch at lawn areas and 1-1/2 inch at groundcover areas.

3.5 ADJUSTING EXISTING UTILITY FEATURES

- H. Adjust existing utility surface features to meet finish grade flush in paving and set two (2) inches above finish grade in planting areas. Extend or reduce risers, boxes, chambers, basins and rings and reset castings, frames, grout beds, access doors, lids, covers and similar appurtenances.

3.6 PROTECTION

- I. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- J. 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.
 - 1. Scarify or remove and replace soil material to depth as directed by City Representative.
- K. Where settling occurs before Project warranty period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.7 CLEANING

- L. Upon completion of work or as directed by City Representative, remove all unsatisfactory soil, trash, debris, surplus materials and equipment from site and legally dispose of off the project site.

END OF SECTION

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SECTION 32 94 00

PLANTING 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. Work Included:
 - 1. Tree Stakes
 - 2. Tree Straps
 - 3. Wood Chip Mulch
 - 4. Aggregate Mulch
- B. Related Sections:
 - 1. Section 31 00 00: Earthwork
 - 2. Section 32 01 90: Landscape Operation and Maintenance
 - 3. Section 32 80 00: Planting Irrigation
 - 4. Section 32 90 00: Planting
 - 5. Section 32 91 13: Soil Preparation
 - 6. Section 32 91 19: Landscape Grading

1.4 SUBMITTALS

- A. Product Data - Manufacturer's current catalog cuts and specifications of the following:
 - 1. Tree Stakes
 - 2. Tree Straps
 - 3. Wood Chip Mulch
 - 4. Aggregate Mulch
- b. Samples:
 - 1. Wood Mulch: 1/2 gal. bag, each type.
 - 2. Aggregate Mulch: 1/2 gal. bag, each type.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all products and specified component parts to project site in appropriate protective packaging as furnished by manufacturer. Packaging for each unit shall be clearly labeled.

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- B. Store units at project site to prevent exposure to weathering, vandalism or damage from work of other trades. Damaged materials will be rejected. Remove all damaged materials from the job site immediately, and replace at no cost to the Owner.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of exterior plants.
 - 1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when exterior planting is in progress.
 - 2. Specifications for products that include manufacturer's written instructions are described in this section for Contractor's convenience. Actual components and installation instructions shall be based on the most currently available manufacturer's product literature, unless otherwise noted.

1.7 MAINTENANCE PERIOD AND FINAL ACCEPTANCE

- A. Refer to Section 32 01 90: Landscape Operation and Maintenance for maintenance of landscape accessory items during the landscape maintenance period.

1.8 REPLACEMENTS

- A. Failed Materials:
 - 1. Repair and/or replace at no cost to the Owner all planting accessory materials exhibiting conditions which are determined as unacceptable due to workmanship by the Contractor.

PART 2 - PRODUCTS

2.1 TREE STAKES: as indicated in Drawings.

2.2 TREE STRAPS: as indicated in Drawings.

2.3 WOOD CHIP MULCH: Organic Clean Small Fir Bark, free of dirt and other debris; as supplied by American Soil and Stone or Approved Equal.

- 1. Size: 1/2" -1"

2.4 AGGREGATE MULCH: Basalt Rock, free of dirt and other debris; as supplied by Broadmoor Landscape Materials or Approved Equal.

- 1. Size 3/8"-3/4"

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Finish Grades: Finish grades for planting areas shall have been established per Section 31 22 19: Landscape Grading prior to installation of any plant material.
2. Landscape Soils: Do not commence planting work prior to completion and acceptance of soil preparation.
3. Irrigation: Verify that irrigation system has been installed and accepted.

3.2 TREE STAKING AND STRAPS

A. General:

1. Trees shall be able to stand upright without support, and shall return to the vertical after their tops have been deflected horizontally and released. Stake or guy trees which do not meet this qualification.
3. Trees shall remain plumb and straight from installation through the warranty period.

B. Staking:

1. Locate stakes as detailed in the Drawings, perpendicular to prevailing wind and as close to the main trunk as is practical, avoiding root injury. Drive stakes a minimum of 12" below rootball.
2. Remove nursery-supplied stake and tie to new stakes using two tree ties. Find proper height for point of tree ties and attach as follows:
 - a. Hold trunk in one hand, pull top to one side and release. Height at which trunk will snap back to upright position while hand-held is base height. Attach tree ties to trunk 6 in. above base height.
 - b. If trunk is too "whippy" to support tree plumb, use auxiliary stake as follows:
 - 1) Attach flexible auxiliary stake to support trunk. Extend stake 30 in. below finish grade up to a point no closer than 24 in. from top of leader.
 - 2) Round and wrap the ends of the stake with friction tape. Attach stake to trunk with 1 in. wide vinyl or polyethylene tape at 10 - 15 inch intervals.

3.3 WOOD CHIP MULCH

- A. Install a 3-inch layer of mulch over all shrub areas including tree and shrub watering basins.
- B. At trees in planting area provide 12-inch diameter circle clear of mulch centered on tree trunk.

3.4 AGGREGATE MULCH

- A. Install a 3-inch layer of mulch over all bioretention planting areas.

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- B. At trees in planting area provide 12-inch diameter circle clear of mulch centered on tree trunk.

3.5 FINISH GRADING

- A. Refer to Section 32 91 19: Landscape Grading.

3.6 CLEANING

- A. Upon completion of work or as directed by Owner, remove all trash, debris, surplus materials and equipment from site and legally dispose of off the project site.

END OF SECTION

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SECTION 33 10 00

LOW PRESSURE WATER SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Site water distribution system for domestic and fire protection services up to 5 feet of any on-site building being served.
- B. Domestic water and fire protection water transmission or distribution system within a roadway or street right-of-way.

1.2 RELATED SECTIONS

- A. Section 31 21 00, Utility Trenching and Backfill

1.3 RELATED DOCUMENTS

- A. ASME
 - 1. ASME A112.1.2: Air Gaps in Plumbing Systems (for Plumbing Fixtures and Water Connect Receptors)
 - 2. ASME B1.20.1: Pipe Threads, General Purpose, Inch
 - 3. ASME B16.1: Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
 - 4. ASME B16.18: Cast Copper Alloy Solder Joint Pressure Fittings
 - 5. ASME B16.22: Wrought Copper and Copper Alloy Solder – Joint Pressure fittings
 - 6. ASME B16.26: Cast Copper Alloy Fittings for Flared Copper Tubes
- B. ASTM
 - 1. ASTM A536: Standard Specification for Ductile Iron Castings
 - 2. ASTM A674: Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids
 - 3. ASTM B61: Standard Specification for Steam or Valve Bronze Castings
 - 4. ASTM B62: Standard Specification for Composition Bronze or Ounce Metal Castings
 - 5. ASTM B88: Standard Specification for Seamless Copper Water Tube
 - 6. ASTM C94: Standard Specification for Ready-Mixed Concrete
 - 7. ASTM F1056: Standard Specification for Socket Fusion Tools for Use in Socket Fusion Joining Polyethylene Pipe or Tubing and Fittings
- C. AWWA
 - 1. C104: Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
 - 2. C105: Polyethylene Encasement for Ductile-Iron Pipe Systems

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3. C110: Ductile-Iron and Gray-Iron Fittings
 4. C111: Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 5. C115: Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
 6. C116: Protective Fusion-Bonded Epoxy Coatings for the Interior & Exterior Surfaces for Ductile-Iron and Gray-Iron Fittings
 7. C150: Thickness Design of Ductile-Iron Pipe
 8. C151: Ductile-Iron Pipe, Centrifugally Cast
 9. C153: Ductile-Iron Compact Fittings
 10. C205: Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 inch and Larger-Shop Applied
 11. C208: Dimensions for Fabricated Steel Water Pipe Fittings
 12. C209: Cold Applied Tape Coatings for Steel Water Pipe, Special Sections, Connections, and Fittings
 13. C210: Liquid-Epoxy Coatings and Linings for Steel Water Pipe and Fittings
 14. C213: Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings
 15. C214: Tape Coatings for Steel Water Pipelines
 16. C218: Liquid Coatings for Aboveground Steel Water Pipe and Fittings
 17. C219: Bolted, Sleeve-type Couplings for Plain-End Pipe
 18. C500: Metal-Seated Gate Valves for Water Supply Service
 19. C502: Dry-Barrel Fire Hydrants
 20. C503: Wet Barrel Fire Hydrants
 21. C504: Rubber Seated Butterfly Valves.
 22. C507: Ball Valves, 6 inch through 60 inch.
 23. C508: Swing-check Valves for Waterworks Service, 2 inch through 48 inch NPS.
 24. C509: Resilient-Seated Gate Valves for Water Supply Service
 25. C510: Double Check Valve Backflow Prevention Assembly
 26. C511: Reduced-Pressure Principle Backflow Prevention Assembly
 27. C512: Air-Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service
 28. C550: Protective Interior Coatings for Valves and Hydrants
 29. C600: Installation of Ductile-Iron Water Mains and Their Appurtenances
 30. C606: Grooved and Shouldered Joints
 31. C651: Disinfecting Water Mains
 32. C800: Underground Service Line Valves and Fittings
 33. C906: Polyethylene (PE) Pressure Pipe and Fittings, 4 inch through 65 inch, for Waterworks
 34. ISO 8179-1: Ductile Iron Pipes – External Zinc-Based Coating
 35. M41: Ductile-Iron Pipe and Fittings
- D. Factory Mutual Insurance Company (FM)
1. FM 1530: Fire Department Connections
- E. National Fire Protection Association (NFPA)
1. NFPA 24: Installation of Private Fire Service Mains and Their Appurtenances

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2. NFPA 70: National Electric Code
3. NFPA 1963: Fire Hose Connection
- F. National Sanitation Foundation (NSF)
 1. NSF 61: Drinking Water System Components-Health Effects
- G. Standard Specifications of the City and County of San Francisco, Department of Public Works, Bureau of Engineering (SSDPWSF), Latest Edition. Also referred to as "City Standard Specifications."
- H. Standard Plans of the City and County of San Francisco, Department of Public Works, Bureau of Engineering (SPDPWSF), Latest Edition. Also referred to as "City Standard Plans."
- I. Standard Plans and Specifications of San Francisco Public Utilities Commission - City Distribution Division (SFPUC - CDD), Latest Edition.
- J. Department of Public Works (DPW) Order No. 176,707 "Regulations for Excavating and Restoring Streets in San Francisco", approved March 26, 2007.
- K. Underwriters Laboratory(UL)
 1. UL 262: Safety Gate Valves for Fire-Protection Service
 2. UL 405: Safety Fire Department Connection Devices
 3. UL 789: Indicator Posts for Fire-Protection Service

1.4 DEFINITIONS

- A. AASHTO: American Association of State Highway and Transportation Officials
- B. ASTM: American Society for Testing Materials
- C. AWWA: American Waterworks Association
- D. DI: Ductile iron
- E. DIP: Ductile iron pipe
- F. FM: Factory Mutual
- G. ISO: International Organization for Standardization
- H. NFPA: National Fire Protection Association
- I. NSF: National Sanitation Foundation
- J. PCC: Portland cement concrete
- K. UL: Underwriters Laboratory

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1.5 SYSTEM PERFORMANCE REQUIREMENTS

- A. External Load: Earth load indicated by depth of cover plus AASHTO H20 live load unless indicated otherwise.

1.6 SUBMITTALS

- A. Follow submittal procedure outlined in Section 01 10 00, Supplemental General Requirements.
- B. Product Data: Manufacturer's literature and data, including, where applicable, sizes, pressure rating, rated capacity, listing/approval stamps, labels, or other marking on equipment made to the specified standards for materials, and settings of selected models, for the following:
 - 1. Piping materials and fittings
 - 2. Gaskets, couplings, sleeves, and assembly bolts and nuts
 - 3. Flexible pipe fittings
 - 4. Restrained pipe fittings
 - 5. Flexible Connectors
 - 6. Expansion joints
 - 7. Flexible expansion joints
 - 8. High deflection fittings/ball joints
 - 9. Gate valves
 - 10. Air release, air/ vacuum and combination air valves
 - 11. Blow-off valves
 - 12. Service connections and water meters
 - 13. Valve boxes, meter boxes, frames and covers
 - 14. Backflow preventers
 - 15. Fire hydrants
 - 16. Post indicator valves
 - 17. Fire department connections
 - 18. Thrust block concrete mix
 - 19. Tapping sleeves and tapping valves
 - 20. Service saddles and corporation stops
 - 21. Identification materials and devices
- C. Shop Plans and Calculations: Where an on-site fire water system is required, Contractor shall provide shop plans for Engineer and agency approval prior to construction. Coordinate with the Plans and identify any proposed modifications or deviations. Shop Plans and Calculations shall be stamped and signed by a registered Fire Protection Engineer licensed by the State of California as required.
 - 1. Include the following information:
 - a. Design assumptions
 - b. Thrust block sizing and calculations
 - c. Materials to be used
 - d. Available water pressure

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- e. Required water pressure
 2. The review of fire system components constitutes only a portion of the review and approval required. A copy of the fire system component submittal package shall be forwarded to the local fire marshal for further review and approval.
- D. Water Pressure Report: At the conclusion of work, the Contractor shall engage a qualified testing service to conduct a flow test of the existing system (providing flow test data for all mains and at least six (6) hydrants). Provide date and location of test, type and method of test performed, static pressure and residual pressure in psig, observed flow in gpm, and orifice size.
- E. Shop drawings: Include plans, elevations, details and attachments.
1. Precast and cast in-place vaults and covers
- F. Field test reports: Indicate and interpret test results for compliance with the Project requirements.

1.7 QUALITY ASSURANCE

- A. Comply with requirements of utility supplying water. Do not operate existing valves or tap existing piping without written permission and/or presence of utility company representative.
- B. Comply with the following requirements and standards:
1. NSF 61: "Drinking Water System Components-Health Effects" for materials for potable water.
 2. NFPA 24: "Installation of Private Fire Service Mains and Their Appurtenances" for materials, installations, tests, flushing, and valve and hydrant supervision.
 3. NFPA 70: "National Electric Code" for electrical connections between wiring and electrically operated devices.
- C. Provide listing/approval stamp, label, or other marking on piping and specialties made to a specified standard.

1.8 MATERIAL DELIVERY, STORAGE AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
1. Ensure that valves are dry and internally protected against rust and corrosion.
 2. Protect valves against damage to threaded ends and flange faces.
 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. Deliver piping 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.

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- C. Handling: Use slings to handle valves and fire hydrants whose size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. During Storage: Use precautions for valves, including fire hydrants according to the following.
 - 1. Do not remove end protectors, unless necessary for inspection, then reinstall for storage.
 - 2. Protection from Weather: Store indoors and maintain temperature higher than ambient dew-point temperature. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- E. Do not store plastic pipe and fittings in direct sunlight.
- F. Protect pipe, fittings, flanges, seals and specialties from moisture, dirt and damage.
- G. Protect linings and coatings from damage.
- H. Handle precast boxes, vaults and other precast structures according to manufacturer's written instructions.
- I. Protect imported bedding and backfill material from contamination by other materials.

1.9 COORDINATION

- A. Coordinate connection to existing water mains with water utility supplying water.
- B. Coordinate piping materials, sizes, entry locations, and pressure requirements with building domestic water distribution piping and fire protection piping.

PART 2 - PRODUCTS

2.1 DIP: SIZES 4 INCH THROUGH 48 INCH

- A. Pipe: Pressure Class 53 pipe for Potable Water conforming to AWWA C151, AWWA Manual M41 and standard thickness per AWWA C150. U.S. Pipe, American Cast Iron Pipe Company, or approved equal.
- B. Fittings: Provide fittings with pressure rating greater than or equal to that of the adjoining pipe.
- C. Pipe and Fitting Lining: Double Cement Mortar, AWWA C104.
- D. Pipe and Fitting Coating: Arc-Sprayed Zinc Coating, ISO 8179.
- E. Fittings

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1. Standard: AWWA C110, sizes 4 inch through 48 inch.
 2. Compact: AWWA C153, sizes 4 inch through 24 inch.
- F. Unrestrained Joints (Rubber Gasket Joints):
1. Push-On Bell and Spigot Joint: Provide shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly conforming to AWWA C110/A21.10. Fittings shall be TYTON by TYTON ends with FIELD LOK gaskets for 8-inch and smaller mains, and Flex-Ring with Fastite gasket or TR Flex with TYTON gaskets for larger than 8-inch mains.
 2. Mechanical Joint: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets shall conform to AWWA C111.
- G. Restrained Joints:
1. Push-On Bell and Spigot Joint: Provide shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly conforming to AWWA C110/A21.10. Fittings shall be TYTON by TYTON ends with FIELD LOK gaskets for 8-inch and smaller mains, and Flex-Ring with Fastite gasket or TR Flex with TYTON gaskets for larger than 8-inch mains. "Megalug" restraint harness, EBAA Iron, or approved equal.
 2. Mechanical Joint: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets shall conform to AWWA C111 with "Megalug," sizes 3 inch through 48 inch, EBAA Iron, or approved equal.
- H. Insulating Joints:
1. Provide a rubber-gasketed or other suitable approved type of insulating joint or dielectric coupling which will effectively prevent metal-to-metal contact at the joint between adjacent sections of dissimilar metals.
 2. Provide joint of the flanged type with insulating gasket, insulating bolt sleeves, and insulating washers.
 3. Provide gasket of the dielectric type, full face, as recommended in AWWA C115.
 4. Provide bolts and nuts as recommended in AWWA C115.
- I. Couplings:
1. Plain End Pipe to Plain End Pipe: Ductile iron or steel bolted couplings, manufacturer's shop coating with low alloy steel bolts and nuts. Steel couplings to conform to AWWA C219. Smith-Blair, Inc., Dresser, or approved equal.
 2. Plain End Pipe to Flanged Pipe: 1) Ductile iron or steel bolted flanged coupling adapters, manufacturer's shop coating with low alloy steel bolts and nuts. Steel flanged couplings to conform to AWWA C219. Smith-Blair, Inc., Dresser, or approved equal; or 2) restrained flange adapter, "Megaflange," sizes 3 inch through 48 inch, EBAA Iron, or approved equal.

2.2 GATE VALVES

- A. Provide valves conforming to AWWA C500 or AWWA C509 that have TYTON by TYTON ends, with FIELD LOK gaskets, resilient seated, non-rising stem, right turn open and nut

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operated. Additional restraint shall be provided for gate valves off tee branches for valves 12 inches and smaller. Flanged end gate valves shall be full-face flange by flange manufactured in accordance with ANSI B16.1, 125 lb. class or ANSI B16.2, 250 lb. class, resilient seated, non-rising stem, right turn open and nut operated.

- B. Valves shall be resilient-seated, with non-rising stem, gray or ductile-iron body and bonnet, with bronze or gray or ductile-iron gate, bronze stem and square stem operating nut unless noted otherwise.
- C. All bolts, nuts and washers, except operating nut, shall be stainless steel.
- D. Stem operating nut to be 2 inches square and open counter-clockwise.
- E. Stem extensions shall be installed to bring the stem operating nut to within 2 feet of finish grade where the depth from finish grade to the stem operating nut exceeds 4 feet.
- F. Equip valves in pump stations and other interior or vault installations with hand-wheels.
- G. Provide protective epoxy interior and exterior coating according to AWWA C550 and manufacturer's recommendations.
- H. For the domestic water system, valves shall also conform to NSF 61.
- I. Service valve Valves and fittings, 2 inch and smaller shall be in accordance with AWWA C800
- J. Where a post indicator is shown, provide valve with an indicator post flange.
- K. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the project include, but are not limited to, the following:
 - 1. Mueller Company
 - 2. M&H Valve Company
 - 3. Crane Company, or approved equal

2.3 AIR RELEASE, AIR/VACUUM AND COMBINATION AIR VALVES

- A. Air release and vacuum valves: Provide valve and service size as shown on the Plans. Valve shall have cast-iron single valve body, and shall conform to AWWA C512. A compound lever system shall have a maximum operating pressure of 300 psi. Provide a protective cap for the outlet of the valve. Provide universal air-vacuum type valves, Crispin, DeZurik/APCO or approved equal.
- B. Combination air valves: Provide valve and service size as shown on the Plans. Valve shall have cast-iron single valve or double valve body, and shall conform to AWWA

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C512. A simple or compound lever system shall have a maximum operating pressure of 300 psi. Provide a protective cap for the outlet of the valve.

- C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the project include, but are not limited to, the following:
1. Crispin
 2. DeZurik/APCO, or approved equal

2.4 BLOW-OFF VALVES

- A. Provide valve and service size as shown in the Plans. Provide 2 inch valves at low points of the piping system, and 4 inch valves at dead-ends of the piping system, unless otherwise directed by the Engineer.
- B. 2 inch blow-off shall have a 2 inch vertical female iron pipe (FIP) inlet and a 2 inch normal pressure and temperature (NPT) nozzle outlet with cap. Valve shall open by counterclockwise rotation of a top-mounted 9/16 inch square operating nut. All working parts shall be serviceable without excavation. Kupferle/Truflo Model TF550, or approved equal.
- C. 4 inch blow-off shall have all brass principal working parts, 4 inch inlet and outlet and is self-draining and non-freezing. Valve shall open by counterclockwise rotation of a top-mounted 2 inch square operating nut. All working parts shall be serviceable without excavation.
- D. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Project include, but are not limited to, the following:
- E. Kupferle/ MainGuard #7600, or approved equal

2.5 SERVICE CONNECTIONS AND WATER METERS

- A. Service connections and water meter details and boxes as indicated.

2.6 VALVE BOXES, METER BOXES, FRAMES AND COVERS

- A. Water Valve Box: Provide pre-cast concrete valve box for each buried valve. Provide box with steel or cast iron traffic cover marked "WATER". Christy Model G5 with G5C cover or approved equal.
- B. Valve or Meter Boxes: Contractor shall verify box size required for water system appurtenances as shown in the Construction Documents. Provide a precast concrete utility box for each buried appurtenance. Provide a traffic-rated lid for H20 loading. A non-traffic rated lid may be used for boxes located in landscape areas. Christy, or approved equal.

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2.7 FIRE HYDRANTS

- A. Hydrant shall be Long Beach Iron Works Model 621 with a valve assembly specified in SFFD specifications, and printed as required by SFFD.

2.8 THRUST BLOCKS

- A. Use concrete conforming to ASTM C94 having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 ½ parts sand, and 5 parts gravel, having the same minimum compressive strength.
- B. Provide thrust blocks or mechanical pipe restraints at all fittings and changes in angle, alignment or elevation.
- C. Where depth or location of existing structures prohibit the use of standard thrust blocks, gravity blocks may be used.

2.9 TAPPING SLEEVES AND TAPPING VALVES

- A. Tapping sleeves shall be epoxy coated and furnished with stainless steel washers, nuts and bolts. Mueller H-615 and H-619, Ford, or approved equal.
- B. Tapping valves shall have flanged inlet, Class 125, conforming to ASME B16.1 and furnished with stainless steel washers, nuts and bolts. Tapping valves shall be constructed with a mechanical joint outlet. Mueller T-687, T-642, T-681, or approved equal.

2.10 SERVICE SADDLES AND CORPORATION STOPS

- A. Service Saddles: Saddles shall conform to AWWA C800 and NSF 61.
 - 1. For DIP: Provide bronze or stainless steel body, double strap type with a 200 psi, maximum working pressure. Mueller BR2 Series, Ford, or approved equal.
- B. Corporation Stops: Provide ground key type; bronze conforming to ASTM B61 or ASTM B62, for a working pressure of 100 psi and suitable for the working pressure of the system.
 - 1. Ends shall be suitable for adjoining pipe and connections, solder-joint, or flared tube compression type joint.
 - 2. Threaded ends shall conform to AWWA C800.
 - 3. Coupling nut for connection to flared copper tubing shall conform to ASME B16.26.
 - 4. Mueller H-15000 Series with "CC" threads and a copper flare straight connection outlet, Ford, or approved equal.

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2.11 IDENTIFICATION MATERIALS AND DEVICES

- A. Warning Tape: Provide warning tape consisting of metallic foil bonded to solid blue plastic film not less than 3 inches wide. Film shall be inert polyethylene plastic. Film and foil shall each not be less than 1 mil thick. The tape continuously shall have printed black-letter, not less than 3/4 inch high, message reading "CAUTION: WATER MAIN BELOW".
- B. Tracer Wire for Nonmetallic Piping: Provide 12 gauge, coated copper or aluminum wire not less than 0.10 inch in diameter, with blue THW, THWN, or THHN rated insulation, in sufficient length to be continuous over each separate run of nonmetallic pipe. Wire shall be tied in at all valves.

2.12 FLEXIBLE JOINT (USED ONLY WHEN SPECIFICALLY INDICATED ON DRAWINGS)

- A. Flexible Joint shall be EBAA Iron, Ductile Iron Flexible Expansion Joints with Megalug Series 1100 mechanical restraints. Bolts used in connections shall be 316 stainless steel. Flexible Expansion Joints shall conform to ANSI/AWWA C153/A21.53 and pass a pressure test of a minimum of 350 psi. Flexible Expansion Joints shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint; having a minimum per ball deflection of 20 degrees for 3" – 12" diameter pipe and 6" minimum expansion. Appropriately sized polyethylene sleeves, meeting ANSI/AWWA C105/A21.5, shall be included for direct buried applications.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

- A. Pipe Depth and Trench Configuration: Conform to elevations, profiles and typical trench section(s) shown on the Plans.
- B. Excavation, Bedding, Backfill, and Compaction: Section 31 21 00 – Utility Trenching and Backfill.
- C. Handling: Carefully handle during loading, hauling, unloading and placing operations to avoid breakage or damage. Use strap type slings for lifting and placing; no chains or hooks will be permitted. Comply with manufacturer's recommendations.
- D. Pipe laying and jointing:
 - 1. Provide proper facilities for lowering sections of pipe into trenches.
 - 2. Do not drop or dump pipe, fittings, valves, or any other water line material into trenches.
 - 3. Cut pipe accurately to length established at the site and work into place without springing or forcing. Replace any pipe or fitting that does not allow sufficient space for proper installation of jointing material.
 - 4. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying.

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5. Grade the pipeline in straight lines; avoid the formation of dips and low points.
 6. Support pipe at proper elevation and grade.
 7. Provide secure firm, uniform support. Wood support blocking will not be permitted.
 8. Lay pipe so that the full length of each section of pipe and each fitting rests solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings.
 9. Provide anchors and supports where indicated and where necessary for fastening work into place.
 10. Make proper provision for expansion and contraction of pipelines.
 11. Keep trenches free of water until joints have been properly made.
 12. Do not lay pipe when conditions of trench or weather prevent proper installation.
 13. All fittings shall be blocked with appropriately sized thrust blocks as shown on the Plans.
- E. Installation of Tracer Wire:
1. Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe.
 2. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.
 3. Form a mechanically and electrically continuous line throughout the pipeline, extending to the nearest valve or other pipeline appurtenance. Extend the wire up the outside of the valve box/riser and cut a hole that is 8 inches from the top, extend a 12 inch wire lead to the inside of the box. At other pipeline appurtenances, terminate the 12 inch wire lead inside the enclosure.
 4. Splice wire with a splicing device consisting of an electro-tin plated seamless copper sleeve conductor. Install as recommended by the manufacturer. Wrap splices and damaged insulation with electrician's tape.
- F. Installation of Warning Tape
1. Install tape approximately 1 foot above and along the centerline of the pipe.
 2. Where tape is not continuous, lap tape ends a minimum of 2 feet.
- G. Curved Alignment: When necessary to conform to the alignment specifically indicated, lay pipe on a curved alignment by means of asymmetrical closure of joints or bending of the pipe barrel. If necessary, use shorter than the standard lengths of pipe to achieve curvature specified. Do not exceed the recommendations of the pipe manufacture for deflections at the joints or pipe bending.
- H. Connections to Existing Lines:
1. Make connections to existing water lines after approval is obtained and with a minimum interruption of service on the existing line.
 2. Make connections to existing lines under pressure in accordance with the recommended procedures of a manufacturer of pipe of which the line being tapped is made.

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- I. Closure: Close open ends of pipes and appurtenance openings at the end of each day's work or when work is not in progress.

3.2 INSTALLATION OF DUCTILE-IRON PIPING

- A. Install pipe and fittings in accordance with requirements of AWWA C600 for pipe installation, joint assembly, valve-and-fitting installation, and thrust restraint.
- B. Jointing:
 - 1. Provide push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly.
 - 2. Provide mechanical joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and with the recommendations of AWWA C111.
 - 3. Provide flanged joints with the gaskets, bolts, and nuts specified for this type joint.
 - 4. Install flanged joints up tight; avoid undue strain on flanges, fittings, valves, and other equipment and accessories.
 - 5. Align bolt holes for each flanged joint.
 - 6. Use full size bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted.
 - 7. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without over straining the flange.
 - 8. Where flanged pipe and fitting have dimensions that do not allow the installation of a proper flanged joint as specified, replace it by one of proper dimensions.
 - 9. Use setscrewed flanges to make flanged joints where conditions prevent the use of full-length flanged pipe. Assemble in accordance with the recommendations of the setscrewed flange manufacturer.
 - 10. Provide insulating joints with the gaskets, sleeves, washers, bolts, and nuts previously specified for this type joint. Assemble insulating joints as specified for flanged joints. Bolts for insulating sleeves shall be full size for the bolt holes.
 - 11. Ensure that there is no metal-to-metal contact between dissimilar metals after the joint has been assembled.
- C. Pipe Anchorage: Provide concrete thrust blocks or restrained joints for pipe anchorage, except where metal harness is indicated on the Plans.

3.3 INSTALLATION OF VALVES

- A. Gate Valves
 - 1. Install gate valves conforming to AWWA C500 and UL 262 in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the

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recommendations of the Appendix (Installation, operation, and Maintenance of Gate Valves) to AWWA C509.

2. Install gate valves conforming to AWWA C509 in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix (Installation, Operation, and Maintenance of Gate Valves) to AWWA C509.

B. Joints:

1. Valves on DI Pipe: Mechanical joint valves for buried locations. Flanged-end valves for installation in vaults/pits.

3.4 INSTALLATION OF VALVE AND METER BOXES

- A. Boxes shall be centered over the appurtenance so as not to transmit shock or stress. Covers shall be set flush with the surface of the finished pavement, or as shown on the Plans. Backfill shall be placed around the boxes and compacted to the specified level in a manner that will not damage or displace the box from proper alignment or grade. Misaligned boxes shall be excavated, plumbed, and backfilled at no additional cost to the Port of San Francisco.

3.5 INSTALLATION OF FIRE HYDRANTS

- A. Install fire hydrants, except for metal harness, plumbed vertical, in accordance with AWWA C600 for hydrant installation and as indicated.
- B. Provide and assemble joints as specified for making and assembling the same type joints between pipe and fittings. Hydrants shall be set so that mounting bolts clear the top of finished grade by three inches so bolts may be easily replaced if needed.
- C. Provide metal harness as specified under pipe anchorage requirements for the respective pipeline material to which hydrant is attached.

3.6 SERVICE LINE CONNECTIONS TO WATER MAINS

- A. Connect service lines of size shown on plans to the main with a rigid connection or a corporation stop and gooseneck. Install a gate valve on the service line.
- B. Connect service lines to ductile-iron water mains in accordance with AWWA C600 for service taps.

3.7 ANCHORAGE INSTALLATION

- A. Mechanically Restrained Joints: Install where indicated for lengths indicated in accordance with manufacturer's instructions.
- B. PCC Thrust Blocks: Install where required and as indicated. Bearing area indicated is to be against undisturbed earth. Allow a minimum of 24 hours curing time before

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introducing water into the pipeline and allow a minimum of 7 days curing time before pressure testing.

3.8 CONNECTION TO EXISTING

- A. Contractor shall submit a work plan delineating the work sequence and duration of each task.
- B. The Contractor to submit a contingency plan in case work extends beyond the allowable shutdown duration
- C. Contractor to notify The Port of San Francisco 48 hours prior to shutdown.
- D. Prior to shutdown the Contractor shall have the following:
 - 1. Approved submittals for the work to be done
 - 2. Approved work plan
 - 3. Approved contingency plan
 - 4. The material, tools and equipment necessary to do the work, including pumps, generator, lighting, etc.
- E. No work shall be done within two weeks from a wet weather event.
- F. Contractor to check the weather (NOAA website) and plan work during dry weather period.

3.9 HYDROSTATIC PRESSURE AND LEAKAGE TEST

- A. General:
 - 1. Provide all necessary materials and equipment, including water.
 - 2. Backfill all trenches sufficient to hold pipe firmly in position.
 - 3. Allow time for thrust blocks to cure prior to testing.
 - 4. Flush all pipes prior to testing to remove all foreign material.
 - 5. Perform pressure and leakage test concurrently.
 - 6. Apply test pressure by means of a pump connected to the pipe.
 - 7. Base test pressure on the elevation of the lowest point in the line.
 - 8. Fill each closed valve section or bulk-headed section slowly. Expel air from section being tested by means of permanent air vents installed at high points or by means of temporary corporation cocks installed at such points. Remove and plug the temporary corporation cocks at the conclusion of the test.
 - 9. Ensure the release of air from the line during filling, and prevent collapse due to vacuum when dewatering the line.
 - 10. The pressure test on mortar-lined pipe shall not begin until the pipe has been filled with water for at least 24 hours to allow for absorption in the cement mortar lining.
 - 11. Allow the system to stabilize at the test pressure before conducting the leakage test.

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12. Do not operate valves in either the opening or closing direction at differential pressures above the valves rated pressure.
13. Maintain test pressure as specified for type of pipe being tested.
14. Pressure Test: Examine any exposed pipe, fittings, valves, hydrants and joints during the test, if no leaks are observed the section of line has passed the pressure test. If leaks are observed, repair any damaged or defective pipe, fittings, valves, or hydrants, and repeat the pressure test.
15. Leakage Test: Perform as specified hereafter for the type of pipe being installed.

B. Preparation for Test

1. Vents shall be provided at the high points of the system and drains provided where means of venting or draining do not exist.
2. Remove or block off, all relief valves, rupture discs, alarms, control instruments, etc. that shall not be subjected to the test pressure.
3. All discs, balls, or pistons from check valves shall be removed if they interfere with filling of the system. Open all valves between inlet and outlet of the section to be tested.
4. Connect pump and provide temporary closures for all of the external openings in the system. Use caution to insure that the closures are properly designed and strong enough to withstand the test pressure.
5. A joint previously tested in accordance with this specification may be covered or insulated.
6. Expansion joints shall be provided with temporary restraint for additional pressure under test or shall be isolated from the test.
7. Flanged joints, where blanks are inserted to isolate equipment during the test, need not be tested.

C. DIP Leakage Test: Perform in accordance with AWWA C600. Selected requirements of AWWA C600 are repeated as follows:

1. The pipe shall be subjected to a hydrostatic pressure of 50 percent above the normal operating pressure, or 150 psi, whichever is greater. In no case shall the pressure be allowed to exceed the design pressure for pipe, appurtenances, or thrust restraints.
2. Maintain the test pressure, +/- 5 psi, for a minimum of four hours.
3. No piping will be accepted if the leakage is greater than that determined by the following formula:

$$L = (S \times D \times P^{1/2}) / 133,200$$

L = Allowable leakage, gallons per hour.

S = Length of pipe tested, feet.

D = Nominal diameter of pipe, inches.

P = Average test pressure during the leakage test, pounds per square inch (gauge).

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3.10 CLEANING

- A. At the conclusion of the work, thoroughly clean all pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood, or other material which may have entered the pipes during the construction period. Debris cleaned from the lines shall be removed from the low end of the pipeline. If after this cleaning, obstructions remain, they shall be removed. After the pipelines are cleaned and if the groundwater level is above the pipe or following a heavy rain, the Port of San Francisco will examine the pipes for leaks. If any further defective pipes or joints are discovered, the Contractor shall repair them. Finished paving shall not be installed prior to completion of all cleaning and testing.

3.11 DISINFECTION OF PIPELINES

- A. After completion of the hydrostatic test, the mains shall be thoroughly flushed with a minimum pipe velocity of 2.5 fps and chlorinated in accordance with the latest revision of AWWA 651, Standards of Disinfecting Water Mains. Any one of the methods therein described may be used, with the additional requirement of 50 ppm chlorination minimum initial application. At the end of the contact period, the mains shall again be flushed, and bacteriological samples taken.
- B. If necessary, the Contractor shall provide, at his expense, outlets from which to take the samples. The location of the chlorination and sampling points will be determined by the Port of San Francisco in the field. Taps for chlorination and sampling shall be installed. The Contractor shall uncover and backfill the taps as required.
- C. Disinfection of tie-ins shall be performed by the Contractor by swabbing with chlorine or by other approved methods. Following a tie-in, the area affected by the tie-in shall be thoroughly flushed and bacteriological samples will be taken as deemed necessary.
- D. All treated water flushed from the lines shall be dechlorinated and disposed of by discharging to the locations identified in the Plans, or by other approved means. No discharge of chlorinated water to any storm sewer or natural water course will be allowed, unless properly dechlorinated.
- E. The Contractor shall rechlorinate and retest any lines that do not meet the requirements of the above testing. The line shall not be placed in service until the requirements of the State Public Health Department are met.

3.12 BACTERIOLOGICAL TESTING

- A. Samples shall be gathered and tests conducted at the expense of the Contractor by a laboratory approved by the Port of San Francisco.
- B. Water samples are to be taken at representative points no less than one test per 500 feet of pipe, plus one test at each end of the pipe; or as required by the Port of San Francisco.

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- C. After the samples have passed the bacteriological testing, the Contractor will be notified and arrangements can be made to make tie-ins and connections to house services.
- D. Each water sample will have passed the bacteria tests if they show zero total coliform per 100 ml and not more than 50 non-sheen bacteria per 100 ml, and when the turbidity is no greater than the source water.
- E. Samples shall be taken no sooner than 24 hours after final flushing.
- F. Jumpers and/or plates shall be pulled within 14 days of the notification of a successful test, or new bacteria samples will have to be taken.
- G. Follow-up bacteriological testing shall take place after tie-ins have been made, and shall meet the same passing requirements as the initial tests.

END OF SECTION

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SECTION 33 10 10

AUXILIARY WATER SUPPLY SYSTEM (AWSS)

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. The Auxiliary Water Supply System (AWSS) is a high pressure water supply system for city fire protection under the authority and management of the San Francisco Public Utilities Commission (SFPUC), City Distribution Division (City). The Contractor shall conduct all AWSS related work with the City through the Engineer only.
- B. The Contractor shall remove and salvage, remove and dispose of as the Contractor's property, install Contractor-furnished materials and equipment, and test, as applicable, AWSS high-pressure piping as shown on the Contract Documents.
- C. The Contractor shall perform all work and furnish all materials which are necessary or required to complete the work as shown on the Contract Documents.
- D. The following AWSS work related to this Section shall be considered incidental to the work of this Section and no separate payment will be made therefore:
 - 1. Concrete work
 - 2. Excavation, pipe bedding, backfill, and compaction
 - 3. Disposal or salvaging
 - 4. Restoration of concrete street base, pavement and sidewalk
 - 5. Demolition
 - 6. Shoring
 - 7. Dewatering of groundwater and potential leakage through closed gate valves
 - 8. Informing, coordinating, and cooperating with other utility companies whose facilities will conflict with the new AWSS work
 - 9. Engineering, furnishing and installing temporary thrust blocks and/or other required anchorage for the hydrostatic testing.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 31 20 00, "Earth Moving"
- B. Section 31 21 00, "Utility Trenching and Backfill"
- C. Section 31 23 19, "Dewatering"
- D. Section 32 12 16, "Asphalt Paving"
- E. Section 33 10 50, "AWSS High Pressure Ductile Iron Gate Valves"

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1.3 REFERENCES

- A. Standard Specifications, City and County of San Francisco Department of Public Works, Bureau of Engineering current revisions. Available for download only at <http://www.sfdpw.org/index.aspx?page=294>
- B. Standard Plans, San Francisco Public Utilities Commission. Available by request to the City.
- C. AWWA C151 Ductile-Iron Pipe, Centrifugally Cast
- D. AWWA C111 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- E. ASME B16.42 Ductile Iron Pipe Flange and Flanged Fittings
- F. State of California Labor Code, Sections 6705 and 6707
- G. State of California Construction Safety Orders, Article 6 – Excavation.

1.4 SUBMITTALS

- A. Shop Drawings are required for: Lay sheets, thrust blocks, valves, hydrants, and box/covers.
- B. Paint product information and sample of paint color.
- C. Warning tape product information.
- D. Polyethylene Encasement, adhesive sealant, and tape or tie-straps.
- E. Trench support plans and calculations in accordance with Section 31 21 00 "Utility Trenching and Backfill".
- F. Hydrostatic Leakage Test Plan:
 - 1. Contractor shall develop a plan to perform hydrostatic leakage tests and provide labor, equipment, and material to implement the plan. Plan shall include details such as the source of water, fill point, discharge point, leak detection procedure, test lengths, repair measures, pressure head to be applied, temporary thrust restraints, and other specified requirements.
 - 2. Hydrostatic Leakage Test Plan shall be submitted to Owner and City Representatives for approval one month prior to the hydrostatic leakage test.

1.5 QUALITY ASSURANCE

- A. ERDIP Installer Qualification: At least one foreman/supervisor class and two worker class installers that have received Certification of Training Completion for the Installation of ERDIP shall be onsite during ERDIP installation.

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- B. The Contractor shall request a three-day training program with the SFPUC and ERDIP manufacturer a minimum of four weeks prior to the scheduled start of ERDIP installation. The training days shall be from Wednesday to Friday. The Contractor shall state the number of staff that will attend the training (minimum 3 and maximum 9) and propose preferred training location and dates for the SFPUC and CDD staff to review. The Owner SFPUC and CDD staff will ultimately determine the location and dates for the training, which may or may not be the same as those proposed by the Contractor.
- C. The training completion date shall not be more than 5 days before the start of commencing ERDIP installation. The cost to hire the ERDIP manufacturer representative(s) for the training shall be borne by the Contractor.

1.6 AS-BUILT DRAWINGS

- A. The Contractor shall submit two full size copies of hand-marked As-Built drawings to the Engineer and City Representative prior to each hydrostatic pressure test (if more than one test is required to complete the Contract work) for the piping being tested.
- B. As-built lettering and mark-up shall be made only on copies of the original AWSS Contract Drawings - not on drawings from other disciplines should the AWSS work be part of a larger contract.
- C. In the event that the drawings are not ready prior to the start of the hydrostatic test, the City will cancel the test until such time that the drawings are presented to the City Representative and the Contractor shall be responsible for any costs to the City for rescheduling.
- D. Each piece of pipe, including nipples, shall be noted on the drawings with their exact lengths. The drawing shall include elevations from finished grade to centerline of pipe; distances for offsets from the original pipe route; and have points of connections, elbows, and valves referenced off property lines and corners as directed by the City Representative as required to adequately reproduce the locations. Type of joints shall be shown and joint symbols accurately located to scale on the drawing. The lettering and mark-ups shall be legible and in red. The drawings shall be stamped "AS-BUILTS" and include the Contractor's company name, the printed name and signature of the Contractor's representative who prepared the as-built drawings along with the name and signature of the Engineer/Inspector/City Representative who received the drawings.

1.7 GUARANTEE

- A. Guarantee materials, equipment and workmanship furnished to be free of defects and agree to replace at no additional expense to the Owner, upon demand within 2 years after installation is accepted, defective components or installations that may be found to be defective.

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PART 2 - PRODUCTS

2.1 CONTRACTOR-FURNISHED MATERIALS

- A. Contractor shall provide, at no additional cost to the Owner, incidental materials not listed in the Contract Documents and not specified as provided by the Owner but that are required for a complete and operating system.

2.2 RETURN UNUSED OR EXTRA MATERIAL

- A. The Contractor shall return all unused or extra materials or removed materials specified "Return to Owner" to the area designated by the Owner. Before the Contractor returns the material, it shall notify the Owner Representative, indicating the type of material and quantities to be returned at least 48 hours in advance (2 full business days).
- B. The Contractor, at its own expense, shall provide the necessary crew, hauling equipment (e.g. fork lift), and transportation for loading and hauling the materials to the Owner's facilities. The materials will be located as directed by the Owner's Representative.
- C. The Contractor shall ask for and retain for its files a receipt turn of materials.

2.3 MATERIALS

- A. Kubota ERDIP pipes, fittings, and accessories (e.g., nuts, bolts, gaskets, coating and lining system, etc.) required for the proper installation and performance of the listed products shall be furnished by the Contractor in the quantities listed below. The quantities in this material list include contingency material to accommodate design changes.
- B. The Contractor shall work with the ERDIP manufacturer to confirm the listed materials and quantities are adequate and if additional restrained joints or concrete thrust blocks/encasements are necessary using the information obtained from the Contractor's field survey and pothole investigation along the proposed alignment in conjunction with other utility drawings in this Contract.
- C. Material quantities are also dependent on the direction in which the ERDIP alignment is installed and the number of vertical bends required to avoid conflicts; therefore the Contractor must coordinate with the ERDIP Manufacturer to determine the most efficient pipe laying sequencing plan and optimum buried depths within the allowed range along the alignment for accurate shop drawing preparation. If additional quantities or materials not listed are required, the Contractor shall immediately notify the Engineer.

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ERDIP MATERIAL LIST BASED ON DRAWINGS (List to be provided by Kubota)

Name	Size x Dimension	Pipe Class	Q'ty	Remarks
NS Pipe (cement mortal lining)	20" x 19.69'	DS		
NS Pipe (cement mortal lining)	20" x 19.69'	DS		For cut Pipes
NS Spigot Ring	20"			
NS Liner	20"			
NS Double Socket tee	20" x 20"			
NS Double Socket level inver tee with Socket branch	20" x 8"			
NS Socket-Spigot Bend	20" x 45 deg.			
NS Double Socket Bend	20" x 45 deg.			
NS Socket-Spigot Bend	20" x 22 1/2 deg.			
NS Double Socket Bend	20" x 22 1/2 deg.			
NS Socket-Spigot Bend	20" x 11 1/4 deg.			
NS Socket pipe with Flange	20"			ANSI Class 300
NS Spigot pipe with Flange	20"			ANSI Class 300
Name	Size x Dimension	Pipe Class	Q'ty	Remarks
NS Accessory for Flange	20"			Gasket Only Kubota can't supply inch size bolt & nut
NS Flanged Spigot	8"			ANSI Class 300
NS Accessory for Flange	8"			Gasket Only Kubota can't supply inch size bolt & nut
NS jointing & cutting tools				

Note: Accessory for NS joint included.

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PROPOSED EXTRA MATERIAL (List provided by Kubota)

Name	Size x Dimension	Pipe Class	Q'ty	Remarks
NS Pipe (cement mortal lining)	20" x 19.69'	DS		For cut Pipes
NS Socket-Spigot Bend	20" x 45 deg.			
NS Double Socket Bend	20" x 45 deg.			
NS Socket-Spigot Bend	20" x 22 1/2 deg.			
NS Double Socket Bend	20" x 22 1/2 deg.			
NS Double Socket Bend	20" x 11 1/4 deg.			
NS Collar	20"			
NS Socket pipe with Flange	20"			ANSI Class 300
NS Spigot pipe with Flange	20"			ANSI Class 300
NS Gland	20"			NS joint accessory (extra)
NS Lock ring	20"			NS joint accessory (extra)
NS Rubber Gasket	20"			NS joint accessory (extra)
NS Rubber Gasket	8"			NS joint accessory (extra)
Name	Size x Dimension	Pipe Class	Q'ty	Remarks
NS backup ring	20"			NS joint accessory (extra)
NS T-head Bolt & Nut	for 20"			NS joint accessory (extra)
NS Accessory for Flange	20"			Gasket Only Kubota can't supply inch size bolt & nut
NS Spigot Ring	20"			
NS Liner	20"			
NS Accessory for Flange	8"			Gasket Only Kubota can't supply inch size bolt & nut

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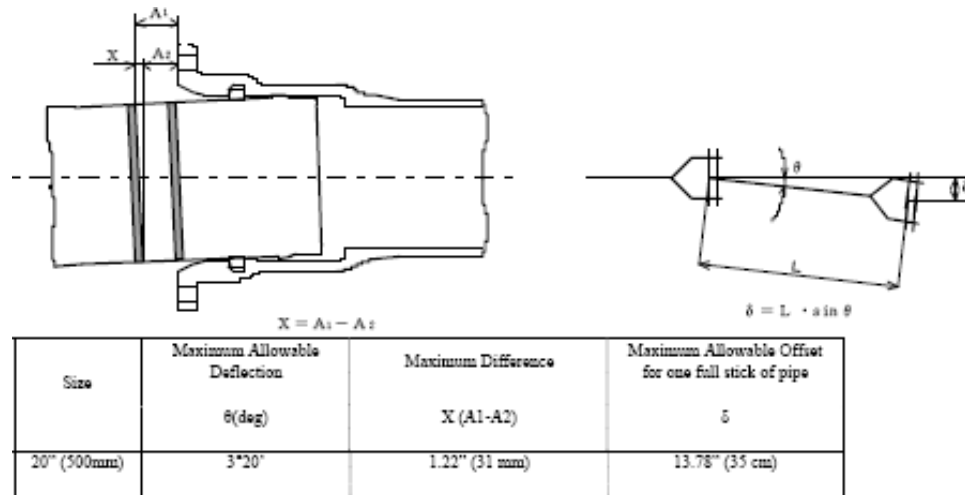
D. ERDIP manufacturer contact:

Mr. Satoshi, Suenaga (Engineering)
Satoshi.suenaga@kubota.com
+81-80-8542-4223

North America Business Section
Pipe Systems Overseas Dept.
Pipe Systems Division Kubota Corporation

Address:
1-3, Kyobashi 2-Chome, Chuo-ku
ERDIP manufacturer
Tokyo 104-8307, Japan

- E. Kubota ERDIP pipes and fittings shall conform to Japan Water Works Association (JWWA) G 113-2010, JWWA G114-2010, and requirements specified herein. Minimum tensile strength shall be 60,000 psi and minimum elongation shall be 10%.
- F. Joint: Kubota Earthquake Resistant (ER) joints NS type. Assembled NS joint can be deflected to the maximum allowable angle. The deflected angle of the joint shall be checked by measuring the distance between the socket end and the white line marked on the spigot at two opposite sides of the pipe or by measuring the offset at the end of the pipe as shown in the figure below.



- G. Pipes and fittings with spigot ends shall be provided with two socket penetration lines (two white painted lines) from the manufacturer.

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- H. Coating for ERDIP: 0.79 mil (0.02 mm) of zinc rich primer conforming to JCPA Z 2009 and JIS K 5552 with standard application of 0.49 ounce/sqft (150 g/sqm). 3.15 mil (0.08 mm) of acrylic and/or epoxy synthetic resin paint conforming to JWWA K 139-2008 with standard application of 0.82 ounce/sqft of pipes and 0.66 ounce/sq ft for fittings. Damaged coating shall be repaired per Appendix B of this Section.
- I. Lining for ERDIP: 0.23-inch (6 mm) in accordance with JWWA A 113-2010. Lining surface shall be coated with acrylic conforming to JWWA K139. Inside surface of the socket shall be coated with synthetic resin (acrylic and/or epoxy paint at 0.66 ounce/sqft).
- J. Lining for Fittings: 12 mil (300 microns) Fusion-bonded epoxy coating conforming to JWWA G 112-2004. Inside surface of the socket shall be coated with synthetic resin (acrylic and/or epoxy paint at 0.66 ounce/sqft).
- K. Factory Hydrostatic Testing:
 - 1. Pipe: Each piece at 500 psi minimum for at least 10 seconds.
 - 2. Fittings: One 45 degree elbow, one tee, one flange to spigot adapter, and one flange to socket adapter of each size and model at 700 psi minimum for at least 10 seconds.
 - 3. Joints: One joint for each joint type for each size used, including flanged joint, at 700 psi minimum for at least 10 seconds. Restrained joints shall not be externally blocked in order to test joint separation performance. The joint shall not leak during testing.
 - 4. Submit videos and/or photos of the testing apparatus and of actual testing in action for each fitting and joint test on DVD along with signed test certification letter to the Owner. The videos and/or photos must capture the pressure readings of the pressure gauge for each test to show the required minimum test pressure was reached.
- L. ERDIP Accessories:
 - 1. Accessories for push-on joint:
 - a. Rubber gaskets, and lock ring centering rubbers will be of synthetic rubber (SBR) conforming to JWWA K 156-2004.
 - b. Lock rings will be of ductile iron conforming to FCD600-3 of JIS G 5502.
 - c. Liners will be of ductile iron and coated with synthetic resin (epoxy) paint.
 - d. Liner centering rubbers will be of synthetic rubber (SBR) conforming to JWWA K 156-2004.
 - 2. Accessories for push-on joint:
 - a. Rubber gaskets and lock ring centering rubbers shall be of synthetic rubber (SBR) conforming to JWWA K 156-2004.
 - b. Glands will be of ductile iron and coated with synthetic resin (acrylic and/or epoxy) paint. Lock rings shall be of ductile iron conforming to FCD600-3 of JIS G 5502 and coated with synthetic resin (epoxy) paint.

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- c. Tee-head bolts, hexagon nuts and set bolts will be of stainless steel. Backup rings and bolts for centering of liner shall be of polyamide resin.
 - 3. Accessories for flanged joint:
 - a. Rubber gaskets (GF-type) will be of synthetic rubber (SBR) conforming to JWWA K 156.
 - b. Hexagon head bolts and nuts will be of stainless-steel.
 - 4. Accessories for spigot ring:
 - a. Spigot ring shall be composed of body, tapping screws, seal rings and O-rings. The body will be of ductile iron conforming to FCD600-3 of JIS G 5502 and coated with synthetic resin (epoxy) paint.
 - b. Tapping screws shall be stainless steel.
 - c. Flanges: ASME/ANSI B16.42, Class 300.
- M. Bolts/Studs, Threaded Rods, & Nuts: ASTM A193 Class 2 Grade B8M (AISI 316) bolts/studs and threaded rods. ASTM A194 Grade 8M (AISI 316) nuts. Coat threads with an anti-seize compound to prevent galling. Provide stainless steel washers meeting the dimensional requirements of ASTM F436.
- N. Hydrant Paint: Paints shall be in accordance with DPW Standard Specifications Section 908.09. The colors shall be as follows and painted as directed by the Owner Representative:
 - 1. Gloss Black
 - 2. OSHA Safety Red (Gloss)
 - 3. OSHA Safety Blue (Gloss)
 - 4. Gloss White
- O. Warning Tape:
 - 1. Manufacturer: THOR Enterprises, Inc.; Line Guard Inc.; or approved equal.
 - 2. General: Warning tape shall be non-detectable underground utility marking tape conforming to ASTM D2103. It shall consist of a minimum 4.0-mil overall thickness, inert 100 percent virgin low-density polyethylene plastic film formulated for extended use underground. The materials shall be acid and alkali resistant. Width of warning tape shall be 6 inches.
 - 3. Color Coding: The tape shall conform to the color code as follows:
 - a. AWSS Pipelines: Warning tape color shall be safety precaution blue.
 - 4. Message Inscription: The warning tape shall include an inscription in black letters to identify the type of utility pipeline on or over which it is installed. The inscription shall be impregnated with color-fast, lead-free, organic pigments suitable for direct burial and prolonged exposure to the elements normally encountered in moderately corrosive type soils. The height of the message letters shall be 1.5 inches minimum, and the message inscription shall be repeated at approximately 2-foot intervals. The message inscription shall be "HIGH PRESSURE AWSS WATER MAIN BELOW".

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2.4 HIGH PRESSURE HYDRANT ASSEMBLY

- A. Hydrants shall be manufactured to the requirements as shown on the set of drawings titled "AWSS – High Pressure Hydrants" and numbered sequentially A- 39480. A copy of this drawing may be obtained through the City Representative.
- B. The AWSS high-pressure hydrant assembly may be obtained from the following supplier:

Olympic Foundry, Inc.,
5200 Airport Way South
Seattle WA 98108

The above supplier is provided for reference only and no preference or prior approval by the City is expressed or implied.

2.5 LATERAL PIPING TO HYDRANTS

- A. Pipe for hydrant laterals after 8-inch gate valve shall conform to AWWA C151 Class 53.
- B. Hydrant Lateral to be TR Flex or Flex Ring.
- C. Restraint shall be EBAA Iron Megalug 1108 TDM, or approved equal.
- D. Flanges: ASME/ANSI B16.42, Class 300.
- E. Coating: 20-mil thick bituminous coating in accordance with AWWA C151.
- F. Lining: Double thickness cement mortar lining per AWWA C104.

2.6 TRENCH SHORING

- A. The requirements below are in addition to the regulatory requirements:
- B. All timber and lumber shall conform to the applicable requirements of the National Design Specification for Wood Construction. Timber and lumber to be left in place, where allowed by the Owner Representative, shall be pressure treated with chemical preservatives.
- C. All structural steel shall conform to the latest editions of the applicable ASTM requirements. Minimum requirements for structural steel shall conform to ASTM A36.
- D. All timber and structural steel used for the support system, whether new or used, shall be sound and free from defects that might impair their strength.

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- E. Steel sheet piling shall be rolled steel shapes of the continuous interlocking type, forming a continuous wall when individual sheets are driven side by side. Sheet piling and all accessories shall conform to the requirements of ASTM A328.
- F. See Section 31 21 00, "Utility Trenching and Backfill" and Section 31 23 19, "Dewatering".

2.7 POLYETHYLENE ENCASEMENT

- A. Buried AWSS pipe, fittings, and valves, except air valve riser stems, shall be protected with two layers of polyethylene encasement.
- B. The sleeves shall be fabricated from polyethylene or polyolefin and shall be cross-linked. The sleeve shall be homogeneous and free from flaws, defects, pinholes, bubbles, cracks, and inclusions. The inner surface shall be coated with an adhesive sealant that will bond to and seal the pipe joints and fittings. The sleeve shall have the following properties:

Property	Unit	Value	Test Method
Density	g/cm3	0.91 to 0.935	ASTM D792
Tensile strength	psi	3,600 min.	ASTM D638
Thickness	mil	8 min.	
Elongation	%	700 min.	ASTM D882
Impact Resistance	g	600 min.	ASTM D1709 Method B
Dielectric strength	volts/mil	6800	ASTM D149
Propagation Tear Resistance	gf (grams force)	2,550 min.	ASTM D1992

- C. The sleeves shall be Dipra V-Bio Enhanced Polywrap. The City currently knows of no equal.
- D. Near every pipe joint, apply an adhesive sealant circumferentially on the pipe wall to form a watertight seal between the pipe wall and inner polyethylene sleeve. This seal will hydraulically isolate each pipe piece in case of ground water breach into the encasement.
 - 1. The adhesive sealant that will bond to and seal the pipe joints and fittings shall have the following physical and chemical characteristics:
 - a. Base: Non-drying synthetic polymers
 - b. Fillers: Inert ingredients
 - c. Non-volatile (% solids): 100%
 - d. Specific gravity: 1.694
 - e. Odor: No unpleasant odor.
 - f. Cone penetration (ASTM D217 52T modified to total moving load of 300 gm, 5 sec, @77°F) 85 to 100 mm/10.
 - g. Temperature usage range (recommended): Minus 20°F to plus 120°F.

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- h. Temperature tolerance range: Minus 40°F to plus 180°F. Will not slump at plus 280°F
 2. The sealant shall have the following electrical characteristics:
Power Factor, ASTM D150-65T
 - a. At 60 hz at 100°C 0.85>PF>0.06
 - b. At 1,000 hz at 100°C 0.39
 - c. At 60 hz after 96 hours at 0.85>PF>0.06
 - d. At 1,000 hz after 96 hours at 115°C 0.26
Resistivity, ASME Power Test Code 28 of 1965, Section 4.05 At 100°C 4.8 x 10⁹ ohm-cm
 - a. After 96 hours at 115°C 1.8 x 10¹⁰ ohm-cm
Dielectric Breakdown, ASTM D149-64 110 Volts/mil
 3. Apply pressure over adhesive sealant by tightly wrapping PVC tape over polyethylene encasement along the adhesive sealant.
 4. The adhesive sealant shall be supplied by Calpico, Inc., 185 harbor Way, South San Francisco, CA 94080, Sealer No. 102; Duo Seal; or equal.

PART 3 - EXECUTION

3.1 REMOVAL AND INSTALLATION OF AWSS FACILITIES

- A. The Contractor shall install all AWSS facilities with a 24-inch minimum clearance from parallel utilities and 12-inch minimum clearance from crossing utilities where crossing angle is greater than 45 degrees.
- B. Only certified Journeyman plumbers who have documented experience in high pressure utility pipelines over 12 inches in diameter and who hold a D-2 Water Distribution License issued by the State of California, shall supervise the removal, fabrication and installation of AWSS piping and valves. The Journeyman plumber shall be at the site and in direct supervision of the personnel at all times AWSS pipe, fittings and valves are being removed, assembled, and installed. A Journeyman plumber equivalent shall have completed an apprenticeship program consisting of 5 years of on-the-job training under a journeyman plumber, hold a D-2 Water Distribution License issued by the State of California, and have completed 1080 hours of classroom instruction along with documented experience working with high-pressure utility pipelines.
- C. All pipes to be removed shall be cut cleanly at a 90-degree angle to the lay of the pipe.
- D. The Contractor shall minimize the downtime of existing and new AWSS facilities in the performance of their work due to the emergency nature of the AWSS mainlines and hydrants. The City will not shut down any mainlines or hydrants until the Contractor has all of the materials at the site and work has begun to excavate the location where work is to be performed. At any work location where the main shall be place out of service

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for a duration greater than 7 consecutive calendar days and no work is performed or work has stopped for any reason, the Contractor shall provide and install temporary jumper hoses between high-pressure hydrants as directed by the City to provide a water supply to the out-of-service piping. The jumper hoses shall be of the 3-inch size, rated at a minimum of 450 psi and be approved by the City. The placement of the jumper hoses and locations of hydrant to be bridged shall be at the discretion and approval of the City.

- E. All fees for retesting, additional tests and shutdowns due to the Contractor's request(s)/error(s), shall be paid by check directly to the "San Francisco Public Utilities Commission" after their invoice is received. Test(s) and shut down(s) that are requested required to be performed before 7:00 a.m. and after 3:30 p.m. will be charged at the overtime rate. No tests or shutdowns shall be performed until the City has received the checks for the invoiced amount.

3.2 INSTALLATION OF ERDIP SYSTEM

- A. Joints for ERDIP pipes and fittings shall be installed per the Manufacturer's procedures detailed in Appendix A of this Section and any other instructions or recommendations from the Manufacturer.
- B. Depth of bury shall be between 4'-0" to 6'-8" measured from grade to pipe crown except as necessary at utility crossings and at connection to existing AWSS.

3.3 INSTALLATION OF HIGH-PRESSURE HYDRANT ASSEMBLIES

- A. The Contractor shall install the high-pressure fire hydrant assemblies where and as shown on the Plans.
- B. Each hydrant shall be carefully examined, the elbow and foot valve thoroughly cleaned, and all dirt and other foreign matter removed before setting the hydrant in place.
- C. Hydrants shall be set plumb and at the proper elevation as shown on the drawings. When compacting the backfill, the hydrant shall be kept plumb, and adequate support shall be provided to prevent future movement. Hydrants, which are out of plumb or not firmly supported, shall be properly reset by the Contractor.
- D. The reinforced concrete hydrant block shall be placed and cured separately from the concrete thrust block placed behind the hydrant. In the event that both are placed together, the Contractor shall remove both items and install them as separate units.
- E. When hydrant risers are field required but not shown on the Contract Drawings to install the high pressure hydrant properly at grade, the hydrant riser shall be installed at no additional cost to the Owner. The Contractor shall provide the stainless steel nuts, bolts, and proper gaskets, and purchase the hydrant risers.

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- F. Where sidewalks are demolished to remove/install the hydrant, the Contractor shall remove the entire concrete pavement up to the next sidewalk joint. No partial concrete pavement units will be allowed to remain and patching will not be allowed. New sidewalk grades shall match the original grade. The Contractor will not be allowed to "raise" the sidewalk around the hydrant circumferences in order to meet the hydrant height requirements shown on the Drawings.
- G. Painting: The Contractor shall paint the above-ground portion of the High-pressure hydrant after installation and after the completion of hydrostatic field test with two finish coats of approved high-gloss enamel in accordance with the applicable requirements of the DPW Standard Specifications, current revision, and these Specifications. The colors shall be in accordance with these Specifications and as directed by the City.

3.4 PIPE NIPPLES

- A. Pipe cutting procedure and equipment shall be as recommended by the ERDIP manufacturer.
- B. Under no circumstances will forcing, raising, or jacking of the pipe be permitted to comply with proper length requirements. A realignment in plan or elevation to comply with the length requirements is also prohibited, unless approved in writing by the City through the Engineer.

3.5 INSTALLATION OF CONCRETE THRUST BLOCKS AND ENCASEMENTS

- A. The Contractor shall furnish and install concrete thrust blocks, as shown on the Contract Drawings and in accordance with the AWSS Standard Plans and Specifications.
- B. Concrete thrust blocks under elbows shall include rebar loops over the fitting bodies to restrain the fitting from moving upwards. The rebar loops shall form a cross over the fitting.
- C. Unless shown otherwise on drawings, all face of concrete shall be reinforced with #4 rebar at 18" OC in each direction.
- D. The concrete for the thrust block shall not be "just poured" over the fitting. The Contractor shall install plywood forms for two sides of the thrust block.
- E. Concrete poured on the fitting, which blocks or covers fasteners or the gland ring, shall be removed before any tests can take place.
- F. Thrust blocks shall bear against undisturbed natural ground. Refer to Contract Drawings for thrust block at vertical bends.
- G. Rebar in concrete encasement shall be deformed bar conforming to ASTM A615.

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- H. Concrete shall have the following properties:
1. Minimum 28-day strength: 3,000 psi
 2. Cement: ASTM C150, Type II or V

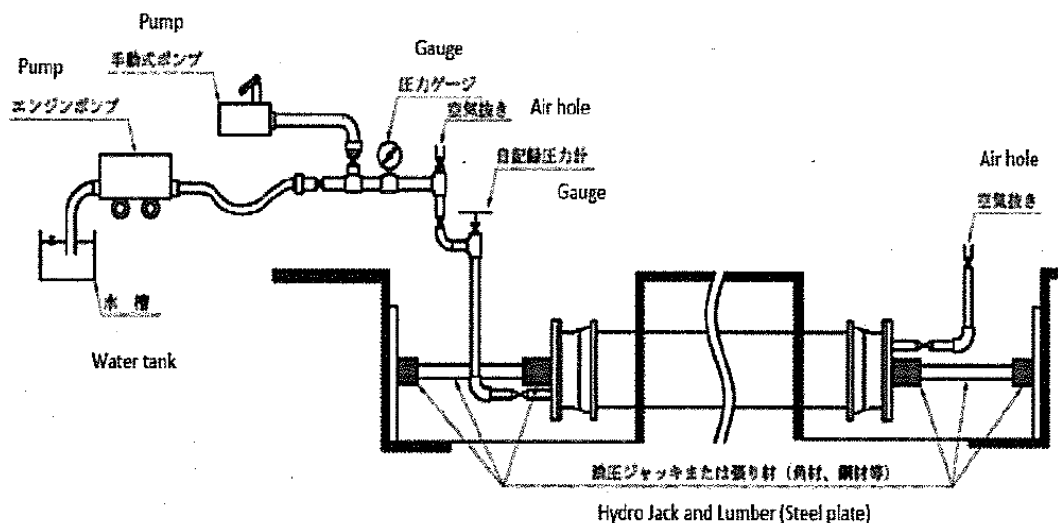
3.6 INSTALLATION OF WARNING TAPE

- A. The pipe, fittings, and pipe encasement shall be installed with a continuous strip of warning tape located 12 inches directly above the pipe but not less than 12 inches below the finished grade. The Contractor shall ensure that the warning tape is not removed or damaged during the backfilling of the trench.
- B. Warning tape ends shall overlap each other a minimum of 12 inches and be fastened together with an approved water resistant adhesive tape.

3.7 HYDROSTATIC FIELD TEST OF AWSS FACILITIES

- A. General: Before acceptance of the new AWSS work by the City, the Contractor will hydrostatically test the new work. The Contractor shall furnish all necessary labor, equipment, water and other necessary material for the test.
- B. Testing of the New AWSS Facilities:
1. At connection of new to old system to be inspected by the Owner and the City, the Contractor shall provide shoring or trench support meeting or exceeding the requirements of DPW/OSHA regulations to have the pipe connection(s) exposed and physically accessible for the duration of the line fill and hydrostatic testing. The Owner Representative and the City Representative will make the final decision regarding the adequacy of the shoring or trench supports.
 2. The Contractor shall be responsible for engineering, furnishing, and installing, prior to the test, suitable temporary thrust blocks and other anchorages to prevent any movement of the AWSS pipeline during the test.

The Contractor shall consult with the ERDIP Manufacturer's engineer for recommendations on necessary temporary thrust restraints. Below is an example of temporary support for hydrostatic field test.



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3. Prior to the hydrostatic test performed by the Contractor, the Contractor shall fill and pressurize the new line to a minimum of 100 psi for 24 hours prior to the testing including releasing trapped air. The Contractor shall also provide the water truck with required fittings and hoses conforming to the City standards and all assistance (minimum personnel shall include the journeyman plumber and two laborers) for filling the line during the hydrostatic test.
 4. For the hydrostatic test, the Contractor shall use a pump to gradually increase the pressure to a minimum of 350 psi at the highest point in the pipe but not to exceed 375 psi at the lowest point in the pipe. The final test pressure shall be held for a minimum of 1 hour. The final pressure shall be maintained for a sufficient time for the Owner Representative and the City Representative to visually check for leakage on every pipe, fitting and valve joint.
 5. The test is successful if no leaks are found. After connections were made to existing system, the line will be tested against the nearest isolation valves by gradually increasing the pressure to 300 psi or lower pressure when approved by the City. The final test pressure shall be held for a minimum of 1 hour. The final pressure shall be maintained for a sufficient time for the Owner Representative and the City Representative to visually check for leakage on joints to existing pipes.
 6. The Contractor, shall at its own expense, provide the equipment to accomplish the retest to the satisfaction of the Owner Representative and the City Representative. The Owner and the City will still witness this retest and subsequently physically check all pipe joints for leakage. The Contractor shall notify the Owner Representative in writing at least 72 hours (3 working days) in advance thereof of the time when the installation is ready for hydrostatic test. The Owner Representative will coordinate with City to schedule the actual test.
- C. Contractor Responsible for All Cost Related to Retest: Should the test fail, it is the responsibility of the Contractor to provide all labor, material, and equipment to fix the leaks and conduct the retest(s) to the satisfaction of the Owner Representative and the City Representative at no additional cost to the Owner or the City. This may include, but shall not be limited to, excavating trenches to expose pipes, fittings, cutting into new pipeline, disassembling pipes and fittings, and installing new gaskets and glands. Additionally, the Contractor will be required to pay the standard fee for retesting prior to the retest, whether the test(s) is/are performed by the City or the Contractor.

3.8 PAVEMENT AND RELATED IMPROVEMENTS

- A. See Section 32 12 16, "Asphalt Paving" for Asphalt Concrete Work.
- B. All roadway pavement restoration and asphalt concrete wearing surface filling of milled areas shall be in accordance with Section 202 – "Concrete Curb", Section 204 – "Concrete Sidewalk", Section 207 – "Concrete Base", Section 210 "Concrete Pavement", Section 212 "Asphalt Concrete Wearing Surface", and Section 217 "Adjustment of Manhole Frames and Other Castings" of the " D.P.W. Standard Specifications", and in accordance with DPW Order No. 178,940, "Regulations for Excavating and Restoring

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Streets in San Francisco", Approved on Nov. 2010, with all modifications unless otherwise specified herein.

- C. Miscellaneous Restoration Work: Sidewalk and pavement restoration shall include the replacement of traffic lane and crosswalk stripes, parking stall markings, and curb painting that are removed or damaged during construction.
- D. Concrete sidewalk pavement shall be restored in accordance with Section 204 of the Standard Specifications, D.P.W.; other types of sidewalk pavement shall be replaced in kind.

3.9 EXCAVATING AND BACKFILLING

- A. Excavating and backfilling shall be in accordance with Section 31 20 00, "Earth Moving", Section 31 21 00 "Utility Trenching and Backfill", and the applicable requirements of the AWSS Standard Plans, except as modified herein.
- B. Pipe Zone Backfill Material:
 - 1. All pipe zone backfill shall be imported. Excavated native material are not allowed for reuse in pipe zone backfill. All import backfill shall be furnished and placed in accordance with Section 703 of the Standard Specifications Department of Public Works, except as specified herein.
 - 2. All import backfill material shall consist of dune sand or equivalent; free from rock, concrete, organic material and other objectionable material. Imported Backfill material shall have 100% passing the 3/8-inch sieve size, 93% to 100% passing the No. 4 sieve size and 0% to 10% passing the No. 200 sieve size. Laboratory test results shall be submitted to the Engineer for approval. Unacceptable material shall be immediately removed from the site of work. The pipe zone is the region in the trench from top of subgrade, which is 3-inch minimum below pipe, to 12-inch above pipe.
- C. When high groundwater table or soft, wet soil is encountered at the trench bottom, a stabilization reinforcement fabric shall be placed and overlain by at least 12 inches of stabilization material as needed to provide a non-yielding subgrade and covered entirely by filter fabric (Mirafi 140 NC), unless greater measures are specified in the plans or as directed by the Owner Representative.
- D. Trench zone backfill outside the pipe zone shall be per Bedding and Cover Material specified in 31 21 00 "Utility Trenching and Backfill" or Pipe Zone Backfill specified above.
- E. Prior to beginning excavation, the Contractor shall notify the utility companies that may be affected by the work.
- F. All trench excavation shall be performed in accordance with Section 702 'Trench Excavation' of the "Standard Specifications D.P.W." and DPW Order No. 178,940,

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'Regulations for Excavating and Restoring Streets in San Francisco', Approved on July 2007 and all modifications, unless otherwise specified herein.

3.10 DEWATERING

- A. Dewatering includes but is not limited to furnishing, installing, maintaining, operating, and subsequently removing dewatering and ground water control systems and disposing of pumped water in accordance with Section 31 23 19, "Dewatering" and Section 31 21 00 "Utility Trenching and Backfill", except as modified herein.
 - 1. Dewatering will be required for lowering the water table around the excavation to elevations as required for constructing new underground structures in dry conditions. Such dewatering shall be maintained at not less than 2 feet below the structure foundation subgrade. Water level shall be maintained at this elevation until placement and compaction has been completed.
 - 2. The Contractor shall be solely responsible for the arrangement, locations, and depths of the dewatering system necessary to accomplish the work specified herein. The Contractor shall have available at the time, sufficient equipment, machinery, and piping including standby pumps, maintained in good working order in case of emergencies.

3.11 SHORING

- A. The term "shoring" as used in connection with the excavation items of this contract, shall include all structures used to support temporarily the earth adjacent to any excavation.
 - 1. The Contractor shall furnish, put in place and maintain, all shoring necessary to support the sides of any excavation and to prevent any movement, which might, in any way, injure the proposed structures or endanger any person. Provision of protection from caving ground does not relieve the Contractor from the requirement of maintaining safety in all operations performed by him/her or his/her subcontractor.
 - 2. The manner of shoring or bracing excavations shall be in accordance with the approved shoring plans, current requirements of the California Labor Code Section 6707, and with the rules, orders and regulations of the State of California Code of Regulations, Title 8, Chapter 4.
 - 3. Wherever, in the opinion of the City Representative, sufficient or proper shoring has not been provided, the Contractor shall, on demand, furnish additional shoring but neither compliance with such demand nor failure of the City Representative to make such demand shall relieve or release the Contractor from his responsibility for the sufficiency of the shoring.
 - 4. The Contractor shall be responsible for any injury occurring to persons or property or to the work due directly or indirectly to improper or insufficient shoring or to the replacement or removal of shoring.
 - 5. Unless otherwise permitted or directed, shoring may be removed from the excavation before backfilling, to the greatest extent practicable and consistent with safety.

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6. For main connections to be done by SFWD crews, solid shoring is required for the excavation regardless of the depth.
7. See Section 31 21 00 "Utility Trenching and Backfill" for additional requirements.

3.12 UNDERGROUND OBSTRUCTIONS

- A. Any data shown on the drawings, or imparted to the Contractor by the City/Owner, relative to location, dimensions, type or character of pipes, conduits, and/or other structures along or across the line of the pipe, are based on information obtained from field surveys and the owners of such structures; the City/Owner assumes no responsibility for the accuracy or completeness of such data, which are offered solely for the convenience of the Contractor and should be checked by the Contractor to the Contractor's satisfaction. The Contractor shall assume full responsibility and shall make no claim against the City/Owner or Engineer on account of any damage to any pipes, conduits and/or other structures, project delays, or for any other inconvenience or added cost of performing the work which may be attributed in any degree to inaccuracy of information furnished relative to the location of such structures, or for failure thereto.
- B. Contractor to review Contract Documents for any utility conflicts and inform the Owner Representative of such anticipated conflicts.
- C. Exploratory Excavations (Potholing):
 1. Contact all affected utility owners and request them to locate their respective utilities prior to the start of "potholing" procedures. The utility owner shall be given 7 days written notice prior to commencing potholing. If a utility owner is not equipped to locate its utility, the Contractor shall locate it.
 2. Clearly paint the location of all affected utility underground pipes, conduits and other utilities on the pavement or identify the location with suitable markers if not nonmetallic pipe, ducts and conduits shall also be similarly located using surface indicators and detection tape, if present and shall then be similarly marked.
 3. After the utility survey is completed, commence "potholing" to determine the actual location and elevation of all utilities where crossings, interferences, or connections to the new pipelines are shown on the Drawings, marked by the utility companies, or indicated by surface signs. Prior to the preparation of piping shop drawings, or the excavating for any new pipelines or structures, the Contractor shall locate and uncover these existing utilities to a point 1 foot below the utility.
 4. Excavations around underground electrical ducts and conduits shall be performed using extreme caution to prevent injury to workmen or damage to electrical ducts or conduits. Similar precautions shall be exercised around gas lines, telephone and television cables.
 5. Backfill after completing potholing. Excavations in paved areas shall be repaired with a minimum of 2-inches of hot asphalt in asphalt pavement areas and 4-inches of concrete in concrete pavement areas.

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- D. Interferences:
1. Where pipes, conduits, or other structures or obstructions are unexpectedly encountered in the excavation of the trench, the Owner Representative may order additional excavation or require the relocation of such portion of the trench as may be necessary for passing the obstruction.
 2. If interferences occur at locations other than shown on the approved Shop Drawings, the Contractor shall notify the Owner Representative, and propose a method for correcting said interferences to the Owner Representative.
 3. If the Contractor does not expose all required utilities prior to shop drawing preparation, he shall not be entitled to additional compensation for work necessary to avoid interferences, nor for repair to damaged utilities.
 4. Any necessary relocations of utilities, whether shown on the Drawings or not, shall be coordinated with the affected utility. The Contractor shall perform the relocation only if instructed to do so in writing from the utility owner and the Owner Representative.

3.13 POLYETHYLENE ENCASEMENT

- A. Double-wrap with 8-mil thick, clear, low-density polyethylene encasement and tape the edges of the encasement with PVC tape. Polyethylene encasement shall be installed in accordance with AWWA C600, AWWA C105, AWWA M41 and the requirements of this section.
- B. The sleeve shall be overlapped one foot in each direction and secured in place around the pipe.
- C. The ends of the outer polyethylene sleeve and the inner polyethylene sleeve shall be staggered by a minimum of 3 feet.
- D. The entire pipe, fittings, valves, and couplings, except valve stems and air valve riser pipe, shall be encased. Tightly wrapped with PVC tape at the terminations.
- E. When it is not practical to wrap valves, tees, and other odd-shaped pieces in a tube, wrap with a flat sheet or split length of polyethylene tube by passing the sheet under the appurtenance and bringing the sheet around the body. Make seams by bringing the edges of the polyethylene sheet together, folding them over twice, and taping them.
- F. Apply an adhesive sealant circumferentially on the pipe wall near every pipe joint to form a watertight seal between the pipe wall and inner polyethylene sleeve. This seal will hydraulically isolate each pipe piece in case of ground water breach into the encasement.
- G. Apply an adhesive sealant circumferentially around each tap location.
- H. Apply pressure over adhesive sealant by tightly wrapping PVC tape over polyethylene encasement along the adhesive sealant.

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- I. The polyethylene film shall be fitted to the contour of the pipe creating a snug, but not tight, encasement with minimum space between the polyethylene and the pipe. Sufficient slack shall be provided in contouring to prevent stretching the polyethylene where it bridges irregular surfaces, such as bell-spigot interfaces, bolted joints, or fittings, and to prevent damage to the polyethylene caused by backfilling operations. Overlaps and ends shall be secured by PVC tape or plastic tie straps.
- J. Polyethylene encasement shall be installed per the AWWA C105, manufacturer's instructions, and Appendix D of this Section.
- K. During hydrostatic pressure test, if any leaks occur, the Contractor shall remove the polyethylene encasement, fix the leaks, allow all water to escape, and re-tape the polyethylene encasement with the tape per the approved repair procedures.

3.14 FIELD QUALITY CONTROL


- A. ERDIP Field Inspection: The Contractor shall retain ERDIP manufacturer representative(s) for a minimum of 10 working days beginning at day one of ERDIP installation for field training and inspection. The City will also have continuous onsite inspection for the AWSS work.
- B. ERDIP Joint Assembly Check Sheet: For every ERDIP joint connection, the Contractor shall fill out the Joint Assembling Check Sheet attached as Appendix C to this specification. Each check list shall be:
 - 1. Checked and signed by the Contractor's foreman.
 - 2. Approved and signed by the City Representative.

END OF SECTION

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I General

1. Overview of applicable joint type

1) Name: NS type ductile iron pipe

Abbreviation: NS type

Abbreviation symbol: 

2) Pipe size 20" to 40" (500mm to 1000mm)

3) Type and thickness of pipe

Straight pipe: S type (one type only)

Fittings: Collar (sleeve), bend, double-socket tee, reducer, short pipe, plug, etc.
Only one type of pipe thickness is available.

4) Nominal laying length of straight pipe

19.69 feet (19' 8 1/4"), (6 m)

5) Standards JWWA G 113, G114

2. NS Joint (20"-40")

1) Structure

(1) Straight pipe

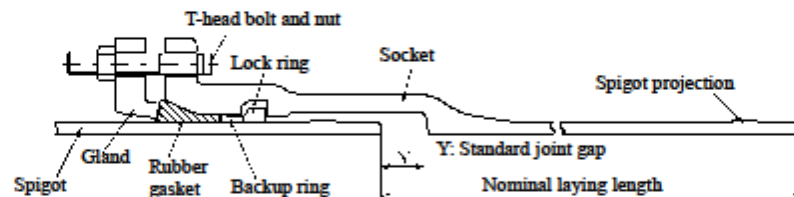


Figure 1 Straight pipe joint structure

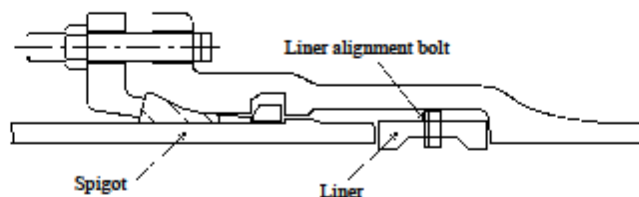



Figure 2 Joint structure of a straight pipe using a liner

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(2) Fittings

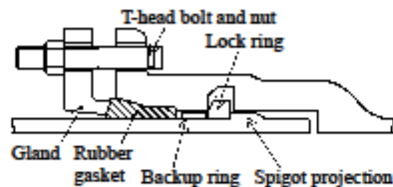


Figure 3 Fittings joint structure

2) Materials of Accessories

Table 1 Materials of Accessories

Name	Material
Rubber gasket	SBR (NBR, EPDM)
Gland	Ductile iron
T-head bolt and nut	Stainless steel
Backup ring	Polyamide resin (PA6)
Lock ring	Ductile iron
Liner	Ductile iron
Liner alignment bolt	Polyamide resin (PA6)
Spigot ring for cut pipe	Ductile iron
Liner holder, bolt, washer	Stainless steel

3. Standard performance

1) Expansion and contraction

Table 2 shows the expansion and contraction of the straight pipe and collar.


Table 2 Expansion and contraction of straight pipe and collar Unit: inches

Pipe size	For each straight pipe joint	For each collar	
		Expansion	Contraction
20"	±2.4"	2.4"	10.2"
24"	±2.4"	2.4"	10.2"
28"	±2.4"	2.4"	11.8"
32"	±2.4"	2.4"	12.0"
36"	±2.4"	2.4"	12.0"
40"	±2.4"	2.4"	12.2"

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2) Allowable deflection angle

Table 3 lists the allowable deflection angles of the straight pipe and collar (on one side).

Table 3 Allowable deflection angles of straight pipe and collar (on one side).

Pipe size	Allowable deflection angle (Installation stage)	Maximum deflection angle
20"	3° 20'	7°
24"	2° 50'	7°
28"	2° 30'	7°
32"	2° 10'	7°
36"	2° 00'	7°
40"	1° 50'	7°

3) Pull-out resistance

Table 4 shows the pull-out resistance of the joint.


Table 4 Pull-out resistance

Pipe size	Pull-out resistance (lbf)
20"	340,000 (1500kN)
24"	408,000 (1800kN)
28"	476,000 (2100kN)
32"	544,000 (2400kN)
36"	612,000 (2700kN)
40"	680,000 (3000kN)

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II. Straight pipe jointing procedure

Assemble NS joint strictly in accordance with this manual. To ensure the assembled joint, it is recommended checking the joint conditions with "Joint check sheet".

1. Pipe installation

Keeping the manufacturer's mark of the pipe facing upward, unload the pipe gently to the specified position, as shown in Figure 4. At that time, arrange the positions of the socket flange holes with reference to the center.

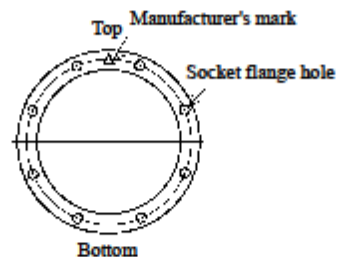


Figure 4 Pipe installation

2. Cleaning the pipe and checking for dimensions

Completely remove the oil, sand lubricant or other foreign substances deposited within a distance of approx. 2feet (60 cm) from the end surface of the spigot outer surface and those deposited on the inner surface of the socket. Measure the dimensions on the top, bottom, right and left of the spigot. If an ellipse has been detected, correct the ellipse.

3. Setting the lock ring

- (1) As illustrated in Figure 5, set the lock ring so that the tapered surface will be located on the side of the socket end face.

Further, when putting the lock ring into the socket groove, set the lock ring in a horizontal position so that the split portion of the lock ring comes to the front, and insert it into the socket. After that, turn it inside the socket so that the lock ring will be held in the groove. If it cannot be easily inserted in position, gently tap it with a plastic hammer.

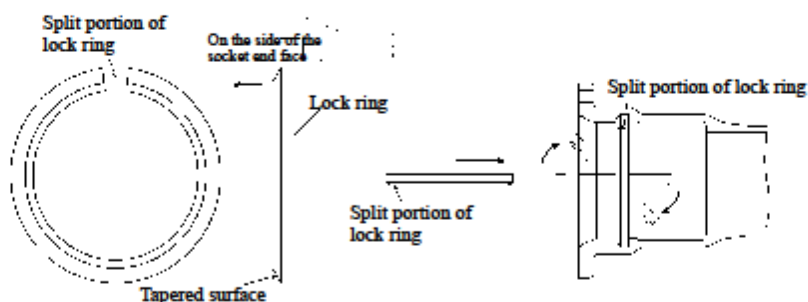


Figure 5 How to set the lock ring into socket




CAUTION


Do not put your hand or finger in the clearance between the pipes and lock ring during work. Otherwise, your hand or finger may be pinched and an accident may occur.

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CAUTION

Set the lock ring correctly. Otherwise, the pull out resistant function of the joint may be damaged.

- (2) As illustrated in Figure 6, use a lock ring expander to expand the ring so that the split portion of the lock ring will reach the dimension "s" (value as a guide) shown in Table 5.

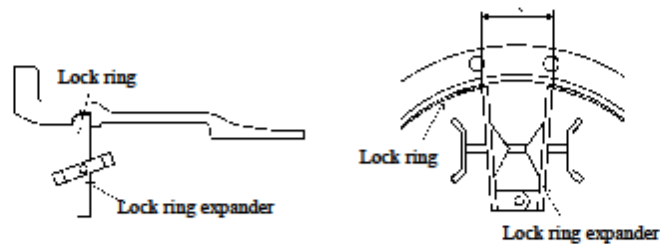


Figure 6 Installation of lock ring expander

Table 5 Dimension "s" (value as a guide)

Pipe size	Dimension "s"
20"	4.8" (122mm)
24"	4.8" (122mm)
28"	5.2" (132mm)
32"	6.02" (153mm)
36"	6.18" (157mm)
40"	6.38" (162mm)

- (3) As illustrated in Figure 7, the stopper width can be adjusted by the stopper interval adjusting screw. As illustrated in Figure 8, insert the stopper into the lock ring split portion by adjusting the stopper width, and remove the lock ring expander.

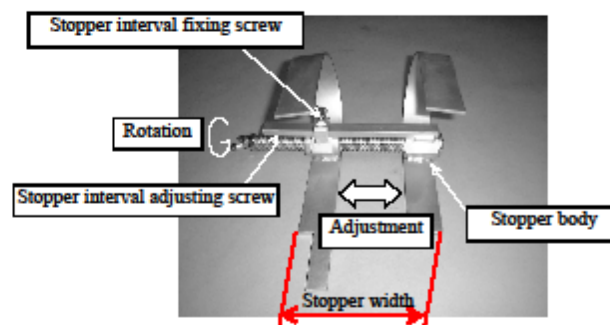



Figure 7 Stopper overview

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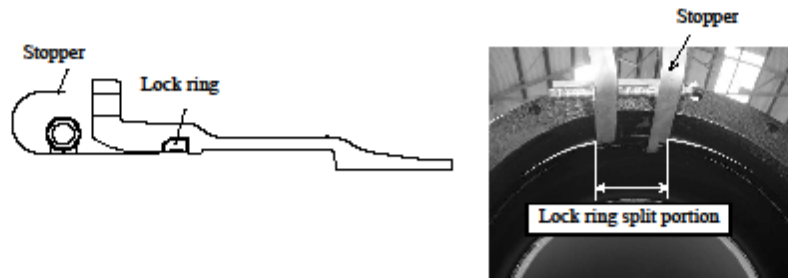


Figure 8 Stopper installation

If the spigot projection comes in contact with the lock ring and the spigot cannot be inserted even after the lock ring split portion has been expanded to the dimension "s", expand the lock ring split portion by further 0.2"(5 mm) and install the stopper in position.

4. Setting the Rubber gasket and back-up ring

- (1) Clean the Rubber gasket and set it to the spigot. At this time, confirm the indication mark (NS) of the rubber gasket and set it in the direction illustrated in Figure 9.
- (2) Clean the back-up ring and set the spigot to it. In this case, set it in the direction illustrated in Figure 9.

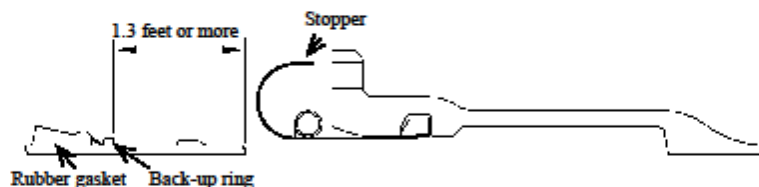






Figure 9 Joining part setting position

 CAUTION	Confirm the orientation of the rubber gasket and back-up ring before setting them. Otherwise, water leakage may occur.
 CAUTION	Use the rubber gasket and back-up ring conforming to the specified type of joining and normal diameter. Otherwise, water leakage may occur.
 CAUTION	Do not use the rubber gasket that was once removed by disassembling the joint. Otherwise, water leakage may occur.

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5. Lubrication

Apply lubricant to the socket interior from end face to socket groove. (See Figure 10.)

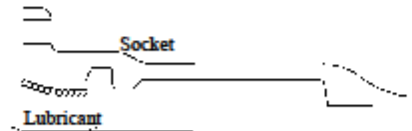


Figure 10 Application of lubricant

6. Alignment of socket and spigot

- (1) Lift the pipe with a crane. In this state, insert the spigot into the socket.
- (2) Slowly insert it so that the socket end face will be located within the width of the white line A of the two white lines indicated on the outside surface of the spigot (white line on the end face side of the spigot) (see Figure 11).
- (3) After the spigot has been inserted, pull out the stopper installed on the lock ring split portion. In this case, make sure that the lock ring holds the outer surface of the spigot. If the spigot comes in contact with the stopper during insertion of the spigot, the stopper may be removed. If the stopper has been removed, repeat the steps from 3. (2).

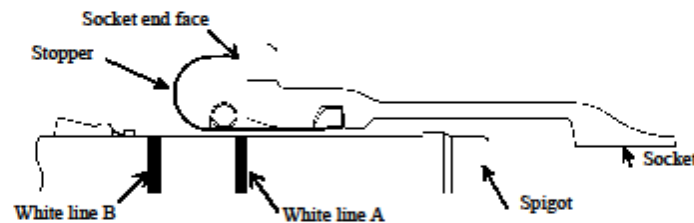


Figure 11 Spigot insertion

7. Back-up ring insertion


Carefully align the pipe so that the dimension between the inside of the socket end and outside of the spigot (clearance between the socket and spigot) will be uniform, as illustrated in Figure 12. Keep the pipe aligned until joining work is over. After having aligned the pipe, use an insertion rod to insert the back-up ring into the clearance between the socket and spigot until the back-up ring will contact the lock ring over the entire periphery, as illustrated in Figure 13.

(Reference) If alignment is difficult in the lifted position, apply a hydraulic jack to the bottom of the pipe. This is also an effective way for alignment.

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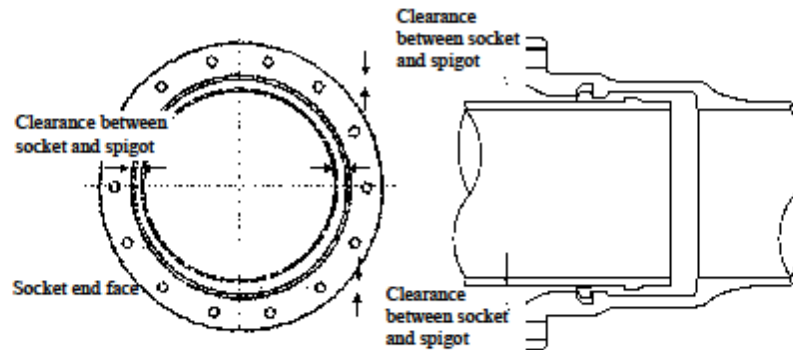


Figure 12 Pipe alignment

When inserting the back-up ring, take care of the following:

- ① Locate the lock ring cut portion between two red lines indicated on the back-up ring so that the cut portion of the back-up ring will not overlap the cut portion of the lock ring. (See Figure 13.)
- ② Make sure that the tapered surfaces of the cut portion of the back-up ring are facing each other. (See Figure 14.)

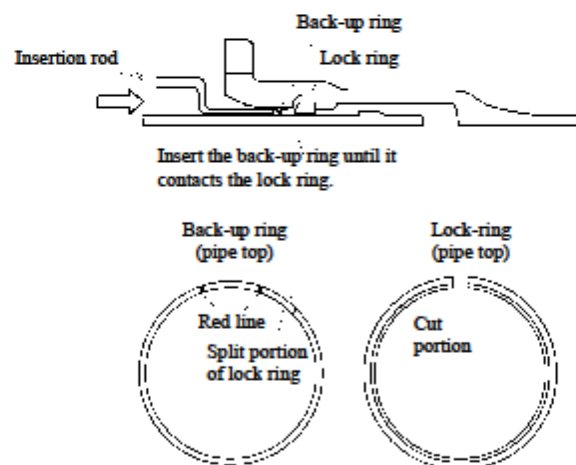



Figure 13 Back-up ring insertion

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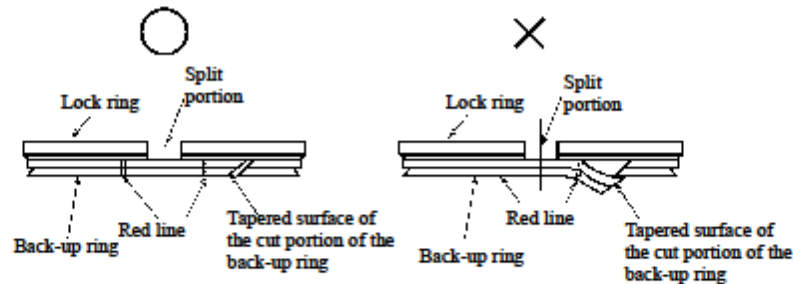


Figure 14 Checking the cut portion of the back-up ring

8. Rubber gasket insertion

- (1) Apply lubricant to the outer surface of the rubber gasket, outer surface of the spigot and inner surface of the socket. Figure 15 shows the range for lubricant application. It should be noted that insertion of the rubber gasket may be difficult if the lubricant applied to the inner surface of the socket in step 7 has been dried. If so, apply lubricant again.
- (2) While maintaining the clearance between the socket and spigot uniform in the vertical and lateral directions, push the rubber gasket into the clearance between the socket and spigot.



Figure 15 Application of lubricant

9. Setting the gland, T-head bolt and nut

(1) Setting the gland


As illustrated in Figure 16, arrange the split portions of the gland in the vertical direction (pipe top-bottom).

In the first place, pass a bolt into the bolt hole of the respective split portions and tighten the nut by hand so that they will be integral with the gland. After that, set all the bolts and nuts into the socket flanges and gland bolt holes.

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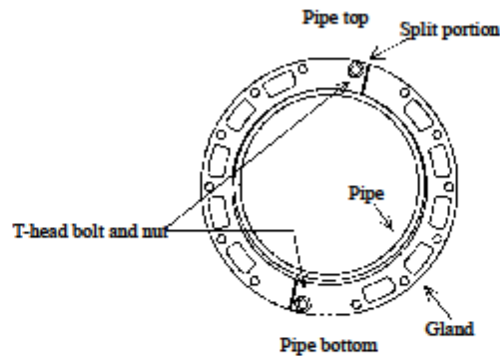



Figure 16 How to set the gland

	CAUTION	When the gland is to be exchanged or set, check for safety. Otherwise, an accident such as fracture of the leg may occur when the gland has been dropped.
	CAUTION	Make sure that the split portions of the gland are arranged in the vertical direction (pipe top-bottom). Otherwise, insertion of the rubber gasket may be partially insufficient, with the result that water leakage may occur.

(2) Gland alignment

As illustrated in Figure 17, set a wedge at two positions on the periphery of the gland split portions on the pipe top side and align the gland. After gland alignment, tighten all the bolts and nuts by hand.

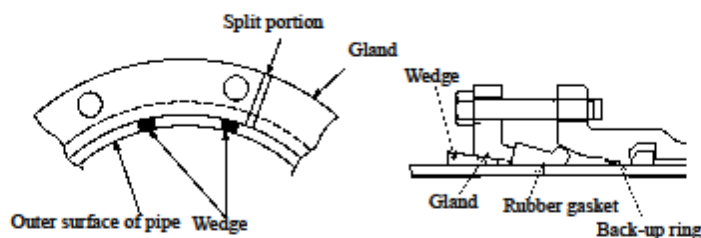



Figure 17 Gland alignment

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10. Tightening

(1) Adjustment of standard joint gap and temporary nut tightening

Make adjustment so that the distance from the socket end face to the end face of the white line B will fall within the specified dimension range [2.8" to 3.1", (70 to 80 mm)], as illustrated in Figure 18. After that, as illustrated in Figure 19, use a ratchet wrench or spanner to tighten the nut little by little on the temporary basis until the round portion of the rubber gasket will be hidden behind the flange surface uniformly over the entire periphery.

Table 6 L₁-dimension

Pipe size	L ₁
20"	86.6" (220mm)
24"	86.6" (220mm)
28"	10.1" (257mm)
32"	10.4" (265mm)
36"	10.4" (265mm)
40"	10.6" (268mm)

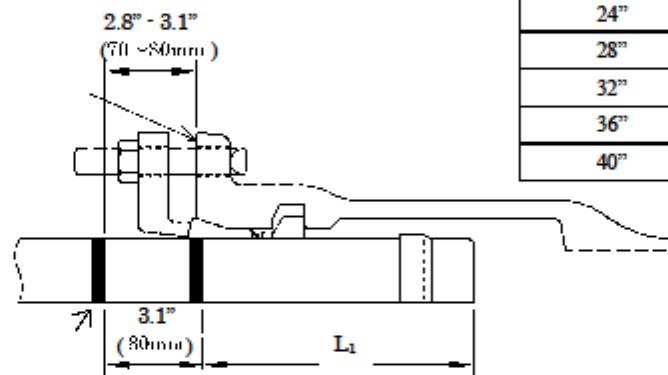


Figure 18 Standard joint gap

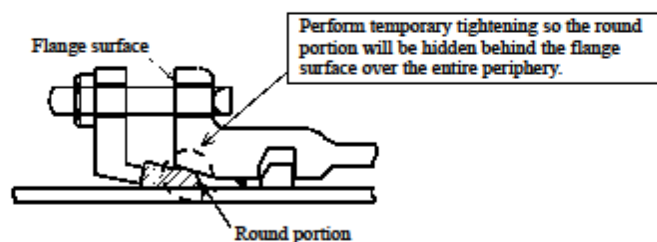


Figure 19 Temporary tightening and rubber gasket insertion


(2) Nut tightening

After temporary tightening, while making sure of the gland alignment, use a ratchet wrench or spanner to tighten the nuts so that the incoming/outgoing status of rubber gasket will be uniform.

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- ① In the first place, tighten the nut located close to the gland split portion on the pipe bottom (the lower portion in Figure 20). Since the clearance between the socket and spigot tends to be comparatively small on the pipe bottom, tighten the nut in preference ("1st" in Figure 20).
- ② Secondly, tighten the T-head bolt and nut close to the split portion on the pipe top (on the top position in Figure 20).
- ③ Thirdly, tighten the nut on side of the pipe ("3rd" and "4th" in Figure 20).
- ④ After that, tighten the nuts on the almost symmetric positions alternately (tightening in a crisscross pattern). In this case, tighten the nut in preference where the space between the gland surface and socket end face is larger or where the rubber gasket is much protruded.

When tightening the nuts, take care of the following in particular:

- Tighten the nuts so that the incoming/outgoing state of the rubber gasket will be almost uniform over the entire periphery.
- Tighten the nuts so that the space between gland surface and socket end face will be almost uniform over the entire periphery. Take care in particular so that the split portions of the gland will not be bent.
- To ensure that uneven tightening will not occur, do not tighten the nut too much in one step. Tighten the nuts in several steps on a per-1/2 inches basis as a guide.

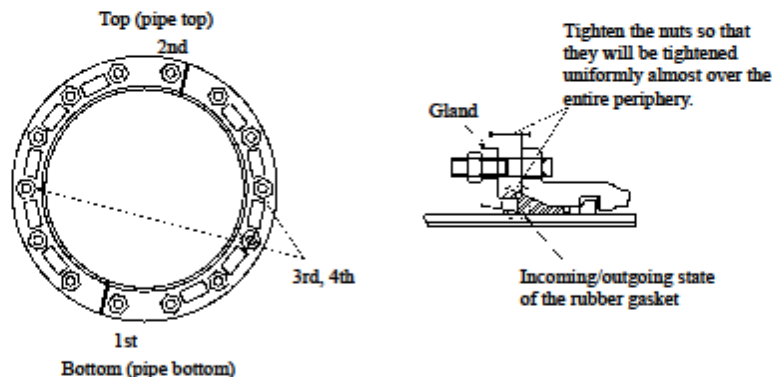



Figure 20 Tightening of bolts and nuts

(3) Additional tightening of nuts

Before the standard tightening torque shown in Table 7 has been reached, perform one additional tightening operation over the entire periphery by a torque wrench in conformity to the method of Figure 21, until the standard tightening torque is reached.

 **CAUTION** To manage the tightening torque, use a torque wrench that has passed the inspection.

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Table 7 Standard tightening torque

Pipe size	Bolt diameter	Standard tightening torque (N·m)
20", 24"	M20mm	100 (73.7ft-lb)
28", 32"	M24mm	140 (103.2ft-lb)
36", 40"	M30mm	200 (147.4 ft-lb)

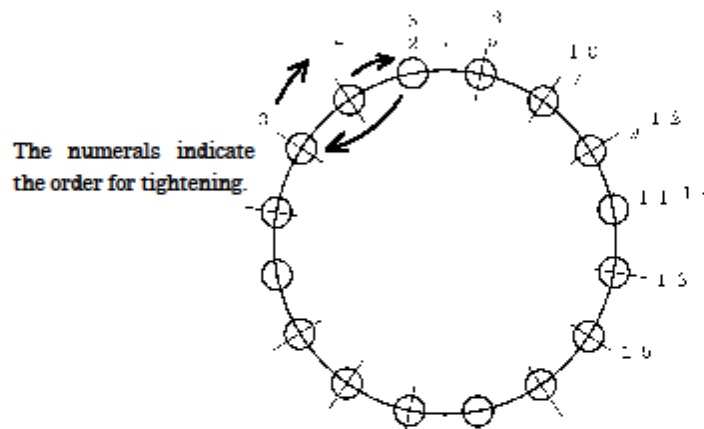


Figure 21 Method of additionally tightening nuts

(4) Confirming tightening torque

After performing one tightening operation over the entire periphery at the standard tightening torque, if the first nut for which tightening was started at the standard tightening torque (bolt 1 in Figure 21) can be moved by hand, tighten only the 1st and 2nd nuts again at the standard tightening torque.




CAUTION

After performing one tightening operation over the entire periphery at the standard tightening torque, if any nut other than the 1st or 2nd nut is tightened again at the standard tightening torque, the tightening torque will be too large.

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11. Checking connection

After tightening the bolts and nuts, check the following items:

(1) Checking for uniform tightening of bolts and nuts

- ① As illustrated in Figure 22, measure the clearance between the gland and socket end face at four locations, and make sure that the difference between the maximum and minimum values does not exceed 0.2" (5 mm).
- ② If the difference between the maximum and minimum values on the same circumference in ① exceeds 0.2" (5 mm), disassemble, inspect and check the joint. Then make the parts joined again. In this case, replace the rubber gaskets and back-up rings by new ones.

(2) Checking the clearance from socket end face to white line

Measure the clearance X from socket end face to white line B. Make sure that the clearance falls within the specified dimension range [2.8" to 3.5" (70 to 89 mm)].

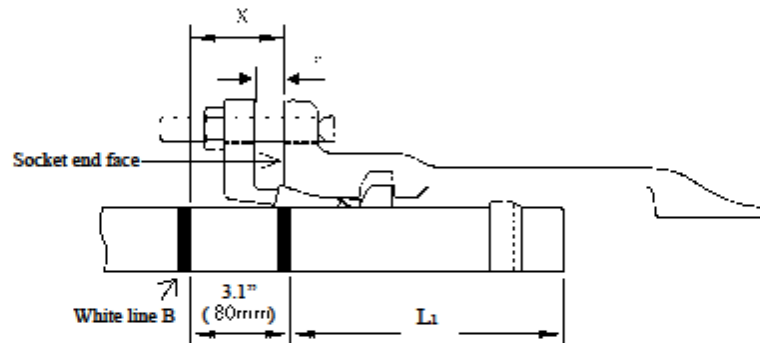


Figure 22 Measurement of clearance between socket end face and gland, and clearance between socket end face and white line

(3) Checking the incoming/outgoing state of rubber gasket

- ① As illustrated in Figure 23, check the incoming/outgoing state with reference to the socket end face of the rubber gasket at four locations. Make sure that there is no simultaneous presence of the states A and C or A, B and C on one and the same circumference.
- ② If there is a simultaneous presence of the states A and C or A, B and C in the incoming/outgoing state of the rubber gasket in the above description, disassemble the joint and then make the parts joined again.

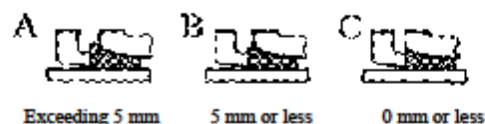



Figure 23 Incoming/outgoing state of rubber gasket

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ASSEMBLING PROCEDURE OF 20"-40" NS JOINT (Inch ver.)				 KUBOTA CORPORATION
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④ Curling of rubber gasket

Make sure that there is no abnormal state such as "the corner of a rubber gasket overriding the gland" or "local rise of rubber gasket" over the entire periphery, as illustrated in Figure 24.

The pipe bottom is particularly difficult to check, but must be checked by all means because a trouble tends to occur to this portion.

If the corner of a rubber gasket overrides the gland, or there is a local rise of rubber gasket, this shall be considered as abnormal. Disassemble the joint and then make the parts joined again. In this case, replace the rubber gasket and back-up ring by new ones.

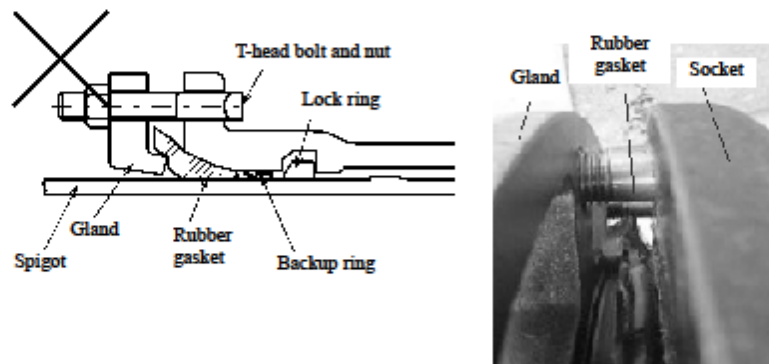


Figure 24 Overriding of rubber gasket (connection failure)

12. Fill in check sheet

The check sheet is used for quality management of ductile iron pipe joining. Fill in the check sheet shall be performed immediately when joining work has been done. (The check sheet is given by manufactures.)

End

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Permit Submittal
January 14, 2019

AWSS High Pressure Gate Valves
33 10 50 - 16

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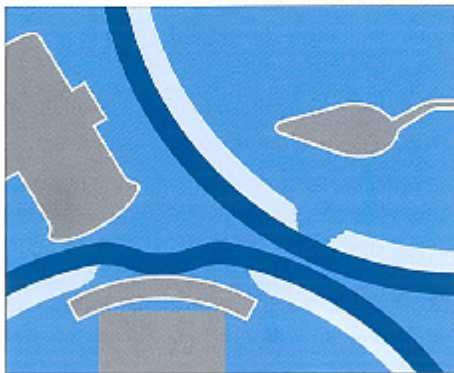
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Kubota



KUBOTA DUCTILE IRON PIPES

DAMAGED PIPE REPAIR MANUAL



SECTIN 02514 - APPENDIX B

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Permit Submittal
January 14, 2019

AWSS High Pressure Gate Valves
33 10 50 - 17

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Preface

Damage to ductile iron pipes, caused by improper handling during transportation, may be rectified by applying certain repair procedures. This manual has been compiled to offer some quick and effective methods of repairing damaged pipes. Although these methods may change according to site conditions, Kubota would advise the site supervisor to follow the repairs outlined in this manual.

The ultimate purpose of this manual is to ensure that the pipes provide lasting service and stand up to the heavy usage regardless of the minor maintenance required.

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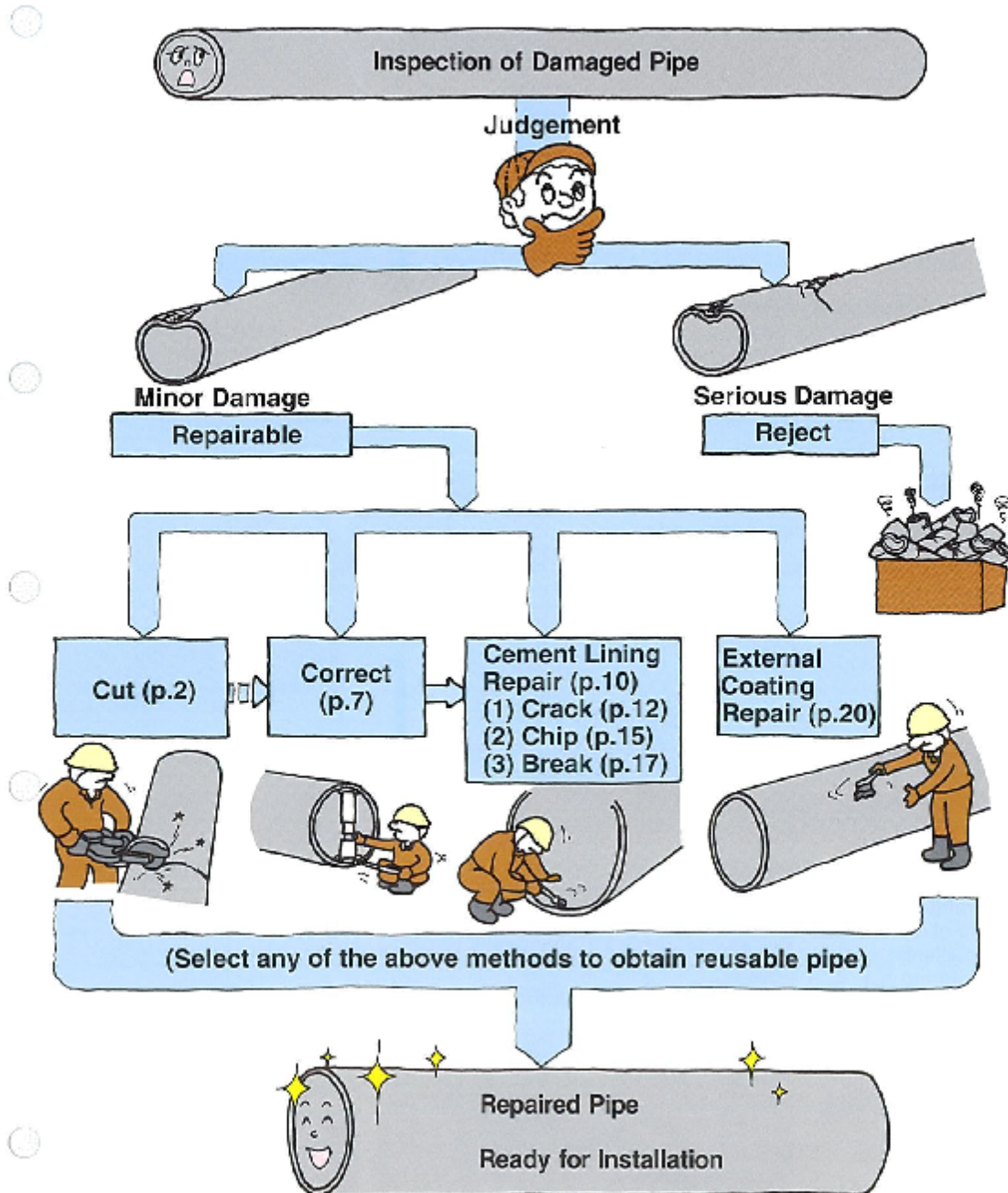
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How to Repair Pipes



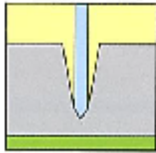
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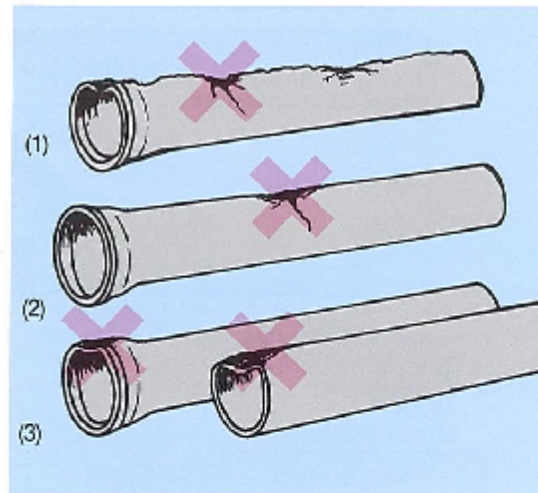


1. Cutting of Pipe

[1] Inspection

Before cutting, carefully inspect the pipe:

- (1) If the pipe is seriously damaged → reject the pipe.
- (2) If there is a hole or crack in the pipe body → reject or cut off the damaged portion.
- (3) If the socket is deformed or the spigot is seriously damaged → cut off the damaged portion.



[2] Tools and equipment

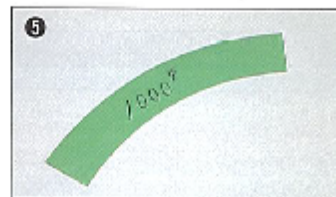
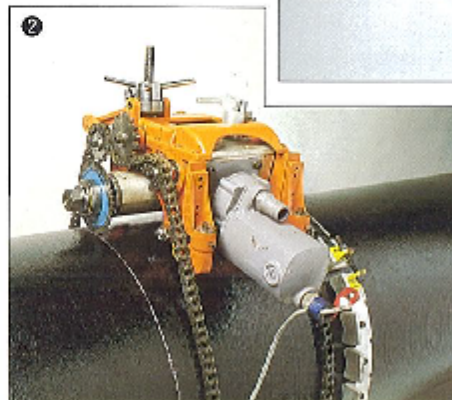
For the convenience of the repair work, the following tools are recommended.

- Engine driven cutter (Photo ①)
- Power operated metal saw (Photo ②)
- Portable disc grinder (Photo ③)
- Measuring tape (Photo ④)
- Curvature gauge made of plywood, tin plate, plastic, etc. (Photo ⑤)

* This tool may be made on site using available materials.

- Taper gauge made of plywood, tin plate, plastic, etc. (Photo ⑥)

* This tool may be made on site using available materials.



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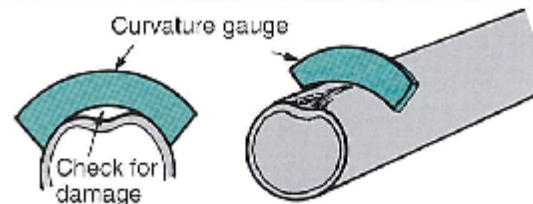
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[3] Procedure

(1) Check the deformed portion. Using a curvature gauge, select an undamaged portion.



(2) Measure the circumference using a measuring tape. (Photo ⑦)

* Dimension must be within the tolerance in Table 1, (Page 5). If it is not, find a portion that satisfies the value.



(3) Draw a line to indicate where to cut. (Photo ⑧)



(4) Cut the pipe along the line using an engine driven cutter (Photo ⑨) or a power operated metal saw. (Photo ⑩)



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(5) Completion of cutting. (Photo 11)



(6) Measure the outside diameter in two or more different directions. (Photo 12)



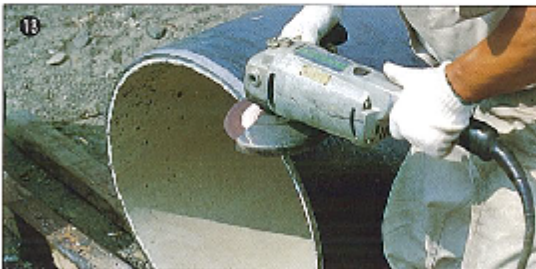
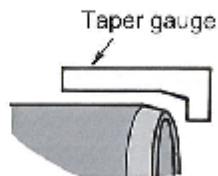
*The dimensions must be within the tolerance in Table 1, (Page 5). If it is not, correct the pipe according to "Correction of Deformed Spigot", Page 7-9.



(7) Taper the edge of the spigot with a portable disc grinder. (Photo 13)

*Taper gauge can be used to easily check the angle of the tapered end.

(See Table 2, Page 6 for the detailed dimensions.)



(8) Draw white lines for jointing. (Photo 14)

* Stenciled lines may be drawn also by spray painting.
(See Table 2, Page 6 for the detailed dimensions.)



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(9) Completed cut pipe. (Photo 15)



Tolerances on Diameter and Circumference

Table 1

(mm)

DN	Outside Diameter	Tolerance on Outside Diameter	Allowable Value of Circumferential Length
80	98	+1.0, -2.0	301.6 ~ 311.0
100	118	+1.0, -2.0	364.4 ~ 373.8
150	170	+1.0, -2.0	527.0 ~ 537.2
200	222	+1.0, -2.0	691.2 ~ 700.6
250	274	+1.0, -2.0	854.5 ~ 863.9
300	326	+1.0, -2.0	1017.9 ~ 1027.3
350	378	+1.0, -2.3	1180.3 ~ 1190.7
400	429	+1.0, -2.3	1340.5 ~ 1350.9
450	480	+1.0, -2.3	1500.7 ~ 1511.1
500	532	+1.0, -2.3	1664.1 ~ 1674.5
600	635	+1.0, -2.3	1987.7 ~ 1998.1
700	738	+1.0, -3.5	2307.5 ~ 2321.6
800	842	+1.0, -3.5	2634.2 ~ 2648.4
900	945	+1.0, -3.5	2957.8 ~ 2971.9
1000	1048	+1.0, -3.5	3281.4 ~ 3295.5
1100	1152	+1.0, -3.5	3608.1 ~ 3622.3
1200	1255	+1.0, -3.5	3931.7 ~ 3945.8
1400	1462	+1.0, -3.5	4582.0 ~ 4596.2
1500	1565	+1.0, -3.5	4905.6 ~ 4919.7
1600	1668	+1.0, -3.5	5229.2 ~ 5243.3
1800	1875	+1.0, -5.0	5874.8 ~ 5893.6
2000	2082	+1.0, -5.0	6525.1 ~ 6543.9

Note: Minus tolerance on outside diameter can be increased additionally 0.5 mm for DN ≤ 600 and 1 mm for DN > 600 when the length of the pipe is within the allowable value.

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Dimensions of Tapered Spigot for Push-on Joint

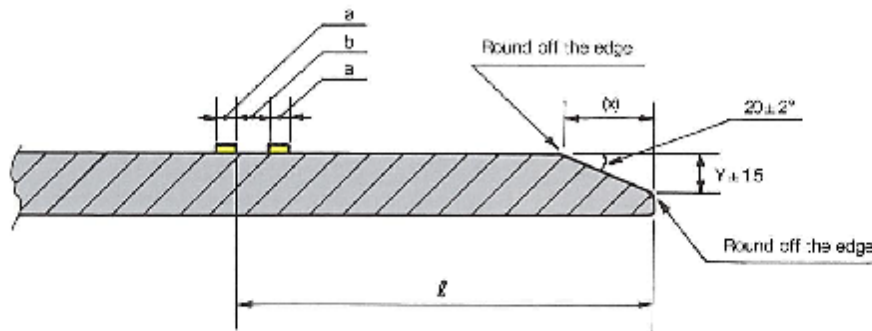


Table 2

(mm)

DN	Dimension of taper		Position of white lines		
	Y	(X), only for reference	L	a	b
80	3.0	9	78	10	13
100	3.0	9	82	10	13
150	3.0	9	93	10	13
200	3.0	9	108	10	13
250	3.0	9	113	10	13
300	3.0	9	118	10	13
350	5.0	14	130	10	13
400	5.0	14	130	10	13
450	5.0	14	130	10	13
500	5.0	14	140	10	13
600	5.0	14	145	10	13
700	6.0	15	180	15	20
800	6.0	15	165	15	20
900	6.0	15	180	15	20
1000	7.5	19	190	15	20
1100	7.5	19	205	15	20
1200	7.5	19	220	15	20
1400	8.5	23	250	15	20
1500	8.5	23	265	15	20
1600	8.5	23	280	15	20
1800	9.5	26	310	15	20
2000	9.5	26	340	15	20

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2. Correction of Deformed Spigot

Although ductile iron pipes are tough and strong, they may be accidentally deformed by improper handling. However minor deformations can be repaired by following the methods described below:

(1)



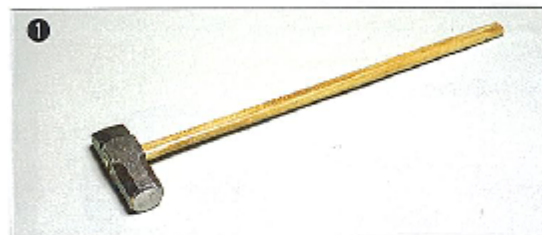
(2)



[1] Inspection

Generally only ellipse on the spigot end can be repaired.

If the spigot is severely deformed and concave or is extensively flat; generally it can not be corrected → cut the pipe.



[2] Tools and equipment

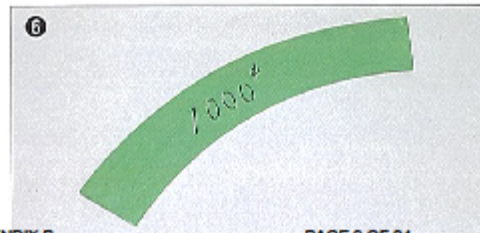
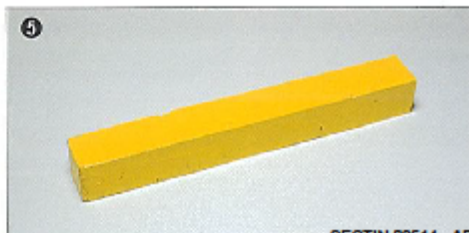
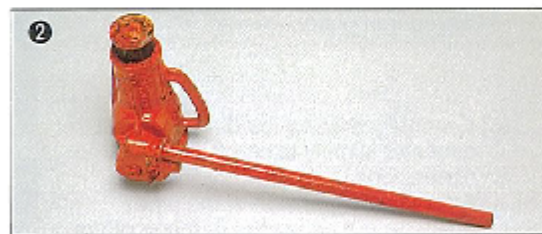
For the convenience of the repair work, the following tools are recommended.

- Hammer (Large) (Photo ①)
- Hydraulic jack (Photo ②)
- Iron plate with curvature that conforms to the inner wall of the repairing pipe. (Photo ③)

* This can be made on site by cutting out pieces from rejected pipe or cut pipe, etc.

- Measuring tape (Photo ④)
- Wood block (Photo ⑤)
- Curvature gauge (Photo ⑥) made of plywood, tin plate, plastic, etc.

* This can be made on site using available materials.



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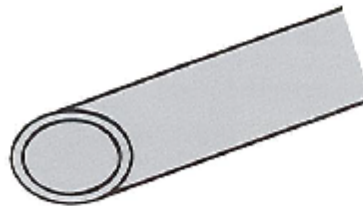
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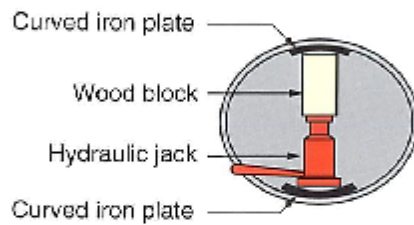
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[3] Procedure

- (1) Position the pipe so that the minimum diameter point is located vertically.



- (2) Set the hydraulic jack, a wood block and iron plates in the pipe. (Photo ⑦)



- (3) Gradually expand the diameter until the diameter slightly exceeds the required dimensions.

* Excessive expansion of the pipe diameter will cause the damage of the mortar lining.



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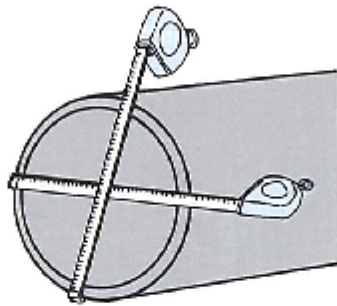
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(4) Release pressure of the hydraulic jack and measure the diameters in two or more directions and see if they are within the tolerance in Table 1, Page 5. If they are not, repeat (3) and (4). (Photo ⑧)



* This procedure may be repeated several times until a correct circle is obtained.



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3. Repair of Cement Lining

Repair Material

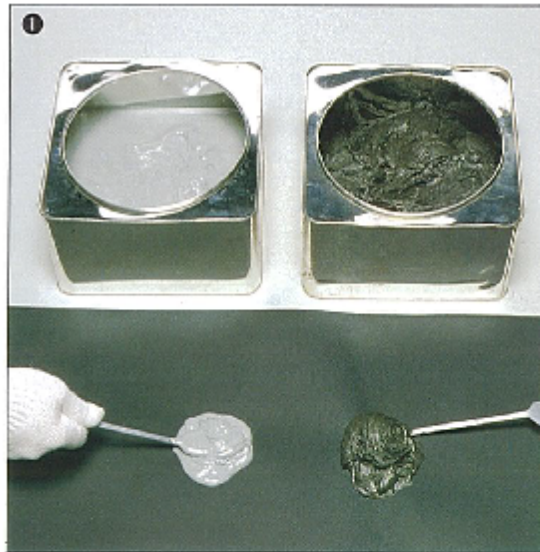
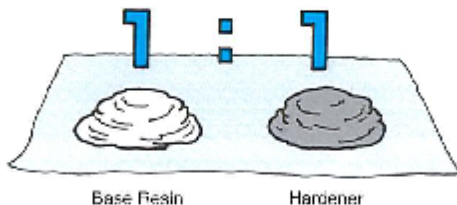
For the repair of the damaged cement lining on site, EPILITE PUTTY KT (Epoxy Resin) or Cement Mortar is recommended.

* If other methods are to be employed, carefully select the appropriate measures according to the basic idea of repair.

[1] EPILITE PUTTY KT

The two different clay-like materials are mixed together and used as putty. The mixing procedure is as follows: (For products other than those supplied by KUBOTA, see manufacturer's instructions.)

- (1) Prepare EPILITE PUTTY KT compound.
Using different spoons, take out "Base Resin" and "Hardener" 1 : 1 by weight. (Photo ①)



- (2) Mix them well until they become uniformly gray. (Photo ② and ③)

* Use the compound within a half hour. (The pot life and condition of the material vary according to the surrounding temperature.)



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[2] Cement Mortar

It is recommended to select cement of the same quality as that used for the cement lining. (e.g. Portland cement, sulphate resisting cement, etc.)

(1) Prepare cement and sand.
Cement : Sand = 1 : 1 by weight
(Photo ④)

(2) Mix them well. (Photo ⑤)

(3) Add water in small amounts to the mixture and continue to mix them.
(Photo ⑥)

(4) Keep mixing until the mixture becomes such that it can be formed into a lump when grasped firmly in one hand.
(Photo ⑦)
* Use the mixture within one hour.



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Repair of Cement Lining

As stated in the international standards, it is not necessary to repair the surface crazing and the small cracks of less than 0.8mm, because they will be filled with

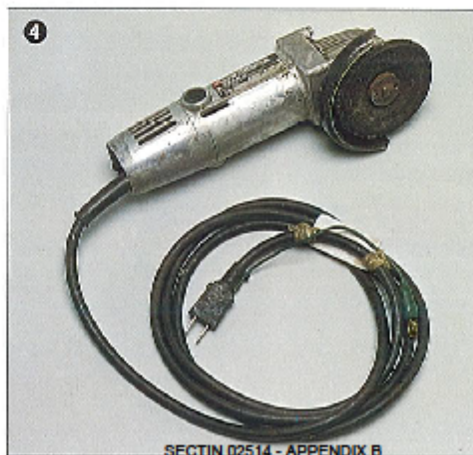
newly hydrated calcium resulting from the reaction of cement and water. This effect is called autogenous healing.

■ Crack (above 0.8mm)

[1] Tools and equipment

For the convenience of the repair work, following tools are recommended.

- Hammer (Photo ①)
- Spatula (Photo ②)
- Brush (Photo ③)
- Portable disc grinder (Photo ④)
- Chisel (Photo ⑤)



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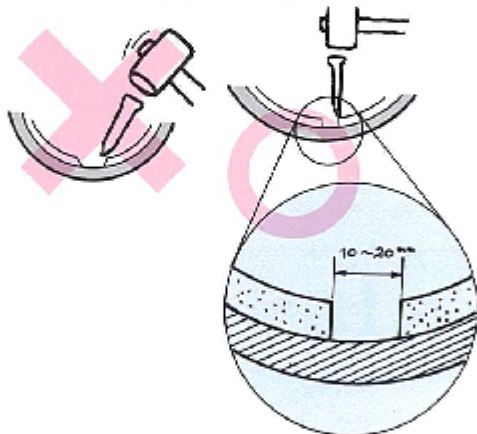
[2] Inspection

When the pipe has large cracks, deformation of pipe body is expected. In this case, correction of the pipe is necessary prior to the repair of the lining. (Photo ⑥)



[3] Procedure

(1) Using a chisel and hammer, cut back the lining. (Photo ⑦)



(2) A portable disc grinder may be used instead of a chisel and hammer. (Photo ⑧)



(3) Clean the surface with a brush etc. (Photo ⑨)

* Remove water and moisture from the surface.



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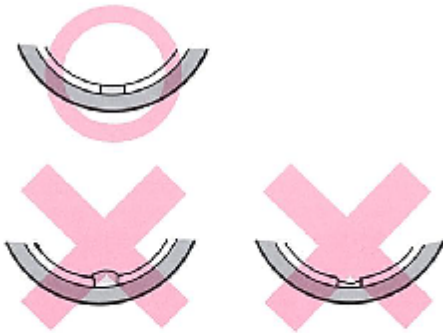
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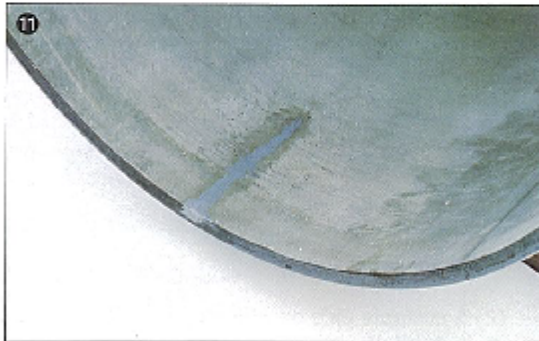
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(4) Fill the cut back portion with EPILITE PUTTY KT (See page 10), and smooth the surface with a spatula. (Photo 10)



(5) Inspect the finished surface. (Photo 11)



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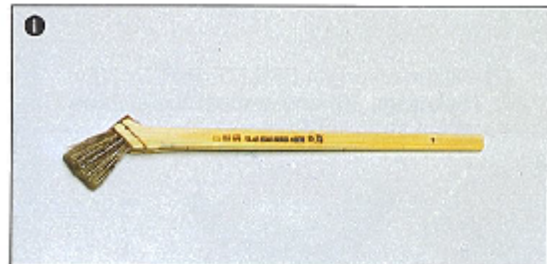
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■ Chip

[1] Tools and equipment

For the convenience of repair work, the following tools are recommended.

- Brush (Photo ①)
- Spatula (Photo ②)



[2] Inspection

Inspect the damaged portion carefully and confirm that there is no deformation or crack on the pipe body. (Photo ③)



[3] Procedure

- (1) Clean the surface with a brush.
(Photo ④)

* Remove water and moisture.



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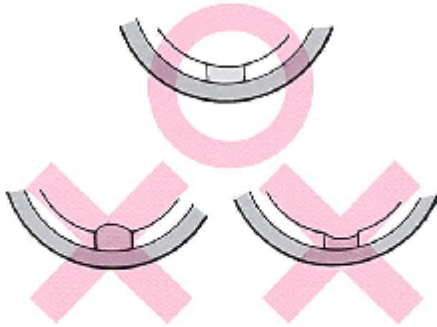
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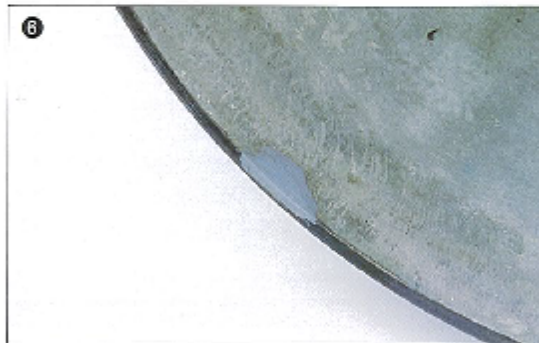
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(2) Fill the chip with EPILITE PUTTY KT
(See page 10) and smooth the surface
with a spatula. (Photo ⑤.)



(3) Inspect the surface. (Photo ⑥.)



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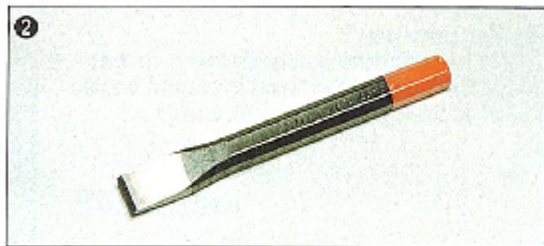
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■ Break

[1] Tools and equipment

For the convenience of repair work, the following tools are recommended.

- Hammer (Photo ①)
- Chisel (Photo ②)
- Brush (Photo ③)
- Spatula (Photo ④)
- Adhesive tape (Photo ⑤)
- Plastic sheet (Photo ⑥)



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[2] Inspection

Inspect the affected area well. If the cement lining is broken off in a large area, cut the pipe to remove the damaged portion. (Photo ⑦)

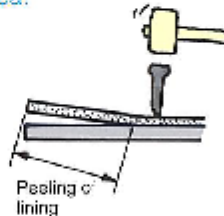


[3] Procedure

(1) Cut back the damaged lining so that the edge of the lining is at right angles to the iron surface. (Photo ⑧)



* If the cement lining is peeled off from the iron surface, cut back the affected area.



(2) Clean the surface with a brush, then apply water to the damaged portion with a brush. (Photo ⑨, ⑩)



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(3) Fill the damaged portion with the mortar mixture (See page 11).
(Photo ⑪)



(4) Tap the filled mortar mixture lightly with a hammer. (Photo ⑫)

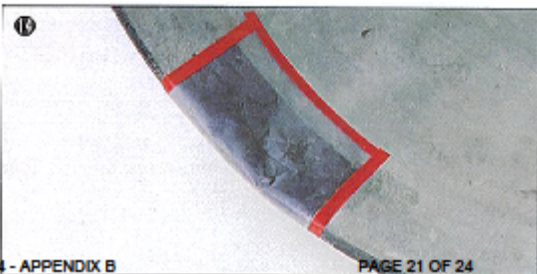


(5) Smooth the surface with a spatula.
(Photo ⑬)



(6) Curing:
Cover the repaired portion with a wet towel or wet paper, then seal up with plastic film and adhesive tape. Keep it on for more than 24 hours. (Photo ⑭)

* Other curing methods may be applied according to the condition at the site and the supervisor's decision.



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4. Repair of External Coating

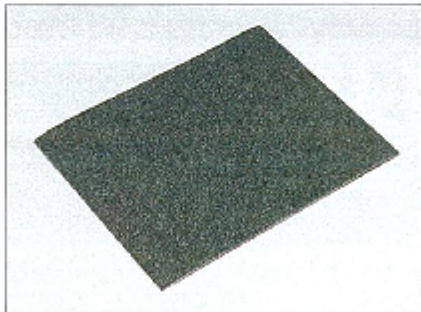
[1] Tools and equipment

For the convenience of the repair work, the following tools are recommended.

- Wire brush



- Sandpaper



- Brush



[2] Procedure

- (1) Remove foreign materials and clean the surface.

* If the surface is rusted, use wire brush or sandpaper to remove the rust, then wipe off with a cloth.



- (2) Use the specified coating material. Follow the manufacturer's instructions.



- (3) Uniformly apply the coating with a brush.



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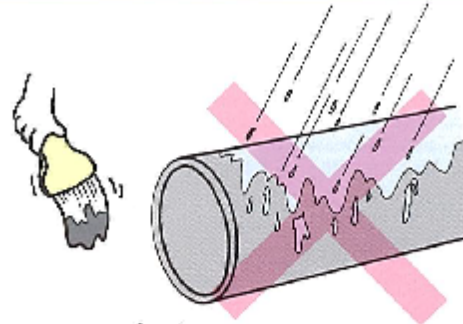
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[3] Precautions

(1) Do not apply coating when the pipe surface is wet.
The coated surface has to be completely dried before installation.



(2) Keep away from open flames because the coating material is inflammable.



(3) Use the coating material only in well ventilated areas.



(4) Avoid contact with the skin and eyes.
If contact occurs, wash affected area immediately with soap* and water.
(*Do not use soap for eyes.)



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Mission Rock Phase 1 Street Improvement Plans

20" - 40" NS-TYPE JOINT ASSEMBLING CHECK SHEET (For Pipes)				Jointed by		Filled by	
Contractor							
Date		Site					
Pipe size		DRG. No.					
<div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="width: 45%;"> <p>① Back-up ring</p> <p>④ Rubber gasket Protrusion</p> </div> <div style="width: 45%;"> <p>②, ③, ⑤ & ⑥</p> <p>Check position</p> </div> </div>							
Pipe No.							
Symbol							
Cleaning & Lubrication							
Gland split portion (up-down)							
① Back-up ring	(1) Direction of rim						
	(2) Split portion						
② Position of white line A and socket end	1						
	2						
	3						
	4						
③ Gap between socket end and gland	1						
	2						
	3						
	4						
④ Rubber gasket	(1) Protrusion	1					
		2					
		3					
		4					
	(2) Turn	All					
⑤ T-head bolts	No.s						
	Torque						
⑥ Distance between socket end and white line B	1						
	2						
	3						
	4						
Judgment							
<p>① (1) Rim faces rubber gasket. (2) Not overlapped to that of lock ring. ② Socket end is above the white line A. ③ max - min $\leq 0.2"$ ④ (1) There shall be no A and C or A, B and C. (2) Not turned up. ⑤ Torque (ft-lb): 73.7 (20", 24"), 103.2 (28", 32"), 147.4 (36", 40") ⑥ max - min $\leq 1.22"$ (20", 24"), 1.26" (28"-36"), 1.30" (40")</p>							
				Checked by		Approved by	

SECTION 02514 - APPENDIX C

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AWSS High Pressure Gate Valves
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Mission Rock Phase 1 Street Improvement Plans

20" - 40" NS-TYPE JOINT ASSEMBLING CHECK SHEET (For Pipes with Liner and Fittings)				Jointed by		Filled by		
Contractor								
Date		Site						
Pipe size		DRG. No.						
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>① Back-up ring</p> <p>④ Rubber gasket</p> </div> <div style="width: 45%;"> <p>②, ③ & ⑤</p> <p>Check position</p> </div> </div>								
Pipe No.								
Symbol								
Cleaning & Lubrication								
Confirmation of lock								
Gland split portion (up-down)								
① Back-up ring	(1) Direction of rim							
	(2) Split portion							
② Position of socket end and marking	1							
	2							
	3							
	4							
③ Gap between socket end and gland	1							
	2							
	3							
	4							
④ Rubber gasket	(1) Protrusion	1						
		2						
		3						
		4						
	(2) Turn	All						
⑤ T-head bolts	No.s							
	Torque							
Judgment								
<p>① (1) Rim faces rubber gasket. (2) Not overlapped to that of lock ring.</p> <p>② Socket end is above the marking provided on site.</p> <p>③ max - min $\leq 0.2"$</p> <p>④ (1) There shall be no A and C or A, B and C. (2) Not turned up.</p> <p>⑤ Torque (ft-lb): 73.7 (20", 24"), 103.2 (28", 32"), 147.4 (36", 40")</p>				Checked by		Approved by		

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Mission Rock Phase 1 Street Improvement Plans

20" - 40" NS-TYPE JOINT ASSEMBLING CHECK SHEET (For Collar)				Jointed by	Filled by
Contractor					
Date		Site			
Pipe size		DRG. No.			
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>① Back-up ring</p> <p>④ Rubber gasket Protrusion</p> </div> <div style="width: 50%;"> <p>②, ③, ⑤ & ⑥</p> </div> </div>					
Pipe No.					
Symbol					
Cleaning & Lubrication					
Gland split portion (up-down)					
① Back-up ring	(1) Direction of rim				
	(2) Split portion				
② T-head bolts	No.s				
	Torque				
③ Gap between socket end and gland	1				
	2				
	3				
	4				
④ Rubber gasket	(1) Protrusion	1			
		2			
		3			
		4			
	(2) Turn	All			
⑤ Distance y_1 between spigot ends	1				
	2				
	3				
	4				
⑥ Distance L' between socket end and white line	1				
	2				
	3				
	4				
Judgment					
<p>① (1) Rim faces rubber gasket. (2) Not overlapped to that of lock ring. ② Torque (ft-lb): 73.7 (20", 24"), 103.2 (28", 32"), 147.4 (36", 40") ③ max - min $\leq 0.2"$ ④ (1) There shall be no A and C or A, B and C. (2) Not turned up. ⑤ See the above table. (Only at connecting pipes laid from opposite) ⑥ See the above table. (Only at pipe laying in same direction)</p>					
				Checked by	Approved by

Table. Distance y_1 and L'

Pipe size	⑤ y_1	⑥ L'
20, 24	10.24	4.13
28	11.81	3.43
32, 36	12.01	3.86
40	12.20	4.06

y_1 : Only at connecting pipes laid from opposite side

L' : Only at pipe laying in same direction

Reference: Position of white lines

Pipe size	L_1
20, 24	8.66
28	10.12
32, 36	10.43
40	10.55

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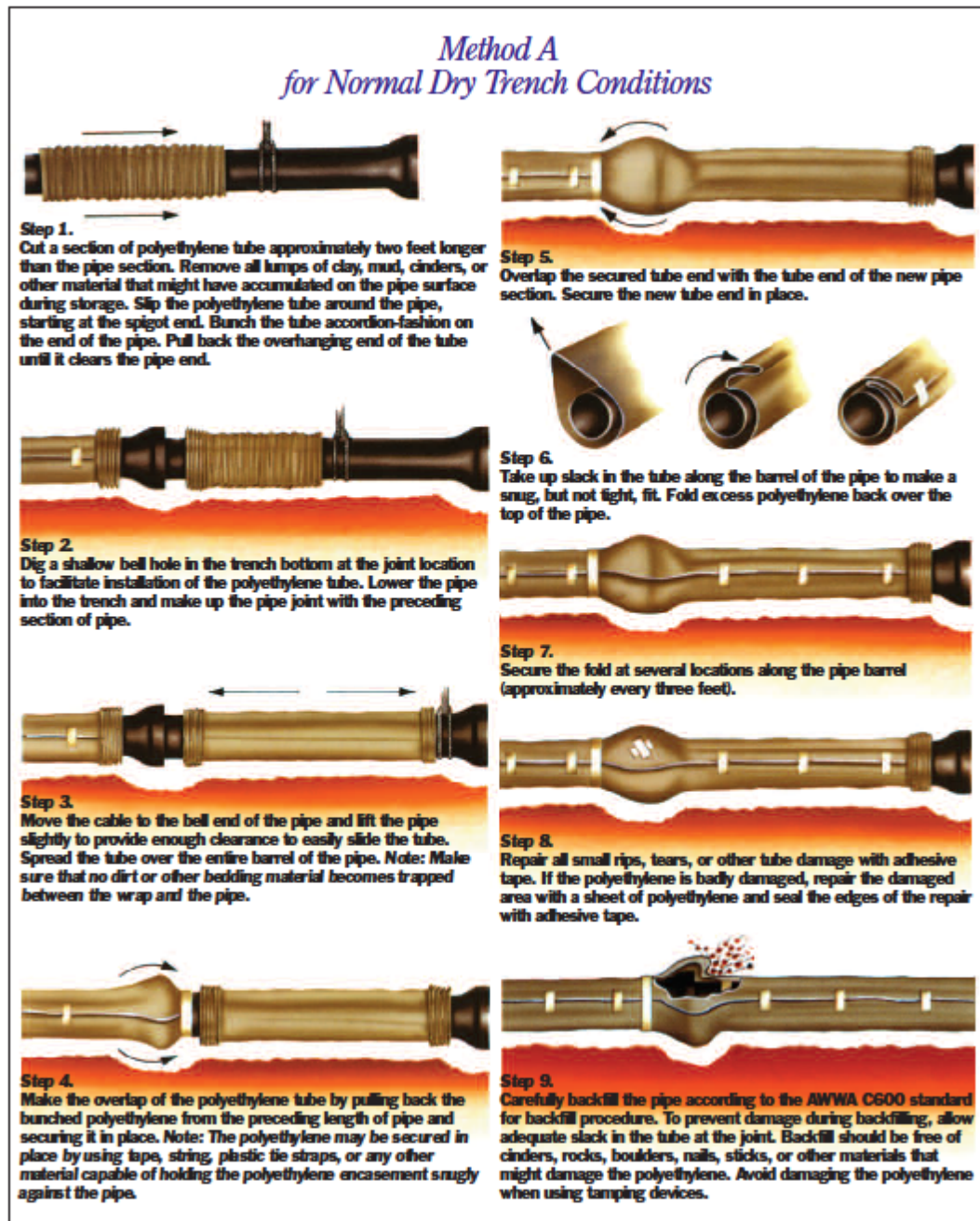
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AWSS High Pressure Gate Valves
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Alternate Method A for Wet Trench Conditions

In wet, sloppy trench conditions, the pipe should be completely covered by the polyethylene tube before it is lowered into the trench. This alternate method is illustrated below.



Step 1.
Cut the polyethylene tube to a length approximately two feet longer than that of the pipe section. Slip the tube over the pipe.



Step 2.
Spread the tube over the entire barrel of the pipe, pushing back both ends of the tube until they clear both pipe ends. Make sure the tube is centered on the pipe to provide a one-foot overlap at each end.



Step 3.
Take up slack in the tube to make a snug, but not tight, fit. (See previous page.) Circumferential wraps of tape or plastic tie straps should be placed at 2-foot intervals along the barrel of the pipe to help minimize the space between the polyethylene and the pipe. Wrap a piece of tape or plastic tie strap completely around the pipe at each end to seal the polyethylene, leaving ends free to overlap the adjoining sections of pipe.



Step 4.
Lower pipe into the trench and make up the pipe joint. Be careful not to damage the polyethylene when handling or jointing the pipe. Complete the installation following dry condition Steps 4, 5 (taking care to seal ends of overlap by wrapping tape or plastic tie straps completely around the pipe at each end), 8, and 9 on previous page. **Note:** When lifting polyethylene-encased pipe, use a fabric-type sling or a suitably padded cable or chain to prevent damage to the polyethylene.

If you have any problems or questions about installing polyethylene encasement, contact DIPRA or one of its member companies.

Appurtenances

Pipe-shaped appurtenances

Cover bends, reducers, offsets, and other pipe-shaped appurtenances in the same manner as the pipe.

Odd-shaped appurtenances

Wrap odd-shaped appurtenances such as valves, tees, and crosses with a flat sheet or split length of polyethylene tube by passing the sheet under and then over the appurtenance and bringing it together around the body of the appurtenance. Make seams by bringing the edges of the polyethylene together, folding over twice, and taping them down.

Joints

Overlap joints as in normal installation; then tape the polyethylene securely in place at valve stems and other penetrations. When bolted-type joints are used, care should always be taken to prevent bolts or other sharp edges of the joint configuration from penetrating the wrap.

Branches, blowoffs, air valves

To provide openings for branches, blow-offs, air valves, and similar appurtenances, make an X-shaped cut in the polyethylene and temporarily fold back the film. After installing the appurtenance, tape the slack securely to the appurtenance and repair the cut and any other damaged areas in the polyethylene with tape.

Service taps

The preferred method of tapping polyethylene-encased Ductile Iron pipe involves wrapping two or three layers of polyethylene adhesive tape completely around the pipe to cover the area where the tapping machine and chain will be mounted. Then install the corporation stop directly through the tape and polyethylene. After the tap is made inspect the entire circumferential area for damage and make any necessary repairs.

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Recommended Tapping Method

To perform the preferred method of tapping polyethylene-encased Ductile Iron pipe, wrap two or three layers of polyethylene adhesive tape completely around the pipe to cover the area where the tapping machine and chain will be mounted.



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Mount the tapping machine on the pipe area covered by the polyethylene tape. Then make the tap and install the corporation stop directly through the tape and polyethylene.



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After making the direct service connection, inspect the entire circumferential area for damage and make any necessary repairs.

SECTION 02514 - APPENDIX D

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SECTION 33 10 50

AWSS HIGH PRESSURE DUCTILE IRON GATE VALVES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. These Specifications specify the requirements for installing high-pressure flanged ductile iron gate valves of various configurations for the City and County of San Francisco's (CCSF) Auxiliary Water Supply System (AWSS) as shown on the Plans.
- B. Valves specified herein shall be flanged, ductile iron body, single or double disc, bronze mounted, non-rising stem, suitable for vertical installation in underground service. Valves shall have wrench-operated nuts. Valves 12-inch and larger shall have a bypass valve integral to the main valve as specified hereinafter.
- C. The exterior of high-pressure flanged ductile iron gate valves and actuators shall be recoated by the Contractor prior to installation.
- D. Except as hereinafter specified or required to meet material, pressure and testing requirements, valves shall conform to the AWWA C500, latest edition.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 33 10 10, Auxiliary Water Supply System (AWSS)

1.3 REFERENCES

- A. ASTM A126 Standard Specification for Gray Iron Castings for Valves Flanges, and Pipe Fittings
- B. ASTM A276 Standard Specification for Stainless Steel Bars and shapes
- C. ASTM A395 Standard Specification for Ferritic Ductile Iron Pressure Retaining Castings for Use at Elevated Temperatures
- D. ASTM A536 Standard Specification for Ductile Iron Castings
- E. ASTM B62 Standard Specification for Composition Bronze or Ounce Metal Castings
- F. ASTM C150 Standard Specification for Portland Cement
- G. ASTM A615 Deformed and plain billet – steel bars for concrete reinforcement

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- H. ASTM C857 Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
- I. ASTM C858 Standard Specification for Underground Precast Concrete Utility Structures
- J. AISI (American Institute of Steel Institute) Steel Products Manuals
- K. ASME B 16.42 Ductile Iron Pipe Flanges and Flanged Fittings
- L. AWWA C500 Standard for Metal-Seated Gate Valves for Water Supply Service
- M. Caltrans Standard Specifications (2015)

1.4 SUBMITTALS

- A. Gate Valves
 - 1. The Contractor shall provide a copy of all test data for the valves certified by the Manufacturer as to accuracy.
 - 2. The Contractor shall provide from the valve Manufacturer valve drawings and gear operator drawings. Drawings shall show outside dimensions, cross-sections, material standards, weights, and complete parts list with parts numbers for ordering replacement parts, and complete maintenance instructions. The submittal drawings shall become the property of the Owner.
 - 3. The Contractor shall submit the Manufacturer's certifications of compliance.

1.5 QUALITY ASSURANCE

- A. Experience: The Manufacturer of the valves shall have at least five (5) years of experience in the manufacturing of ductile iron gate valves and valves similar in type, size and pressure rating to these specifications.

1.6 TESTING AND INSPECTION

- A. The Manufacturer shall test the valves with bypass valves installed. Copies of all test data shall be certified by the Manufacturer and shall be submitted to the Engineer.
 - 1. Hydrostatic Tests: Separate seat and shell hydrostatic tests shall be performed on every valve furnished by the Contractor.
 - a. The shell test shall be performed with gate unseated. Hydrostatic test pressure shall be two times the design service pressure or 900 psig, whichever is greater. Pressure shall be maintained for 5 minutes during which no leakage, sweating of water, or other defects shall be evident.
 - b. Seat tests shall be performed separately on each side of the gate, with the gate seated and the bypass valve closed. Test pressure shall be maintained at 450 psig for 5 minutes minimum. If leakage is noted, the pressure shall be maintained for 12 minutes minimum. Leakage past the disc shall not exceed 1 ounce/hour/inch of nominal valve diameter.

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2. Functional Tests: Following the hydrostatic tests, each valve shall be fully opened and fully closed to verify smooth and satisfactory operation.
 - a. The maximum torque required to open each valve from the closed position at an unbalanced pressure of 350 psig shall be measured and documented for each valve. Operating torque shall not exceed the limit specified hereinafter
 - b. The total number of turns required to open and to close each valve shall be counted and documented, and shall be as specified hereinafter.

PART 2 - PRODUCTS

2.1 HIGH-PRESSURE GATE VALVES

- A. High pressure gate valves in AWSS mains and AWSS hydrant laterals shall be furnished by the Contractor.
- B. Valves conform to AWWA C500 and valve flanges conform to ANSI Standard B16.42 Class 300 Ductile Iron Flanges.
- C. Components shall be as specified below. ASTM and other standards shall be the most recent issue.
 1. Cast ductile iron: ASTM A 536 or A 395.
 - a. Tensile and yield stresses shall be 65,000 psi and 45,000 psi, respectively. Elongation may be 5 percent to 18 percent in 2-inch length, as determined appropriate by the valve Manufacturer for these service conditions.
 2. Cast bronze trim (Not including stem): ASTM B 62.
 - a. All bronze in contact with water shall be "low zinc bronze" with maximum 7 percent zinc and 2 percent aluminum.
 3. Stainless Steel: ASTM A 276, AISI Type 304 or 316.
- D. Components
 1. Body, bonnet, disc, and stuffing box shall be cast of ductile iron, as specified above. Manufacturer's standard stem seal in lieu of stuffing box will be considered.
 2. Disc shall be either solid wedge or double disc with tapered or parallel seats, cast of ductile iron as described previously.
 3. Valve stem shall be low zinc bronze, not more than 7 percent zinc and 2 percent aluminum. Bronze shall be not less than 60,000 psi tensile, 36,000 psi yield. Material must be recommended by the valve Manufacturer, with written approval by the Engineer.
 4. Trim: Valves shall have resurfaceable disc seat rings and threaded, replaceable body seat rings. Disc ring, body ring, packing gland, disc bushing, backseat bushing, and other trim shall be bronze, ASTM B 62.
 5. Packing: Asbestos containing materials shall not be used.

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6. Disc Guides: The AWWA C500 requirement for bronze disc guides on valves 16 inches and larger is not a requirement of these Specifications.
7. Gear Enclosure: Ductile iron, or cast iron of ASTM A 126 Grade B.
8. Bolts, Studs, and Nuts: Fasteners shall be American English standards, not metric. Fasteners for packing gland shall be bronze. Other exterior bolting, such as for bonnet flange, shall be Type 304 or 316 stainless steel.

2.2 DIMENSIONAL REQUIREMENTS

- A. The table below lists major configuration requirements of the valves, which will be specified in detail hereinafter.

Table of Configurations

Item	Pipe Diameter	No. of Turns	Bypass Valve	Valve Operator
Line Valves				
1	20 inch	267	4-inch	Gear with Operating Nut
2	8-inch	35	None	Operating Nut
Bypass Required for Line Valves Above				
3	4-inch	18	-----	Operating Nut

- B. Bypass valves shall conform to these Specifications.

2.3 OPERATIONAL REQUIREMENTS

- A. Pressure Rating: The valves shall be designed for a working pressure of not less than 450 psig (350 psig static plus an additional 100 psi allowance for water hammer shock pressure), and a hydrostatic test of not less than 900 psig.
- B. Service: Fluid is cold water; normally clean. Valves are for a high pressure, emergency fire protection system. Emergency conditions may subject the valves to several days of sea water use, although it is expected that the valves would be flushed with clean water shortly after such use. Valves 12 inches and larger and their bypass valves shall be installed in vaults. The 8-inch valves shall be designed for long-term burial in the ground.
- C. Manufacturer's Standard Valve: Valves shall be modified from Manufacturer's standard Class 250, 300, or stronger valve. Modifications shall include, but are not limited to, material and thickness of body, bonnet, flanges and all other pressure parts as required to safely achieve test pressures herein specified. Modifications deemed advisable by the Manufacturer may be proposed. Valves shall be similar to Crane 3E, U.S. Pipe Series 7000, American-Darling 102, or approved equal, as determined and approved by the Engineer.

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- D. Pipe Diameters: Diameters shown are nominal diameter of ductile iron pipe.
- E. Flanges: Flange dimensions, drilling, and design pressure ratings shall conform to ANSI Standard B16.42 Class 300 Flanges. Flange class to be called out in the Contract Drawings. Raised faces may be serrated but not grooved for O-rings. Bolt holes shall be drilled and spot-faced on the back.
- F. Operating Positions: All valves of this Section shall be designed for use with stems vertically upward.
- G. Operating Nut: All valves, including those with motorized gear operators, shall have a manual operating nut facing upward. Operating nuts shall be as shown in the Drawing No. HPS-50022. No exception to operating nut dimensions will be considered with respect to wrench compatibility.
- H. Number of Turns: The valves shall open fully with counter-clockwise turns of the operating nut in the number specified in the preceding Table of Configurations, plus or minus three turns. In the open position, the disc shall not protrude into the water passageway (bore of the body seat ring). No exception will be considered to the number of turns specified.
- I. Torque: Torque required to open the valves shall not exceed 250 ft-lb at an unbalanced pressure of 350 psig.
- J. Gear Operator: Valves 12 inches and larger shall be furnished with fully enclosed gear operator
- K. Coatings: All ferrous surfaces of valves except faces of end flanges and machined mating surfaces shall be coated inside and out with at least two coats of asphalt varnish. End flanges and ferrous machined mating surfaces shall be coated with an easily removable rust-preventative. Bronze materials shall not be coated.
- L. Identification: Each valve body or bonnet shall have cast on it the Manufacturer's name, size, working pressure rating, year of manufacture, and "DI" or Ductile Iron." In addition, "SF - AWSS" shall be cast onto each body or bonnet in letters at least 1 inch high. Each valve shall also carry a unique identifying number, which may be inscribed or cast into the body or bonnet, embossed on a stainless steel tag firmly secured to the bonnet flange, or other permanent method.

2.4 8-INCH HYDRANT GATE VALVES

- A. Install valve boxes consisting of a valve box, riser, frame, cover and dustpan according to the AWSS Standard Plans regardless if shown or called out on the Contract Drawings.
- B. Pipe riser for valve box shall be 10-inch nominal diameter, ductile iron pipe, thickness Class 52, not cast iron as shown on the standard plans.

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- C. The Contractor shall furnish and install all flange nuts, bolts, lock washers, gaskets, and accessories as required for gate valve installation.

2.5 CONCRETE VALVE SUPPORT FOR DIRECT BURIED VALVES

- A. Cast-in-place concrete valve support shall be constructed per the Contract Drawing. Concrete material and construction shall conform to the requirements of Caltrans Standard Specification, Section 90 and the following requirements.
 - 1. Cement: ASTM C150, Type II or V
 - 2. Minimum 28-day concrete strength: 3,000 psi.
 - 3. Combined aggregate gradation: 1/2 inch max.
 - 4. Curing time: minimum 3 day moist cure.
 - 5. Compressive strength test: a set of 4 cylinders per batch of concrete. Test one cylinder at 7-days, two cylinders at 28-days, and hold one spare cylinder to verify test results, if needed.
 - 6. Reinforcement: deformed bar, ASTM A615.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION AND COATING FOR HIGH-PRESSURE GATE FOR DIRECT BURIED VALVES

- A. The surface preparation for exterior surfaces shall be Near White Metal Abrasive.
- B. Blast Cleaning per SSPC-SP12 / NACE 5 Surface Preparation and Cleaning of Steel and Other Hard Materials by High and Ultra-High Pressure Water Jetting Prior to Recoating.
- C. The coating material shall be Amerlock-2 as manufactured by Ameron International, or Carboguard-954HB as manufactured by Carboline Company, or approved equal.
- D. The coating material shall be applied in minimum of two coats, at 7-8 mils per coat; the total dry film thickness shall be 14-16 mils.
- E. The prime coat shall be white. Topcoat for the valve actuator shall be red color. Topcoat for valve body shall be OSHA-blue, or as approved by the Owner and City Representatives.

3.2 WAX TAPPING FOR DIRECT BURIED VALVES

- A. All fasteners should be wrapped with a petrolatum wax tape in accordance with AWWA Standard C217-16.
- B. Wax-tape-wrapped valve and fittings should be over-wrapped with polyethylene encasement in accordance with AWWA C105/A21.10- 12.
- C. The folds, creases, and splices should be taped tight and the ends tightly taped to prevent ingress of groundwater.

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- D. An appropriate tape to use shall meet AWWA C209-13.

END OF SECTION

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SECTION 33 20 00

NON-POTABLE WATER SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Site water distribution system for recycled services up to 5 feet of any on-site building being served.
- B. Recycled water transmission or distribution system within a roadway or street right-of-way.

1.2 RELATED SECTIONS

- A. Section 31 21 00, Utility Trenching and Backfill
- B. Section 33 10 10, Auxiliary Water Supply System

1.3 RELATED DOCUMENTS

- A. ASME
 - 1. ASME A112.1.2: Air Gaps in Plumbing Systems (for Plumbing Fixtures and Water Connect Receptors)
 - 2. ASME B1.20.1: Pipe Threads, General Purpose, Inch
 - 3. ASME B16.1: Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
 - 4. ASME B16.18: Cast Copper Alloy Solder Joint Pressure Fittings
 - 5. ASME B16.22: Wrought Copper and Copper Alloy Solder – Joint Pressure fittings
 - 6. ASME B16.26: Cast Copper Alloy Fittings for Flared Copper Tubes
- B. ASTM
 - 1. ASTM A536: Standard Specification for Ductile Iron Castings
 - 2. ASTM A674: Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids
 - 3. ASTM B61: Standard Specification for Steam or Valve Bronze Castings
 - 4. ASTM B62: Standard Specification for Composition Bronze or Ounce Metal Castings
 - 5. ASTM B88: Standard Specification for Seamless Copper Water Tube
 - 6. ASTM C94: Standard Specification for Ready-Mixed Concrete
 - 7. ASTM F1056: Standard Specification for Socket Fusion Tools for Use in Socket Fusion Joining Polyethylene Pipe or Tubing and Fittings

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C. AWWA

1. C104: Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
2. C105: Polyethylene Encasement for Ductile-Iron Pipe Systems
3. C110: Ductile-Iron and Gray-Iron Fittings
4. C111: Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
5. C115: Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
6. C116: Protective Fusion-Bonded Epoxy Coatings for the Interior & Exterior Surfaces for Ductile-Iron and Gray-Iron Fittings
7. C150: Thickness Design of Ductile-Iron Pipe
8. C151: Ductile-Iron Pipe, Centrifugally Cast
9. C153: Ductile-Iron Compact Fittings
10. C205: Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 inch and Larger-Shop Applied
11. C208: Dimensions for Fabricated Steel Water Pipe Fittings
12. C209: Cold Applied Tape Coatings for Steel Water Pipe, Special Sections, Connections, and Fittings
13. C210: Liquid-Epoxy Coatings and Linings for Steel Water Pipe and Fittings
14. C213: Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings
15. C214: Tape Coatings for Steel Water Pipelines
16. C218: Liquid Coatings for Aboveground Steel Water Pipe and Fittings
17. C219: Bolted, Sleeve-type Couplings for Plain-End Pipe
18. C500: Metal-Seated Gate Valves for Water Supply Service
19. C502: Dry-Barrel Fire Hydrants
20. C503: Wet Barrel Fire Hydrants
21. C504: Rubber Seated Butterfly Valves.
22. C507: Ball Valves, 6 inch through 60 inch.
23. C508: Swing-check Valves for Waterworks Service, 2 inch through 48 inch NPS.
24. C509: Resilient-Seated Gate Valves for Water Supply Service
25. C510: Double Check Valve Backflow Prevention Assembly
26. C511: Reduced-Pressure Principle Backflow Prevention Assembly
27. C512: Air-Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service
28. C550: Protective Interior Coatings for Valves and Hydrants
29. C600: Installation of Ductile-Iron Water Mains and Their Appurtenances
30. C606: Grooved and Shouldered Joints
31. C651: Disinfecting Water Mains
32. C800: Underground Service Line Valves and Fittings
33. C906: Polyethylene (PE) Pressure Pipe and Fittings, 4 inch through 65 inch, for Waterworks
34. ISO 8179-1: Ductile Iron Pipes – External Zinc-Based Coating
35. M41: Ductile-Iron Pipe and Fittings

D. Factory Mutual Insurance Company (FM)

1. FM 1530: Fire Department Connections

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- E. National Fire Protection Association (NFPA)
 - 1. NFPA 24: Installation of Private Fire Service Mains and Their Appurtenances
 - 2. NFPA 70: National Electric Code
 - 3. NFPA 1963: Fire Hose Connection
- F. National Sanitation Foundation (NSF)
 - 1. NSF 61: Drinking Water System Components-Health Effects
- G. Underwriters Laboratory(UL)
 - 1. UL 262: Safety Gate Valves for Fire-Protection Service
 - 2. UL 405: Safety Fire Department Connection Devices
 - 3. UL 789: Indicator Posts for Fire-Protection Service
- H. Standard Specifications of the City and County of San Francisco, Department of Public Works, Bureau of Engineering (SSDPWSF), Latest Edition. Also referred to as "City Standard Specifications."
- I. Standard Plans of the City and County of San Francisco, Department of Public Works, Bureau of Engineering (SPDPWSF), Latest Edition. Also referred to as "City Standard Plans."
- J. Standard Plans and Specifications of San Francisco Public Utilities Commission - City Distribution Division (SFPUC - CDD), Latest Edition.
- K. Department of Public Works (DPW) Order No. 176,707 "Regulations for Excavating and Restoring Streets in San Francisco", approved March 26, 2007.
- L. AWWA Standards, Latest Revision.
- M. California Administrative Code, Title 22, §64572, Water Main Separation
- N. SFWD standard drawings, SFWD Rules and Regulations governing Water Services to customers, Latest Editions.
- O. SFPUC Asset Protection Standards, May 2017 or Latest Edition.

1.4 DEFINITIONS

- A. AASHTO: American Association of State Highway and Transportation Officials
- B. ASTM: American Society for Testing Materials
- C. AWWA: American Waterworks Association
- D. DI: Ductile iron
- E. DIP: Ductile iron pipe

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- F. FM: Factory Mutual
- G. ISO: International Organization for Standardization
- H. NFPA: National Fire Protection Association
- I. NSF: National Sanitation Foundation
- J. PCC: Portland cement concrete
- K. UL: Underwriters Laboratory

1.5 SYSTEM PERFORMANCE REQUIREMENTS

- A. External Load: Earth load indicated by depth of cover plus AASHTO H20 live load unless indicated otherwise.

1.6 SUBMITTALS

- A. Follow submittal procedure outlined in Section 01 10 00, Supplemental General Requirements.
- B. Product Data: Manufacturer's literature and data, including, where applicable, sizes, pressure rating, rated capacity, listing/approval stamps, labels, or other marking on equipment made to the specified standards for materials, and settings of selected models, for the following:
 - 1. Piping materials and fittings
 - 2. Gaskets, couplings, sleeves, and assembly bolts and nuts
 - 3. Flexible pipe fittings
 - 4. Restrained pipe fittings
 - 5. Flexible Connectors
 - 6. Expansion joints
 - 7. Flexible expansion joints
 - 8. High deflection fittings/ball joints
 - 9. Gate valves
 - 10. Air release, air/ vacuum and combination air valves
 - 11. Blow-off valves
 - 12. Service connections and water meters
 - 13. Valve boxes, meter boxes, frames and covers
 - 14. Backflow preventers
 - 15. Fire hydrants
 - 16. Post indicator valves
 - 17. Fire department connections
 - 18. Thrust block concrete mix
 - 19. Tapping sleeves and tapping valves
 - 20. Service saddles and corporation stops
 - 21. Identification materials and devices

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- C. Shop Plans and Calculations: Where an on-site fire water system is required, Contractor shall provide shop plans for Engineer and agency approval prior to construction. Coordinate with the Plans and identify any proposed modifications or deviations. Shop Plans and Calculations shall be stamped and signed by a registered Fire Protection Engineer licensed by the State of California as required.
 - 1. Include the following information:
 - a. Design assumptions
 - b. Thrust block sizing and calculations
 - c. Materials to be used
 - d. Available water pressure
 - e. Required water pressure
 - 2. The review of fire system components constitutes only a portion of the review and approval required. A copy of the fire system component submittal package shall be forwarded to the local fire marshal for further review and approval.
- D. Water Pressure Report: At the conclusion of work, the Contractor shall engage a qualified testing service to conduct a flow test of the existing system (providing flow test data for all mains and at least six (6) hydrants). Provide date and location of test, type and method of test performed, static pressure and residual pressure in psig, observed flow in gpm, and orifice size.
- E. Shop drawings: Include plans, elevations, details and attachments.
 - 1. Precast and cast in-place vaults and covers
- F. Field test reports: Indicate and interpret test results for compliance with the Project requirements.

1.7 QUALITY ASSURANCE

- A. All testing required by this Section and other Sections of these Specifications shall be witnessed by the Developer's Agent. Retesting required as a result of failed tests shall be at the expense of the Contractor.

1.8 MATERIAL DELIVERY, STORAGE AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. Deliver piping 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.

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- C. Handling: Use slings to handle valves and fire hydrants whose size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. During Storage: Use precautions for valves, including fire hydrants according to the following.
 - 1. Do not remove end protectors, unless necessary for inspection, then reinstall for storage.
 - 2. Protection from Weather: Store indoors and maintain temperature higher than ambient dew-point temperature. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- E. Do not store plastic pipe and fittings in direct sunlight.
- F. Protect pipe, fittings, flanges, seals and specialties from moisture, dirt and damage.
- G. Protect linings and coatings from damage.
- H. Handle precast boxes, vaults and other precast structures according to manufacturer's written instructions.
- I. Protect imported bedding and backfill material from contamination by other materials.

1.9 COORDINATION

- A. Coordinate connection to existing water mains with water utility supplying water.
- B. Coordinate piping materials, sizes, entry locations, and pressure requirements with building domestic water distribution piping and fire protection piping.

PART 2 - PRODUCTS

2.1 PIPE

- A. Piping Materials Less Than 4"
 - 1. Pipe shall be copper tubing, type K and shall conform to CCR Title 22, Section c64570. Soft or hard type K copper tubing shall be per service size as shown in SFWD Standard Drawings.
 - 2. Bronze Valves and Fittings shall conform to AWWA C800 and be the same as awarded under the current City Procurement Contract for such materials.
 - 3. Angle cocks shall be Ford Angle Ball Meter Valve with stainless steel bolts and nuts.
- B. Piping Materials 4" to 8"
 - 1. Pipe shall be ductile iron, Class 53 and conforming to the latest revision of ANSI/AWWA C151/A21.51 and shall conform to CCR Title 22, Section 64570.

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2. Pipe shall be bell and spigot, push-on type, tyton joint that is designed to accommodate "Field-Lok™" gaskets.
 3. The ductile iron pipe shall be cement-mortar lined conforming to ANSI/AWWA C110/A21.10 or ANSI/AWA C153/A21.53. The cement mortar lining shall be double the standard thickness.
 4. Pipe shall be the same as awarded under the current City Procurement Contract for such materials.
- C. Piping Materials Larger Than 8"
1. Pipe shall be ductile iron, Class 53 and conforming to the latest revision of ANSI/AWWA C151/A21.51 and shall conform to CCR Title 22, Section 64570.
 2. Pipe shall be bell and spigot with TR FLEX joint and Tyton gaskets.
 3. The ductile iron pipe shall be cement-mortar lined conforming to ANSI/AWWA C110/A21.10 or ANSI/AWA C153/A21.53. The cement mortar lining shall be double the standard thickness.
 4. Pipe shall be the same as awarded under the current City Procurement Contract for such materials.
- D. For Service Lateral pipe incorporating flanged fittings:
1. Flanges shall match the type used by SFWD for meters and appurtenances.
 2. All flange bolts and nuts shall be in accordance with ANSI B-16.42, 1979 Class 300 except material for the bolts shall be stainless steel, ANSI Type 304 ASTM A 193 B8, Class II and material for the nuts shall be stainless steel, ANSI Type 304 ASTM A 194 B8, Class I.55
 3. All gaskets shall conform to ANSI/AWWA C111/A21.11 standard. Flange joint gaskets shall be full face, non-asbestos with nitrite NBR binder, 1/8" thick. Gaskets shall be constructed of EPDM and meet ANSI/NSF-61.

2.2 VALVES

- A. Corporation stops shall be used for service laterals 2" diameter and smaller. Corporation stops shall be tapped into the main as shown in the SFWD Standard Drawings.
- B. 12-inch and smaller gate valves shall conform to ANSI/AWWA C509. 16-inch gate valves shall conform to ANSI/AWWA C515. 12-inch and 16-inch gate valves shall have mechanical joint ends restrained with EBAA Megalug glands. Flanged end gate valves shall be full-face flange by flange manufactured in accordance with ASA B16.1, 125 lb. Class or ASA B16.2, 250 lb. Class. Operation nut shall be painted red. Refer to CDD's latest valve contract for approved make and model.

2.3 FITTINGS

- A. Fittings shall be Tyton by Tyton ends with U.S. Pipe "Field-Lok" type gaskets for 8-inch and smaller mains, and TR Flex with Tyton gaskets for larger than 8-inch mains.

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2.4 POLYETHYLENE ENCASEMENT

- A. Polyethylene encasement for ductile iron pipe and fittings shall be purple in color, 8 mils in thickness, low density, and shall conform to AWWA C105.
- B. The inside surface of the polyethylene wrap to be in contact with the pipe exterior shall be infused with a blend of anti-microbial biocide to mitigate microbiologically influenced corrosion and a volatile corrosion inhibitor to control galvanic corrosion

2.5 METER BOX AND COVER

- A. Meter boxes and covers for standard 1- and 2-inch (recycled) services shall be made of polyethylene and polymer concrete. Meter vaults for services larger than 2-inch shall be fiberglass vaults with torsion assisted frame and cover. Meter boxes, vaults and covers shall be manufactured by Armorcast or approved equivalent. Refer to SFWD standard drawings. Meter boxes and covers shall be the same as awarded under the current City Procurement Contract for such materials.

2.6 MARKING TAPE

- A. Refer to Section 33 10 10 Auxiliary Water Supply System

2.7 VALVE BOX AND COVER

- A. Valve box and cover shall be for reclaimed water. Valve boxes shall have a special, heavy-duty, triangular cover, with the following inscription cast on the top surface: "RECLAIMED WATER", plus a universal icon for non-potable water.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

- A. Construction staking for RWL shall include reference points indicating offset and elevation to pipe at 50-foot station maximum.
- B. The trench shall be excavated so that a 4-inch thick layer of sand bedding can be installed beneath the pipe bottom such that the barrel of the pipe will have an even bearing along its entire length, and with sufficient clearance provided for any necessary operations in connection with the laying of the pipe. Bell holes shall be excavated for each pipe bell or joint.
- C. Before any pipe may be installed, the grade of the trench bottom shall be to the satisfaction of the Developer's Agent. Immediately prior to installing the pipe, the contractor shall remove all loose rocks and other objectionable material from the bottom of the trench and bell holes. When the trench is properly prepared, the pipe shall be lowered therein, singly, without jar or strain and assembled by piece inside the trench.

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- D. Joints for pipe, fittings, and valves shall be fastened by use of "Field-Lok™" Gaskets unless otherwise directed by the Developer's Agent. Field-Lok gaskets are only for 8" and smaller DIP joints.
- E. The pipe shall be joined in strict adherence to the pipe manufacturer's printed installation instructions.
- F. When the pipe is cut in the field, the outside of the cut end shall be beveled about one-quarter inch at an angle of about 30 degrees and the leading edge rounded. The prepared cut end shall be marked at 3-1/4" for an 8" water line.
- G. If the joint assembly is not accomplished with the application of reasonable force, the plain end of the pipe shall be removed to check the proper position of the gasket. At the end of each day, the contractor shall plug the end of the laid pipe.
- H. No pipe shall be placed within the trench closer than 75 feet from the end of said trench as excavated, or from any obstruction visible in said trench area. The purpose of this stipulation is to permit the Developer's Agent to adjust said trench line and grade as conditions require.
- I. Thrust blocks shall be installed at all fittings or angular bends of 11-1/4 degrees or larger, and greater than 12" in diameter. No thrust blocks required for lines 12" in diameter and smaller.
- J. All connections to existing reclaimed water mains will be made by the SFWD. Dead ends of pipes shall be fitted with bell-flange adapters and blind flange. Connections of new pipe to existing dead ends shall incorporate a bell-flange adapter connected to the existing bell-flange adapter on the existing dead end pipe.
- K. Provide locating/marketing tape in the trench, continuously over the centerline of the pipe. Color-coded identification tape differentiating the reclaimed water piping from other utility lines shall be consistent throughout the project. Reclaimed water pipes shall be installed with a purple identification tape or polyethylene vinyl wrap (Pantone 512). The identification tape shall be locator-type marking tape. The tape and wrap shall be at least three inches in width, and shall have white or black printing on a purple field (Pantone 512), with the following inscription:

"RECLAIMED WATER -- DO NOT DRINK"

Plus a universal icon for nonpotable water.

Text shall not be separated by gaps of more than 6 inches. If the tape is wrapped around the pipe, there shall be two parallel rows of text so that the warning is readable after overlapping. Identification tape shall be continuous in coverage. If tape is attached to sections of pipe before they are placed in the trench, there shall be extra lengths of flaps to provide continuous coverage when the section is installed.

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During pipeline installation, a 3-inch wide identification tape shall be placed in the trench 12 inches above the top of the pipe. Tape shall be oriented longitudinally, and centered along the top of the distribution line, with the printed side facing up. Necessary precautions shall be taken to insure the tape is not distorted or otherwise misplaced during backfilling operations. The intent of this tape is to provide warning during future excavation activities that reclaimed water pipeline is located below, and thus avoid damage and interruption of service.

- L. Valves shall be purple. Valves shall be identified with a stamped brass or engraved plastic disc not less than 1.5 inches in diameter permanently affixed to the valve, with the inscription:

"RECLAIMED WATER"

Plus a universal icon for nonpotable water.

- M. Reclaimed water pipelines shall maintain minimum separation distances from potable water pipelines in conformance with The Waterworks Standards, Title 22, Chapter 16, Section 64572. In addition, reclaimed water pipelines shall maintain the same minimum DOHS separation distances from sanitary sewer lines to prevent recontamination. Installation of pipelines in common trenches shall be prohibited.
- N. The entire pipe system shall be encased with purple polyethylene tubes or sheets in accordance with AWWA C105.
- O. All rubber gasket joints, fusion epoxy coated flanges and flexible couplings on ductile iron pipelines shall be bonded with insulated copper cable to insure electrical continuity of pipeline and fittings.
- P. Insulating flanges and/or couplings shall be installed to electrically isolate the buried portion of pipeline from other metallic pipelines, reinforced concrete structures and above grade buildings or structures.
- Q. All joints on Service Laterals shall be restrained per SFWD Standards.

3.2 IDENTIFICATION OF "FIELD-LOK™" GASKET JOINTS

- A. The Contractor shall identify all joints with "Field-Lok™" gaskets by spraying white marking paint on top of each bell and also by taping a direct burial tape around the spigot end of each pipe, just in front of the bell.

3.3 FLEXIBLE JOINT INSTALLATION

- A. Flexible Expansion Joints shall be installed where located on the Project Drawings pursuant to the Manufactures installation recommendations.

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3.4 HYDROSTATIC TEST IN THE FIELD

- A. When the pipeline or a portion of the pipeline laid under this contract is completed, the Contractor shall test the line to a hydrostatic pressure of 225 pounds per square inch. The actual pressure test of 225 psi shall be maintained for not less than 2 hours during which time no additional water shall be added to the line under test. Contractor shall provide a minimum of 72 hours' notice to the City Representative in advance of the pressure test. Unless otherwise directed by the Developer's Agent, the pipe joints shall be exposed during the test. All service lines to be incorporated in the pipeline shall be installed before the pipeline may be tested and shall be included in the test. All tests shall be witnessed by the Developer's Agent.
- B. For testing of new pipe connected to existing pipe, the connecting bell-flange adapters shall have an 1/8" blind flange inserted between. Upon completion of the test, the blind flange shall be removed, a gasket inserted, and the flange bolts retightened, all in the presence of the City inspector.
- C. The Contractor shall furnish all necessary labor, material and equipment, such as pumps, piping, connections, pressure gauges, etc., for the test. The Contractor shall submit for approval and also furnish and install necessary temporary restraints such as anchorage and blocking to prevent movement of the pipe under test.
- D. Contractor may backfill the new installation (except open ends) prior to hydrostatic test. If any section of the pipe under test develops a leak visible to the eye in the rubber gasket joints or in the pipe itself, the Contractor shall repair or replace the defective portion of the pipe as directed by the Developer's Agent at no additional cost. This work shall include removal of the polyethylene encasement, allowing all water to escape; and retaping of polyethylene encasement per the approved repair procedures. After all repairs are made, the pipe shall be retested.
- E. No external restraint shall be used to prevent possible axial pipe movement at any end cap or blind flange (such as lumber between the cap or blind flange and end of trench).

3.5 DISINFECTION

- A. Upon completion of satisfactory hydrostatic test, the Water Department will disinfect the main. The Water Department will supply and install all piping, fittings and other materials necessary to disinfect the main, except screw taps, flushing assemblies, and risers, which shall be installed by the Contractor. The Contractor shall not backfill the site of such work until the satisfactory disinfection of the main is verified by the Developer's Agent.

3.6 INSTALLING PIPE FITTINGS

- A. The Contractor shall include the procurement, placing, restraining, and protecting of all fittings, valves, joint restraints, and all other appurtenances to be incorporated in

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the work, all as indicated in the Contract Documents or as directed by the Developer's Agent.

- B. Installation:
 - 1. All fittings shall be installed in the manner specified for installing pipe under Item 3.1 unless otherwise specified herein, and as directed by the Developer's Agent.
 - 2. All fittings, bends, tees, and gates of 4, 6, 8-inches in diameter shall be fastened to the pipe or to each other by use of "Field-Lok™" gaskets. All fittings, bends, tees, and gates 12-inches and larger shall use TR FLEX joints and Tyton gaskets. Caps shall be fastened to the pipe by use of tie rods and lugs or restrainers as shown p e r S F W D S t a n d a r d s . All joints within 26 feet upstream from an end cap, blind flange, hydrant, or blow-off valve outlet shall be restrained with tie-rods and/or restraining devices. Additional joint restraints shall be installed at locations directed by the Developer's Agent. Contractor is not allowed to restrain joints by welding on lugs to pipe.
 - 3. All bends, tees, and gates 12-inches and larger shall use TR FLEX joints and Tyton gaskets
 - 4. Joints on all laterals to the main shall be restrained as required and directed by the Developer's Agent.
- C. The Contractor shall paint all tie rods, restraining ring assembly, bands and other miscellaneous metal attached to the pipeline, installed by the Contractor during main connections, or large service connections with two (2) coats Kopper Bitumastic No. 505 or two (2) coats Protecto Wrap CA160 or approved equal, applied in accordance with the manufacturer's directions.
- D. Installation of securing devices for fittings, such as restraining ring assembly, bands, tie rods, and other miscellaneous metal, and furnishing and application of protective painting to devices will be considered as incidental work, and no direct payment will be made therefore.
- E. Valve Boxes:
 - 1. Over each valve, blow-off or other similar appurtenance, a piece of ductile iron pipe of such size as may be required by the Water Department shall be place vertically to form a valve box. A cover (D&L Foundry M-9009 or M-9014, as applicable), shall be placed on top of the pipe or box. The bottom of the box shall rest on a steel plate required by the Water Department so placed as to prevent the box from bearing on the gate. Steel plates supporting boxes, over blow-offs or air valves shall be set on an asphalt bed. Contractor shall cut the box to such lengths that the top of the gate cover will be flush with the surface of the finished pavement.

3.7 INSTALLING SHORING

- A. Work Included:

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1. Under this item, the Contractor shall install an approved shoring system for all excavations 5 feet or more in depth.
2. All shoring shall be installed in accordance with standards established by the California Division of Industrial Safety and in conformance with all other applicable rules and requirements.
3. If the Contractor intends to use a shoring plan which varies from the Standards established by the California Division of Industrial Safety, the plan shall be prepared and signed by a Registered Civil Engineer and submitted to the Developer's Agent for approval at least five (5) working days before the Contractor intends to begin excavating. The Contractor shall not start excavation prior to approval of the shoring plan by the Developer's Agent.
4. In locations where the City crews will install service lines or connections to other lines, regardless of depth, the Contractor shall install a solid sheeting type shoring system, approved by the Developer's Agent, which is capable of protecting all excavations from excessive water that may be present and give ample access to the crews to perform the installation. This shoring system is more stringent than CAL/OSHA Standards.
5. All shoring materials and equipment shall be removed from the excavation prior to completion of work.

3.8 INSTALLATION OF SCREW TAPS

- A. The Contractor shall drill, tap and install all screw taps and risers as indicated in the Contract Documents or as required by the Developer's Agent.
- B. Installation:
 1. Any screw taps not satisfactorily installed in the opinion of the Developer's Agent shall be removed and replaced at the expense of the Contractor. Where the screw tap installation is unsatisfactory, it shall be removed and replaced with a solid cast iron plug. The Contractor shall relocate screw taps to locations as directed by the Developer's Agent.
 2. Contractor shall install a screw tap for 1" services on all size mains and use service saddles for 2" services on 4", 6" and 8" size mains. 2" services on mains larger than 8" shall use screw taps.

3.9 INSTALLATION OF SERVICE PIPE

- A. The Contractor shall remove pavement; excavate service trench; provide and install service pipe and fittings; complete in place and ready for connections with service meter or existing service pipe; furnish and place backfill material in the trench; and clean the site of the work together with all other work necessary or incidental thereto
- B. The locations for services indicated on the drawings are subject to change as directed by the Developer's Agent. Service pipe larger than two inches nominal diameter shall be ductile iron. Size, location, and termination points of all service laterals must be approved by SFWD CDD Engineer prior to installation.

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- C. Service Trench Excavation and Backfill:
1. All work and materials included in this Item shall be in accordance with the provisions of Section 31 21 00, "Utility Trenching and Backfill" The service trench shall be of sufficient width to properly install the service pipe and have a flat bottom of at least two feet below the gutter grade, as indicated on the Project Drawings.
 2. The bottom of the trench shall slope uniformly to the main from a point approximately ten feet from the main.
- D. Service Fittings:
1. Service fittings shall be flare type fittings, soldered joint type fittings, or other type fittings currently in use by Water Department. Contractor shall make cold flares by use of flaring tools approved by the Water Department whenever a flare-type fitting is furnished. Heat shall not be applied to flare tubing. Joints for other types of fittings shall be in accordance with the method recommended by the manufacturer and approved by the Water Department.
 2. Provide insulating type joints to electrically separate dissimilar pipe materials where dissimilar pipes are joined.
- E. Installing Service Pipe and Fittings:
1. The Water Department shall install service pipe connections to existing mains prior to service pipe installation. The Contractor shall install service pipe connections to all new mains. The Contractor shall install service pipe and fittings to a point inside the meter box, and thence from the meter box to one foot beyond the back of sidewalk, or as otherwise directed by the Developer's Agent. The Contractor shall coordinate with the Water Department to confirm the flange to flange dimension for each meter installation prior to service pipe installation. The service meter will be installed and connected to the service line by the Water Department. Size, location, and termination points of all service laterals must be approved by SFWD CDD Engineer prior to installation.
 2. The Contractor shall use jacking methods to install service pipe across existing traffic lanes wherever possible. Approval of the Developer's Agent shall be obtained before any excavation for service line is permitted in the existing traffic lanes.
- F. Meter Boxes:
1. Contractor shall procure, purchase and install meter boxes. Contractor shall purchase, procure, and install meter box covers per SFWD Standards. Contractor shall accurately locate the meter box installation in the field and confirm piping arrangement so that box and cover is integrated into the streetscape in accordance with the project drawings, landscape details. Contractor shall adjust meter box to appropriate grade and install cover. Contractor to provide excavation, stabilization material under box, and backfill. Materials shall be the same as awarded under the current City Procurement Contract for such materials.

END OF SECTION

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SECTION 33 30 00

SEPARATED SANITARY SEWER

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- A. Standard Specifications of the City and County of San Francisco, Department of Public Works, Bureau of Engineering (SSDPWSF), Latest Edition. Also referred to as "City Standard Specifications."
- B. Standard Plans of the City and County of San Francisco, Department of Public Works, Bureau of Engineering (SPDPWSF), Latest Edition. Also referred to as "City Standard Plans."
- C. Department of Public Works (DPW) Order No. 176,707 "Regulations for Excavating and Restoring Streets in San Francisco", approved March 26, 2007.
- D. City and County of San Francisco Plumbing Code.

1.2 WORK INCLUDED

- A. Section includes (but is not necessarily limited to):
 - 1. Installation of sanitary sewer main.
 - 2. Installation of sanitary side sewer, building sewer and building drain to the property line.
 - 3. Testing
- B. Comply with all other provisions of the Contract Documents.

1.3 RELATED SECTIONS

- A. Section 31 21 00, "Utility Trenching and Backfill"

1.4 QUALITY ASSURANCE

- A. All testing required shall be witnessed by the Owner's Agent and the City. Retesting required as a result of failed tests shall be at the contractor's expense.

1.5 EQUIPMENT

- A. Contractor shall ensure that all equipment used on this site is operated, inspected and maintained in accordance with applicable Cal/OSHA standards.

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1.6 SUBMITTALS

- A. Submit complete specifications, catalog information and cuts, descriptive drawings, and literature for each equipment item to be furnished under this Section, with all exceptions to the Specifications noted. Provide submittals for:
 - 1. Pipe, Structures, and Fittings
 - 2. Manhole frames and covers
 - 3. Settlement monument ring and cover
- B. Submit construction work-plan in writing for approval from the SFPUC-WWE. Work plan shall consist at a minimum detailed construction schedule and decommissioning sequence for existing sewer main in easements.
- C. Television Inspections per Section 3.2.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Sanitary sewer structures, pipes, fittings, and materials shall be per requirements of Part 3, 'Sewerage and Drainage', of the City Standard Specifications and the City Standard Plans, except as modified herein.

2.2 PIPE MATERIAL

- A. Sanitary sewer mains:
 - 1. Sanitary sewers 6" to 24" inside diameter shall be High Density Polyethylene (HDPE), ASTM D3035, with SDR of 17.
- B. Sanitary sewer laterals: Sanitary sewer laterals shall be HDPE with SDR equal to main sewers, from main or manhole to P-trap. P-trap shall be cast iron pipe. Vent riser shall be HDPE with SDR equal to main sewers. Provide calder, with stainless steel shear band type coupling before trap to connect dissimilar pipes. Sanitary Sewer vents shall be 4" diameter minimum and cover shall be 6"x6" cast iron sidewalk vent box with perforated steel plate lid, as available from CalSteam, San Francisco, CA.
- C. Connections of HDPE to HDPE shall be made by electrofusion of the pipe ends, the use of electrofusion couplings, or heat fusion in accordance with ASTM F2620.
- D. Service laterals shall connect to new mains with standard factory made tee fittings.
- E. Submittals for type of pipe and fittings to be reviewed and approved by Owner's Agent and submitted to DPW/ITF for City review and approval.

2.3 MANHOLES AND CLEANOUTS

- A. Manholes and cleanouts shall conform to the City Standard Plans and Specifications.

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- B. Manhole lid frame and cover shall be D&L Foundry Model A-1024 or South Bay Foundry Model SBF 1900. Cover shall be marked "Sanitary Sewer".
- C. Elastomeric bearing pads used at pipe-to-manhole connections per CCSF Standard Plans 87,181 may be substituted with Hydrotite DSS-0420, or approved equal.

2.4 SERVICE SADDLE & SETTLEMENT MONUMENT

- A. Service saddles shall be JCM 406 Coated Service Saddle with Double Stainless Steel Straps, Romac Industries, Inc. 305-H or 306-H, or Smith-Blair 317 TaperSeal Service Saddle with spring washers, or equal.
- B. Settlement monument ring and cover shall be D&L Foundry & Supply Model Number K-6001-2 or equal. Identify settlement monument with "SANITARY SEWER".

PART 3 - EXECUTION

3.1 GENERAL

- A. Installation of sanitary sewers and structures shall conform to requirements of Part 3, 'Sewerage and Drainage', of the City Standard Specifications.
- B. Installation of sewer lateral connection shall be per section 316 of City Standard Specifications and Standard Plan File No. 87,196 & 87,197.
- C. Where the street is to be paved before lot improvements are made, sewer lateral must be constructed beyond the curb and to the back of sidewalk before the paving is started. The upper end of each side sewer not in service when the work is backfilled shall be closed with a stopper, marked with a redwood post, and marked with the letter "S" on the curb.
- D. Openings in the existing sanitary sewer main shall be made with a sharp cutting tool, and an approved saddle of appropriate size shall be epoxied or strapped to the sewer main.
- E. Contractor shall provide bypass plan for review and approval by CCSF for connection to any existing Separated Sanitary Sewer main.
- F. All new work including manholes shall be tested at no additional cost to Owner or City.
- G. Testing shall be in conformance with City Standard Specifications, Section 319, with 72 hours advance notice to Owners Agent and the City. HDPE pipe shall be tested in conformance with ASTM F 1417-92 "Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air."

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- H. All manholes shall be vacuum tested and shall meet the requirements of ASTM C1244 prior to acceptance. Manholes shall be tested prior to backfill. The contractor may propose, in writing, to test manholes after backfill. If approved by the Owner's Agent, in writing, manholes may be tested after backfill is complete. However, should the manholes fail the vacuum test after backfill has occurred, the contractor shall be responsible for any and all costs associated with the re-excavation of the manholes in order to perform repairs or warranty work and the cost of retesting.
- I. No repairs shall be undertaken without prior written notice and repair proposal to Owner's Agent and the City.
- J. All HDPE pipe 12" or greater shall be deflection tested. Maximum installed deflections of HDPE pipe shall be five percent (5%) of mean internal diameter. Contractor shall provide mandrel deflection testing equipment and labor. Pipe exceeding deflection limits shall be replaced or re-compacted at contractor's expense.
- K. Any main that appears to be not installed at line and grade shall be mandrel tested at no additional cost to the City. Mandrel shall be submitted for review and approval by the City prior to use. Mandrel shall be rigid.
- L. For installation using HDPE pipe, the bead formed when sections of pipe are joined shall be immediately removed from the interior of the pipe per Manufacturers recommendations.
- M. Supply one additional manhole cover for each sub-phase or 10% of the total manhole covers in each sub-phase, whichever is greater.

3.2 TELEVISION INSPECTION

- A. Submit pre- and post-construction video inspection of existing laterals and existing connecting mains that will be connected to or potentially impacted by the project in accordance with SFPUC Video Survey Requirements for Sewer Assets.
- B. The video inspections shall be submitted to the SFPUC Collections System Division (CSD) within 6 months prior to a request for Notice of Completion. CSD will determine whether any construction activities have negatively impacted the existing sewers and the Subdivider shall be responsible for all damage to the existing sewers caused by the construction of the Project.
- C. Inspection videos shall be in PACP format, or the current CSD standard at the time of submittal for the SFPUC WWE review. Contractor shall coordinate with SFPUC for field witness of CCTV and testing.
- D. The contractor is responsible for obtaining asset numbers for all new and existing manholes and pipes from Mr. Alan Liu, SFPUC Sewer Operations, aliu@sfgwater.org /

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415-641-2372, 160 Napoleon Street, San Francisco, CA 94124, by advance appointment between the hours of 6:30 AM and 3:00 PM Monday through Friday.

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SECTION 33 40 00

SEPARATED STORM DRAINAGE

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- A. Standard Specifications of the City and County of San Francisco, Department of Public Works, Bureau of Engineering (SSDPWSF), Latest Edition. Also referred to as "City Standard Specifications."
- B. Standard Plans of the City and County of San Francisco, Department of Public Works, Bureau of Engineering (SPDPWSF), Latest Edition. Also referred to as "City Standard Plans."
- C. Department of Public Works (DPW) Order No. 178,940 "Regulations for Excavating and Restoring Streets in San Francisco."

1.2 WORK INCLUDED

- A. Section includes:
 - 1. Installation of separated storm drain pipe, catch basins, manholes, sand traps and appurtenances.
 - 2. Testing
- B. Comply with all other provisions of the Contract Documents.

1.3 RELATED SECTIONS

- A. Section 31 21 00, "Utility Trenching and Backfill"

1.4 QUALITY ASSURANCE

- A. All testing shall be witnessed by the Owner's Agent and the City. Retesting required as a result of failed tests shall be at the Contractor's expense.

1.5 EQUIPMENT

- A. Contractor shall ensure that all equipment used on this site is operated, inspected and maintained in accordance with applicable Cal/OSHA standards.

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1.6 SUBMITTALS

- A. Submit complete specifications, catalog information and cuts, descriptive drawings, and literature for each item to be furnished under this Section, with all exceptions to the Specifications noted. Provide submittals for:
 - 1. Pipe (including gaskets), structures, and fittings
 - 2. Manhole frame and cover
- B. Submit construction work-plan in writing for approval from the SFPUC-WWE. Work plan shall consist at a minimum detailed construction schedule and decommissioning sequence for existing sewer main in easements.
- C. Television Inspections per Section 3.3.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Separated storm drain pipe and structures shall be per requirements for the combined sewer system as described in Part 3 'Sewerage and Drainage' of the City Standard Specifications and as indicated in the City Standard Plans, except as modified herein or in the Project Drawings.

2.2 SEPARATED STORM DRAINAGE MATERIALS

- A. Storm drain mains:
 - 1. Storm drain mains shall be HDPE SDR 17 conforming to ASTM D3035 and requirement for HDPE contained in these specifications RCP conforming to the requirements for RCP contained in these specifications.
 - 2. Unless otherwise noted, storm drain mains larger than 24" inside diameter, can be Class V vertically cast reinforced concrete pipe (RCP), conforming to the requirements for RCP contained in these specifications.
 - 3. Requirements for HDPE:
 - a. Connections of HDPE to HDPE shall be made by heat (butt) of the pipe ends, in accordance with ASTM F2620.
 - b. Connection of HDPE to HDPE using Electrofusion coupling shall be approved by the City on a case-by-case basis
 - c. Pipe sizes shown in Project drawings are nominal pipe diameters.
 - 4. RCP materials shall conform to the requirements of latest ASTM Class V RCP shall have a designated D-load to produce a 0.01-inch crack of pipe shall be 3000. The D-load to produce the ultimate load shall be 3750. Class V RCP shall be designed and manufactured with concrete strength at 6000 psi with minimum wall B design.
 - 5. The RCP shall be vertically cast pipe. Cement shall be Type II conforming to ASTM C150.

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6. All RCP shall be designed and manufactured with minimum wall B Design. For all RCP, double circular steel reinforcements shall be provided. The area of the outer cage steel reinforcement shall not be less than 75 percent of the inner cage. Design calculations shall be submitted for approval.
 - a. For Class V RCP: No wire fabric/mesh or welded wire design shall be allowed unless use of welded wire mesh is accepted by the SFPUC on a case-by-case basis.
 7. For rebar design, no less than 12 longitudinal bars at approximately equal spacing shall be provided for each cage. A minimum 3/8-inch diameter size shall be used for the longitudinal bars.
 8. A minimum 1-1/2 inches concrete covering over reinforcing steel from the outside and one inch from the inside surface of the pipe shall be provided.
 9. All pipe-to-pipe connections shall be of a watertight bell/spigot connection. Joints of RCP shall be of Deep Bell (Flared Bell) with gasket type. All pipe-to-pipe connections shall be of a watertight bell/spigot connection. No cast-in-place joint connections will be allowed. RCP pipe joints shall have Neoprene rubber gasket.
- B. Flexible Joints and Couplings:
1. Flexible Joints for RCP shall consist of couplings or standard bell and spigot joints with Neoprene rubber gaskets.
 2. Couplings shall consist of a fabricated steel coupling joining two ends of pipe meeting provisions of ANSI/AWWA C219-97 and having the following characteristics:
 - a. Middle ring of ASTM A36, min. yield 36k psi
 - b. Follower rings of ASTM A576/ASTM A36
 - c. Gaskets of NSF-61 Buna-S/SBR/Gr. 30/Gr. 27 per ASTM D2000/AWWA C-111/C-219
 - d. Bolts of Type 316 SST w/ heavy hex nuts
 - e. Lining and Coating of NSF 61 Fusion Bonded Epoxy, 12 mils min. dft applied per AWWA C-213
 - f. Baker Coupling Series 200/212, Romac Series 400, or approved equal.
 - g. Paint cut ends of RCP with epoxy paint to protect exposed reinforcement.
- C. Pipes for service laterals and culverts shall be HDPE SDR 17 and shall connect to the main as shown on the Project Drawings.
- D. Fittings for cleanouts shall be ductile iron pipe with Neoprene rubber gaskets. Cleanout boxes shall be Christy G5 Box with G5C lid and vandal resistant hold-down option, marked with appropriate utility description.
- E. Manhole frame and cover shall be D&L Foundry A-1024 or South Bay Foundry SBF 1900 CPH. Manhole covers for separated storm drain manholes shall be marked "STORM DRAIN".

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- F. Perforated pipe for tree trench drains shall be 4" diameter dual wall polyethylene (PE) pipe. Perforated pipe for flow-through planter sub-drains shall be 6" diameter dual wall polyethylene (PE) pipe. Perforated pipe for soil cell distribution piping shall be 4" dual wall polyethylene (PE) pipe, and for soil cell sub-drain/collection piping shall be 4" dual wall polyethylene (PE) pipe. Please note that the 4" soil cell distribution pipe does not connect to the City storm drain main and will be maintained by the Project's Master HOA. All perforations shall be slotted type and conform to AASHTO Class II specifications and measure 0.125 inch thick by 0.875 inch long, providing a minimum inlet area of 1.0 square inch per linear foot of pipe. For tree trench drains beyond the limits of structural soil, drain pipe shall be non-perforated pipe meeting the same specification. Fittings shall match strength of pipe.
- G. Catch basins and bicycle-proof grates shall be as shown on Project Drawings.
- H. Flared end sections shall be precast concrete.
- I. Manhole bases may be precast concrete as approved by Owner's Agent and CCSF. Walls shall be constructed to avoid pipes entering within 8" of wall joints. Precast bases must be filled and formed with lean concrete to provide smooth channels connecting inlet and outlet pipes.
- J. Elastomeric bearing pads used at pipe-to-manhole connections per CCSF Standard Plan 87,181 may be substituted with Hydrotite DSS-0420, or accepted equal.

2.3 STORM DRAIN FLAP VALVE

- A. Valve to be Coplastix model GP-15 flap valve with stainless steel frame work and Coplastix flap seal, by Ashbrook Simon-Hartley, or accepted equal.

2.4 STORM DRAIN CHECK VALVE

- A. Valve to be Tideflex CheckMate, Tideflex TF-1 ONYX Valve Series DBRS Reverse Slip-In Check Valve, or approved equal.

2.5 SERVICE SADDLE & SETTLEMENT MONUMENT

- A. Service saddles shall be JCM 406 Coated Service Saddle with Double Stainless Steel Straps, Romac Industries, Inc. 305-H or 306-H, or Smith-Blair 317 TaperSeal Service Saddle with spring washers, or equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Installation of storm drainage pipe and structures shall conform to requirements of Part 3, 'Sewerage and Drainage', of the City Standard Specifications.

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3.2 STORM DRAIN FACILITIES

- A. The invert slope of the pipe shall be uniform between two sewer structure invert/keys elevations. Field adjustment of the slope may be necessary after verification by the contractor of the invert/keys elevations of sewer pipes or sewer structures. The descending order of precedence shall be as follows:
 - 1. Invert Elevation
 - 2. Invert Conform Elevation
 - 3. Slope
 - 4. Existing Elevation
 - 5. Approximate Elevation
- B. Flexible Joints:
 - 1. Flexible Joints shall be installed at each manhole connection as shown on SPDPWSF File No. 87,181, 87,182, and 87,183. Flexible Joints are not required at HDPE pipe-to-manhole connections.
 - 2. Additional flexible joints shall be installed where indicated on the Construction Documents.
- C. Contractor shall provide a bypass plan for review and approval by CCSF for connection to any existing storm drain main.
- D. At catch basins with sand traps, connection of the 10" storm drain lateral to the cast iron trap shall be made with rubber a compression coupling meeting the requirements of ASTM C425, incorporating grade 316 stainless steel band clamps.
- E. All new work including manholes shall be tested at no additional expense to Owner or City.
- F. Low pressure testing shall be in conformance with City Standard Specifications, Section 319, with 72 hours advance notice to Owners Agent and the City.
- G. HDPE pipe shall be tested in conformance with ASTM F 1417-92 "Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air."
- H. All manholes shall be vacuum tested and shall meet the requirements of ASTM C1244 prior to acceptance. Manholes shall be tested prior to backfill. The contractor may propose, in writing, to test manholes after backfill. If approved by the Owner's Agent, in writing, manholes may be tested after backfill is complete. However, should the manholes fail the vacuum test after backfill has occurred, the contractor shall be responsible for any and all costs associated with the re-excavation of the manholes in order to perform repairs or warranty work and the cost of retesting.
- I. All HDPE pipe 12" or greater shall be deflection tested. Maximum installed deflections of HDPE pipe shall be five percent (5%) of mean internal diameter. Pipe exceeding deflection limits shall be replaced or re-compacted at contractor's expense.

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- J. Any main that appears to be not installed at line and grade shall be mandrel tested at no additional cost to the City. Contractor shall provide mandrel deflection testing equipment and labor. Mandrel shall be submitted for review and approval by the City prior to use. Mandrel shall be rigid.
- K. No repairs shall be undertaken without prior written notice and repair proposal to Owners Agent and the City.
- L. For installations using HDPE pipe, the bead formed when sections of pipe are joined shall be immediately removed from the interior of the pipe per Manufacturers recommendations.
- M. Supply one additional manhole cover for each sub-phase or 10% of the total manhole covers in each sub-phase, whichever is greater.

3.3 TELEVISION INSPECTION

- A. Submit pre- and post-construction video inspection of existing laterals and existing connecting mains that will be connected to or potentially impacted by the project in accordance with SFPUC Video Survey Requirements for Sewer Assets.
- B. The video inspections shall be submitted to the SFPUC Collections System Division (CSD) within 6 months prior to a request for Notice of Completion. CSD will determine whether any construction activities have negatively impacted the existing sewers and the Subdivider shall be responsible for all damage to the existing sewers caused by the construction of the Project.
- C. Inspection videos shall be in PACP format, or the current CSD standard at the time of submittal for the SFPUC WWE review. Contractor shall coordinate with SFPUC for field witness of CCTV and testing.
- D. The contractor is responsible for obtaining asset numbers for all new and existing manholes and pipes from Mr. Alan Liu, SFPUC Sewer Operations, aliu@sfgwater.org / 415-641-2372, 160 Napoleon Street, San Francisco, CA 94124, by advance appointment between the hours of 6:30 AM and 3:00 PM Monday through Friday.

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SECTION 33 46 00

LANDSCAPE DRAINAGE

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. Work Included: Provide landscape drainage, complete, as shown and as specified.
- B. Related Sections include:
 - 1. Section 31 00 00: Earthwork
 - 2. Section 32 84 00: Planting Irrigation
 - 3. Section 32 90 00: Planting
 - 4. Section 32 91 19: Landscape Grading
 - 5. Section 33 30 00: Sanitary Sewerage Utilities
 - 6. Section 33 40 00: Storm Drainage Utilities

1.3 REFERENCES

- A. Standard Specifications - Standard Specifications of the State of California, Business and Transportation Agency, Department of Transportation, CALTRANS, latest edition.
- B. ASTM - American Society for Testing and Materials

1.4 SUBMITTALS

- A. Manufacturers' Current Product Data: For each type of product indicated.
- B. Samples:
 - 1. Drain Grates: One (1) for each type and finish indicated.
 - 2. Filter Fabric: Six (6) in. x six (6) in.
- C. Shop Drawings: Submit trench drain shop drawings showing layout, profiles and product components, including anchorage, accessories, finish colors, patterns and textures.

1.5 PROJECT/SITE CONDITIONS

- A. Protection of Utilities:

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1. Provide temporary support and protection of underground and surface utility structures, drains, services and other improvements to remain.
2. Where grade or alignment of pipe is obstructed by existing utility structures such as conduits, ducts or pipes, permanently support, relocate, remove or reconstruct the obstruction.
3. Restore all damaged improvements to original condition at no additional cost to Owner.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: All containerized products shall be delivered to the site in manufacturer's original, unopened, legibly labeled containers. All pipe to be delivered bound securely to prevent damage. Supply pallets as required to protect products.
- B. Storage: Protect materials from damage, water and rust. Store pipes on beds, which are full length of pipe. (Protect plastic materials from direct sunlight.)
- C. Pipe: Cap openings to prevent entry of dust, debris and other foreign matter.

1.7 SEQUENCING AND SCHEDULING

- A. Concealed Work: Verify locations of existing stubouts to receive landscape area drains. Verify and locate existing pipes and structures to be coordinated with landscape drainage work. Review all available records and make all necessary explorations and excavations.
- B. Lines and Levels: Establish for each drainage system and coordinate with other systems to prevent conflicts and maintain proper clearances.
- C. Notification: Submit written notification of all discrepancies in the Drawings or existing conditions, which preclude successful installation of landscape drainage work as specified.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Perforated and Non-Perforated Polyethylene Tubing:
 1. Type: ASTM F405 corrugated tubing and fittings, for less than 10 in. diameter, and ASTM F667 for 10 in., 12 in. and 15 in. diameters.
 2. Manufacturer: Advanced Drainage Systems, Inc., (800) 742-1933, or equal.
- B. Perforated and Non-Perforated Polyvinyl Chloride Pipe (PVC):
 1. Type: ASTM D1785, PVC 1120-1220, Schedule 40, pipes and fittings.
 2. Perforations: 3/8 in. diameter, 4 in. apart center to center longitudinally, in two rows 120 degrees apart.
 3. Manufacturer: R & G Sloane Manufacturing Co, Inc., (213) 767-4726, or Lasco, (714) 993-1220.

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- C. Storm Drain Pipe and fittings: Type - ASTM D3034, SDR 35, Schedule 40.
- D. Clean-out Grate, Round Structural Foam Polyolefin Grate with UV inhibitor, fits 4 inch drain pipe riser:
 - 1. Model Number NDS #11, Color: Black, ADA compliant/heel-proof.
 - 2. Manufacturer: NDS, www.ndspro.com 1(800) 726-1994.
- E. Inspection Tube Grate, Round Structural Foam Polyolefin Grate with UV inhibitor, fits 3 inch drain pipe riser:
 - 1. Model Number NDS #14, Color: Black, ADA compliant/heel-proof.
 - 2. Manufacturer: NDS, www.ndspro.com 1(800) 726-1994.
- F. Area Drain in Planting Area:
 - 1. Model Number NDS #90, Color: Black, Atrium
 - 2. Manufacturer: NDS, www.ndspro.com 1(800) 726-1994.

2.2 ACCESSORIES

- A. Sand Backfill: Fine granular material naturally produced by the disintegration of rock, free of organic material, mica, loam, clay and other deleterious substances to be thoroughly suitable for pipe bedding.
- B. Filter Fabric: "Mirafi 140N or 140NC" by Mirafi, Inc., (800) 222-6036, or "Supac 4NP" by Phillips Fibers Corporation and distributed by Pacific Corrugated Pipe, (415) 489-4744 (Bay Area) or "Poly Filter X" by Carthage Mills, Inc., (513) 242-2740. Use only one brand for entire project.
- C. Drain Rock:
 - 1. Description: Clean, coarse sand and gravel or crushed stone free from injurious materials or soil and all deleterious chemicals.
 - 2. Physical Properties:

<u>Percentage Passing</u>	<u>Sieve Size</u>
100	2 in.
70-100	3/4 in
40-100	3/8 in.
25- 50	#4
15- 35	#8
5- 18	#30
0- 10	#50
0- 3	#200

- D. Backfill for Subdrains: Class II permeable material in accordance with Standard Specification 68-2.02F(3) "Class 2 permeable material".

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify exact locations and quantity of all drains relative to planting areas and adjacent to paving, prior to beginning of work. Identify required lines, levels, contours, and datum. Immediately report to Owner's Representative all discrepancies found prior to installation of drains.
- B. Deviations: Make no deviations from specified line or grade without written acceptance of change by Owner's Representative.

3.2 INSTALLATION

- A. Final vertical and horizontal location of drains to be approved by Owner's Representative.
- B. Trenching and Backfilling:
 - 1. Obstructions and Debris: Remove hardpan, rock, mud, quicksand, debris or other unsuitable bedding material. Further excavate the trench a suitable limit as directed by the Engineer. Backfill with import material approved by the Engineer that will provide adequate pipe bedding.
- C. Pipe Installation:
 - 1. General: In compliance with Section 33 40 00: Storm Drainage Utilities.
- D. Slot, Trench and Area Drains:
 - 1. Install to locations and rim elevations as shown and detailed on the Drawings.
 - 2. Connect to pipe stubouts in strict accordance with the manufacturer's current printed specifications.
- E. Subsurface Drainage System:
 - 1. Preparation of Trench: Accurately excavate trench as shown on the Drawings.
 - 2. Filter Fabric: Place fabric in bottom of trench and extend up sides and beyond trench. Overlap 12 in. at ends of roll.
 - 3. Drain Rock and Pipe: Install bedding portion of drain rock and bed pipe in place. Do not damage or displace filter fabric.
 - 4. Review: Prior to installing remaining drain rock backfill, request review by Owner's Representative for progress of the work.
 - 5. Closing: Upon acceptance, add remaining drain rock and lap over the ends of the filter fabric as shown on the Drawings.
 - 6. Soil Backfill: Backfill with permeable planting soil mix to a minimum depth of 6 in. above filter fabric as shown on Drawings.

3.3 FIELD QUALITY CONTROL

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- A. Tests: Field density test for compaction.

3.4 PROTECTION

- A. General: Keep clean and protect sub-drainage system until commencement of work under Section 32 91 13: Soil Preparation.
- B. Sediments: Regularly inspect and clean all drain sediment buckets to prevent flooding. Sweep or hose clean all trench drains as necessary.
- C. Subdrain: Monitor sub-drainage systems and immediately identify all problems with drainage. Make adjustments as necessary to maintain proper sub-drainage.

END OF SECTION