

SECTION 02050

DEMOLITION, SALVAGE, AND ABANDONMENT

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Contractor shall perform all demolition of existing facilities, equipment, and materials as required by the Contract Documents in an orderly and safe manner.
- B. Contractor shall salvage and return to the City of Sausalito existing facilities, equipment, and materials as required by the Contract Documents.
- C. Contractor shall abandon existing facilities, equipment, and materials as required by the Contract Documents.

1.02 CONTRACTOR SUBMITTALS

- A. Contractor shall submit proposed methods, equipment, and sequence of operations for demolition of structures and other facilities. The submittal shall include proposed methods and materials for shutting off, capping, plugging, and removing pipelines.
- B. The proposed demolition and abandonment schedule shall be submitted for review.

1.03 OWNERSHIP OF MATERIAL AND EQUIPMENT

- A. Materials and equipment not designated for reuse or salvage shall become the property of Contractor.

PART 2 – PRODUCTS

2.01 EQUIPMENT AND MATERIALS FOR DEMOLITION

- A. Only equipment and materials submitted and approved shall be used for demolition.
- B. Fires shall not be used for disposal of demolished items or refuse.
- C. Drop hammers, impact hammers, or other types of impact devices shall not be used under circumstances that may allow damage to existing underground utilities.

PART 3 – EXECUTION

3.01 SALVAGE OF EXISTING FACILITIES

- A. Existing materials and equipment removed by Contractor under the provisions of the Contract, and not reused in the Work shall become Contractor's property and shall be removed from the site of the Work upon completion of the Work.
- B. Contractor shall carefully remove, in a manner to prevent damage, any and all materials and equipment specifically designated in the Contract Documents to be removed and salvaged, or to remain the property of the City of Sausalito. Contractor shall store and protect all salvaged items specified or indicated in the Contract Documents to be reused in the Work.
- C. Salvaged items not designated for reuse in the work, and items to be retained as Owner's property, shall be delivered to the City of Sausalito's Corp. yard by Contractor in good and clean condition to corner of Nevada Street and Tomales, Sausalito, CA 94965.
- D. Any items damaged during the removal, storage, or handling as a result of carelessness, negligence, or improper procedures shall be replaced by Contractor with corresponding items of equal or greater value.
- E. Contractor may at its option furnish and install new items in lieu of those indicated to be salvaged or reused, in which case the original items shall become the property of Contractor and shall be removed from the Site after completion of the Work.
- F. Existing materials and equipment removed by Contractor shall not be reused in the Work, except where otherwise called for in the Contract Documents.

3.02 ENVIRONMENTAL CONTROLS

- A. Contractor shall minimize the generation of dust and other airborne particles. If required by Laws and Regulations, temporary enclosures and other suitable measures shall be used to prevent the spread of dust, dirt, airborne particles, and debris.
- B. Noise generated by the demolition activities shall be limited to levels allowed by Laws and Regulations. Demolition equipment shall have noise suppression devices.
- C. Water shall not be used in a manner that creates dangerous or objectionable conditions such as flooding, erosion, overspray, or sedimentation in nearby ditches or streams. Stormwater shall be contained and managed as required by Laws and Regulations.

- D. If underground fuel storage tanks, asbestos, PCBs, contaminated soils, or any other hazardous materials are encountered the affected demolition work shall be stopped and Engineer and Owner notified promptly.
- E. Promptly remove equipment and materials not designated for reuse or salvage and all waste and debris resulting from demolition operations. Dispose of removed equipment, materials, waste, and debris in a manner that conforms to applicable Laws and Regulations.

3.03 EXAMINATION OF SITE

- A. Prior to demolition, Contractor shall make an inspection with Engineer to determine the baseline condition of existing structures and other facilities adjacent to the items designated for demolition. Engineer will make a written report of the condition of each adjacent facility and will transmit the report to Contractor for review. Contractor shall not proceed with demolition operations until after the inspection and report have been completed and the Engineer has authorized Contractor to proceed.
- B. Contractor shall mark or tag existing equipment to be salvaged or to remain in place as the property of Owner. Engineer will determine and mark the locations of the limits of removal for connecting piping, electrical facilities, and other related facilities.

3.04 PROTECTION OF PROPERTY

- A. Take precautions to prevent damage to facilities which are to remain in place or are to be salvaged, and be responsible for any damages to these facilities resulting from this work. Repair or replace damages to such work to return the facilities to its pre-existing condition at no additional cost to the Owner.
- B. Contractor shall provide safe access to adjacent property, facilities, and buildings at all times. Roadways, sidewalks, and passageways shall not be obstructed.
- C. Demolition shall be performed using procedures that prevent damage to adjacent property. Contractor shall promptly repair damage to Owner's property and property owned by others.
- D. Contractor shall be responsible for integrity of adjacent structures and facilities, and shall be liable for any damage due to movement or settlement. Suitable shoring for support of adjacent structures shall be installed and maintained.
- E. If adjacent structures or facilities appear to be in danger by the demolition operations, Contractor shall take additional steps to prevent damage.
- F. Contractor shall erect and maintain enclosures, barriers, warning lights, and other required protective devices.

3.05 UTILITY SERVICES

- A. Contractor shall comply with the operating rules and regulations of utility companies that have jurisdiction over utilities affected by the demolition operations.
- B. Notify and coordinate with the utility companies, adjacent building occupants, and farming operations when temporary interruptions of utility services are required.

3.06 BACKFILL OF STRUCTURES AND EXCAVATIONS

- A. Backfill of excavations and structures shall as shown on the Drawings and in accordance with Section 02300 Earthwork.
- B. Materials from the demolition work shall not be used for backfill unless approved by Engineer.

3.07 DISPOSAL OF DEMOLISHED MATERIALS

- A. Concrete, site debris, rubbish, and other materials resulting from demolition operations, as well as mechanical and electrical equipment designated to be demolished, shall be the property of the Contractor and shall be legally disposed of at the Contractor's expense.

3.08 DEMOLITION WITHIN WET WELL AND OTHER STRUCTURES

- A. Buildings and structures shall be demolished to the lines and grades indicated on the plans. Where no limits are shown, the limits shall be 5 feet outside of new facilities to be installed. Removals beyond these limits shall be at Contractor's expense. If removals are considered excessive by Engineer, and will affect the performance, serviceability, or value of adjacent facilities, Contractor shall reconstruct the structures that were excessively removed.
- B. Structures shall be demolished as shown on the Drawings. Concrete and masonry shall be removed in small sections.
- C. Demolish structures to a minimum of 3 feet below finished grade indicated on the Drawings. Backfill the remaining structure and demolition excavations to the levels shown on the Drawings.

3.09 DEMOLITION OF MECHANICAL FACILITIES

- A. Mechanical demolition consists of dismantling and removal of existing piping, pumps, motors, water tanks, equipment, and other mechanical items. It includes cutting, capping, and plugging as required to preserve the operation of existing facilities to remain in service.

- B. Existing water, chemical, gas, fuel oil, and other piping shall be removed as shown on the Drawings.
1. Piping shall be removed to the limits shown, or to a point where it will not interfere with the new facilities. Piping not indicated to be removed, or which does not interfere with the new construction, shall be removed to the nearest solid support, capped, and left in place.
 2. Chemical and fuel piping and tanks shall be emptied of contents and cleaned before removal. Fuels, chemicals, and other contents from the demolition work shall be removed and disposed of at a location that is in compliance with Laws and Regulations. Contractor shall verify that the remaining piping and tanks are in a safe condition prior to removal or capping.
 3. Piping Through Walls:
 - a. Where piping of size less than 12" passes through existing walls, the piping shall be cut and capped on each side of the wall.
 - b. Piping 12" and larger shall be completely removed. Contractor shall sawcut a square scoremark at the pipe to a depth just less than the reinforcing steel on each side of the wall. The concrete shall be chipped and removed to remove the pipe. Reinforcing steel shall be added to restore any bars cut during removal of the pipe, and to provide reinforcing at least equal to reinforcing in the existing wall. The opening shall be formed and grouted with nonmetallic, nonshrink grout per Section 03600.
 4. Pipe and tank capping materials shall be suitable for the types of pipe and tank to be capped.
 5. Where underground piping associated with mechanical facilities is to be altered or removed, cap the remaining piping that is to be abandoned. Abandoned underground piping may be left in place unless it interferes with new work or is shown to be removed. Piping less than 15" in size may be capped and abandoned in place. Piping equal or greater than 15" in size shall be filled with sand and plugged prior to abandonment.
- C. Where existing piping is to be cut and capped, but a portion will remain in service, Contractor shall do the following.
1. Capping and plugging materials and installation work shall be in accordance with the applicable building codes, standards, and specifications that govern the remaining piping.
 2. Remaining piping shall be pressure tested before being returned to service in accordance with the applicable building codes, and as approved by Engineer.

3.10 DEMOLITION OF ELECTRICAL FACILITIES

- A. Demolition of electrical facilities shall be in accordance with applicable codes and standards for electrical construction.
- B. Electrical removals consist of disconnecting and removing existing switchgear, distribution switchboards, control panels, bus ducts, conduits and wires, panelboards, lighting fixtures, and associated electrical equipment.
- C. Where existing electrical facilities are to be removed, but a portion will remain in service, Contractor will do the following.
 - 1. Remove the facilities as required, and provide terminations consisting of new conduit caps, junction boxes, and panel modifications required to maintain the remaining facilities in service and maintain the integrity of the grounding systems.
 - 2. Remove wiring in underground duct systems. Verify the functions of wiring before disconnecting and removing and cap ducts that will not be continued in service.
 - 3. Work required for facilities that remain in service shall be in accordance with applicable codes and standards for electrical construction and the Specifications.

3.11 DEMOLITION OF PIPELINES AND YARD PIPING

- A. Piping shall be removed to the limits shown, or to a point where it is not beneath new structures and it will not interfere with the new facilities. Where limits are not shown, piping shall be removed to a point that is at least 5 feet outside of the limits of new construction.
- B. Normally, piping shall be removed to the first joint outside of the limits required. Where sections of pipe exceed 16 feet in length, the piping may be cut using saws, cutting torches, or other approved methods to provide clean and unbroken end points.
- C. Where underground piping is to be removed, plug the remaining piping that is to be abandoned. Abandoned underground piping may be left in place unless it interferes with new work, is beneath new structures, or is shown to be removed. Piping less than 15" in size shall be plugged and abandoned in place. Piping equal or greater than 15" in size shall be filled with sand and plugged prior to abandonment. Where indicated, piping shall be filled with flowable fill in compliance with Section 02220 Controlled Low Strength Material.
- D. Where existing piping is to be demolished, but a portion will remain in service, Contractor shall do the following.

1. Capping and plugging materials and installation work shall be in accordance with the Specifications. If the pipe materials are not in the Specifications, the applicable building codes, standards, and specifications that govern the remaining piping shall be used for installation of capping and plugging materials.
 2. Remaining piping shall be pressure tested before being returned to service in accordance with the applicable building codes, and as approved by Engineer.
- E. Plugs for abandoned piping shall consist of solid concrete or brick and mortar plugs installed for a length of at least 2 feet. As an alternative, Contractor may install approved plugs or caps that are of the same material as the pipe.
- F. Manholes along pipelines to be abandoned shall be filled with sand and have covers removed.

3.12 CLEANING

- A. During and upon completion of the demolition operations, promptly remove unused tools and equipment, surplus materials, rubbish, debris, and dust and shall leave work areas in a clean condition.
- B. Do not sweep, grade, or flush surplus materials, rubbish, or debris into storm drains, channels, lakes, or streams.

****END OF SECTION****

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SECTION 02080

SHEETING, SHORING AND BRACING

PART 1 – GENERAL

1.01 SECTION INCLUDES

Requirements for temporary excavation support systems for excavation equal to and greater than 5 feet deep, and where indicated on the Drawings.

1.02 INSTALLER QUALIFICATIONS

Shoring installer must have a minimum of five successful past installations of shoring systems of comparable overall heights and comparable penetration of soils similar to those found on the project site.

1.03 PERFORMANCE REQUIREMENTS

- A. Design and install excavation support and protection systems that are capable of:
 - 1. Supporting excavation sidewalls and bottom to maintain the required excavation or trench section.
 - 2. Resisting soil and hydrostatic pressure and superimposed construction loads and other live loads.
 - 3. Protecting existing facilities in the vicinity of the excavation from damage due to settlement or movement of soil
 - 4. Provide professional engineering services needed to assume engineering responsibility, including preparation of Shop Drawings and a comprehensive engineering analysis by a qualified professional engineer registered in the state of California.
- B. Install and remove excavation support and protection systems without damaging existing buildings, pavements, utilities, railroad facilities and other improvements adjacent to excavation.
- C. Trench Excavations
 - 1. Provide protection systems to protect workers from hazard of caving ground and other hazards.
 - 2. Install protection system in locations where:
 - a. Protection system is specifically indicated on the Drawings.
 - b. Trenches are equal to, or greater than, 5 feet deep.
 - c. Trenches are less than 5 feet deep, but there is a potential for cave-in.
 - d. When engineering analyses prepared by the Contractor indicate the stability of existing structures and facilities may be jeopardized by settlement or movement of soil.

3. Protection Systems:

- a. Sloping or benching systems for excavated slopes.
- b. Structural support systems, shield systems, and other protection systems.

1.04 GENERAL DESIGN REQUIREMENTS

- A. Design excavation support systems to meet requirements and standards of the Occupational Safety and Health Administration (OSHA).
- B. Design excavation support systems to meet the requirements of California Code of Regulations, Title 8 – Construction Safety Orders and California Labor Code Sections 6705 to 6707.
- C. Design structural steel members in accordance with the American Institute of Steel Construction (AISC) Manual of Steel Construction Allowable Stress Design and the Uniform Building Code.
- D. Excavation support systems for trench excavations shall be selected by the Contractor based on the soil conditions, depths of trench excavations, groundwater conditions and other site conditions. No attempt has been made by Engineer to define acceptable trench shoring options.

1.05 GEOTECHNICAL REPORT

A soil investigation report has been prepared by DCM/GeoEngineers Engineering, dated September 2009. This report was obtained only for the Owner's use in design and is not part of the Contract Documents. A copy of the report may be obtained from the City of Sausalito or West Yost Associates. The information presented in this report is not a warrant of subsurface conditions.

1.06 SUBMITTALS

- A. Prepare and submit in accordance with Section 01300.
- B. Submit information as a complete package. Include all items required by the Contract Documents. Incomplete submittals will not be reviewed and will be returned for resubmittal as a complete package.
- C. Shop Drawings
 1. For support of excavations equal to or greater than 5 feet, shop drawings shall be signed and sealed by a professional engineer who is registered to practice in the state of California.
 2. Clearly indicate structural sections of shoring members, welding details, bolting details and bracing details.
 3. Indicate existing and new structures, pipelines and other improvements located in the vicinity and impacting the design of the shoring system.

4. Provide details for bracing, reinforcement and sealing around penetrations.
- D. Calculations: Structural calculations verifying and demonstrating the structural safety and adequacy of the sheeting, shoring and bracing to be used.
 1. Prepared, signed and sealed by a registered Professional Civil or Structural Engineer who is registered to practice in the State of California.
 2. Provide calculations for the different load, support and other conditions that occur during the sequence of installation, construction of facilities protected by the shoring and the sequence of removal of the internal bracing and shoring.
- E. Sheet Pile Driving Equipment: Information on type of equipment to be used, including manufacturer, model number and driving energy.
- F. Qualifications of registered Professional Engineer and shoring installer, including project references.
- G. Prepare a detailed plan illustrating the sequence of installation and removal of shoring systems and internal bracing. Include sketches showing the various stages in the sequence.
- H. Letter confirming installation of the shoring system is in accordance with the shoring design.
- I. Control Points and Stability Measurements:
 1. Submit proposed location and details of control points and method and schedule for obtaining stability measurements.
 2. Submit field notes documenting stability measurements.

1.07 JOB SITE POSTINGS

- A. Maintain at least one copy of the protection system design at the job site while the excavation is open in accordance with the requirements of California Code of Regulations, Title 8 Construction Safety Orders and the California Labor Code.]

1.08 SEQUENCE AND SCHEDULING

- A. Do not begin excavations or installation of excavation supports until submittals for excavation support systems have been accepted by the Engineer and until materials necessary for installation are on site.
- B. Allow a minimum of 15 calendar days for Engineer's review of submittals for excavation support systems.

- C. Do not begin excavations or installation of excavation supports until initial survey measurements on control points on existing structures and other improvements are obtained to document initial elevations and locations.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. General: Provide materials that are either new or in serviceable condition.
- B. Structural Steel Soldier Beams: ASTM A 36, ASTM A 690 or ASTM A 992.
- C. Steel Sheet Piling: ASTM A 328, ASTM A 572 or ASTM A 690; with continuous interlocks.
- D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness as determined by design calculations, but not less than 3 inches.
- E. Lean Concrete Mix:
 - 1. Controlled Low Strength Material in accordance with Section 02220, as modified below.
 - 2. A mixture of sand, fine aggregate, water and 2 sacks of cement per cubic yard to create a flowable mixture that fills voids.
 - 3. Minimum Compressive Strength: 1500 psi.

PART 3 – EXECUTION

3.01 PREPARATION

Prior to beginning installation of the excavation support system, pothole to locate existing buried utilities in the vicinity of the excavation. Survey utilities and compare actual locations to those locations indicated on the Drawings and the Shop Drawings. Determine any areas of conflict and revise the design and layout of the excavation support system to eliminate these conflicts.

3.02 SLOPING AND BENCHING OF EXCAVATED FACES

- A. Where structural excavation support systems are not specifically indicated on the Drawings, sloping and benching systems for exposed faces of excavations may be utilized, as deemed appropriate by the Contractor's competent person per Cal-OSHA T8-1451.

3.03 TRENCHING SUPPORT SYSTEMS

- A. Where structural excavation support systems are not specifically indicated on the Drawings, trench support systems consisting of hydraulic jacks and plates, trench shield systems, and other trench protection systems may be utilized, as deemed appropriate by the Contractor's competent person per Cal-OSHA T8-1451.

3.04 BRACING

- A. Locate bracing to clear temporary and permanent work and to allow lowering of material and equipment into the excavation.
- B. If necessary to move brace, install new bracing before removing original brace.
- C. Install internal bracing when calculations indicate bracing is required to prevent spreading or distortion of braced frames.
- D. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.05 INSPECTION

- A. Designer of the shoring system is responsible for confirming proper installation of the shoring system. Shoring system designer, or a representative of the designer, shall make site visits to confirm installation is in accordance with the accepted shoring design.
- B. Submit letter of proper installation confirming installation is in accordance with the shoring design.

3.06 MONITORING AND STABILITY MEASUREMENTS

- A. Establish stability control points on shoring and structures in vicinity of the excavation for measurement of horizontal and vertical movement. Clearly identify benchmarks and record existing elevations.
 - 1. Control Points on Shoring Systems:
 - 2. Set points at distances not exceeding 25 feet at each support level.
 - 3. Support levels include levels of tie-backs, wales, bottom of excavation and other types of supports.
 - 4. Set control points in corners of the following existing structures:
 - a. Monitor excavation support and protection systems once per week during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.
 - b. Survey control points established on adjacent structures and improvements once per week during excavation and for as long as the excavation remains open.
 - c. Use the services of a qualified professional engineer or land surveyor to monitor control points.
 - d. Maintain an accurate log of surveyed elevations and control point positions for comparison with original elevations and positions. Promptly notify the Engineer if changes in elevations

or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

3.07 REMOVAL

- A. Remove excavation support and protection systems when backfilling of the excavation has progressed sufficiently to support the remaining open excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.
- B. Repair or replace adjacent work damaged or displaced by removing excavation support and protection systems.

****END OF SECTION****

SECTION 02120

PRESSURE PIPELINE TESTING

PART 1 – GENERAL

1.01 REQUIREMENT

- A. Contractor shall perform cleaning, flushing, and testing of all pipelines and appurtenant piping, including conveyance of test water from Engineer-designated source to point of use and all disposal thereof, all in accordance with the requirements of the Contract.

1.02 CONTRACTOR SUBMITTALS

- A. Contractor shall submit a minimum 48-hour advance written notice of the proposed testing schedule for review and concurrence of Engineer.
- B. Contractor's proposed plans for water conveyance, control, and disposal shall be submitted in writing.
- C. The submittals shall indicate Contractor's proposed division of the pipeline into sections for testing and the design of bulkheads, test heads, and other appurtenances required for testing.

PART 2 – PRODUCTS

2.01 MATERIALS REQUIREMENT

- A. All test equipment, temporary valves, bulkheads, or other water control equipment and materials shall be determined and furnished by Contractor subject to Engineer's review. No materials shall be used which would be injurious to the construction or its future function.

PART 3 – EXECUTION

3.01 GENERAL

- A. Unless otherwise provided herein, water for flushing and testing will be furnished by the City; however, Contractor shall make all necessary provisions for conveying the water for flushing and testing from Engineer-designated source to the points of use.
- B. All pipelines shall be tested. All testing operations shall be performed in the presence of Engineer.

- C. Release of water from pipelines, after testing has been completed, shall be in accordance with a written disposal plan reviewed by Engineer. Contractor shall not discharge water that contains chemicals or contaminants that exceed the limits established by the appropriate regulatory agencies.

3.02 PRESSURE TESTING OF PIPELINES

- A. Prior to pressure testing, pipelines shall be cleaned of all debris, construction materials, dirt, and any other materials not suitable for inclusion in the completed pipeline. Pipeline cleaning shall conclude with water flushing, performed so that the velocity of flushing water is at least 2.5 ft/sec in the pipeline to be tested.
- B. Contractor shall test all pipelines either in sections or as a unit. No section of the pipeline shall be tested until all field-placed concrete, thrust blocks, or mortar have attained an age of at least 14 days.
- C. The test shall be made by closing valves when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water. Contractor shall be responsible for ascertaining that all test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to, or movement of, the adjacent pipe. Care shall be taken to see that all air vents are open during filling. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the air valves at a reasonable velocity. All the air within the pipeline shall be properly purged.
- D. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for at least 24 hours to allow the concrete or mortar lining, as applicable, to absorb water and allow the escape of air from any air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to Engineer shall be taken.
- E. Test
 - 1. The pressure test shall consist of maintaining the test pressure on the pipeline by introduction of a measured amount of water, if necessary, for a period of four hours. The test pressure shall be the 150 psi or 50 psi greater than the operating pressure of the pipeline, whichever is greater. The amount of water introduced into the pipeline to maintain the test pressure shall be measured volumetrically using a calibrated test reservoir.
 - 2. All visible leaks shall be repaired in a manner acceptable to Engineer.
 - 3. The test pressure shall not be applied against a closed valve that is connected to a potable water system.
- F. Allowable Leakage
 - 1. The maximum allowable leakage for pipelines with rubber-gasketed joints shall be 0.0919 gallons per hour per inch per 1,000 feet.

2. Exposed pipe, and pipe with welded, solvent-welded, butt fused, flanged, or coupled joints shall have no leakage.
3. In the case of pipelines that fail to pass the prescribed leakage test, Contractor shall determine the cause of the leakage, take corrective measures to repair the leaks, and again test the pipelines.

3.03 CONNECTIONS TO EXISTING SYSTEM

- A. Where connections are to be made to an existing force main system, the interior surfaces of all pipe and fittings used in making the connections shall be cleaned before they are installed.

****END OF SECTION****

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SECTION 02130

NON PRESSURIZED PIPELINE TESTING

PART 1 – GENERAL

1.01 GENERAL

- A. Acceptance testing of non-pressurized pipelines includes the following:
1. Visual inspection of pipes.
 2. Leakage testing of pipes.
 3. Leakage testing of manholes.
 4. Television inspections.
- B. Contractor shall perform cleaning and testing of all pipelines and appurtenant facilities, including conveyance of test water from Engineer-designated source to point of use and disposed thereof, all in accordance with the Contract Documents.

1.02 REFERENCES

This Section contains references to the following documents. They are a part of this Section as specified and modified. In case of conflict between this Section and the listed documents, the requirements of this Section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by the organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, reference to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
ASTM C828	Standard Test Method for Low Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C924	Standard Practice for Testing Concrete Pipe Sewer Lines by Low Pressure Air Test Method
ASTM D3034	Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
UNI-B-3	Recommended Standards for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe

1.03 PERFORMANCE REQUIREMENTS

- A. Gravity flow sanitary sewers and drainage pipelines are required to have a straight alignment and uniform grade between manholes.
- B. Plastic pipe is required to have no more than 5% deflection when measured at least 30 days following completion of backfilling for the segment being tested, using a standard mandrel as defined herein.
- C. Refer to table for measuring leakage in sewers and drainage pipelines at the end of this Section. Perform leakage testing to verify that leakage criteria are met.
- D. Sections of pipelines and manholes that fail any test shall be repaired or replaced, as acceptable to Engineer, and retested until the test is passed.

1.04 SUBMITTALS

- A. Submittals shall conform to requirements of Section 01300 Submittals of these Technical Specifications.
- B. Before testing begins and in adequate time to obtain approval through the submittal process, prepare and submit a test plan for review by Engineer. Include testing procedures, methods, equipment, and tentative schedule. Obtain advance written approval for deviations from the Drawings and Specifications.
- C. Submit test reports for each test on each segment of pipeline.
- D. Submit videotapes of line survey and post-completion television inspection of gravity sanitary sewers and drainage pipelines with each monthly pay estimate.

1.05 GRAVITY SANITARY SEWER AND DRAINAGE PIPELINE QUALITY ASSURANCE

- A. Repair, correct, and retest manholes or sections of pipe which fail to meet specified requirements when tested.
- B. Provide testing reports and videotape of television inspection. Tape quality shall be acceptable to Engineer.
- C. Upon completion of tape reviews by Engineer, Contractor will be notified regarding final acceptance of the sewer segment.

1.06 SEQUENCE AND SCHEDULING

- A. Perform testing as work progresses. Schedule testing so that no more than 1,000 LF of installed sewer remains untested at any one time.
- B. Coordinate testing schedules with Engineer and perform testing under observation of Engineer.

PART 2 – PRODUCTS

2.01 EXFILTRATION TEST

- A. Contractor shall provide a transient water meter for use when water for testing will be taken from the City system. Conform to City requirements for water meter use.
- B. Test Equipment
 - 1. Pipe plugs.
 - 2. Pipe risers where the manhole cone is less than 2 feet above highest point in pipe or service lead.

2.02 INFILTRATION TEST EQUIPMENT

- A. Calibrated 90° V-notch weir.
- B. Pipe plugs.

2.03 LOW PRESSURE AIR TEST

- A. Minimum Requirement for Equipment
 - 1. Control panel.
 - 2. Low pressure air supply connected to control panel.
 - 3. Pneumatic plug of acceptable size for diameter of pipe to be tested and capable of withstanding internal test pressure without leaking or requiring external bracing.
 - 4. Air hoses from control panel to the following:
 - a. Air supply.
 - b. Pneumatic plugs.
 - c. Sealed line for pressuring.
 - d. Sealed line for monitoring internal pressure.
- B. Testing of Pneumatic Plugs

Place a pneumatic plug in each end of a length of pipe on the ground. Pressurize plugs to 25 psig; then pressurize sealed pipe to 5 psig. Two plugs are acceptable if they remain in place against the test pressure without external aids.

2.04 EQUIPMENT FOR GROUNDWATER DETERMINATION

Pipe probe or small diameter casing for groundwater elevation determination.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Provide labor, equipment, tools, test plugs, risers, air compressor, air hose, pressure meters, pipe probe, calibrated weirs, or any other device necessary for property testing and inspection.
- B. The selection of test methods and pressures for gravity sanitary sewers and drainage pipelines shall be determined based on groundwater elevation.

3.02 VISUAL INSPECTION OF GRAVITY NON PRESSURIZED PIPELINES

Check pipe alignment visually by flashing a light between structures. Verify if alignment is true and no pipes are misplaced. In case of misalignment or damaged pipe, remove and re-lay or replace pipe segment.

3.03 LEAKAGE TESTING FOR NON PRESSURIZED PIPELINES

- A. Non pressurized pipelines shall be tested as complete systems including service laterals.
- B. Test Options
 - 1. Test non-pressurized pipes for leakage by low pressure air testing.
 - 2. Test new or rehabilitated sanitary sewer manholes with water or low pressure air. Manholes tested with low pressure air shall undergo a physical inspection prior to testing.
- C. Compensating for Groundwater Pressure
 - 1. Where groundwater exists, install a pipe nipple at the same time sewer line is placed. Use a 1/2" capped pipe nipple approximately 10" long. Make the installation through manhole wall on top of the sewer line where line enters manhole.
 - 2. Immediately before performing line acceptance test, remove cap, clear pipe nipple with air pressure, and connect a clear plastic tube to nipple. Support tube vertically and allow water to rise in the tube. After water stops rising, measure height in feet of water over invert of the pipe. Divide this height by 2.3 ft/psi to determine the groundwater pressure to be used in the line testing.
- D. Air Test

An air test shall be conducted on gravity flow piping only.

- 1. The testing method shall properly consider the existing groundwater elevations during the test. When the prevailing groundwater is above the sewer being tested, the air pressure shall be increased 0.43 psi for each foot the water table is above the flow line of the sewer.
- 2. If the test is not passed, the leak shall be found and repaired to the satisfaction of the Engineer and the length of repaired line retested. If the test section fails the test for excessive leakage, the Contractor shall repair

or replace all defective materials and/or workmanship at no additional cost to the Owner.

3. The pressure gauge used for acceptance testing shall be calibrated and supplied by Contractor. The test pressure gauge full range shall measure and read from 0 to 10 psi. A current certification of calibration shall also be provided by the Contractor upon request from the Engineer.
4. The air testing equipment shall be set up such that the pressure gauge is at ground level during the test.
5. The air test procedure shall be as follows:
 - a. The length of line tested at one time shall be limited to the length between adjacent manholes.
 - b. Pressurize the test section to 4.0 pounds per square inch (psi) and hold above 3.5 psi for not less than five (5) minutes.
 - c. Add air, if necessary, to keep the pressure above 3.5 psi. At the end of the five (5) minute stabilization period, note the pressure and begin the time period.
 - d. If the pressure drop is more than 1.0 psi in the time given in the following table, the section of pipe shall have failed the test.

Minimum Test Time for Various VCP and DIP Sizes

Nominal Pipe size, inches	Time, minutes/100 ft	Nominal Pipe size, inches	Time, minutes/100 ft
8	1.2	27	4.2
10	1.5	30	4.8
12	1.8	33	5.4
15	2.1	36	6.0
18	2.4	39	6.6
21	3.0	42	7.3
24	3.6		

3.04 LEAKAGE TESTING FOR MANHOLES

- A. The test shall be performed after completion of the manhole assembly, including mortaring of exterior joints, backfilling, and compaction, and just prior to placing asphalt concrete, installing the manhole frame and cover and concrete collar. The test may also be performed at the Contractor's option prior to installation of grade rings unless otherwise required on the Contract Drawings.
- B. The Contractor shall furnish the materials and equipment necessary to conduct the test.

- C. All lift holes shall be filled with non-shrink grout prior to testing.
- D. All pipes entering the manhole shall be temporarily plugged, taking care to securely brace the plugs to prevent being sucked into the manhole during testing. Unused channels shall be permanently plugged and eliminated with mortar. The plug shall not affect the flow characteristics of the remaining channel(s).
- E. Vacuum Testing
 - 1. Install vacuum tester head assembly at top access point of manhole and adjust for proper seal on straight top section of manhole structure. Following manufacturer's instructions and safety precautions, inflate sealing element to the recommended maximum inflation pressure; do not over-inflate.
 - 2. Evacuate manhole with vacuum pump to 10" mercury (Hg), disconnect pump, and monitor vacuum for the time period specified in the following table.

Depth in Feet	Time in Seconds by Manhole Diameter		
	48"	60"	72"
4	10	13	16
8	20	36	32
12	30	39	48
16	40	52	64
20	50	65	80
24	60	78	96
T ^(a)	5	6.5	8.0

^(a) Add T times for each additional 2 foot depth. (The values listed above have been extrapolated from ASTM C924-85.)

- 3. If the drop in vacuum exceeds 1" Hg over the specified time period tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.
- F. Hydrostatic Testing
 - 1. Fill manhole with water to top of frame. Add water over a 24-hour period to compensate for absorption and evaporation losses. After 24 hours, refill to top of frame and observe for loss of water. If, after a 4-hour period the water level is reduced by more than 1/4", the leakage shall be considered excessive. Contractor shall make necessary repairs and retest the manhole.
 - 2. If water loss exceeds amount tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test produce until satisfactory results are obtained.

3.05 CLOSED CIRCUIT TELEVISION INSPECTION (CCTV)

- A. All new gravity flow sewer main pipe installations shall be inspected by closed circuit television subject to the following conditions and requirements:
1. The entire sewer system as shown on the Contract Drawings is ready for television inspection when the following work has been completed:
 - a. All structures are in place, all channeling is complete, and pipelines are accessible from structures.
 - b. All other underground facilities, utility piping and conduits are installed.
 - c. Pipelines to be inspected have been cleaned and flushed and in the case of PVC pipe, mandrel tested.
 - d. Final air test has been completed.
 2. The Contractor shall inform the Engineer 48 hours in advance of performing the television inspection. The Engineer shall have the right to witness the CCTV inspection as it occurs. The CCTV inspection shall be video recorded in color with digital video disk (DVD) format. A DVD disk of the television inspection shall be produced and delivered to the Engineer together with a typed log of the inspection.
 3. The following observations from CCTV inspection will be considered defects in the construction of sewer pipelines and will require correction subject to the approval of the Engineer prior to paving:
 - a. Low spot (1 inch or greater)
 - b. Joint separation (3/4 inches or greater opening between pipe sections)
 - c. Cocked joints present in straight runs, or on the wrong side of pipe curves.
 - d. Chips in pipe ends more than 1/4 inch deep
 - e. Cracked or damaged pipe or evidence of the presence of an external object bearing upon the pipe (rocks, roots, etc.)
 - f. Dropped or offset joints
 - g. Infiltration
 - h. Debris or other foreign objects
 - i. Other obvious deficiencies
 4. The Inspector shall notify the Contractor in writing of any deficiencies revealed by the CCTV inspection that will require repair. If corrective work is indicated and viewing of the DVD is desired, the Engineer shall be contacted to set a time for the viewing with the Contractor.
 5. All corrective work shall be completed by the Contractor. The Contractor shall test and perform a television inspection of all the repair work from manhole to manhole.

6. CCTV inspection of new work and correction of observed defects will not relieve the Contractor of his responsibility for the one-year guarantee period. The Engineer may inspect and/or test portions of any new sewer installation during said guarantee period.

3.06 TESTING OF SANITARY SEWER FORCE MAINS

Sewage force mains shall be tested in accordance with Section 02120 Pressure Pipeline Testing.

****END OF SECTION****

SECTION 02140

CONTROL OF GROUNDWATER

PART 1 - GENERAL

1.01 SCOPE

Contractor shall provide the following services for control of groundwater, surface water, and excavation drainage.

- A. Dewatering, depressurizing, and draining to maintain trench, structure, and embankment excavations and foundation beds in a dry and stable condition, and controlling groundwater conditions in excavations.
- B. Protection of the Work against surface runoff, exfiltration from existing pipes and structures, and rising flood waters.
- C. Facilities to convey groundwater to the proper locations.

1.02 REFERENCES

This Section contains references to the following documents. They are a part of this Section as specified and modified. In case of conflict between this Section and the listed documents, the requirements of this Section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by the organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, reference to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
OSHA 29 CFR Part 1926	Federal Regulations, Standards-Excavation
State Water Resources Control Board (SWRCB) Order No. 99-08-DWQ, National Pollutant discharge elimination system (NPDES) General Permit No. CAS000002	Water Discharge Requirements (WDRS) for Discharges of Storm Water Runoff Associated with Construction Activity

1.03 DEFINITIONS

- A. Groundwater control includes both dewatering and depressurization of water-bearing soil and rock formations.
 - 1. Dewatering includes lowering the water table and intercepting seepage which would otherwise emerge from slopes or bottoms of excavations, and disposing of removed water. The intent of dewatering is to increase stability of excavations and excavated slopes; prevent dislocation of material from slopes or bottoms of excavations; improve excavating and hauling characteristics of excavated material; and prevent failure, heaving, or pumping of the bottom of excavations.
 - 2. Depressurization includes reduction in piezometric pressure within soil strata not controlled by dewatering alone, as required to prevent failure, heaving, or pumping of excavation bottom or instability of excavations.
- B. Excavation drainage includes keeping excavations free of surface water, seepage water, and exfiltration from existing pipes and structures.
- C. Surface drainage includes use of temporary drainage ditches and dikes and installation of temporary culverts and sump pumps with discharge lines as required to protect the Work from any source of surface water.
- D. Equipment and instrumentation for monitoring and control of the dewatering system includes piezometers and monitoring wells, and devices, such as flow meters, for observing and recording flow rates.

1.04 PERFORMANCE REQUIREMENTS

- A. Design, install, operate and maintain a groundwater, surface water, and excavation drainage control system, compatible with requirements of all laws and regulations to produce the following results:
 - 1. Effectively lower groundwater levels, reduce piezometric pressures, and eliminate infiltration of water into excavations.
 - 2. Lower and maintain groundwater levels to elevations at least 2 feet below the depth of stripping and at least 3 feet below excavation subgrades, or to lower elevations if indicated. Develop substantially dry and stable subgrades for subsequent earthwork compaction and construction operations.
 - 3. Preclude damage to adjacent properties, buildings, structures, utilities and other work.
 - 4. Prevent the loss of fines, seepage, boils, quick conditions, or softening of the foundation soils.
 - 5. Maintain stability of sides and bottoms of excavations.

6. Remove and exclude water including storm water, groundwater, irrigation water, surface water, and exfiltration from existing pipes, and wastewater from all excavations.
- B. Groundwater control systems may include single-stage or multiple-stage well point systems, eductor and ejector-type systems, deep wells, or combinations of these equipment types. Excavation and surface drainage may also include sump pumping.
- C. Groundwater control and drainage systems shall be located so as not to interfere with utilities, construction operations, adjacent properties, traffic, pedestrians, bicycles, emergency vehicles or adjacent water wells.
- D. Contractor shall assume sole responsibility for groundwater control systems and for any loss or damage resulting from partial or complete failure of protective measures and any settlement or resultant damage caused by the groundwater control operations. Groundwater control systems or operations shall be modified if they cause or threaten to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells, or affect potentially contaminated areas. Contractor shall repair damage caused by groundwater control systems or resulting from failure of the system to protect property as required.
- E. An adequate number of piezometers shall be installed at the property locations and depths as required to provide meaningful observations of the conditions affecting the excavation and adjacent structures.
- F. Contractor shall maintain backup pumping facilities capable of pumping the entire flow produced by dewatering activities, in the event of the failure of the primary pumping facilities.

1.05 SUBMITTALS

Submittals shall be provided in accordance with Section 01300 Submittals of these Technical Specifications and shall include the following information:

- A. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the Specifications are indicated and, therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the Specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to

the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

- B. Submit a Groundwater and Surface Water Control Plan for review by the Engineer prior to start of any work. The Plan shall be signed by a Professional Engineer registered in the State of California. The Plan shall satisfy all requirements of a Storm Water Pollution Prevention Plan, as required by SWRCB Order No. 99-08-DWQ, as well as the requirements of this Section. Information regarding the SWRCB Storm Water Program is available at:

http://www.waterboards.ca.gov/water_issues/programs/stormwater/gen_const.shtml

The Plan shall include the following:

1. Required elements of SWPPP, as described in the SWRCB General Permit. Required elements include a site map(s) that shows the construction site perimeter, existing and proposed buildings, lots, roadways, storm water collection and discharge points, general topography both before and after construction, and drainage patterns across the project, and Best Management Practices (BMPs) to be used to protect storm water runoff and the placement of those BMPs.
 2. A description of proposed groundwater control systems indicating arrangement, location, depth and capacities of system components, installation details and criteria, and operation and maintenance procedures.
 3. Design calculations demonstrating adequacy of proposed systems for intended applications.
- C. Submit the following records upon completion of each installation:
1. Installation and development reports for well points, eductors, and deep wells.
 2. Installation reports and baseline readings for piezometers and monitoring wells.
 3. Initial flow rates.
- D. Submit the following records on a weekly basis during operations:
1. Records of flow rates and piezometric elevations obtained during monitoring of dewatering and depressurization.
 2. Maintenance records for groundwater control installations, piezometers, and monitoring wells.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Comply with requirements of agencies having jurisdiction.
- B. Comply with all laws and regulations for development, drilling, and abandonment of wells used in dewatering systems.
- C. Obtain all necessary permits from agencies with control over the use of groundwater and matters affecting well installation, water discharge, and use of existing storm drains and natural water sources. Because the review and permitting process may be lengthy, take early action to pursue and submit for the required approvals.
 - 1. Discharge of dewatering water to the sanitary sewer system is not desirable to the City of Sausalito. However, this option may be considered by the Engineer, if necessary.

PART 2 – PRODUCTS

2.01 EQUIPMENT AND MATERIALS

- A. Equipment and materials shall be selected by Contractor as necessary to achieve desired results for dewatering. Selected equipment and materials are subject to review of Engineer through submittals required in Subsection 1.05 Submittals.
- B. Eductors, well points, or deep wells, where used, shall be furnished, installed and operated by an experienced contractor regularly engaged in groundwater control system design, installation, and operation.
- C. All equipment shall be in good repair and operating order.
- D. Sufficient standby equipment and materials shall be kept available to ensure continuous operation, where required.

PART 3 – EXECUTION

3.01 GROUNDWATER CONTROL

- A. Install, operate, and maintain groundwater control systems in accordance with the Groundwater and Surface Water Control Plan. Notify Engineer in writing of any changes made to accommodate field conditions and changes to the Work. Provide revised drawings and calculations with such notification.
- B. Provide for continuous system operation, including nights, weekends, and holidays. Provide standby pumping equipment capable of pumping the entire flow produced by dewatering activities, in the event of the failure of the primary pumping equipment. Provide appropriate backup energy source if electrical power is primary energy source for dewatering systems.

- C. Monitor operations to verify that the system lowers groundwater levels at a rate required to maintain a dry excavation resulting in a stable subgrade for performance of subsequent operations.
- D. Do not allow groundwater or drainage water levels to rise until foundation concrete has achieved its design strength and backfilling operations have begun.
- E. During backfilling, the dewatering effort may be reduced to maintain water level a minimum of 5 feet below the prevailing level of backfill. However, do not allow the water level to result in uplift pressures in excess of 80% of the downward pressure produced by weight of structure or backfill in place.
- F. Remove all groundwater control systems upon completion of construction or when dewatering and control of surface or groundwater is no longer required.
- G. Replace any excavation performed for convenience of dewatering in foundation beds with materials as impermeable as original foundation material. Compact backfill to not less than 95% of the maximum dry density in accordance with Section 02300 Earthwork or as indicated on the Drawings.
- H. Provide additional groundwater control installations, or change groundwater control methods, in the event that the installations installed and operated according to the Groundwater Control Plan do not provide satisfactory results based on the performance criteria defined by the Plan and by the Specifications. Revise and submit the revised plan.

3.02 MAINTENANCE AND OBSERVATION

- A. Conduct daily maintenance and observation of piezometers and monitoring wells while the groundwater control installations are operating. Groundwater control installations shall be maintained in reliable operating condition.
- B. Replace damaged and destroyed piezometers or monitoring wells with new piezometers or wells as necessary to meet the observation schedule.
- C. Remove and grout piezometers inside or outside the excavation area when groundwater control operations are complete. Remove and grout monitoring wells when directed by the Engineer.

****END OF SECTION****

SECTION 02145

SEWER BYPASSING AND CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION

A. SCOPE:

This Project consists of removal and replacement of a portion of an existing active sewer. It shall be the Contractor's responsibility to maintain at all times the sewer flows through the Project site and from the adjacent properties.

The Contractor shall provide plugs and/or bypass pumping during work on the sewer. The Contractor shall accommodate flows from laterals at all times. The Contractor may request that property owners minimize wastewater flows during scheduled work in accordance with Section 02145-3.07.

This section specifies the requirements for temporary bypassing, dewatering, and disposal of raw wastewater and treated wastewater as required to perform the work. Contractor shall extract, pump, and/or dispose of wastewater from bypassing and dewatering gravity, sanitary sewer pipelines, sewer laterals, and storm drain discharges as required by the Contractor's Storm Water Pollution Prevention Plan (SWPPP) referenced in Section 01060.

Dewatering requirements for grading, excavation, backfilling, and compacting are specified in Section 02140.

B. REQUIREMENTS:

Contractor shall provide labor, materials, and full-time supervision, as required, to contain, bypass, dewater, and dispose of raw wastewater, as necessary for spot repairs, rehabilitation, and other modifications made to complete the work.

The work shall not result in water or wastewater flows to surcharge or exceed the limits specified in this Section, except where otherwise indicated. Surcharge shall be defined as the condition where the depth of flow exceeds the crown elevation in any pipe in any existing gravity pipe systems. Water or wastewater discharges or disposals shall be in conformance with the requirements of the SWPPP.

Contractor shall bypass, dewater, and dispose of water from pipeline systems including, but not limited to, the following:

1. Sanitary sewer mains, laterals, manholes, and cleanouts

1.02 SUBMITTALS

Within 14 calendar days of notice to proceed, the Contractor shall submit drawings and complete design data in accordance with Section 01300. Submittal shall show all proposed methods, equipment, and discharge locations for bypassing and dewatering. The submittal shall include the following information:

1. Drawings shall indicate the locations of temporary plugs, taps, pumping systems, suction and discharge piping, and locations of sanitary sewers and manholes to receive discharges of raw wastewater.
2. Data shall include the locations of off-site disposal areas or facilities, locations and elevations of existing sanitary sewer systems, and the capacities of duty and standby pumps, prime movers, power and standby power, and other equipment.
3. Design calculations shall prove the adequacy of the bypassing, dewatering, and disposal system(s) and selected equipment. Design calculations shall confirm that the bypassing and pumping operations shall not cause surcharge in any portion of the existing sanitary sewer system. Design calculations shall be signed and sealed by a civil engineer registered in the State of California qualified to perform said analysis.

1.03 JOB CONDITIONS

A. PROTECTION:

Where bypassing is required, the Contractor shall ensure that service for connecting laterals is not disrupted. All bypassed flow shall be discharged into the nearest (downstream) sanitary sewer manhole. Contractor shall take appropriate steps to ensure odor control at the discharge manholes.

Bypassing and dewatering operations resulting in discharges to the ground surface, streams, creeks, culverts, ditches, storm drains, or groundwater shall not be permitted. The Contractor shall perform work so as to protect the public from potential health hazards, and shall protect the environment from contamination.

All bypass pumping and dewatering operations shall conform to Section 01560 13.0, Noise Abatement.

B. SCHEDULING:

The bypassing and dewatering systems shall not be shut down between shifts, on holidays or weekends, or during work stoppages without written permission from the Construction Manager.

The Contractor shall provide 14 days written notice to THE CITY prior to performing all bypassing, dewatering, and disposal work.

C. PERMITS AND APPROVALS

The Contractor shall obtain all approvals from the jurisdictions owning and operating the sanitary sewer to receive discharges of raw or treated wastewater, including, but not limited to, the following jurisdictions:

1. City of Sausalito

PART 2 – PRODUCTS

No products are included in this section.

PART 3 – EXECUTION

3.01 PLUGGING, BLOCKING, AND PUMPING

Flow control will be required for this Project. For this Project, bypass pumping will be allowed during Contractor's working hours. No bypass pumping shall be performed on weekends or overnight except during Contractor's night work activities. The Contractor shall provide bypass pumping of flows in sanitary sewer mains of approximately 700 gallons per minute. The Contractor shall also provide control of flow for the installation of sanitary sewer laterals and control of sewer flow, where applicable. The Contractor shall submit a plan for bypass pumping around the work area and facilities where wastewater flows must be interrupted. The plan shall include, at a minimum, the following information:

- A. A site plan showing the size and layout of pumps, valves, and temporary pipelines. Layout shall show how temporary facilities will be protected during use.
- B. Catalog data on pump controls and audible alarms.
- C. Catalog data for portable generators when electric pumps are used.
- D. An emergency response plan to be followed in the event of a failure of the bypass pumping systems.

The plan shall be reviewed by the City and the Construction Manager prior to the start of construction of the bypass system.

The Contractor shall furnish, install and operate pumps, plugs, conduits, and other equipment to divert the flow of wastewater around the pipeline reach in which work is to be performed and to maintain service to all properties connected to the sewer being replaced. Plugs shall be so designed that all or any portion of the wastewater can be released. Plugs shall be provided with a tag line. The pumping system shall be of sufficient capacity to manage existing flows plus additional flow that may occur during a rainstorm. If pumping is required outside normal working hours, engines shall be equipped and/or shielded in a manner to keep noise to a minimum. Noise level shall conform to the noise ordinance requirements of the City, unless otherwise approved by the Construction Manager.

STANDBY PUMPS AND STANDBY POWER SHALL BE PROVIDED WITH COMPLETE 100 PERCENT REDUNDANCY.

Bypass pumping shall be done in such a manner as will not damage private or public property, or create a nuisance or public health menace. The pumped wastewater shall be in an enclosed hose or pipe that is adequately protected from traffic, and shall be redirected into the sanitary sewer system. Dumping or free flow of wastewater on private property, gutters, trenches, streets, sidewalks, or into storm sewers is prohibited. The Contractor shall be liable for all damages associated with this work. After the work is completed, flow shall be restored to original conditions and temporary facilities removed.

At least ten (10) working days prior to removing existing sewer piping, the Contractor shall submit for approval to the Construction Manager a detailed Bypass Pumping Plan showing the layout, equipment and method of the bypass pumping system.

3.02 SEWER DEWATERING

Contractor shall extract, pump, and/or dispose of wastewater from bypassing and dewatering the existing sewers.

Contractor shall dewater all sagged or submerged portions of the existing sewer as required for abandonment, make connections, and as otherwise required to complete the work. Dewatering of excavations shall be conducted in accordance with the these Specifications.

The Contractor shall coordinate all work with the City. The Contractor shall comply with Section 01010 for work outage requests related to the City's existing facilities.

3.03 SEWER BYPASSING

Where Contractor's work on constructing project pipeline requires local sanitary sewers owned and operated by others to be removed temporarily, sewer bypassing shall be accomplished by pumping or diverting the upstream flow around the Contractor's work in accordance with owner of sewer system.

The Contractor shall provide temporary pumps, conduits, and other equipment to bypass the sewer flow. Contractor shall furnish the necessary labor and supervision to set up and operate the pumping and bypass system. Engines shall be equipped with mufflers and/or shall be enclosed to comply with all local noise ordinances. Pumps and bypass lines shall be of adequate capacity and size to handle the flows. All bypassed flow shall be discharged to the nearest downstream manhole.

Unless otherwise specified, the Contractor shall bypass flow around his work whenever the depth of flow, as measured at the inlet pipe to the upstream manhole adjacent to the Contractor's work, exceeds the crown elevation of the pipe. The Contractor shall bypass flow around his work whenever the Contractor's equipment operating in the sewer provides an obstruction that restricts flow and causes the depth of flow to exceed the crown elevation.

3.04 STANDBY EQUIPMENT

The Contractor shall maintain on site sufficient equipment and materials to ensure continuous and successful operation of the bypass and dewatering systems. Standby pumps shall be fueled and operational at all times. The Contractor shall maintain on site a sufficient number of valves, tees, elbows, connections, tools, sewer plugs, piping and other parts or system hardware to ensure immediate repair or modification of any part of the system as necessary. Bypassing and dewatering system(s) shall have 100 percent redundancy.

3.05 DAMAGES

The Contractor shall pay for all fines and repair without cost to the Owner any damage that may result from his negligence, inadequate or improper installation, maintenance and operation of bypassing and a dewatering system including mechanical or electrical failures.

3.06. MONITORING

Monitoring of the flow levels and pump operation shall be provided to assure continued operation of bypass pumping. Monitoring by Contractor's personnel shall take place at all times that bypass pumps are in operation (including 24-hour, around-the-clock operation). An audible alarm system shall be installed to notify workers when the pumps fail to operate. In the event the pumps fail, workers shall immediately evacuate trenches until the bypass pumping system is operational. In the event that wastewater is spilled as a result of the Contractor's operations, the Contractor shall pay any and all fines imposed on the City.

3.07 LATERALS AND PROPERTY OWNER NOTIFICATION

- A. within one week of receipt of Notice to Proceed, send a letter to each property owner/resident with lateral replacement work. The letter shall inform the resident of the work to be performed and the approximate date and time that the work will occur.
- B. Provide at door hanger at each property with lateral replacement work 48 hours in advance of the work advising the resident of the date and time of the work.
- C. Knock on the doors at each property with lateral replacement work approximately 2 hours advance notice of the lateral work. The Contractor shall also notify each property resident as soon as work is completed.
- D. While laterals are disconnected for more than 2 hours, the Contractor shall continue to accommodate flows from laterals by installing temporary piping, pumps, and containers.

****END OF SECTION****

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SECTION 02160

SITE PREPARATION

PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. Contractor shall perform site preparation work, as required by this Section, during its initial activities at the Site. The Work of this Section includes the following:
 - 1. Installation of safety and protective barriers
 - 2. Construction of Contractor Site access, work areas, and storage areas
 - 3. Clearing and other initial work required for the earthwork operations
 - 4. Excavations for structures and fill areas
 - 5. Over-excavation and removal of unsuitable materials

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 LOCATING EXISTING FACILITIES

- A. Contractor shall review the Drawings and other resources for the existing facilities at the Site to determine and mark the approximate locations of underground facilities. Locations of underground facilities within the work area shall be determined by exploratory excavations prior to any excavations or construction traffic in the affected areas.
- B. Public utility agencies that are owners of underground utilities at the Site shall be contacted and coordinated by Contractor to have the utilities located and marked prior to construction activities in the affected areas. Following the marking by the utility agencies, the location of each underground utility shall be determined by exploratory excavations prior to any excavations in the affected areas.

3.02 SAFETY AND PROTECTIVE BARRIERS

- A. Contractor shall install appropriate barriers such as temporary fencing, sound barriers, berms, or concrete traffic barriers to protect workers, visitors, lift station operations, and existing facilities from damage and disturbance. Remove temporary fences when work in the vicinity is substantially complete.
- B. Protective concrete slabs or encasements shall be provided for existing underground facilities that may be damaged by Contractor's equipment and vehicles.
- C. Contractor shall prepare and submit drawings that define the proposed safety and protective barriers prior to any construction activities.

3.03 PRIMARY SITE ACCESS, WORK, AND STORAGE AREAS

- A. Contractor shall develop its primary access and work area within the limits of work as indicated on the Drawings, clean up areas at the conclusion of the project, and return the areas to their original condition.
- B. Storage of materials and vehicles on the street is not allowed.
- C. Staging and storage areas are to be located within City property but not with the Humbolt Avenue Right-of-Way. Staging and storage areas should be placed to minimize disruption of Spinnaker Restaurant parking.
- D. City has not secured rights of access from the property owners or residents. If the Contractor requires access from private property, the Contractor shall make arrangements for such access.

3.04 CLEARING

- E. All construction areas shall be cleared of grass and weeds to at least a depth of 6" and cleared of structures, pavements, fences, concrete and masonry debris, trees, logs, upturned stumps, loose boulders, and any other objectionable materials of any kind which would interfere with the performance or completion of the Work, create a hazard to safety, or impair the Work's subsequent usefulness or obstruct its operation.
- F. All material from the clearing process that is not to be incorporated into the Work shall be removed from the Site and disposed of in compliance with Laws and Regulations. Material at the Site shall not be burned as a means of disposal.
- G. Following clearing of the Site, Contractor shall allow a period of at least 3 working days for Engineer's review for presence of unsuitable materials. Where indicated or ordered, soil identified as unsuitable by Engineer shall be over-excavated and either removed from the Site or incorporated into fill as required in Section 02320. When such over-excavation is indicated, both over-excavation and subsequent backfill to the required grade shall be performed by Contractor. When such over-excavation is not indicated but is ordered by Engineer, such over-excavation and any resulting backfill will be paid for in accordance with a negotiated price.

3.05 DUST CONTROL

- A. The contractor shall control all dust generated as a result of the Contractor's performance of the Work, either inside or outside the right-of-way. The Contractor shall apply water or a dust palliative for the alleviation or prevention of dust nuisance. Should the Contractor elect to use a dust palliative, the palliative and method of application shall be approved by the Engineer prior to use of the palliative on the Site.

****END OF SECTION****

SECTION 02220

CONTROLLED LOW STRENGTH MATERIAL

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Requirements for controlled low strength material (CLSM) as backfill and encasement material in specific locations.

1.02 DEFINITION

- A. Controlled Low Strength Material (CLSM): A highly flowable, lean concrete mix consisting of a mixture of cement, fly ash, densely graded mineral aggregates, water and admixtures. Characteristics include:
 - 1. Capable of freely flowing to fill excavations and voids without compaction or other additional effort.
 - 2. Used in trenches and for backfill adjacent to structures where clearance is limited, and in other areas specifically identified on the Drawings or specified.
 - 3. Low permeability to prevent migration of adjacent fines into the set mix.
 - 4. Easily excavated after curing with minimum risk of damage to buried utility.

1.03 SUBMITTALS

- A. Mix Design: Identify name and/or number of the mix design. Provide the proportions and gradations of materials proposed for CLSM.
- B. Certified test results for compressive strength.

1.04 QUALITY ASSURANCE

- A. Demonstrate that the CLSM mix meets the specified requirements, including compressive strength.
- B. Enlist the services of a testing laboratory to prepare test cylinders and to transport cylinders to the laboratory for testing.
- C. Testing expenses shall be borne by the Contractor.
- D. Test Cylinders
 - 1. Procedure: Make 6-inch diameter by 12-inch high test cylinders in accordance with ASTM C31.

2. Required Number: Not less than 3 cylinders for each 200 cubic yards of CLSM placed, with a minimum of 3 cylinders for each location where CLSM is used.
 3. Test two cylinders at 28 days, third cylinder is spare.
- E. Field Testing: Furnish slump testing equipment and test slump in accordance with ASTM C143.
 - F. Mix design based on historical mixes with the same strength requirements as those in these Specifications may be substituted in lieu of mix conformation testing.

PART 2 – PRODUCTS

2.01 GENERAL

- A. CLSM Mix: Consist of a mixture of cement, fly ash, aggregate, water, and admixtures that produce a controlled low strength material capable of filling all spaces between the pipe, the bedding and the trench walls.
- B. Mix shall be provided by ready-mix plant. On-site batching will not be permitted.

2.02 MATERIALS

- A. Cement: Conforming to ASTM C150, Type III with total alkali content not more than 0.8%.
- B. Water: Clean, potable water.
- C. Fly Ash: Class C or Class F in conformance with ASTM C618.
- D. Aggregate Materials
 1. Densely graded rock conforming to the following gradation:

Sieve Size	Percentage Passing
1"	100
No. 8	50-100
No. 200	0-5

2.03 DESIGN REQUIREMENTS

- A. Water-cement Ratio: Not to exceed 3.5.
- B. Maximum Cement Content: 30 pounds per cubic yard.

- C. Use fly ash to improve flow-ability of the fresh CLSM and to regulate the strength. Do not use more than 300 pounds per cubic yard.
- D. Compressive Strength: Between 50 and 100 psi when tested at 28 days. Test in accordance with ASTM C39.

2.04 CONSISTENCY AND MIXING

- A. Consistency: Similar to that of a thick liquid so that it flows readily and fills spaces and voids around pipes and structures.
- B. Slump: Between 6 inches and 8 inches when tested in accordance with ASTM C143.
- C. Uniform consistency and appearance.
- D. Mixing Method and Time: As required to produce a uniform mixture of cement, fly ash, aggregate, admixtures, and water.

2.05 MEASUREMENT OF MATERIALS

- A. Use weighing equipment to determine the amount of cement, fly ash, and aggregate entering into each batch. Where batches are proportioned to contain an integral number of conventional sacks of cement, and the cement is delivered at the mixer in the original unbroken sacks, the weight of the cement contained in each sack may be taken without weighing as 94 lbs.
- B. Use a suitable water meter or other acceptable method of measuring the quantity of water entering the mixer.

PART 3 – EXECUTION

3.01 PLACEMENT

- A. Thoroughly settle and consolidate CLSM as the material is placed in excavations. Fill the entire depth of the layer that is being consolidated, into a dense, homogeneous mass, filling all spaces and voids and bringing only a slight excess of water to the exposed surface. Place and consolidate CLSM by means that will not cause segregation of the mix.
- B. Do not place CLSM under the following conditions:
 - 1. When the air temperature is below 40 degrees Fahrenheit.
 - 2. When the excavation contains water or when the bottom or walls of the excavation are frozen or contain frozen material.

- C. Prevent flotation of pipes by placing CLSM in two or more lifts, with each lift reaching an initial set before the succeeding lift is placed. Contractor shall be responsible for prevention and, if necessary, correction of flotation and displacement of the pipeline due to the use of CLSM.
- D. Encase repair coupling in CLSM to inhibit further root intrusion.

3.02 PROTECTION OF CLSM

- A. Protect CLSM from equipment, traffic and backfilling operations until the surface has achieved an initial set and has hardened enough to develop a minimum penetration number of 650 when tested in accordance with ASTM C403.
- B. If the trench backfill is not to be placed over the CLSM within eight hours after CLSM placement, place a 6 inch layer of moist backfill over the CLSM.

****END OF SECTION****

SECTION 02300

EARTHWORK

PART 1 – GENERAL

1.01 SCOPE

This Section includes requirements for site excavation, engineered fill construction, and finish grading. Requirements are also specified for structure and trench excavation and backfill.

1.02 GEOTECHNICAL REPORT

A soil investigation report has been prepared by DCM/GeoEngineers Engineering, dated September 2009. This report was obtained only for the Owner's use in design and is not part of the Contract Documents. A copy of the report may be obtained from the City of Sausalito or West Yost Associates. The information presented in this report is not a warrant of subsurface conditions.

1.03 QUALITY ASSURANCE

A. Reference Specifications, Codes, and Standards

This Section references the following documents. They are a part of this Section insofar as specified and modified herein. In case of conflict between the requirements of this Section and the listed documents, the requirements of this Section shall prevail.

Reference	Title
County of Marin County	County of Marin Uniform Construction Standards, Adopted 2008 and the latest amendments approved prior to the date of Approval of the Contract Documents
Caltrans	Standard Specifications, State of California Business, Transportation and Housing Agency, Department of Transportation, 2006
ASTM C 33	Standard Specification for Concrete Aggregates
ASTM C117	Material Finer Than 75-Micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C136	Sieve Analysis of Fine and Coarse Aggregates
ASTM D1556	Density of Soil in Place by the Sand-Cone Method
ASTM D1557	Moisture Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb. (4.54-kg) Rammer and 18-in. (457-mm) Drop
ASTM D2487	Classification of Soils for Engineering Purposes
ASTM D2922	Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D3017	Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

State Standard Specifications: Whenever this specification is referenced, the following is understood.

1. All references to statistical testing are deleted.
2. All references to measurement and payment are deleted.

B. Testing

The Engineer will take samples and perform moisture content, gradation, compaction, and density tests during placement of backfill materials to check compliance with these Specifications. The Contractor shall remove surface material at locations designated by the Engineer and provide such assistance as necessary for sampling and testing. The Engineer may direct the Contractor to construct inspection trenches in compacted or consolidated backfill to determine that the Contractor has complied with these Specifications. Tests will be made by the City in accordance with the following:

Test	Standard Procedure
Moisture content	ASTM D3017
Density in-place	ASTM D1556 or ASTM D2922
Moisture-density relationships	ASTM D1557

C. Submittals

Submittals shall be made in accordance with Section 01300 Submittals, and shall include test results, certifications, and source for all earthwork materials.

1.04 DEFINITIONS

A. Backfill

Material used in refilling a cut or other excavation (not including bedding material, or structure backfill).

B. Structure Backfill

Material used to refill space between cut or excavation and foundation/below grade walls.

C. Compaction

The process of mechanically stabilizing a material by increasing its density at a controlled moisture condition. "Degree of Compaction" is expressed as a percentage of the maximum density obtained by the test procedure described in ASTM D1557.

D. Excavation

The removal of soil to obtain a specified depth or elevation.

E. Fill

Specified material placed at a specified degree of compaction to obtain an indicated grade or elevation.

F. Lift

Layer (or course) of soil placed on top of a previously prepared or placed soil in a fill or embankment.

G. Rock

Rock is defined as any material which cannot be excavated with a crawler D-9 Caterpillar Dozer with ripper teeth, and requires the use of rock teeth, jack-hammering, blasting and/or other special methods of excavation.

H. Subgrade

The bottom layer of material (sometimes in-situ soil or rock) graded or otherwise prepared for supporting the addition of base material, fill material, or structural foundations.

I. Unsatisfactory Material

Existing, in-place soil or other material which can be identified as having insufficient strength characteristics or stability to carry intended loads in fill or embankment without excessive consolidation or loss of stability. As a minimum, materials classified as PT, OH, or OL by ASTM D2487 are unsatisfactory.

J. Optimum Moisture Content

Optimum moisture content shall be determined in accordance with ASTM D1557.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Fill, backfill, and embankment materials: Selected or processed clean earth, rock, or sand, free from grass, roots, brush, other vegetation, corrosive and hazardous materials, manmade objects, and debris.

B. Suitable Materials

1. Selected and obtained from on-site excavations and designated borrow areas.
2. Processed on-site materials.

3. Imported from offsite borrow areas and processing plants.
 - a. If imported materials are required by this Section, or to meet the quantity requirements of the Project, provide the imported materials at no additional expense to Owner, unless a unit price item is included for imported materials in the Bidding Schedule.

C. The following types of suitable materials are defined:

1. Drainage Rock: Clean gravel or crushed rock of one-inch (1") maximum size, with no material passing a No. 4 sieve.
2. Rock Rip Rap: Rocks shall be angular, rounded boulders will not be accepted. Rock slope protection shall conform to the following weight requirements:

Weight (pounds)	Percentage Larger Than
200	0-5
75	50-100
25	90-100

And meet the following quality requirements:

Test	California Method	Requirement
Apparent Specific Gravity	206	2.5 min.
Absorption	206	4.2% max.
Durability Index	229	52 min.

3. Foundation Material: Clean, durable, natural crushed (i.e., angular) aggregate graded within the following requirements:

Sieve Size	Percentage Passing
2-inch	100
1-1/2-inch	90-100
¾ inch	5-30
3/8 inch	0-5
No. 200	0-2

4. Aggregate Base: Caltrans Class 2, ¾ inch maximum. Course crushed rock aggregate base material of such nature that it can be compacted readily by watering and rolling to form a firm, stable base. Sand equivalent per California Method 217 of no less than 22. Resistance or R-value per California Method 301 of no less than 78. The aggregate base course material shall meet the following gradation requirements:

Sieve Size	Percentage Passing
1-inch	100
¾ inch	90-100
No. 4	35-60
No. 30	10-30
No. 200	2-9

5. Light Weight Aggregate: Processed, naturally occurring volcanic cinder or and expanded shale/clay/slate (ESCS) material produced by the rotary kiln process. No by-product slags, cinders, or by-products of coal combustion shall be used. Lightweight aggregate shall be durable, non-corrosive and meet the following gradation requirements:

Sieve Size	Percentage Passing
1-1/2-inch	100
1 inch	95-100
¾-inch	90-100
3/8 inch	15-85
No. 200	0-9

Light weight aggregate shall have durability index per California Method 229B of no less than 35. Resistance or R-value per California Method 301 of no less than 50. Light weight aggregate shall have a maximum calculated saturated surface dry unit weight of 60 pounds per cubic foot.

6. Grease Interceptor Backfill: Backfill must meet ASTM C-33 for quality and soundness. Use either approved pea gravel or crushed stone no more than 5% of either material may pass through the No. 8 sieve. Pea gravel shall be clean naturally rounded aggregate whose size shall not be less than 1/8" but not more than 3/4". Crushed stone shall be washed with angular particle size that is not be less than 1/8" but not more than 1/2". Dry density must be a minimum of 95 pounds per cubic foot.
7. Sand Backfill: Sand with 90% to 100% passing a No. 4 sieve, and not more than 5% passing a No. 200 sieve.

8. Geotextile: Non-woven material consisting of polyester, nylon or polypropylene filaments formed into a stable network. The geotextile fabric should be permeable, not act as a wicking agent, be inert to commonly encountered chemicals, be rot-proof, be resistant to ultra violet light and conform to the following physical properties:

Property	Test Value	Test Method
Weight	8.2 oz/yd ² (min.)	ASTM D5261
Grab tensile strength	205 lb (min.)	ASTM D4632
Elongation at break	50% (max.)	ASTM D4632
Puncture strength	130 lb (min.)	ASTM D4833
Burst strength	380 psi (min.)	ASTM D3786
Apparent opening size	#80 (max.)	ASTM D4751
Permittivity	1.2 sec ⁻¹ (min.)	ASTM D4491
UV resistance	70% (min.)	ASTM D4355

Seams in geotextile fabric shall be overlapped by 24".

9. Gravel Surfacing: Crushed rock aggregate base material of such nature that is can be compacted readily by watering and rolling to form a firm, stable base for vehicle traffic. The material shall meet the following gradation requirements:

Sieve Size	Percentage Passing
1-inch	100
¾ inch	90-100
½ inch	30-60
3/8 inch	0-20
No. 4	0-2
No. 30	-

10. Embankment Fill:

- Granular, low to non-expansive soil
- Plasticity index 15-40
- Liquid limit 35-60
- Meeting the following gradation requirements:

Sieve Size	Percentage Passing
3-inch	100
No. 200	more than 50

11. Engineered Fill / Structure Backfill: Engineered and structure fill material shall be ¾-inch maximum Class 2 aggregate base conforming to Section 26-1 of the State Standard Specifications.
12. Crushed Rock: Crushed rock shall conform to the following gradation:

Sieve Size	Percent Passing by Weight
1"	100
¾"	90-100
½"	20-50
No. 4	0-5

Crushed rock material shall be composed of hard, durable, sound pieces having a specific gravity of not less than 2.60.

13. Pipe Bedding Material
 - a. Pipe bedding material shall be either crushed rock or sand, as indicated on the Drawings. However, pipe bedding for PVC pipe shall be sand only.
 - b. Sand bedding material shall be sand or silty sand of which 100% will pass ¾-inch sieve and which shall have a minimum sand equivalent of 30, as determined by Test Method No. Calif. 217.
14. Trench Backfill: Trench backfill shall be the material between the pipe bedding material and the top of the trench or subgrade. The material for trench backfill may be of job excavated, native material provided that such material is free of organic materials or other unsuitable materials as determined by the Engineer that may cause voids or depressions to develop during or after placement of the backfill. Rocks, stones, and solid earth chunks exceeding 3" in greatest dimension shall be removed from the trench backfill material.
15. Planting Soil: Planting soil shall consist of fertile, friable soil of loamy character, and shall contain an amount of organic matter normal to the region. It shall be obtained from well-drained arable land and shall be reasonably free from subsoil, refuse, roots, heavy or sticky clay, stones larger than one inch in size, coarse sand, noxious seeds, sticks, brush, litter, and other deleterious substances. Planting soil shall be capable of sustaining healthy plant life.

2.02 UNSUITABLE MATERIALS

A. Unsuitable materials include the materials listed below:

1. San Francisco Bay Mud Soils
2. Soils which, when classified under ASTM D 2487, fall in the classifications of Pt, OH, CH, MH, or OL, or in a classification that contains Pt, OH, CH, MH, or OL in combination with any other letter designation, such as CH/CL.
3. Soils which cannot be compacted sufficiently to achieve the density specified for the intended use, or are unstable or pump regardless of the degree of compaction.
4. Materials that contain hazardous or designated waste materials including petroleum hydrocarbons, pesticides, heavy metals, and any material which may be classified as hazardous or toxic according to applicable regulations.
5. Soils that contain greater concentrations of chloride or sulfate ions, or have a soil resistivity or pH less than the average values for existing on-site soils.
6. Topsoil, sludge and sludge-entrained soils.
7. Rocks, stones, and boulders larger than allowed for use as suitable fill and backfill materials.

PART 3 – EXECUTION

3.01 GENERAL

A. Control of Water

The Contractor shall keep excavations free from water during construction. The static water level shall be drawn down a minimum of 2 feet below the bottom of excavations to maintain the undisturbed state of natural soils and allow the placement of any fill to the specified density. Disposal of water shall not damage property or create a public nuisance. Disposed of water to the City's sanitary sewer system will not be allowed.

Additional requirements for dewatering are specified in Section 02140 Control of Groundwater.

B. Overexcavation

Overexcavation shall be per the recommendations in the Geotechnical Report.

C. Shoring and Sheeting

Shore and sheet excavations in accordance with Section 02080 Sheeting, Shoring and Bracing.

D. Surplus Material

1. Unless otherwise specified, surplus excavated material shall be disposed of at the Contractor's expense.
2. The Contractor shall verify that there is sufficient material available for the completion of the Work before disposing of any material inside or outside the Site. Shortage of material, caused by premature disposal of any material by the Contractor, shall be replaced by the Contractor at his/her expense.
3. The Contractor shall protect all excavated material that is to be used as native backfill from exposure to weather. Any material that is damaged due to exposure to weather shall be replaced with engineered fill at the Contractor's expense.
4. Material shall not be stockpiled to a depth greater than 5 feet above finished grade within 25 feet of any excavation or structure.
5. The Contractor shall maintain stability of the soil adjacent to any excavation.

E. Hauling

When hauling is done over highways or city streets, the loads shall be trimmed and the vehicle shelf areas shall be cleaned after each loading. The loads shall be watered after trimming to eliminate dust.

F. Maintenance of Roadways

All earthwork operations shall be performed in a manner which does not disrupt the continuous flow of traffic on existing roadways. All streets shall be swept clean daily where dirt and debris result from Contractor's operations.

G. Finish Grading

Finish grades and existing or natural grades in the area of Work are indicated on the Contract Drawings. The Contractor shall do all grading, filling or excavating as required to completely grade the Site to lines and grades shown, and to provide for the indicated drainage. Where finished grade corresponds practically with existing grade, the ground shall be worked up and graded off evenly with existing grade. Filled areas shall be compacted so as to prevent settlements or wash and the Contractor shall be responsible for a period of one year after final acceptance of the project to provide additional fill as necessary to bring to grade any areas which settle below the indicated grades and to replace or repair any planting or work damaged by such settlement.

The Contractor shall provide slight drainage away from the building walls in all directions. All grades, fills, or slopes shall be trimmed to even natural lines, suitable for planting or landscaping.

H. Tolerances

Finished grade shall be to the line and grade shown on the Contract Drawings to within a tolerance of plus or minus 0.05 feet. Allowance for topsoil and grass cover, and subbase and pavement thickness shall be made so that the specified thickness can be applied to attain the finished grade.

I. Control of Erosion

The Contractor shall maintain earthwork surfaces true and smooth and protected from erosion. Where erosion occurs, the Contractor shall provide fill or shall excavate as necessary to return earthwork surfaces to the grade and finish specified.

3.02 EXCAVATION

A. General

Excavation shall be to the elevations and dimensions indicated. Excavations shall be kept free from water while construction is in progress. The Engineer shall be notified immediately in writing in the event that it becomes necessary to remove hard, soft, weak, or wet material to a depth greater than indicated. Soil disturbed or weakened by the Contractor's operations and soils permitted to soften from exposure to weather shall be excavated to firm foundation and refilled with engineered fill material compacted to 95% of ASTM D1557, maximum density. All work of this nature will be at the Contractor's expense.

B Trench Excavation

Trench excavation shall conform to County Detail 330 as supplemented these Contract Documents. Trench sides shall be constructed as nearly vertical as practicable. Sides of trenches shall not be sloped between the bottom of the trench and the elevation of the top of the pipe. Bottom of trenches shall be graded accurately to provide uniform bearing and support for each section of pipe or conduits on undisturbed soil, or bedding material as indicated or specified at every point along its entire length except for portions where it is necessary to excavate for bell holes and for making proper joints. Bell holes and depressions for joints shall be dug after trench has been graded. Dimension of bell holes shall be as required for properly making the particular type of joint to ensure that the bell does not bear on the bottom of the excavation. Trench dimensions shall be as indicated.

C. Structural Excavation

1. General

The bottom excavation elevation shall be sufficient to allow the proper placing of forms and concrete construction to the elevations indicated, as specified herein. Slopes shall vary no more than 0.5 feet from specified grade. Prior to placing structure foundation materials, the subgrade shall be scarified and recompactd in accordance with Subsection 3.05 Compaction.

Unless otherwise specified, excavations shall extend a sufficient distance from walls and footings to allow for placing and removal of forms, installation of services, and for inspection, except where concrete is specified to be placed directly against excavated surfaces.

2. Foundation Inspection

Whenever any structure excavation is substantially completed to grade, the Contractor shall notify the Engineer who will make an inspection of the foundation for uniformity and suitability as a structure foundation. No concrete or masonry shall be placed until the foundation has been inspected by the Engineer. The Contractor shall, if directed by the Engineer, dig test pits and make test borings and foundation bearing tests. If the material tested complies with the Specifications, the cost thereof will be paid for as extra work. If the material tested does not comply with the Specifications, the cost thereof (initial testing, remedial work, re-testing) will be borne by the Contractor.

3.03 SUBGRADE PREPARATION

Ground surfaces receiving engineered fill shall be prepared by clearing and grubbing as specified in Section 02160 Site Preparation, and by removing soil which is high in organic content and other deleterious material. Subgrade shall then be scarified to a depth of 12", moisture conditioned and recompactd as specified for fill.

3.04 FILLING OPERATIONS

A. General

The Contractor shall be responsible for the maintenance and protection of all embankments and fills made during the contract period and shall bear the expense of replacing any portion which has been displaced due to carelessness, negligent work, erosion or failure to take proper precautions.

All fill work shall be engineered fill. If the existing slope in an area to be filled is greater than 5:1, the Contractor shall bench the area prior to filling to allow each two lifts to be keyed 1 foot into the existing slope. Site fill shall be placed in 8" lifts and compacted as specified herein.

B. Construction of Engineered Fill

All engineered fill material shall be placed in layers of 8" or less in loose thickness, uniformly moisture conditioned to 3% to 5% above optimum moisture content and compacted to 95% relative compaction as determined by ASTM D1557.

No fill shall be placed during weather conditions which will alter the moisture content of the fill materials sufficiently to make adequate compaction impossible. After placing operations have been stopped because of adverse weather conditions, no additional fill material shall be placed until the last layer compacted has been checked and found to be compacted to the specified densities.

C. Structure Backfill and Foundation Materials

1. Structure Backfill

Unless otherwise specified, structure backfill shall be constructed as specified in Subsection 3.04 Paragraph B of this specification section.

After completion of construction below the elevation of the final grade, and prior to backfilling, forms shall be removed and the excavation shall be cleaned of debris.

Structure backfill shall not be placed until the subgrade portions of the structure have been inspected by the Engineer. No backfill material shall be deposited against concrete structures until the concrete has developed a strength of not less than 2,500 psi in compression, or until the concrete has been in place for 28 days, whichever occurs first. Backfill material shall be placed in uniform layers (6" thick) and shall be brought up uniformly on all sides of the structure.

2. Structure Foundation Materials

Materials immediately below structures shall be crushed rock. Materials shall be placed in 6" lifts and compacted as specified herein.

D. Pipe Bedding and Trench Backfill

1. General

Pipe bedding and trench backfill shall conform to these Contract Documents.

2. Bedding

Bedding shall be placed in 6" maximum loose lifts. Provide uniform and continuous support for each section of utility except at bell holes or depressions necessary for making proper joints. Bring up evenly on each side and along the full length of the pipe. Ensure that no damage is done to piping or their protective coatings. Compact each loose lift as specified below before placing the next lift. Do not place bedding in freezing weather or where the material in the trench is already frozen or is muddy, except as authorized.

3. Backfilling

Backfill shall be placed in 6" maximum loose lifts. Do not backfill in freezing weather or where the material in the trench is already frozen or is muddy, except as authorized. Where settlements greater than the tolerance allowed herein for grading occur in trenches and pits due to improper compaction, excavate to the depth necessary to rectify the problem, then backfill and compact the excavation as specified herein and restore the surface to the required elevation. Coordinate backfilling with testing of utilities. Provide buried locator tracer tape installed between the bedding and initial backfill as per Specification 025010.

3.05 COMPACTION

A. General

Compact each layer or lift of material specified so that the in-place density tested is not less than the percentage of maximum density identified herein. Compaction shall be accomplished by mechanical equipment such as tamping rollers, sheepsfoot rollers, pneumatic tire rollers, vibrating rollers, or other mechanized tampers suitable for the Work. Compaction of materials behind earth retaining structures shall be accomplished solely by means of mechanical plate compactors. Compaction of materials by ponding and jetting is prohibited. Compaction equipment and procedures are subject to approval by the Engineer.

B. Structure Subgrade

Native subgrade under structures shall have a density of 90% of ASTM D1557, Method D, maximum density to a depth of 12"; if the existing subgrade natural density is less than 95% of ASTM D1557, Method D, maximum density, it shall be compacted to that value at the Contractor's expense.

C. Structure Foundation Materials and Backfill

Structure foundation material and backfill materials shall be compacted to 95% of ASTM D1557, Method D, maximum density.

D. Compaction of Pipe Bedding

Compact to 85% of ASTM D1557 maximum density.

E. Compaction of Trench Backfill

Compact backfill material to 90% of ASTM D1557 maximum density, except that the upper 18" of trench backfill shall be 95% of maximum density.

F. Compaction of Paving Subgrade

Compact subgrade to 95% of ASTM D1557 maximum density.

3.06 CLEAN UP

After completing all earthwork, the Contractor shall leave the Site in a neat and clean condition, doing all such grading as is required by the Contract Drawings. Any existing features, structures, and other facilities damaged or affected by the Work shall be replaced, repaired, or restored to their original condition or better.

3.07 DUST CONTROL

- A. The contractor shall control all dust generated as a result of the Contractor's performance of the Work, either inside or outside the right-of-way. The Contractor shall apply water or a dust palliative for the alleviation or prevention of dust nuisance. Should the Contractor elect to use a dust palliative, the palliative and method of application shall be approved by the Engineer prior to use of the palliative on the Site.

****END OF SECTION****

SECTION 02310
TRENCH EXCAVATION

PART 1 – GENERAL

1.01 GENERAL

In general, a trench is defined as an excavation in which the depth is greater than the width of the bottom of the excavation. Additionally, a trench shall include excavation for appurtenant structures including but not limited to, manholes, transition structures, junction structures, vaults, valve boxes, catch basins, thrust blocks, and boring pits. The Contractor's attention is directed to the rules, orders, and regulations of the California Division of Occupational Safety and Health (CAL/OSHA) for a more specific definition.

- A. The requirements specified in this Section apply to all trench excavations. Nothing in these Specifications shall relieve the Contractor from conforming to the requirements of CAL/OSHA. If there is a conflict between the two aforementioned standards, the more stringent requirement shall apply.
- B. Trench excavation shall include the removal of all water and materials of any nature which interfere with the construction work.
- C. The method for installation of pipe or conduit (open trench, tunnel, or bore and jack) shall be shown on the Plans.
- D. Where pipe is to be installed in new embankment, the embankment shall be first constructed to the following dimensions and compacted prior to any excavation for placement of pipe:
 - 1. A height of 12 inches above the top of pipe.
 - 2. A width of not less than 5 times the diameter of the pipe on each side of the pipe, after which the trench shall be excavated.
- E. Excavated material from trenches located within paved areas shall be immediately loaded into trucks and hauled off and disposed of outside the public right of way. No excavated material shall be placed or stored within the public right of way unless otherwise allowed by the Engineer.

1.02 EXISTING UNDERGROUND UTILITIES

- A. The Contractor shall contact Underground Services Alert (U.S.A.), at least 48 hours in advance of any excavation.
 - 1. The Contractor shall not commence excavation in a location prior to U.S.A. members marking the location of their utilities or indicating that none exist within the excavation limits outlined by the Contractor.

2. The Contractor shall notify the Inspector of any conflict discovered as a result of the U.S.A marking prior to commencing excavation at that location.
- B. It is the Contractor's responsibility to verify the location and elevation of all existing utilities within the limits of excavation.
- C. All existing pipes within the trench zone and any other facilities adjacent to the trench shall be carefully supported and protected from damage as a result of the Contractor's operations.

1.03 EXCAVATION METHOD

Methods used in excavation shall be such as not to cause damage to surrounding property or to unnecessarily damage pavement. Street pads for backhoe outriggers and other equipment shall be utilized to prevent unnecessary damage.

1.04 MINIMUM AND MAXIMUM TRENCH WIDTH

All trench widths shall be in compliance with the Drawings. In the event that unsuitable materials or unstable trench walls are encountered, the trench width shall be modified in accordance with the applicable ASTM standard.

- A. The pipe or conduit shall be positioned in the center of the trench.
- B. The trench width for utility company owned facilities shall conform to the utility company standards.
- C. The minimum trench width for City owned facilities shall conform to the requirements of Table 1.

Table 1

Pipe Material	Pipe Size (Nominal Diameter)	Minimum Trench Width
All Pipes	6-Inches and less	O.D. ^(a) + 12-inches
Ductile Iron Pipe	Greater than 6-inches	O.D. + 24-inches
Polyvinyl Chloride and High Density Polyethylene Pipes	Greater than 6-inches	O.D. + 16-inches ^(c)
Reinforced Concrete and Vitrified Clay Pipes	Greater than 6-inches	O.D. + 16-inches

^(a) O.D. – Outside Diameter

^(b) Where trench walls can not sustain a vertical cut, trench width shall be three times O.D.

- D. If the maximum trench width specified on the Plans is exceeded, the Contractor shall be required to provide a higher strength bedding class or a higher strength pipe as approved by the Engineer.
- E. The minimum trench width for installation of water service, signal conduit of two inches in diameter or less, shall be in accordance with the manufacturer's recommendation for the conduit.

1.05 FOUNDATION

- A. All loose material shall be removed from the new trench bottom before placing the bedding material.
- B. Special Foundation Treatment
 - 1. Whenever the bottom of the trench is soft or rocky, or, otherwise unsuitable as a foundation for the pipe in the opinion of the Engineer, the unsuitable material shall be removed as directed by the Engineer to provide a stable and satisfactory foundation.

1.06 MAXIMUM LENGTH OF OPEN TRENCH

- A. The maximum length of open trench where prefabricated pipe is to be laid shall be the distance necessary to accommodate that amount of pipe which can be installed and backfilled in that same day, but in no case shall exceed 400 feet.
- B. At the end of each working day, there shall be no open trench in paved or improved areas unless it is plated in accordance with these Specifications. Improved areas are defined as any areas within 300 feet of any existing housing or commercial structure or paved area whether paved with asphalt concrete or Portland cement concrete.
- C. A maximum of 25 feet of trench may be left open in unimproved areas if barricaded.

1.07 TRENCH PLATES

Trench plates shall be used for temporary cover of trenches and other excavations, unless otherwise specified.

- A. When the backfilling of trenches and excavations can not be completed in the same day within areas with no vehicle traffic, a temporary fence or barrier may be used, along with $\frac{3}{4}$ " plywood. For excavation within a paved street section or within the concrete curb and gutter and sidewalk area where vehicle traffic may be present, trench plates shall be required and the following conditions shall apply:
 - 1. The plates shall be of steel construction capable of supporting H2O loading.

2. The plates shall have a skid resistant surface.
3. The plates must extend beyond the edge of the trench wall to adequately support the traffic loads on it. In no case shall the plates extend less than twelve (12) inches beyond the trench wall.
4. Each plate must be fully supported around the perimeter to prevent wobbling or rocking.
5. The plates shall be secured to prevent any movement.
6. Trenches and excavations shall be adequately shored and braced to withstand highway traffic loads.
7. Temporary paving or cold-mix asphalt concrete (cutback) shall be placed and continuously maintained around all outside edges of the trench plates until removal of the plates.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

****END OF SECTION****

SECTION 02320

TRENCH FOUNDATION, BEDDING AND BACKFILL

PART 1 – GENERAL

1.01 GENERAL

- A. The foundation, bedding and backfill for all trenches shall conform with the requirements of these Specifications and the Drawings. These requirements also apply to non City-owned Utilities located within the City right-of-way. The Plans may require more stringent requirements than specified in these Specifications.
- B. The trench foundation shall be defined as the material below the bottom elevation of the bedding.
- C. Bedding shall be defined as that material supporting the pipe from the trench foundation surrounding, and extending to one foot above the top of pipe.
- D. Backfill for all pipe materials shall be defined as that layer of material extending from above the bedding material to the elevation of the subgrade within the proposed or existing paved area. The backfill shall extend to the finish grade and conform to the adjacent grade where the trench is located within an unpaved area.
- E. No jetting will be allowed for trench bedding or backfill.
- F. All existing pipes within the trench zone and any other facilities adjacent to the trench shall be supported and protected from damage as a result of the Contractor's operations.

1.02 SPECIAL FOUNDATION TREATMENT

- A. Special foundation treatment shall be required whenever the bottom of the trench has been over excavated as required in Section 02310 Trench Excavation.
- B. The over excavated portion of trench shall be backfilled with drain rock in accordance with these Specifications.
- C. Geotextile filter fabric shall be placed between the crushed rock and bedding material as specified on the Drawings.
- D. An additional layer of geotextile fabric may be required to stabilize the trench bottom. The specification for this fabric shall be as approved by the Engineer.

1.03 BEDDING

- A. Particular attention must be given to the placement of the bedding material to ensure that firm support to the pipe is obtained to prevent any change in alignment of the pipe.
- B. The bedding shall be shaped to accommodate the pipe bell and other related appurtenances to allow the bottom of the pipe to be supported uniformly by the bedding. The bedding material shall be sliced into the haunch of the pipe with a shovel or other hand tool to fill the voids in this area. The remainder of bedding shall be carefully placed and consolidated to the proper depth in eight (8) inch maximum lifts.
- C. Bedding Material
 - 1. Bedding materials for non City-owned utilities shall conform to the Utility Company specifications except that at a minimum, the material shall conform to the minimum requirements for Bedding Material as specified in these City Standard Specifications whenever the trench is located within the limits of an existing paved area.

1.04 BACKFILL

- A. The Contractor shall not place any backfill material until the Engineer has inspected and accepted the placement of the bedding.
- B. Backfill shall conform to the Drawings.
- C. Native material and Class II Aggregate Base Rock backfill shall be placed in uniform layers. The thickness of each layer of backfill shall not exceed eight (8) inches before compaction. Compaction equipment or methods which may cause displacement or damage to the pipe shall not be used.
- D. Existing Paved Areas

Trenches located within the existing paved areas shall be backfilled with Class II Aggregate Base Rock (Aggregate Base) conforming to these Specifications. The Aggregate Base backfill shall be compacted to the requirements indicated on the Drawings. The Aggregate Base shall be placed to the elevation to allow for placement of asphalt concrete in accordance with the Drawings. Temporary paving shall be installed and maintained until final pavement is completed. Asphalt concrete shall conform to these Specifications and placed in accordance with the Drawings.

- E. New Paved Areas

Trenches located within new paved areas (areas required to be paved with the Project Plans) may be backfilled with native material providing that the native

material is free of rock(s), rubbish, debris and other objectionable material. The maximum size of any component of the native material shall not exceed 2-1/2 inches in size. The backfill shall be compacted to the requirements indicated on the Drawings. When the required compaction can not be achieved with the native material, select import material shall be required. The backfill shall be placed up to the new pavement subgrade elevation shown on the Plans.

F. Unpaved Areas

Trenches located within unpaved areas may be backfilled with native material providing that the native material is free of rock(s), rubbish, debris and other objectionable material. The maximum size of any component of the native material shall not exceed 2-1/2 inches in size. The backfill shall be compacted to the requirements indicated on the Drawings. When the required compaction can not be achieved with the native material, select import material shall be required. The backfill shall be placed to final grade to conform to the elevation of the adjoining surface elevation.

1.05 TUNNELING, BORING, AND JACKING

- A. Tunneling, boring, and jacking shall only be permitted when approved by the Director of Public Works.
- B. Any pipe or facility that is placed underground in any method other than open cut trenching shall be considered as tunneling or boring and jacking.
- C. All existing utilities shall be potholed for actual depth prior to tunneling or boring and jacking.
- D. All voids between the inside of the casing and the pipe shall be completely backfilled by blowing sand or pumping grout between the casing and the pipe.

1.06 UTILITY COMPANY CONDUIT INSTALLATION

Installation of Utility Company conduit shall be done by either open cut trenching (when the trench width is greater than six inches), open cut trenching (when the trench width is six inches or less) or by bore and jack. The method of installation shall be subject to the approval of the Engineer.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

****END OF SECTION****

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SECTION 02330

GEOTEXTILE FABRICS

PART 1 – GENERAL

1.01 GENERAL

- A. Geotextile fabrics consisting of Subgrade Separation Fabric, Subgrade Stabilization Fabric, Trench Filter Fabric, Rock Slope Protection Fabric, and Pavement Fabric shall conform to this Section.
- B. Geotextile fabric shall be placed as required by the Plans and various sections of the Specifications, which includes the Drawings.
- C. A Certificate of Compliance for each kind of fabric used on the Project shall be furnished to the Engineer in conformance with the provisions in Section 6-1.07, "Certificates of Compliance" of the Caltrans Standard Specifications.
- D. Geotextile fabric shall be furnished in protective covers capable of protecting the fabric from ultraviolet rays, abrasion, and water.
- E. Atmospheric exposure of geotextile fabric (with the exception of Pavement Fabric) to the elements following lay down of the material shall be a maximum of 14 days. Pavement Fabric shall be covered with asphalt concrete the same day the fabric is laid down. Fabric not in compliance with these requirements shall be removed from the Work and disposed of at the Contractor's expense.
- F. The Contractor shall immediately repair damaged fabric, as identified by the Engineer. The Contractor shall clear the damaged area plus an additional three (3) feet of all fill material. Cover the damaged area with a new fabric patch extending three (3) feet beyond the perimeter of the damage.

PART 2 – PRODUCTS

- 2.01 Subgrade Separation Fabric shall be furnished and installed over the entire limits of subgrade for all roadways, curbs, curb and gutters and driveways as shown on the Drawings. The requirement to install fabric does not supersede the Contractor's obligation to conform to Section 19-2.02, "Unsuitable Material" of Caltrans Standard Specifications.
 - A. Subgrade Separation Fabric shall be, at the option of the Contractor, either woven or nonwoven type material, unless the Plans specify the type, and shall meet or exceed the specifications presented in Table 1.

Table 1. Subgrade Separation Fabric

Property	ASTM Test Method	Woven Minimum Average Roll Value ^(a) English/Metric	Nonwoven Minimum Average Roll Value ^(a) English/Metric
Grab Tensile Strength	D 4632	247 lbs/1100N ^(b)	157 lbs/700N
Trapezoidal Tear Strength	D 4533	90 lbs/400N	56lbs/250N
Puncture Strength	D 4833	90 lbs/400N	56lbs/250N
Permittivity	D 4491	0.05 sec ⁻¹	1.2 sec ⁻¹
Apparent Opening Size (AOS)	D 4751	Maximum #40 sieve/ 0.425mm	Maximum #70 sieve/ 0.212 mm
UV after 500 hours	D 4355	70%	70%

^(a) All values in this table are the minimum values allowed in each direction except as noted, and are based on Minimum Average Roll Value (MARV).

^(b) The abbreviation shown as "N" for the metric unit designates Newtons.

2.02 Subgrade Stabilization Fabric shall be furnished and installed over the entire limits of subgrade for paved locations where the Engineer determines that the subgrade is unstable for placement of aggregate base rock.

A. Subgrade Stabilization Fabric shall be woven fabric subject to the following conditions as specified herein.

1. Street and Paved Roads and Other Paved Locations - At locations where the Inspector determines the subgrade is unstable for placement of aggregate base rock and requires additional support, the Engineer may require the Contractor to install a woven Subgrade Stabilization Fabric in lieu of a Subgrade Separation Fabric, or install a Geogrid in combination with Subgrade Separation or Stabilization Fabric. The Geotechnical Engineering firm testing the materials on the Project will make a recommendation for the specification of the woven Stabilization Fabric and/or Geogrid. The Contractor shall furnish and install the Geogrid and/or Geotextile fabric as recommended by the Geotechnical Engineer and approved by the Engineer. The Geotextile fabric shall meet or exceed the specifications presented in Table 2. These requirements do not supersede the Contractor's obligation to conform to Section 19-2.02, "Unsuitable Material" of Caltrans Standard Specifications.

Table 2. Subgrade Stabilization Fabric

Property	ASTM Test Method	Woven Minimum ^(a) Average Roll Value (English)/(Metric)
Wide Width Tensile Strength	D 4595	2400 lbs/ft 35 kN/meter ^(b)
Grab Tensile Strength	D 4632	315 lbs/ft 1.4 kN/meter
Trapezoidal Tear Strength	D 4533	125 lbs/0.556kN
Puncture Strength	D 4833	140 lbs/0.622kN
Permittivity	D 4491	0.50 sec ⁻¹
Apparent Opening Size (AOS)	D 4751	Maximum #40 sieve/0.425 mm
UV after 500 hours	D 4355	80%

^(a) All values in this table are the minimum values allowed in each direction except as noted, and are based on Minimum Average Roll Value (MARV).

^(b) The abbreviation shown as "kN" for the metric unit designates kiloNewtons.

2.03 Trench Filter Fabric shall be furnished and installed in all trench conditions between the bedding and backfill material whenever crushed rock or pea gravel is used as bedding. Trench Filter Fabric shall also be furnished and installed at all other locations required by the Plans.

A. Trench Filter Fabric shall be a nonwoven material type and meet or exceed the specifications presented in Table 3.

Table 3. Trench Filter Fabric

Property	ASTM Test Method	NonWoven Minimum ^(a) Average Roll Value (English)	Nonwoven Minimum ^(a) Average Roll Value (Metric)
Grab Tensile Strength	D 4632	112 lbs	500 newtons
Trapezoidal Tear Strength	D 4533	40 lbs	180 newtons
Puncture Strength	D 4833	40 lbs	180 newtons
Permittivity	D 4491	1.5 sec ⁻¹	1.5 sec ⁻¹
Apparent Opening Size (AOS)	D 4751	Maximum #70 Sieve	Maximum 0.212 mm
UV after 500 hours	D 4355	70%	70%

^(a) All values in this table are the minimum values allowed in each direction except as noted, and are based on Minimum Average Roll Value (MARV).

PART 3 – EXECUTION

3.01 SUBGRADE SEPARATION FABRIC

A. Installation

1. The fabric shall be unrolled and laid smooth without wrinkles or folds on the prepared subgrade in the direction of construction traffic with the following exception, the fabric may be either cut or folded to fit horizontal curvilinear alignment of the roadway.
2. Adjacent rolls shall be overlapped a minimum of 30" in the longitudinal and transverse directions of the base placement. The fabric may be held in place by pins, staples, or piles of base material.
3. Unless otherwise allowed by the fabric manufacturer's published recommendations, which will be furnished to the Engineer by the Contractor a minimum of two (2) working days in advance of the planned installation, the fabric will be installed in strict conformance with these recommendations and the installation shall conform to the criteria identified below:

- i. The Contractor's vehicles or equipment shall not be allowed directly onto the fabric.
 - ii. Aggregate base rock shall be placed by end dumping on to the fabric from the edge of the fabric, or over previously placed aggregate base rock.
 - iii. Aggregate base rock shall be spread using a motor grader or bulldozer, maintaining a lift thickness of six (6) inches.
 - iv. Vibratory compaction is not permitted on the initial lift of aggregate base rock material.
4. The Contractor shall not cover the fabric until the Engineer has inspected the fabric for proper installation and to ensure that the fabric has not been damaged (i.e. holes, rips, tears). Damaged fabric shall be repaired in accordance with Subsection 1.01 Paragraph F of this Section.

3.02 SUBGRADE STABILIZATION FABRIC

- A. Installation of Subgrade Stabilization Fabric shall conform to Subsection 3.01 Paragraph A of this Section.

3.03 TRENCH FILTER FABRIC

- A. Installation
1. Trench Filter Fabric shall be installed in such a manner to prevent migration of fines.
2. Adjacent rolls shall be overlapped a minimum of 24" in the longitudinal and transverse directions.

****END OF SECTION****

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SECTION 02500

PAVING

PART 1 – GENERAL

1.01 DESCRIPTION

This Section specifies paving consisting of aggregate base, asphaltic concrete, and associated materials.

1.02 QUALITY ASSURANCE

A. References

This Section contains references to the following documents. They are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by the organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, reference to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
ASTM D1557	Test Method for Laboratory Compaction Characteristic of Soil using Modified Effort (56,000 ft-lb/ft ³ (2,700 KN-m/m ³))
Caltrans 2006 Standards	State of California Department of Transportation Standard Specifications, May 2006

B. Testing

Testing will be conducted by the Engineer to determine compliance with the specified degree of compaction and moisture content.

1.03 PAVING SYSTEMS

The paving system shall be as specified on the Drawings.

1.04 SUBMITTALS

Submittals shall be provided in accordance with Section 01300 Submittals of these Specifications and shall include the following information:

- A. A copy of this Section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the Specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph referenced to a detailed written explanation for requesting the deviation. The Engineer shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the Specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
- B. Asphalt concrete mix design showing complete aggregate gradings, void content, maximum density, compacted unit weight, and Hveem Stability for each percentage of binder used in the mix design determination.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Aggregate Base

Aggregate base shall be Type A, Class 2 aggregate base, conforming to the following gradation from Caltrans Section 26:

Seive Size	Percent Passing
1"	100
¾"	87-100
No. 4	30-65
No. 30	5-35
No. 200	0-12

B. Asphalt Concrete

1. Asphalt concrete shall be Type A medium asphalt concrete using PG-64-16 asphalt binder, and shall conform to the Drawings and provisions in Caltrans Section 39, "Asphalt Concrete".
2. Aggregate used in asphalt concrete shall conform to the 1/2" maximum, medium grading requirements of Caltrans Section 39-2.02, with a minimum of 2 fractured faces.

C. Asphaltic Tack Coat

PG-64-16 asphalt conforming to Caltrans Section 92. The application rate shall be 0.15 gal/yd².

PART 3 – EXECUTION

3.01 GENERAL

Construction shall conform to the details, dimensions and grades specified. Maximum variations in finished grade of paving shall be ± 0.05 feet.

3.02 AGGREGATE BASE PLACEMENT

A. Subgrade

Areas to be paved shall be graded and compacted in accordance with Section 02300.

B. Aggregate Base

Placement, moisturizing, spreading, and compacting of aggregate base shall comply with all requirements of Caltrans Sections 26-1.03 through 26-1.05 inclusive, the details on the Drawings, and Section 02300.

3.03 ASPHALT CONCRETE PAVEMENT PLACEMENT

- A. Asphalt concrete shall be placed where indicated on the Drawings. Storing, proportioning, mixing, equipment, spreading, and compacting of asphalt concrete pavement shall comply with Caltrans Sections 39-3 and 39-5 through 39-7, as modified herein.
- B. The tack coat shall be applied to all vertical surfaces as required in Caltrans Section 39-4.02.
- C. Each layer (lift) of asphalt concrete shall be a minimum of 0.12 foot compacted thickness, and a maximum 0.24 foot compacted thickness. Sections 0.25 foot or thicker shall be placed in equal lifts.
- D. Finished asphalt concrete surfaces shall be to the grades indicated on the Drawings.

3.04 RESTORATION OF EXISTING PAVEMENT

The Contractor shall repair/replace all pavement facilities damaged as a result of construction activities, including trench repair. Pavement repair shall be 1" thicker than existing pavement section or a minimum of 4" AC on 12" aggregate base, whichever is greater. Trench resurfacing shall be as indicated.

3.05 EXISTING UTILITIES

The Contractor shall raise all iron to grade, including, but not limited to, manhole frames, valve boxes, electric pull boxes and survey monument boxes.

****END OF SECTION****

SECTION 02510

PIPELINES AND SITE PIPING, GENERAL

PART 1 – GENERAL

1.01 SUMMARY

- A. Contractor shall furnish and install all piping systems shown and specified, in accordance with the requirements of the Contract Documents. Each system shall be complete with all necessary fittings, supports, anchors, thrust restraints, thrust blocks, expansion joints, valves, accessories, insulation, lining and coating, testing, disinfection, excavation, backfill, and encasement to provide a complete and functional installation.
- B. This Section contains general requirements for site piping and pipelines, and is applicable to buried pipe outside of structures. For requirements for piping above ground; in structures; and vaults; and piping that is part of or associated with equipment, buildings, mechanical, and process systems, see Section 15010 Mechanical Piping, General.
- C. The piping indicated on the Drawings is intended to define the general layout, configuration, routing, pipe sizes, and pipe types. The Drawings are not pipe construction or fabrication drawings. Not all pipe supports, fittings, reducers, anchorages, and expansion provisions are shown on the Drawings. It is Contractor's responsibility to develop the details necessary to construct all piping systems and to provide and install all piping components for a complete and functional system.

1.02 REFERENCED DOCUMENTS

- A. The following documents are referenced in this Section.

ASME B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B1.20.1	Pipe Threads, General Purpose (Inch)
ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
ASME B16.5	Pipe Flanges and Flanged Fittings NPS ½ Through NPS 24
ASME B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	Square and Hex Nuts (Inch Series)

ASTM A 193	Alloy Steel and Stainless Steel Bolting Materials for High- Temperature Service
ASTM A 307	Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
ASTM A 325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM D 2000	Standard Classification System for Rubber Products in Automotive Applications
AWWA C110	Ductile-Iron and Gray-Iron Fittings, 3 in.-48 in. (76 mm-1,219 mm), for Water
AWWA C111	Rubber-Gasket Joints for Ductile- Iron Pressure Pipe and Fittings
AWWA C115	Flanged Ductile Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C207	Steel Pipe Flanges for Waterworks Service-Sizes 4 in. through 144 in. (100 mm through 3,600 mm)
AWWA C606	Grooved and Shouldered Joints
NSF Standard 61	Drinking Water System Components -- Health Effects

1.03 SUBMITTALS

- A. Contractor shall submit complete shop drawings and certificates, test reports, and affidavits of compliance of all piping systems, in accordance with the requirements of Section 01300 Submittals, and the requirements of the pipe material Technical Specifications.
- B. The shop drawings shall include all necessary dimensions and details on pipe joints, fittings, fitting specials, valves, appurtenances, design calculations, and material lists. The submittals shall include detailed layout, spool and fabrication drawings which show all pipe spools, spacers, adapters, connectors, fittings, valves, and pipe supports necessary to provide complete and functional piping systems.
- C. Contractor shall submit as part of the shop drawings statements from the pipe fabricators certifying that all pipes will be fabricated subject to an established quality control program. An outline of the program shall be submitted to Engineer for review prior to the fabrication of any pipe.
- D. Submit tabulated data resulting from the field investigations, exploratory excavations, and surveying for underground utilities.

1.04 FIELD INVESTIGATIONS, EXPLORATORY EXCAVATIONS, AND SURVEYING FOR EXISTING UNDERGROUND UTILITIES

- A. Prior to preparation of shop drawings for underground piping, and prior to excavation for installation of underground facilities, Contractor shall perform field investigations, exploratory excavations, and surveying for existing underground utilities and other interferences shown on the Drawings, and for facilities where connections will be made as part of the Work. This is a special item of Work, and is in addition to any other provisions in the Contract Documents and any requirements of Laws or Regulations for locating existing underground utilities and interferences. Payment for this item shall be considered payment for locating existing underground utilities and interferences, whether or not the utility interference is shown with reasonable accuracy on the Drawings.
- B. Contractor shall determine the following properties of each existing underground utility and interference.
 - 1. Location, including the design station or coordinates where the existing utility will interfere with the proposed pipeline or structure, and where connections will be made to existing facilities.
 - 2. Elevation of the invert of the existing utility and critical elevations of interfering structures.
 - 3. The utility size, material type, and type of existing backfill.
- C. Surveying shall be performed by a firm or individual that possesses a valid license for land surveying in the State of California. The basis for the surveying shall be that used for the Project.
- D. Explorations shall be excavated, backfilled, and paved with temporary pavement in accordance with the Contract Documents.
- E. Contractor shall use the information obtained from the field investigations for planning construction operations, preparation of shop drawings for proposed pipelines and structures, preparations for connections to existing facilities, and for the record drawings. Where existing underground utilities will otherwise interfere with the design locations of pipelines or structures, Contractor shall propose grade or alignment adjustments to avoid potential conflicts. Such adjustments shall be prominently identified on the shop drawings for review by Engineer.

1.05 QUALITY ASSURANCE

- A. All pipe shall be subject to inspection at the place of fabrication and manufacture. During the manufacture of the pipe, Engineer shall be given access to all areas where manufacturing is in progress and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.

- B. Except where otherwise specified, all materials used in the manufacture of pipe shall be tested in accordance with applicable specifications and standards. Welds shall be tested as specified. Contractor shall perform all tests at no additional cost to Owner.
- C. All expenses incurred in making Samples for certification of tests shall be borne by Contractor.

1.06 MANUFACTURER'S SERVICE REPRESENTATIVE

- A. Where the assistance of a manufacturer's service representative is advisable, to obtain pipe joints, supports, or special connections in compliance with the Contract Documents, Contractor shall furnish such assistance at no additional cost to Owner.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All pipes, fittings, and appurtenances shall be furnished in accordance with the requirements of the applicable Technical Specifications and as specified herein.
- B. Pipes, fittings, and appurtenances for raw or potable water service shall be listed by the NSF International as certified drinking water system component in compliance with NSF Standard 61.
- C. Supports for piping shall be per Section 15096 Pipe Hangers and Supports.
- D. All requirements pertaining to thickness, application, and curing of pipe coatings and linings shall be in accordance with the requirements of the applicable Technical Specifications. External ferrous metal surfaces of pipes above ground or in structures shall have surface preparation and prime coatings applied in the shop and finish coatings applied in the field after installation, all in accordance with Section 09900 Painting. Surfaces of field assembled non-ferrous and non-metallic piping above ground or in structures shall have all coatings applied in the field in accordance with Section 09900.
- E. Thrust restrain design pressure shall be 200% of pipe design pressure or the test pressure, whichever is greater. Maximum expected test pressure is defined in Section 02120 Pressure Pipeline Testing.
- F. Piping Expansion and Movement Provisions
 - 1. Sleeve-type couplings and telescoping sleeve couplings shall be provided where indicated on the Drawings to accommodate piping movement and expansion. Contractor shall provide provisions for thrust restraint and movement limitation where couplings are required.

2. If acceptable to Engineer, Contractor may install additional sleeve-type or grooved end mechanical couplings to facilitate piping installation, provided that the installation includes additional pipe supports and hydraulic thrust protection.

G. Bolts, Nuts, Tie Rods, and Other Fasteners for Steel Pipe, Fittings, Couplings, and Appurtenances

1. Except as specified below, bolts shall be ASME B18.2.1 standard hexagon head bolts with ASME B18.2.2 standard hexagon nuts.
2. Threads shall be in accordance ASME B1.1, standard coarse thread series. Threads shall be Class 2A for bolts, and Class 2B for nuts.
3. Bolts and nuts shall be ASTM A307 Grade B Class D flanges. Bolts for Class E and Class F flanges shall be ASTM A193 Grade B7.
4. Bolts, nuts, tie rods, and other fasteners shall be hot-dip galvanized after fabrication. Do not substitute stainless steel fasteners for galvanized fasteners.
5. Furnish fasteners for steel pipe in unopened containers with the product labels and alloy type intact and legible.

H. Bolts, Nuts, Tie Rods, and Other Fasteners for Ductile Iron Pipe, Fittings, Couplings, and Appurtenances

1. Bolts, nuts, and other fasteners shall be high strength, low alloy steel in accordance with AWWA C111. Do not substitute stainless steel fasteners for low alloy steel fasteners.
2. Furnish fasteners for ductile iron pipe in unopened containers with the product labels and alloy type intact and legible.

2.02 PIPE FLANGES

A. General

1. Flat-faced flanges shall not be bolted to raised-face flanges.
2. All machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.
3. Studs and bolts shall extend through the nuts a minimum of 1/4-inch. All-thread studs shall be used only on valve flange connections where space restrictions preclude the use of regular bolts.
4. Insulating flanges shall have bolt holes 1/4-inch diameter greater than the bolt diameter.

B. Flanges for Steel Pipe and Special Sections

1. Where the design pressure is 150 psi or less, flanges shall conform to either AWWA C207 Class D or ASME B16.5 150-lb class. Where the design pressure is greater than 150 psi, up to a maximum of 275 psi, flanges shall conform to either AWWA C207 Class E, Class F, or ASME B16.5 150-lb class. Where the design pressure is greater than 275 psi up to a maximum of 700 psi, flanges shall conform to ASME B16.5 300-lb class.
2. Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown. Attachment of the flanges to the pipe shall be by welding and conform to the applicable requirements of AWWA C207. Flanges for miscellaneous small pipes shall be in accordance with the standards specified for these pipes.

C. Flanges for Ductile Iron Pipe

1. Flanges shall be ductile iron conforming with AWWA C115.
2. Threaded connections shall be used to connect flanges to pipe, or flanges may be integrally cast with the pipe.
3. Flanges shall be rated for a 250 psi working pressure. Dimensions shall match those of ASME B16.1, Class 125 flanges and ASME B16.5, Class 150 flanges.
4. Where indicated, flanges shall be either threaded or integrally cast to meet the requirements of ASME B16.1, Class 250.

D. Flange Gaskets

1. Gaskets for flanged joints shall be full-faced, compressed sheets of aramid fiber base, with nitrile or neoprene binder and non-stick coating, suitable for temperatures to 700 degrees F, a pH of one to eleven, and pressures to 1,000 psig. Gaskets shall be 1/16-inch thick for flange sizes up to 24 inches, and 1/8-inch thick for flange sizes greater than 24 inches.
2. Blind flanges shall have gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange.
3. Flange Gasket Manufacturers, or Equal:
 - a. John Crane, Style 2160;
 - b. Garlock, Style 3000 or 3300.
4. Flange gaskets for chemical service shall be as indicated for the respective pipe materials in the Technical Specifications.

2.03 INSULATING FLANGE SETS

- A. Insulating flange sets shall be provided where indicated. Each insulating flange set shall consist of an insulating gasket, insulating sleeves and washers, and a steel washer. Insulating sleeves and washers shall be one piece when flange bolt diameter is 1-1/2-inch or smaller and shall be made of acetal resin.
- B. For bolt diameters larger than 1-1/2-inch, insulating sleeves and washers shall be 2-piece and shall be made of polyethylene or phenolic.
- C. Steel washers shall be in accordance with ASTM A 325. Insulating gaskets shall be full-face.
- D. Insulating Flange Set Manufacturers, or Equal:
 - 1. JM Red Devil, Type E
 - 2. Maloney Pipeline Products Co.
 - 3. Pipeline Seal and Insulator, Inc.

2.04 BLIND FLANGES

- A. Blind flanges shall be in accordance with AWWA C207, or as required by the requirements for the respective pipe materials in the Technical Specifications.
- B. All blind flanges for pipe sized 12-inches and over shall be provided with lifting eyes in form of welded or screwed eye bolts.

2.05 THREADED INSULATING CONNECTIONS

- A. Threaded insulating bushings, unions, or couplings, as appropriate, shall be used for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are indicated.
- B. Threaded insulating connections shall be of nylon, Teflon, polycarbonate, polyethylene, or other non-conductive materials, and shall have ratings and properties to suit the service and loading conditions.

2.06 MECHANICAL COUPLINGS

- A. Prior to assembly, pipe ends for sleeve and mechanical-type couplings shall have the pipe end coating hold-back areas abrasive blasted and coated with epoxy in accordance with Section 09900 Painting.
- B. Grooved End Couplings
 - 1. Cast grooved end couplings shall be provided where indicated. The couplings shall conform to the requirements of AWWA C606.

2. All gaskets for grooved end couplings shall be compatible with the piping service and fluid utilized, in accordance with the coupling manufacturer's recommendations.
3. The wall thickness of all grooved piping shall conform with the coupling manufacturer's recommendations to suit the highest expected pressure. Pipe and fittings shall be cut grooved, and the methods and equipment for grooving shall be in accordance with mechanical pipe coupling manufacturer's specifications. Pipe to be grooved shall have wall thicknesses not less than the minimum recommended by the coupling manufacturer for cut-grooving and AWWA C606.
4. Couplings shall hold in place a composition water-sealing gasket designed so that internal water pressure serves to increase the seal's water tightness. For water and wastewater, sealing gaskets shall be chlorinated butyl rubber in accordance with ASTM D2000, Grade No. 3BA610A15B44Z with special heat-resistance test of 16 hours at 350 degrees F and maximum elongation change of minus 30%.
5. Steel Pipe Couplings Manufacturers, or Equal:
 - a. Gustin-Bacon (banded or grooved)
 - b. Victaulic Style 41 or 44 (banded, flexible)
 - c. Victaulic Style 77 (grooved, flexible)
 - d. Victaulic Style 07 or HP-70 (grooved, rigid)
6. Ductile Iron Pipe Couplings Manufacturers, or Equal
 - a. Gustin-Bacon
 - b. Victaulic Style 31 (flexible or rigid grooving)

Note: Ductile iron pipe couplings shall be furnished with flush seal gaskets. Ductile iron pipe ends require radius cut grooves.
7. PVC Pipe Couplings Manufacturers, or Equal:
 - a. Gustin-Bacon
 - b. Victaulic Style 775

Note: Couplings for PVC pipe shall be furnished with radius cut or standard roll grooved pipe ends.

C. Sleeve-Type Couplings and Flanged Coupling Adapters

1. Construction
 - a. Sleeve-type couplings shall be provided where indicated. The couplings shall be in accordance with AWWA C219 unless otherwise specified, and shall be of steel with steel bolts, without pipe stop, and shall be of sizes to fit the pipe and fittings shown.
 - b. The middle ring shall be not less than 1/4 inch in thickness and shall be either 5 or 7 inches long for sizes up to and including 30-inches and

10 inches long for sizes greater than 30-inches. The couplings shall be 16 inches long for long-body sleeve couplings.

- c. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof-test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to air test for porosity. The followers shall be a single-piece contoured mill section welded and cold-expanded as required for the middle rings. They shall be of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling.
- d. The shape of the follower shall be of such design as to provide positive confinement of the gasket.
- e. Sleeve-type couplings shall be fusion bonded epoxy coated at the factory.
- f. For flanged coupling adapters, provide anchor studs for all sizes up to and including 12-inch.

2. Pipe End Preparation

- a. The ends of the pipe shall be prepared for sleeve-type couplings as indicated and specified by the coupling manufacturer.
- b. Plain ends for use with couplings shall be smooth and round for a distance of 12-inches from the ends of the pipe, with outside diameter not more than 1/64-inch smaller than the nominal outside diameter of the pipe.

3. Gaskets for Water and Wastewater Service

- a. Gaskets for sleeve-type couplings shall be rubber compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. Gaskets for wastewater and sewerage applications shall be Buna N, grade 60, or equivalent elastomer.
- b. The rubber gaskets shall meet the following specifications:
 - i. Color - Jet Black
 - ii. Surface - Non-blooming
 - iii. Durometer Hardness - 74 ± 5
 - iv. Tensile Strength - 1,000 psi Minimum
 - v. Elongation - 175% Minimum
- c. The gaskets shall be immune to attack by impurities normally found in water or wastewater. All gaskets shall meet the requirements of ASTM D 2000, AA709Z, meeting Suffix B13 Grade 3, except as noted above. All gaskets shall be compatible with the piping service and fluid.

4. Gaskets for chemical service shall be as indicated for the respective pipe materials.

5. Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a rubber sleeve of an

insulating compound in order to obtain insulation of all coupling metal parts from the pipe.

6. All sleeve-type couplings on pressure lines shall be harnessed unless thrust restraint is provided by other means.
7. Sleeve Type Couplings Manufacturers, or Equal:
 - a. Dresser, Style 38
 - b. Ford Meter Box Co., Inc., Style FC1 or FC3
 - c. Smith-Blair, Style 411
8. Flange Coupling Adapters Manufacturers, or Equal:
 - a. Dresser, Style 127 or 128
 - b. Rockwell, Style 912 or 913
9. Sleeve-type couplings for use with ductile iron pipe shall be as manufactured by the following, or equal. (Thrust ties shall be provided as required to resist the test pressure.)
 - a. Dresser, Style 53 or 153
 - b. Smith-Blair, Style 441
10. Transition sleeve-type couplings used to connect pipes with small differences in outside diameter shall be manufactured by the following, or equal:
 - a. Dresser, Style 53 or 153
 - b. Smith-Blair, Style 413

2.07 PIPE THREADS

- A. All pipe threads shall be in accordance with ASME B1.20.

2.08 SEGMENTED RUBBER SEALS

- A. Seals shall be modular mechanical type, consisting of interlocking rubber links shaped to continuously fill the annular space between the pipe and wall sleeve. Links shall be assembled with bolts to form a continuous rubber seal around the pipe. Tightening of the bolts shall cause the rubber links to expand and provide a completely watertight seal.
- B. Bolts, nuts, and other metal parts shall be stainless steel.
- C. Seals shall be constructed to provide electrical insulation between the pipe and a metallic wall sleeve when the seals are used in corrosion protection systems.

PART 3 - EXECUTION

3.01 GENERAL

- A. All pipe materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground, to provide protection against damage and degradation caused by ground contact. All defective or damaged materials shall be replaced with new materials.
- B. Plastic and rubber pipe materials, and pipe materials with tape or paint-type coatings, shall be covered during storage to prevent direct exposure to sunlight.
- C. All pipes, fittings, and appurtenances shall be installed in accordance with the requirements of the applicable Technical Specifications. Buried piping shall be installed in conformance with Section 02300 Earthwork.
- D. After assembly, all exposed pipe threads and joint surfaces at screwed flanges shall be cleaned of all oil and epoxy coated, to provide continuous corrosion protection and serve as a primer for subsequent pipe coatings. All pipe ends at mechanical couplings shall be abrasive blasted and epoxy-coated prior to assembly in accordance with Section 09960 High Performance Coatings.
- E. Where core drilling is required for pipes passing through existing concrete, core drilling locations shall be determined by radiographs of the concrete construction to avoid damage to embedded raceways and reinforcing steel.
- F. For metallic pipes or metallic pipe sleeves that pass through concrete walls, the pipes and sleeves shall be electrically isolated from the reinforcing steel, and shall not be touching the reinforcing steel or connected to it for support.
- G. Where required to prevent joint separation or movement due to internal pressure, piping shall be provided thrust blocks, restrained joints, or other approved joint restraints.
 - 1. If restrained joints are not indicated, thrust blocks shall be installed in accordance with the details on the Drawings. If thrust block details are not included on the Drawings, Contractor shall provide the thrust blocks using details in accordance with the pipe manufacturer's instructions.
 - 2. If restrained joints are indicated, they shall be the following types of joints. The joints shall be provided in accordance with the pipe material Technical Specifications.
 - a. Welded joints designed to resist the thrust loads
 - b. Threaded joints
 - c. Flanged joints
 - d. Soldered joints
 - e. Plastic pipe solvent-welded joints
 - f. Joints specially designed for thrust restraint such as some types of mechanical couplings, and locking-type bell and spigot restrained joints for ductile iron pipe.

- g. Where indicated, joints that have tie rod-type joint harness assemblies.

3.02 FIELD TESTING AND DISINFECTION

- A. Conduct pipeline testing in accordance with Section 02120 Pressure Pipeline Testing, and Section 02130 Non-Pressurized Pipeline Testing, as applicable.
- B. Disinfect potable water pipelines in accordance with Section 15154, Pressure Pipeline Testing and Disinfection, and Section 03315, Hydraulic Structure Testing, as applicable.

3.03 CORROSION PROTECTION

- A. Where indicated, buried piping shall be provided corrosion protection or monitoring systems in accordance with Section 02995, Piping Cathodic Protection.
- B. All buried metallic surfaces of piping, valves, couplings, and appurtenances shall be protected with coating systems as indicated in the appropriate pipe material Technical Specification.
- C. All buried pipe joints in metallic piping systems that are not welded or soldered shall be bonded for electrical continuity using details indicated. Joints indicated to be insulating or dielectric shall not be bonded.

3.04 PIPE IDENTIFICATION

- A. Plastic Tracer Tape
 - 1. Where plastic tracer tape is indicated, it shall be installed 2 feet above the crown of each pipe.
 - 2. For pipes with cover of 8 feet or greater, a second tape shall be buried 12 inches below finished grade directly above the pipe centerline.
- B. Magnetic Tracer Tape
 - 1. Where magnetic tracer tape is indicated, it shall be installed 2 feet above the crown of each pipe.
 - 2. For pipes with cover of 8 feet or greater, a second tape shall be buried 12 inches below finished grade directly above the pipe centerline.

C. Tracer Tape and Wires

1. Tracer tape shall be 12 inches wide, colored the same as the background colors specified for the project piping systems, or as acceptable to Engineer if colors have not been specified.
2. Printed on the tapes at 2 foot intervals shall be a caution statement plus words that identify the pipe fluid, such as "Raw Water", "Treated Water", "Sanitary Sewer", etc.
3. The material shall be an inert plastic material suitable for direct burial and capable of stretching to twice its original length. The tape shall be as manufactured by Allen Systems, W. H. Brady, or equal.
4. Magnetic tracer tape shall meet the requirements for plastic tracer tape, but shall be a 3-inch wide plastic tape in combination with an integral metallic tape.
5. Tracer wire shall be single strand No. 12, TW electrical wire, UL listed.
6. Where tracer wire is indicated, it shall be laid on the top of the pipe and taped at 10-foot intervals to the pipe. Wire shall be installed in continuous lengths with no splices except at valve operator boxes, fire hydrants, and other above-ground appurtenances.
7. At valve operator boxes, fire hydrants, and other appurtenances, tape shall be brought to the surface and terminated in the boxes by running up the box exterior, then terminating through a penetration in the box wall 2"-6" below the surface. At hydrants and appurtenances, tape shall be terminated above ground. At the ends of pipelines tape shall be brought to the ground surfaces and terminated in valve boxes as noted above.
8. During pipeline testing, continuity of all tracer wire, connections and splices shall be checked and repaired as necessary.

****END OF SECTION****

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SECTION 02605

PRECAST CONCRETE UTILITY STRUCTURES

PART 1 – GENERAL

1.01 SUMMARY

- A. This Section includes precast concrete manholes, utility vaults, and grease interceptors.

1.02 SUBMITTALS

- A. Prepare and submit in accordance with Section 01300.
- B. Product Data
 - 1. Manhole frames and covers.
 - 2. Rubber boot-type pipe connectors for connecting piping to manholes.
- C. Utility Structure Details:
 - 1. Manufacturer's standard shop drawings for each size and type of precast utility structure.
 - a. Provide dimensions of structure.
 - b. Identify location of each type of insert cast into the structure.
 - 2. Illustrate construction details related to joints between precast sections, method of connecting pipe to the structure, size and location of pipe penetrations, reinforcement details and concrete mix design.
- D. Structural Design
 - 1. Laboratory results verifying compressive strength of concrete mix design used in the manufacture of precast concrete utility structures.
 - 2. Calculations and related sketches prepared, stamped and signed by a civil or structural Professional Engineer licensed to practice in the State of California.

1.03 DESIGN REQUIREMENTS

- A. Concrete Mix Design for products covered by this Section
 - 1. Minimum Compressive Strength: 4,000 psi at 28 days.
 - 2. Cement: Type II low alkali Portland cement meeting requirements of ASTM C150.
 - 3. Fly Ash: Class C or Class F meeting requirements of ASTM C618, not to exceed 25% by weight.

4. Aggregates: Conform to requirements of ASTM C33.
- B. Manhole Risers, Conical Tapered Sections and Grade Rings
1. Comply with design requirements specified in ASTM C478.
- C. Manholes
1. Conform to ASTM C858.
 2. Base design and manufacture A-16 (HS 20-44) loading in accordance with ASTM 857.
- D. Utility Vaults
1. Base design and manufacture to A-16 (HS 20-44) loading with 30% impact in accordance with ASTM C 857.
 2. Traffic Loads
 - a. Utility Vaults in Roadways: H-20 structural load rating according to AASHTO HB 17.
 - b. Utility Vaults in Driveways, Parking Lots and other Off-Roadway Locations: H-10 structural load rating according to AASHTO HB 17.
 3. Earth Loads: Design for lateral earth pressure of 85 pounds per cubic foot and equivalent fluid pressure of 60 pounds per cubic foot applied at a depth of $\frac{1}{3} H$ below the ground surface where H is the height of the utility vault.
 4. Seismic Loads: Design in accordance with the requirements of Seismic Zone 4 per California Building Code.
 5. Buoyancy: Select wall and slab thicknesses to provide sufficient weight against buoyancy due to groundwater elevations.
 - a. Consider groundwater elevation at the ground surface.
 - b. Utilize a safety factor of 1.5.
 - c. Do not take credit for friction forces that may develop between the soil backfill and concrete walls of the utility vault.
 6. Access Hatch Loading Criteria
 - a. Access hatches subject to wheel loads from vehicular traffic: H-20 structural load rating according to AASHTO HB 17.
 - b. Access hatches not subject to wheel loads from vehicular traffic: 300 pounds per square foot with a deflection not to exceed $\frac{1}{150}$ of the span.
- E. Grease Interceptor
1. Base design and manufacture to H-20 structural load rating with earth loads 3.0' to 5.0' soil cover.

2. Earth Loads: Design for lateral earth pressure of 85 pounds per cubic foot and equivalent fluid pressure of 60 pounds per cubic foot applied at a depth of $\frac{1}{3} H$ below the ground surface where H is the height of the utility vault.
3. Seismic Loads: Design in accordance with the requirements of Seismic Zone 4 per California Building Code.
4. Buoyancy: Select wall and slab thicknesses to provide sufficient weight against buoyancy due to groundwater elevations.
 - a. Consider groundwater elevation at the ground surface.
 - b. Utilize a safety factor of 1.5.
 - c. Do not take credit for friction forces that may develop between the soil backfill and concrete walls of the utility vault.
5. Access Hatch Loading Criteria
 - a. Access hatches subject to wheel loads from vehicular traffic: H-20 structural load rating according to AASHTO HB 17.

1.04 COORDINATION

- A. Coordinate layout and installation of utility structures with the final arrangement of other utilities, site grading, and surface features as determined in the field.

PART 2 – PRODUCTS

2.01 PRECAST CONCRETE MANHOLES

- A. Manufacturers: One of the following or equal:
 1. Old Castle Precast.
 2. Jensen Precast.
- B. Conform to the requirements of ASTM C478.
- C. Construct precast reinforced concrete manholes in accordance with design, size, shape, form and details indicated on the Drawings and specified.
 1. Minimum Diameter: 48 inches.
- D. Conical Tapered Sections: Use eccentric type cones with same wall thickness and reinforcement as riser sections.
- E. Accessories
 1. Rubber Boot Pipe Connectors
 - a. Manufacturers: One of the following or equal:

- i. "Kor-N-Seal" flexible rubber boot with stainless steel accessories as manufactured by NPC, Inc.
 - ii. "Z-LOK XP" or "A-LOK" flexible connector as manufactured by A-LOK Products, Inc.
- 2. Joint Sealing Compound: Preformed cold-applied ready-to-use plastic joint sealing compound.
 - a. Manufacturers: One of the following or equal:
 - i. Quikset Utility Vaults, Quik-Seal.
 - ii. K. T. Snyder Company, Ram-Neck.
- 3. Manhole Frame and Cover Sets
 - a. Cast Iron: ASTM A 48, Class 30B.
 - b. Type, size:
 - i. Sampling Manhole: 36-inch diameter with 10-inch center port with cover, Neenah R-1900-E, or equal.
 - ii. Sewer and Force Main Manholes: 24-inch hinged Pamrex Cover as manufactured by Certainfeed, no equal.
 - c. Grind mating surfaces of cover and frame to ensure flat, true fit and even seating.

2.02 PRECAST CONCRETE UTILITY VAULTS

- A. Manufacturers: One of the following or equal:
 - 1. Old Castle Precast.
 - 2. Jensen Precast.
- B. Description
 - 1. Factory-fabricated, reinforced concrete vault with cover and accessories.
 - 2. Open or integral closed bottom as indicated on the Drawings or as scheduled.
 - 3. Monolithically poured walls and bottom, unless open-bottom vaults are indicated on the Drawings or scheduled.

2.03 GREASE INTERCEPTOR

- A. Manufacturers: One of the following or equal:
 - 1. Old Castle Precast.
 - 2. Jensen Precast.
- B. Description
 - 1. Capacity 2,000 gallons.
 - 2. Factory fabricated, reinforced concrete.
 - 3. Construct precast reinforced concrete great interceptor to be water tight.

C. Accessories

1. Rubber Boot Pipe Connectors
 - a. Manufacturers: One of the following or equal:
 - i. "Kor-N-Seal" flexible rubber boot with stainless steel accessories as manufactured by NPC, Inc.
 - ii. "Z-LOK XP" or "A-LOK" flexible connector as manufactured by A-LOK Products, Inc.
2. Joint Sealing Compound: Preformed cold-applied ready-to-use plastic joint sealing compound.
 - a. Manufacturers: One of the following or equal:
 - i. Quikset Utility Vaults, Quik-Seal.
 - ii. K. T. Snyder Company, Ram-Neck.
3. Manhole Frame and Cover Sets
 - a. Cast Iron: ASTM A 48, Class 30B.
 - b. Type, size:
 - i. Manway Cover: 24" diameter cast iron gaslated ring and cover.

- D. Use 24" diameter grade rings as specification drawings.

PART 3 – EXECUTION

3.01 MANUFACTURE

- A. Utilize a central batching facility to ensure accurate weighing and mixing of materials to consistently obtain a suitable concrete mix.
- B. Concrete Batching: Properly proportion sand, aggregate and cement with sufficient water to produce a concrete mix of uniform quality and slump.
- C. Concrete Compaction: Use either external or internal mechanical vibration during placement of the concrete mix within the forms.
- D. Curing: Steam cure concrete while still in the forms and after an initial set has taken place.
 1. Steam temperature: Not to exceed 160 degrees F, nor raised from normal ambient temperature at a rate exceeding 40 degrees F per hour.
 2. Terminate steam curing after sufficient time has elapsed to produce adequate strength to withstand any structural strain that may occur during the form stripping operation.
 3. Additional curing may be applied by means of water spraying or membrane curing compound to reach the ultimate strength requirements.
- E. Reinforcing Steel: Position within the forms as required for design loads. Tie reinforcing steel sufficiently to withstand displacement during the pouring operation.

3.02 INSTALLATION

A. Concrete Manholes

1. Manhole Bases: May be pre-cast or cast-in-place at Contractor's option. If cast-in-place base is used:
 - a. Form that portion of base above invert elevation of sewer pipe to provide smooth channel section as indicated on the Drawings.
 - b. Place base concrete as a monolith.
2. Manhole Invert: Construct with smooth transitions to provide an unobstructed flow path through the manhole. Remove sharp edges and rough sections.
 - a. When a full section of pipe is laid through the manhole, break out the top portion of the pipe. Cover the exposed edge of pipe with mortar and trowel smooth.
3. Manhole Sections
 - a. Set each manhole section plumb.
 - b. Use sections of various heights and adjustment rings in order to bring top of manhole ring and cover to required elevation.
4. Joints in Manhole Sections
 - a. Seal joints with joint sealing compound.
 - b. Clean joints with brush, prime and apply sealing compound in accordance with manufacturer's printed instructions.
 - c. Remove silicon treated protective paper from one side of preformed rope and lay preformed rope, paper side up, on cleaned joint surface. Press surface firmly end-to-end around entire joint, making minimum 1-inch laps where necessary. Remove protective paper from preformed rope and lower next section into place.
 - d. Seal joints watertight.

B. Manhole Frame and Cover Sets

1. Location and Grade
 - a. In Paved Areas: Set cover flush with pavement.
2. Setting Frames
 - a. Clean bearing surfaces and provide uniform contact.
 - b. Set manhole frames at required grade and securely attach to top of precast manhole shaft unit or on adjustment rings, using cement mortar.
3. Setting Covers: After frames are securely set in place, install covers and perform necessary cleaning and scraping of foreign materials from frames

and covers as required to assure proper fit. Replace frames and covers that create noise when passed over by traffic.

C. Utility Vaults

1. Comply with ASTM C 891.
2. When vaults are provided in sections, install vault sections level and plumb and with orientation and depth coordinated with connecting pipes.
3. Support vault on a level bed of aggregate base material, 6 inches deep and compacted to 95% of maximum density.
4. Seal joints with joint sealing compound. Clean joints and apply sealing compound in accordance with the manufacturer's requirements.
5. Finish Elevations of Utility Vaults
 - a. Paved Areas, Roadway Shoulders and Other Areas of Vehicular Traffic: Set structure so that cover is flush with finished pavement elevation.
 - b. Other Locations: Set utility vault so that cover is 4 inches above finished grade.

D. Grease Interceptor

1. Install grease interceptor on concrete slab as indicated on the Drawings.
2. Set grease interceptor plumb and level in accordance with manufacturer instructions.
3. Anchor slab to grease interceptor with stainless steel hardware and fasteners.
4. Use grade rings to bring manways to grade.
5. Joints in Manhole Sections
 - a. Seal joints with joint sealing compound.
 - b. Clean joints with brush, prime and apply sealing compound in accordance with manufacturer's printed instructions.
 - c. Remove silicon treated protective paper from one side of preformed rope and lay preformed rope, paper side up, on cleaned joint surface. Press surface firmly end-to-end around entire joint, making minimum 1-inch laps where necessary. Remove protective paper from preformed rope and lower next section into place.
 - d. Seal joints watertight.

3.03 PIPE CONNECTIONS

- A. Install connecting pipe at the required alignment and grade.

- B. Set connecting pipes through the full thickness of the structure wall, flush with the inner face of the wall.
- C. Use standard flexible pipe connector boots, specifically manufactured for the intended service, to connect pipe to the manhole. Grout pipe to the manhole so that the connection is watertight.

3.04 CLEANING

- A. Upon completion, clean each structure of all silt, debris, and foreign matter.

3.05 TESTING

- A. Test manholes for leakage.
- B. Test grease interceptor for leakage as per manufacturer instructions.

****END OF SECTION****

SECTION 02713
GEOTEXTILE FABRIC

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Geotextile fabric.

1.02 SUBMITTALS

- A. Product Data: Manufacturer's data on each type of fabric.
- B. Samples: Provide 12 inch by 12 inch sample of each type of geotextile.

1.03 FUNCTION

- A. Separation Barrier
 - 1. Install geotextile fabric between backfill as indicated on Drawings.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver, unload, and store geotextile fabric in manufacturer's wrapping with a minimum amount of handling.
- B. Protect geotextile rolls from excessive dust, rainfall, mud, ultraviolet exposure, and debris.
- C. Follow manufacturer's recommendations regarding storage.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. One of the following or equal:
 - 1. Propex
 - 2. Mirafi

2.02 MATERIALS

- A. Type 1 Geotextile Fabric: Non-woven polypropylene such as Mirafi 140N or equal manufactured for the functions previously described and with the material properties specified below.

Property	Test Method	Woven Geotextile Fabric
		Type 1
Unit Weight (oz/yd ²)	ASTM D-5261	4-8
Thickness (mils)	ASTM D 5199	40
Tensile Strength (lbs)	ASTM D 4632	120
Burst Strength (psi)	ASTM D 3786	225
Puncture Strength (lbs)	ASTM D 4833	65

PART 3 - EXECUTION

3.01 PREPARATION

- A. Subgrade and earthwork as specified in Section 02200.

3.02 PLACEMENT

- A. Handle geotextile fabric in a manner that will not damage fabric.
- B. When used in trenches for lagoon underdrains, place geotextile in the trench as shown on the Drawings to conform to the shape of the trench with no wrinkles or folds.
- C. On Sideslopes: Secure fabric in anchor trench, and then roll down the slope. Keep the sheet in continual tension to prevent folds and wrinkles.
 - 1. Weight unrolled geotextile fabric with sandbags or equivalent ballast. Do not utilize materials that may tear, puncture, or otherwise damage the geotextile fabric.

3.03 INSTALLATION

- A. Overlaps: 36 inches minimum
 - 1. Sew or heat-tack fabric at overlap or place fill so that overlap does not separate.
 - 2. Remove fill and reestablish overlap for any seams that separate
- B. Curves: Angle-pleated or cut into short pieces and laid down to overlap a minimum of 18 inches.
- C. Repairs
 - 1. Remove and replace geotextile sheets that cannot be satisfactorily repaired. Remove and replace geotextile fabric with tears greater than 10 percent of the width of the roll.

2. Patch any holes or tears with the same geotextile fabric. Patch shall be a minimum of 12 inches larger in all directions than the area to be repaired. Thermally spot bond patch in place.

****END OF SECTION****

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SECTION 03301
CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Requirements for cast-in-place concrete work.

1.02 SUBMITTALS

- A. Shop Drawings
 - 1. Reinforcing Steel: Prepare shop fabrication and field installation drawings in accordance with CRSI Manual of Standard Practice and ACI SP.
 - 2. Layout drawings for construction joints.
- B. Product Data: Waterstops, curing compound data.
- C. Concrete Mix Design: Data on the concrete mix, including aggregate gradations and admixtures, in accordance with ASTM C94.
- D. Quality Control Submittals
 - 1. Manufacturer's application instructions for curing compound.
 - 2. Ready-mix delivery tickets for each truck in accordance with ASTM C94.

1.03 QUALITY ASSURANCE

- A. Supplier Qualifications: A firm experienced in manufacturing ready-mixed concrete and that complies with ASTM C94 requirements for production facilities and equipment.
- B. Source Limitations: Use the same brand of cement from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- C. Concrete and Reinforcement: Unless otherwise specified, meet the requirements of ACI 301 and 318.
- D. Hot Weather Concreting: Conform to ACI 305R.

PART 2 – PRODUCTS

2.01 FORMWORK

- A. Exposed Areas: Use hard plastic finished plywood.
- B. Unexposed Areas: Use new ship lap or plywood.
- C. Earth cuts may be used for forming footings.

2.02 CONCRETE

- A. Ready-mixed meeting ASTM C94, Option A.
- B. Portland Cement: ASTM C150, Type II.
- C. Aggregates: Furnish from one source.
 - 1. Natural Aggregates
 - a. Free from deleterious coatings and substances in accordance with ASTM C33, except as modified herein.
 - b. Free of materials and aggregate types causing pop outs, discoloration, staining, or other defects on surface of concrete.
 - 2. Non-Potentially Reactive: In accordance with ASTM C33, Appendix XI, paragraph X1.1.
 - 3. Aggregate Soundness: Test for fine and coarse aggregates in accordance with ASTM C33 and ASTM C88 using sodium sulfate solution.
 - 4. Fine Aggregates
 - a. Clean, sharp, natural sand.
 - b. ASTM C33.
 - c. Materials Passing 200 Sieve: 4 percent maximum.
 - d. Limit deleterious substances in accordance with ASTM C33, Table 1 with material finer than 200 sieve limited to 3 percent, coal and lignite limited to 0.5 percent.
 - 5. Coarse Aggregate
 - a. Natural gravels, combination of gravels and crushed gravels, crushed stone, or combination of these materials containing no more than 15 percent flat or elongated particles (long dimension more than five times the short dimension).
 - b. Materials Passing 200 Sieve: 0.5 percent maximum.

D. Admixtures: Do not use admixtures that contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Air-Entraining: ASTM C260.
2. Water-Reducing: ASTM C494, Type A or D.
3. Superplasticizers: ASTM C494, Type F or G.
4. Fly Ash: ASTM C618, Class C or F.
5. Color Pigments: Inert mineral or metal oxide pigments, natural or synthetic; resistant to lime and other alkalies.

E. Concrete Mix Design

1. Minimum Compressive Field Strength: 4,000 psi at 28 days when cured and tested in accordance with ASTM C31 and C39.
2. Coarse Aggregate Size: 1½ inches and smaller.
3. Slump Range: 3 to 5 inches.
4. Air Entrainment: Between 3 and 6 percent by volume.
5. Water Reducers: Use in concrete without plasticizers.

F. Proportions

1. Design mix to meet aesthetic and structural concrete requirements.
2. Water-cement ratio (water-cement plus fly ash ratio) shall control amount of total water added to concrete as follows:

Coarse Aggregate Size	W/C Ratio
1½ inch	0.50
1 inch	0.45

3. Minimum Cement Content (Combined Cement Plus Fly Ash Content):
 - a. 517 pounds per cubic yard for concrete with 1½ inch maximum size aggregate.
 - b. 540 pounds per cubic yard for 1 inch maximum size aggregate.
4. Increase cement content (combined cement plus fly ash content), as required meeting strength requirements and water-cement ratio.
5. Fly Ash Content: minimum 20 percent, maximum 50 percent by weight of total cement content.

G. Mixing: Minimum 70 and maximum 270 revolutions of mixing drum. Non-agitating equipment is not allowed.

2.02 REINFORCING STEEL

- A. Deformed Bars: ASTM A615, Grade 60.
- B. Welded Wire Reinforcement: ASTM A185, fabricated from as-drawn steel wire into flat sheets.
- C. Bar Supports:
 - 1. For Slab Rebar: Concrete blocks or plastic bar supports.
 - 2. For Rebar in Walls, Beams, Columns, and Slabs Exposed to View: Galvanized steel chairs with plastic tips or plastic bar supports and side form spacers.

2.03 ANCILLARY MATERIALS

- A. Curing Compound
 - 1. Material: Solvent based containing chlorinated rubber solids in accordance with ASTM C309, with additional requirement that the moisture loss not exceed 0.030 gram per centimeter squared per 72 hours.
 - 2. Manufacturers and Products
 - a. Master Builders Co.; Masterkure CR
 - b. Euclid Chemical Co.; Euco Super Floor Coat
- B. Epoxy Bonding Agent and Adhesives (for Binding New Concrete to Existing Concrete)
 - 1. Epoxies: Two component material for use on dry or damp surfaces and conforming to the requirements of ASTM C881.
 - 2. Apply in accordance with manufacturer's recommendations.
 - 3. Manufacturers: One of the following or equal:
 - a. Sika Armatec 110 EPOCEM; Sika Chemical Corporation.
 - b. CCS Bonder Paste LWL; Chemco Systems.
- C. Waterstops
 - 1. General: Place hydrophilic and/or rubber dumbbell type or center bulb type waterstops at construction joints and other joints as specified and indicated on the Drawings.
 - 2. Hydrophilic Waterstops:
 - a. Use: For concrete repairs or when attaching new concrete to existing structures.

- b. Manufacturers: One of the following or equal:
 - 1) Greenstreak, Hydrotite CJ.
 - 2) Tremco, Parastop II.
 - c. Installation: As indicated on the Drawings and in accordance with manufacturer's instructions.
 - 3. Rubber Waterstops
 - a. Use: At new construction joints where indicated on the Drawings.
 - b. Material: PVC or rubber waterstops manufactured by one of the following, or equal:
 - 1) Greenstreak.
 - 2) Progress Unlimited.
 - 3) Williams Products.
 - c. Size:
 - 1) Construction and Contraction Joints. 6-inch flat dumbbell type.
 - 2) Expansion Joints: 9-inch wide dumbbell with hollow center bulb.
- D. Vapor Barrier
 - 1. Material: 15 mil, multilayer plastic, 0.01 minimum permeance rating.
 - 2. Manufacturers: One of the following or equal:
 - a. StegoWrap, Stego Industries.
 - b. Premoulded Membrane Vapor Seal with Plasmatic Corel, W. R. Meadows.

PART 3 – EXECUTION

3.01 FORMWORK

- A. Design, construct, erect, brace and maintain formwork in accordance with ACI 301.
- B. Form Ties
 - 1. Fixed conical or spherical type inserts that remain in contact with forming material and allow for dry packing of form tie holes.
 - 2. Space ties to withstand pressures and to limit deflection of forms to acceptable limits.
 - 3. Wire ties are not acceptable.

C. Construction

1. In accordance with ACI 347.
2. Make joints tight to prevent escape of mortar and to avoid formation of fins.
3. Brace as required to prevent distortion during concrete placement.
4. On exposed surfaces locate form ties in uniform pattern or as shown.
5. Construct so ties remain embedded in the wall with no metal within 1-inch of concrete surface when forms, inserts, and tie ends are removed.

D. Form Removal

1. Remove after concrete has attained 28 day strength, or approval is obtained in writing from Engineer.
2. Remove forms with care to prevent scarring and damaging the surface.

3.02 PLACING REINFORCING STEEL

A. Place reinforcing steel in accordance with CRSI Recommended Practice for Placing Reinforcing Bars.

B. Field bending or welding of reinforcing bars will not be allowed.

C. Bar Supports: Provide in sufficient quantity to prevent sagging and to support bars during concrete placement.

D. Splices and Laps

1. Top Bars: Horizontal bars placed such that 12 inches of fresh concrete is cast below in single placement.
2. Horizontal wall bars are considered top bars.
3. Bar lap splices shall conform to General Structural Notes on the Drawings.
4. Tie splices with 18-gauge annealed wire as specified in CRSI Standard.

3.03 PLACING CONCRETE

A. Place concrete in accordance with ACI 301.

B. Before placing concrete:

1. Check reinforcing steel for proper placement and correct discrepancies.
2. Remove excessive rust, mill scale, dirt, oil and other material from rebar that may adversely affect bonding to concrete.
3. Remove water from excavation and debris and foreign material from forms.

- C. Before depositing new concrete on existing concrete, clean surface using sandblast or other mechanical means to obtain a ¼ inch rough profile, and apply epoxy bonding agent in accordance with the manufacturer's instructions.
- D. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 2 feet deep. Place within 1½ hours after adding cement to mix.
- E. Placement Limitations: 8 feet maximum vertical drop to final placement, when not guided with chutes or other devices to prevent segregation due to impact with reinforcing.
- F. Hot Weather
 - 1. Prepare ingredients, mix, place, cure, and protect in accordance with ACI 305R.
 - 2. Maintain concrete temperature below 80 degrees F at time of placement, or furnish test data or provide other proof that admixtures and mix ingredients do not produce flash set plastic shrinkage, or cracking due to heat of hydration. Ingredients may be cooled before mixing to maintain fresh concrete temperatures at 80 degrees F or less.
 - 3. Make provisions for windbreaks, shading, fog spraying, sprinkling, ice, or wet cover, or other means to provide concrete with temperature specified.
 - 4. Maximum allowable temperature differential between reinforcing steel and concrete: Not greater than 20 degrees F at the time of concrete placement.

3.04 COMPACTION

- A. Vibrate concrete as follows:
 - 1. Apply approved vibrator at points spaced not farther apart than vibrator's effective radius.
 - 2. Apply close enough to forms to vibrate surface effectively but not damage form surfaces.
 - 3. Vibrate until concrete becomes uniformly plastic.
 - 4. Vibrator must penetrate fresh placed concrete and into previous layer of fresh concrete below.

3.05 CONSTRUCTION JOINTS

- A. Locate as shown or as approved.
- B. Maximum Spacing Between Construction Joints: 40 feet.

3.06 FINISHING FLOORS AND SLABS

- A. Unexposed Slabs: Screed to true surface, bull float with wood float, and wood trowel to seal surface and to provide a uniform surface.
- B. Exposed Slabs to Receive Grout: Screed to indicated elevation and leave without special finish.
- C. Exposed Floors and Slabs: Screed to true surface and use bull float to form a uniform surface with minor texture then apply final surface finish.
- D. Final Surface Finishes for Exposed Floors and Slabs: Apply final surface finish as scheduled.
 - 1. Top Slabs shall receive a Walkway finish: Apply to concrete surfaces that will be used for foot traffic such as walkways around basins and sidewalks. Apply steel trowel surface, then a light hairbroom finish to produce a profile that is parallel to the slab drainage.
- E. Tolerances: Exposed surfaces shall not vary from level or true plane more than $\frac{1}{4}$ inch in 10 feet when measured with a straightedge.

3.07 FINISHING AND PATCHING FORMED SURFACES

- A. Unexposed Surfaces: Provide rough-formed concrete texture as imparted by form-facing material, fill form tie holes with nonshrink grout and grind off projections, fins, and rough spots.
- B. Exposed Surfaces: Provide smooth-formed concrete texture as imparted by form-facing material, arranged in an orderly and systematic manner with a minimum number of seams. Fill form tie holes with nonshrink grout and grind off projections, fins, and rough spots. Where scheduled, apply rubbed surface as follows:
 - 1. Smooth Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive to produce a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 - 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes.
 - a. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces.
 - b. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout.
 - a. Mix one part Portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white
 - b. Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces.
 - c. Compress grout into voids by grinding the concrete surface in a swirling motion, then finish the surface with a cork float.:
- C. Patching Defective Areas: Patch *defective* areas and repair rough spots resulting from form release agent failure or other reasons to provide smooth uniform appearance.
 1. Cut out honeycombed and defective areas.
 2. Cut edges perpendicular to surface at least 1-inch deep. Do not feather edges. Soak area with water for 24 hours.
 3. Finish surfaces to match adjacent concrete.
 4. Keep patches damp for minimum 7 days or spray with curing compound to minimize shrinking.

3.07 PROTECTION AND CURING

- A. Protect fresh concrete from direct rays of sunlight, drying winds, and wash by rain.
- B. Keep concrete slabs continuously wet for a 7 day period. Intermittent wetting is not acceptable.
- C. Use curing compound only where approved by Engineer. Cure formed surfaces with curing compound applied in accordance with manufacturer's directions as soon as forms are removed and finishing is complete.
 1. Do not use curing compound on concrete surfaces that will be painted.
- D. Remove and replace concrete damaged by freezing.

3.08 FIELD QUALITY CONTROL

- A. Concrete Samples:
 1. Provide concrete for making composite samples for testing slump, air content, and for making cylinders for determination of compressive strength.
 2. Prepare samples in accordance with ASTM C172. Select trucks or batches of concrete on a random basis.
 3. Samples may be obtained at the discharge chute of the truck or at the point of discharge into forms.

- B. Sampling Frequency: One composite sample for each 100 cubic yards of structural concrete, or fraction thereof, of each concrete mixture placed in any one day.
- C. Evaluation will be in accordance with ACI 301, Chapter 17 and Specifications.
- D. Slump tests and concrete cylinders shall be made by the Contractor. Contractor shall handle cured test cylinders, transport to the testing laboratory and pay testing costs.
- E. Enforcement of Compressive Strength Requirements:
 - 1. Compressive strength of concrete will be considered acceptable if the following conditions are satisfied:
 - a. Averages of all sets of 3 consecutive strength test results are greater or equal to the specified compressive strength.
 - b. No individual strength test (average of 2 cylinders) falls below specified compressive strength by more than 500 pounds per square inch.
 - 2. Whenever one, or both, of 2 conditions stated above is not satisfied, provide additional curing of affected portion of structure, then obtain test cores from the affected area.
 - a. Obtain 3 test cores in accordance with ASTM C 42 and ACI 318.
 - b. Concrete will be considered acceptable if the average compressive strength of the 3 test cores is equal to at least 90 percent of the specified 28-day compressive strength and no single core is less than 80 percent of the specified 28-day compressive strength.
 - c. Concrete will be designated as defective when the specified conditions are not achieved.
 - d. Fill core holes with concrete.
 - 3. Engineer may require the Contractor to strengthen defective concrete by means of additional concrete, additional reinforcing steel, or replacement of defective concrete, all of the Contractor's expense.

****END OF SECTION****

SECTION 03600

GROUT

PART 1 – GENERAL

1.01 SUMMARY

- A. Contractor shall furnish, install, cure, repair, finish, and perform all other work as required to produce finished grout.

1.02 REFERENCED DOCUMENTS

- A. The following documents are referenced in this section.

Reference	Title
ASTM C109	Compressive Strength of Hydraulic Cement Mortars
ASTM C230	Flow Tables for Use in Tests of Hydraulic Cement
ASTM C404	Aggregates for Masonry Grout
ASTM C531	Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfaces, and Polymer Concretes
ASTM C579	Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing and Polymer Concretes
ASTM C882	Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear
ASTM C1107	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1181	Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts
ASTM E96	Moisture Vapor Transmission of Materials

1.03 SUBMITTALS

- A. Contractor shall make the following submittals.
1. Manufacturer's literature certifying compliance with the specified properties for Class I, II, and III grouts.
 2. Certified testing lab reports for ASTM C 1107, Grade C (as revised herein) requirements for Class I and II grouts tested at a fluid consistency for temperatures of 45, 73.4, and 90 degrees F with a pot life of 30 minutes at fluid consistency.

3. A twenty-four hour grout evaluation of Class I grout performed by an independent testing laboratory and dated within the last 18 months.
4. Test results and manufacturer's service report from the demonstration and training session verifying the compressive strength and summarizing the activities covered in the pre-installation demonstration and training session for each grout.
5. Certifications that all grout used on the project are free of chlorides or other chemicals that may cause corrosion.
6. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of grout used in the Work.
7. The name and phone number of the grout manufacturer's representative, who will give jobsite service, demonstrations, and training. The representative shall have at least one year of experience with the chosen grouts.
8. Manufacturer's certification of installation, including all job service reports, certifying the grouts used on the job were used in accordance with manufacturer's recommendations.

1.04 QUALITY ASSURANCE

A. Field Tests

1. Compression test specimens will be taken during construction from the first placement of each type of grout, and at intervals thereafter as selected by Engineer to insure continued compliance with these specifications. The specimens will be made by Engineer or its representative.
2. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by Engineer. A set of three specimens will be made for testing at 7 days, 28 days, and each additional time period as appropriate.
3. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C 579, Method B, at intervals during construction as selected by Engineer. A set of three specimens will be made for testing at 7 days, and each earlier time period as appropriate.
4. All grout which fails to meet the requirements of these Specifications is subject to removal and replacement at the cost of Contractor.
5. The cost of all laboratory tests on grout will be borne by Owner, but Contractor shall assist Engineer in obtaining specimens for testing. However, Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the specifications. Contractor shall supply all materials necessary for fabricating the test specimens.

B. Pre-installation Demonstration and Training

1. The grout manufacturer shall give a demonstration and training session for Class I, II, and III grouts to be used on the Project, before any installation of grout is started.
2. Contractor shall have the employees who will be doing the actual work participate in this training and demonstration session. The manufacturer shall train Contractor's employees in how to perform the work and cure the grout.
3. Test specimens (6 cubes total) shall be made for compression testing at 1, 3, and 28 days for each class of grout to be used.
4. The training session shall use a minimum of one bag of Class I grout mixed to fluid consistency. Tests shall be conducted for flow cone and bleed tests. The remaining grout shall be mixed, placed, and curing initiated, on actual project placements such as baseplates and tie holes to provide on-the-job training for Contractor.
5. The manufacturer shall mix enough Class II and III grout for a minimum of one base plate and a set of 6 test specimens.
6. If the project includes placement in formwork throughbolt holes and blockouts, the manufacturer shall also train Contractor's employees in mixing and curing of each of these applications.
7. Contractor shall transport the test cubes to an independent test laboratory, obtain the test reports, and report these demonstration and training test cube strengths to Engineer.

PART 2 – PRODUCTS

2.01 APPLICATION

- A. Unless indicated otherwise, grouts shall be provided as listed below whether called for on the Drawings or not.

<u>Application</u>	<u>Type of Grout</u>
Reinforcing steel set in grout	Non-Shrink Class III
Beam and column (1 or 2 story) base plates less than 16 inches in the smallest dimension	Non-Shrink Class II
Column base plates (greater than 2 story or larger than 16 inches in the least dimension)	Non-Shrink Class I
Storage tanks, bins, hoppers, and other non-driven equipment	Per Section 11050, Equipment Baseplates, Supports, and Foundations
Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.	Non-Shrink Class II (Class I where placement time exceeds 10 minutes)

Under precast concrete elements	Non-Shrink Class I
Toppings and concrete fill less than 4 inches thick	Topping grout
Toppings and concrete fill greater than 4 inches thick	Structural concrete
Any application not listed above, where grout is called for on the Drawings	Non-Shrink Class I, unless noted otherwise

2.02 PREPACKAGED NON-SHRINK GROUTS

A. Classes I and II Non-Shrink Grouts

1. All non-shrink grouts shall be a prepackaged, preblended, inorganic, flowable, non-gas-liberating, non-metallic, portland cement-based grout requiring only the addition of water. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout specified herein shall be that recommended by the manufacturer for the particular application.
2. Class I Non-Shrink Grout
 - a. Class I non-shrink grouts shall have a minimum 28 day compressive strength of 7000 psi.
 - b. The grout shall meet the requirements of Corps of Engineers Standard CRD-C621 and ASTM C 1107 Grade C or Grade B (as modified below) when tested using the amount of water needed to achieve the following properties.
 - i. Fluid consistency (20 to 30 seconds) per CRD-C611
 - ii. At temperatures of 45, 73.4, and 95 degrees F.
 - c. The length change from placement to time of final set shall not be a shrinkage amount greater than the amount of expansion measured at 3 or 14 days. The expansion at 3 or 14 days shall not exceed the 28-day expansion.
 - d. The non-shrink property shall not be based on a chemically generated gas or gypsum expansion.
 - e. Fluid grout shall pass through the flow cone, with a continuous flow, 1 hour after mixing.
3. Class II Non-Shrink Grout
 - a. Class II non-Shrink grouts shall have a minimum 28-day compressive strength of 7000 psi.
 - b. The grout shall meet the requirements of ASTM C1107 and the following requirement when tested using the amount of water needed to achieve the following properties.

- i. Flowable consistency (140 percent flow on ASTM C 230, five drops in 30 seconds.)
- ii. Flowable for 15 minutes.
- iii. Fluid working time of at least 30 minutes.
- c. The grout when tested shall not bleed at maximum allowed water content.
- d. The non-shrink property shall not be based on a chemically generated gas or gypsum expansion.

B. Class III Non-Shrink Epoxy Grout

- 1. Epoxy grout shall be a pourable, non-shrink, 100 percent solids system. The epoxy grout system shall have three components; resin, hardener, and specially blended aggregate, all premeasured and prepackaged. The resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents shall not be used. Component ratios shall not be varied unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged. Epoxy grout shall be Five Star Epoxy Grout by Five Star Products, Inc., Ceilcote 648 by Master Builders, or equal.
- 2. The vertical volume change at all times before hardening shall be between 0.0 percent shrinkage and 4.0 percent expansion when measured according to ASTM C 827 (modified for epoxy grouts by using an indicator ball with a specific gravity between 0.9 and 1.1). Alternatively, grouts which maintain an effective bearing area of at least 95 percent are acceptable
- 3. The length change after hardening shall be negligible (less than 0.0006 in/in) and the coefficient of thermal expansion shall be less than 0.00003 in/in/F when tested according to ASTM C 531.
- 4. The compressive creep at one year shall be negligible (less than .001 in/in) when tested under a 400 psi constant load at 140 degrees F according to ASTM C 1181.
- 5. The 7-day compressive strength shall be a minimum of 14,000 psi when tested according to ASTM C 579.
- 6. The grout shall be capable of maintaining at least a flowable consistency for a minimum of 30 minutes at 70 degrees F.
- 7. The shear bond strength to portland cement concrete shall be greater than the shear strength of the concrete when tested according to ASTM C 882.

2.03 TOPPING AND FILL GROUT

- A. Grout for topping of slabs and fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and mixed as specified herein. All materials and

procedures specified for normal concrete in Section 03300, Cast-In-Place Concrete, shall apply except as noted otherwise herein.

- B. Topping and fill grout shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water cement ratio of 0.45. Where concrete fill is thicker than 3 inches, structural concrete, as specified in Section 03300, may be used when accepted by Engineer.
- C. Coarse aggregate shall be graded as follows.

<u>Sieve Size</u>	<u>Percentage Passing</u>
1/2-inch	100
3/8-inch	90-100
No. 4	20-55
No. 8	5-30
No. 16	1-10
No. 30	0

- D. Final mix design shall be as determined by trial mix design under supervision of the approved testing laboratory.
- E. Minimum compressive strength of topping and fill grout at the end of 28 days shall be 4,000 psi.

2.04 CURING MATERIALS

- A. Curing materials shall be as specified in Section 03300 for topping and fill grouts and as recommended by the manufacturer of prepackaged grouts.

2.05 CONSISTENCY

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow.
- B. The slump for topping grout and concrete fill shall be adjusted to match placement and finishing conditions but shall not exceed 4 inches.

PART 3 – EXECUTION

3.01 GENERAL

- A. The manufacturers of prepackaged non-shrink grouts shall provide on-site technical assistance upon request.
- B. Base concrete or masonry must have attained its design strength before grout is placed, unless authorized by Engineer.

- C. When cementitious grouts are used on concrete surfaces, the concrete surface shall be saturated with water for 24 hours prior to placement of the grout. Upon completion of saturation period excess water shall be removed prior to grouting with clean (oil free) compressed air. Concrete substrate shall not be wet prior to placement of epoxy grout.

3.02 GROUTING PROCEDURES

- A. All mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer. Grouts shall be machine-mixed in a mortar mixer.
- B. Baseplate grouting for equipment shall be in accordance with Section 11050, Equipment Supports and Foundations.
- C. Grouting for Non- Equipment Baseplates
 - 1. For base plates, the original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a one-inch thickness of grout or a thickness as shown on the Drawings.
 - 2. All surfaces that will be in contact with grout shall be free of grease, oil, dirt, loose rust, curing compounds, laitance, loose concrete and other deleterious materials.
 - 3. The base plate shall be set in position at the proper elevation by steel wedges or double nuts on the anchor bolts. Where the plate size or configuration dictates, air relief holes shall be drilled in the base plate to minimize the potential for trapped air. Liquid tight forms shall then be placed around the baseplate with pouring clearance provided on one side and 45 degrees slopes formed on the other sides. Forms shall be coated as recommended by the grout manufacturer for easy form release. The grout shall be placed in a flowable or fluid consistency from one side only allowing the grout to flow to the opposite side and completely fill the space up to the bottom of the base plate. Techniques and procedures shall follow those presented in the pre-installation demonstration.
 - 4. Column and beam base plates, grouted with Class II grout, which are less than 200 square inches in area, may be grouted by the dry pack method. The grout shall be of a trowel able consistency and tamped or ridded solidly into the space between the plate and the base concrete.
 - 5. Cementitious grouts shall be trimmed to form a uniform 45 degrees smooth fillet from the bottom edge of the base plate on each side prior to final set.
- D. Topping and Fill Grout
 - 1. All mechanical, electrical, and finish work shall be completed prior to placement of topping or fill grout. The base slab shall be given a roughened textured surface by sandblasting or hydroblasting to expose the aggregates

and produce a 3/16-inch amplitude roughness. Jackhammers or chipping hammers shall not be used.

2. The minimum thicknesses shall be one inch for topping grout and 1-1/2 inches for fill grout. Where the finished surface of grout is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2-inches wide by 1-1/2-inches deep so as to maintain a minimum thickness of 1-1/2-inches.
3. The base slab shall be thoroughly cleaned and wetted to a saturated surface dry condition, prior to placing topping and fill. No grout shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of Type II cement slurry shall be broomed into the surface of the slab just before topping or fill placement. The cement slurry shall not be allowed to dry before topping placement. If it does dry, it must be immediately removed using wet stiff brooms and reapplied. The topping and fill grouts shall be compacted by rolling or tamping, brought to established grade, and floated. Fill grouts for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade. Coat surface with evaporation retardant to prevent plastic shrinkage cracks.
4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.
5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping and fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement or mixture of dry cement and sand shall be applied to the surface.
6. As soon as topping or fill finishing is completed, coat surface with curing compound. After the topping is set and sufficiently hard in clarifiers and where required by Engineer, the tank shall be filled with sufficient water to cover the entire floor for 14 days.

3.03 CONSOLIDATION

- A. Grout shall be placed in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.
- B. Following the curing period, conduct a soundness test in the presence of Engineer, by tapping a hammer against all grout surfaces to detect areas with weak adhesion to the base slab. Areas found to have weak adhesion or voids between the grout and base slab shall have the defective grout chipped out, removed, and replaced to obtain grout with strong adhesion and no voids.

****END OF SECTION****

SECTION 05501

ANCHOR BOLTS

PART 1 – GENERAL

1.01 SUMMARY

- A. Contractor shall select, furnish, and install anchor bolts in accordance with the Contract Documents.

1.02 REFERENCED DOCUMENTS

- A. The following documents are referenced in this section.

Reference	Title
ANSI B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ANSI B18.2.2	Square and Hex Nuts (Inch Series)
ASTM A 36	Carbon Structural Steel
ASTM A 307	Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
ASTM A 320	Alloy-Steel Bolting Materials for Low-Temperature Service

1.03 CONTRACTOR SUBMITTALS

- A. Provide submittals in accordance with 01300, "Submittals" of these Specifications.
- B. Submittals shall include product data for all materials, ICBO testing reports, and installation instructions from manufacturers.
- C. For cast in place anchor bolts, submittals shall include Shop Drawings for each set of anchor bolts, complete with material designations, dimensions, and details for sleeves.
- D. For anchor bolts installed into core drilled cavities for retrofit or modification installations, submit details of the proposed anchor bolts, sleeves, and other items.

1.04 QUALITY ASSURANCE

- A. For applications that require special inspection in accordance with the Technical Specifications or applicable building codes, Contractor shall coordinate the inspection activities to ensure that the special inspector is present for the required operations. Contractor shall provide at least 7 days prior written notice to Engineer and the special inspector for operations that require special inspection.

- B. During special inspection, Contractor shall provide access, lighting, safety equipment, and scaffolding, as necessary for the inspections. If scaffolding is required for the inspections, Contractor shall provide workers to move and relocate the scaffolding as required to provide access to all areas for inspection purposes.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Contractor shall provide anchor bolts using design data provided in accordance with the requirements in Section 11000, Equipment General Requirements, the requirements in the Technical Specifications, and as indicated on the Drawings.
- B. Anchor Bolt Type Requirements
 - 1. Anchor bolts for the following service shall be cast in place with concrete foundations, slabs, walls, or other structure components.
 - a. Engine-driven equipment.
 - b. Pumps, blowers, and mechanical equipment.
 - c. Anchor bolts that are embedded in structural elements other than foundations, slabs, and walls. Such locations include, but are not limited to, pedestals, beams, columns, and other similar structural elements.
 - d. Locations where anchor bolts are likely to have service temperatures greater than 120 degrees F, where equipment or structural systems are required to resist heat from normal or abnormal operation, where the supported items are components of a fire protection system, or where the supported items are required to function during potential fire conditions.
 - e. Locations where anchor bolts are inside chemical containment areas.
 - f. Locations where anchor bolts are exposed to splash, spillage, and vapors from chemicals.
 - g. Locations where anchor bolts can be exposed to grease, oil, fuel, solvents, or other chemicals.
 - h. Locations indicated in the Contract Documents.
 - 2. Cast In Place Anchor Bolt Details
 - a. Provide a steel pipe sleeve with an inside diameter at least 2 inches greater than the bolt diameter. The sleeve shall be at least 6 inches long for anchor bolts up to size 1 3/8-inch and at least 12 inches long for greater sizes.
 - b. At the bottom of the sleeve weld a square plate of minimum thickness 1/4 inch. The anchor bolt shall be inserted through a drilled, concentric hole in the plate and welded to the plate.

- c. The embedment anchor bolt length shall be at least 10 inches for sizes up to 7/8 inch size, 18 inches for sizes up to 1 3/8 inches, and 24 inches for greater sizes.
 - d. Fill the cavity between the anchor bolt and sleeve with a polyurethane filler material foamed into place. Apply tape or putty to the anchor bolt threads to prevent bond with the baseplate grout.
 - e. Cast anchor bolts into the structural slabs or members to provide the total embedment lengths required for each application.
 - f. On retrofit or modification installations, core drill a cavity for the anchor bolt and sleeve assembly and grout the assembly into the base slab using Class III non-shrink grout per Section 03600, Grout. Submit details of grouted anchor bolts for review by Engineer.
 - g. For cast in place anchor bolts, the bolts shall be threaded only on the top ends, as necessary for the installation. Rod threaded for its entire length shall not be used.
- 3. Adhesive anchor bolts may be used for any service or location not indicated as required for cast in place anchor bolts in the above list.
 - 4. Expansion anchor bolts may be used for support of heating, cooling, and other air ducts; support for piping of size 8-inch and less; support for electrical conduit and cable trays; and support for equipment that weighs less than 400 pounds.
 - 5. Where indicated to be a specific type in the Technical Specifications or Drawings, those specific types shall be provided.
 - 6. The minimum anchor bolt sizes shall be 5/8-inch for equipment, 1/2-inch for pipe supports, and 3/8-inch for light duty applications such as conduit supports and small channel supports for small piping.

2.02 MATERIALS

A. Materials for anchor bolts shall be in accordance with the following requirements.

- 1. Anchor bolts for this Project shall be stainless steel in accordance with ASTM A 320, Type 316.

B. Bolt Requirements

- 1. The nuts shall be capable of developing the full strength of the bolts. All bolts and cap screws shall have hexagon heads.
- 2. Bolts shall be ANSI B18.2.1 hexagon bolts with ANSI B18.2.2 heavy hexagon nuts.
- 3. The length of all bolts shall be such that after joints are made up, each bolt shall extend through the entire nut, but in no case more than 1/2-inch beyond the nut.

C. Adhesive Anchors

1. Epoxy adhesive systems shall be ITW Ramset/Redhead Epcon System or Masterbuilders Concrecive Epoxy Cartridge Dispensing System and Concrecive Paste LPL.
 2. For adhesive anchor bolts, the anchor bolt rods shall be threaded for their entire length.
- D. Expanding-Type Anchors
1. Expanding-type anchors shall be steel wedge-type ITW Ramset/Redhead anchors, McCulloch Industries Kwick-Bolt, or equal. Lead caulking anchors or other types of non-structural anchors shall not be used.

PART 3 – EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

- A. Install anchor bolts in accordance with the manufacturer's printed instructions. In addition, review the applicable ICBO reports to determine if there are any limitations associated with installation procedures.
- B. Use equipment Shop Drawings to determine anchor bolt layout dimensions. Install anchor bolts using accurate templates. At least 16 hours in advance of concrete placement, notify Engineer to obtain observation of the anchor bolt layout checking procedure by Contractor. Any required corrections to anchor bolt locations shall be made before the end of the day in advance of concrete placement.
- C. Support anchor bolts firmly in the correct positions and check bolt positions as concrete is placed and finished.
- D. For adhesive anchor bolts, install the bolts in holes drilled using percussion drilling equipment to produce holes with roughened surfaces.

****END OF SECTION****