# TECHNICAL SPECIFICATIONS

## Castroville Pipeline
## for the
## Monterey Peninsula Water Supply Project

## MONTEREY COUNTY, CALIFORNIA

California American Water
511 Forest Lodge Road, Suite 100
Pacific Grove, CA 93950

CALIFORNIA
AMERICAN WATER

**Prepared by** AECOM **August 2018**

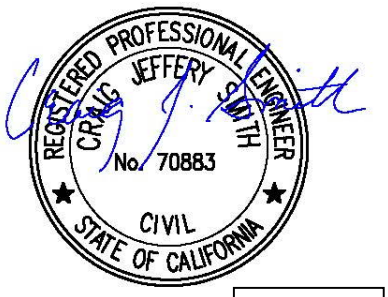
**TECHNICAL SPECIFICATIONS**
**CERTIFICATIONS**

The various portions of the Technical Specifications for the Castroville Pipeline for the Monterey Peninsula Water Supply Project have been prepared under the direction of the following design professionals, licensed in the State of California.

As to PROJECT MANAGER, CIVIL ENGINEER by AECOM and responsible for the following specifications:

Craig J. Smith, PE
AECOM

Division 1: All
Division 2: All
Division 3: All
Division 5: All
Division 9: All
Division 10: All
Division 13: All
Division 15: All
Division 16: All




8/17/18

As to CIVIL ENGINEER by AECOM and responsible for the following specifications:

Jenn Hyman, PE
AECOM

Division 1: All
Division 2: All except 02340, 02413, 02445
Division 3: All
Division 5: All
Division 9: All
Division 10: All

Division 13: 13110
Division 15: All

8/17/18

As to TUNNELING ENGINEER by AECOM and responsible for the following specifications:

Seung Han Kim, PE
AECOM

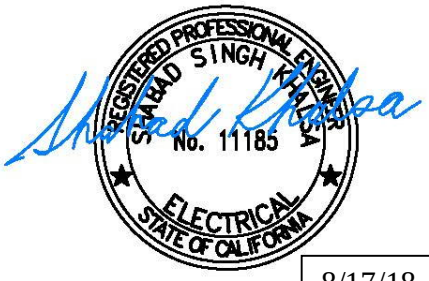
Division 2: 02340, 02413 and 02445

8/17/18

As to ELECTRICAL ENGINEER by AECOM and responsible for the following specifications:

Shabad Khalsa, PE
AECOM

Division 13: All except 13110
Division 16: All

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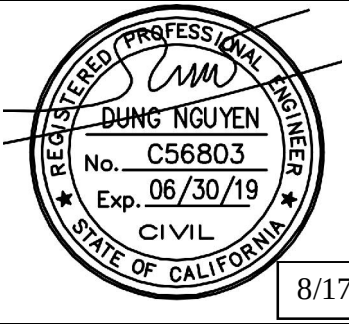
As to STRUCTURAL ENGINEER by AECOM and responsible for the following specifications:

Dzung Nguyen, PE
AECOM

Division 5: All

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**TECHNICAL SPECIFICATIONS**
**TABLE OF CONTENTS**


| Section No. | Title |
|---|---|
| **DIVISION 01 – GENERAL REQUIREMENTS** | |
| 01010 | Summary of Work |
| 01025 | Measurement and Payment |
| 01050 | Field Engineering |
| 01060 | Regulatory Requirements |
| 01062 | Environmental Requirements |
| 01090 | Reference Standards |
| 01150 | Water Treatment and Disposal |
| 01300 | Contractor Submittals |
| 01301 | Schedule of Values |
| 01311 | Construction Schedule |
| 01313 | Construction Schedule Constraints |
| 01400 | Quality Control |
| 01505 | Mobilization |
| 01510 | Temporary Utilities |
| 01520 | Security |
| 01530 | Protection of Existing Facilities |
| 01532 | Site Condition Surveys |
| 01550 | Site Access and Storage |
| 01561 | SPP, Erosion and Sediment Controls |
| 01570 | Traffic Control |
| 01580 | Project Signs |
| 01590 | Field Offices |
| 01600 | Products, Materials, Equipment, and Substitutions |
| 01601 | Seismic Design Criteria |
| 01640 | Demolition and Reconstruction |
| 01656 | Pressure Pipeline Testing and Disinfection |
| 01660 | Equipment Testing and Plant Startup |
| 01700 | Project Closeout |
| 01720 | Record Drawings |
| 01730 | Operation and Maintenance Data |
| **DIVISION 02 – SITEWORK** | |
| 02052 | Site Preparation Clearing Grubbing and Stripping |
| 02111 | Disposal of Excavated Materials |
| 02140 | Dewatering |
| 02160 | Excavation Support Systems |
| 02200 | Earthwork |
| 02231 | Aggregate Base and Subbase |
| 02270 | Erosion and Sediment Control |
| 02274 | Geotextiles |
| 02340 | Boring and Jacking |
| 02413 | Horizontal Directional Drilling |

02445 Geotechnical Instrumentation and Monitoring
02460 Asphalt Concrete Paving
02490 Precast Concrete Vaults
02565 Ductile Iron Pipe
02570 Steel Pipe, Mortar Lined and Mortar Coated
02597 Poly Vinyl Chloride Pressure Pipe, Rubber Joints
02600 Fusible PVC Pipe
02830 Chain Link Fencing
02890 Traffic Signs and Markers
02930 Seeding

**DIVISION 03 – CONCRETE**

03100 Concrete Formwork
03200 Concrete Reinforcement
03300 Cast-in-Place Concrete
03350 Concrete Finishing
03410 Structural Precast Concrete
03600 Grout

**DIVISION 05 – METALS**

05051 Anchor Bolts and Adhesive Anchors
05500 Miscellaneous Metalwork
05550 Miscellaneous Drainage Facilities

**DIVISION 09 – FINISHES**

09900 Paints and Coatings

**DIVISION 10 – SPECIALITIES**

10425 Signs
10430 Existing Structures

**DIVISION 13 – SPECIAL CONSTRUCTION**

13110 Cathodic Protection
13300 Instrumentation and Control General
13330 Field Instrumentation
13340 Control Panels
13350 Programmable Controls Systems
13370 Application Programming

**DIVISION 15 – MECHANICAL**

15000 Piping, General
15005 Piping Identification
15006 Pipe Supports
15007 Copper Pipe and Fittings
15200 Valves and Seismic Joints

15201 Valve and Gate Actuators

**DIVISION 16 – ELECTRICAL**

16010 Electrical General
16110 Conduit Raceways
16120 Wire and Termination

**APPENDICES**

APPENDIX A – Permits (Most Permits are Pending)
APPENDIX B – Survey and Benchmark Information
APPENDIX C – CAW Standard Drawings
APPENDIX D – AREMA Pipeline Specifications for TAMC ROW
APPENDIX E – Traffic Control Plans
APPENDIX F – Standard Trench Paving Specifications for Monterey County
APPENDIX G – Easements (Pending)
APPENDIX H – Maps of Preliminary Biological Surveys Performed by AECOM
APPENDIX I – Aerially Deposited Lead Memorandum for Caltrans Compliance
APPENDIX J – American Water Safety Requirements
APPENDIX K – American Water Electrical Requirements
APPENDIX L – Monte Rd. Bridge Drawings
APPENDIX M – Control Strategy Memo
APPENDIX N – TAMC Lease Agreements

**TECHNICAL SPECIFICATION**
**DIVISION 1: GENERAL REQUIREMENTS**
**SECTION 01010: SUMMARY OF WORK**

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## PART 1 GENERAL

### 1.01 INVESTIGATION PRIOR TO BIDDING

A. The CONTRACTOR shall be familiar with the Contract Documents for the Castroville Pipeline which includes Drawings, Specifications, and Reference Reports.

1. Pipeline Drawings
2. Pipeline Details
3. Specifications
4. Standard General Conditions
5. Technical Specifications (Divisions 1 – 16)
6. Specification Appendices
7. Reference Reports by AECOM
    a. Geotechnical Assessment Report
    b. Geotechnical Investigation Report
    c. Environmental Data Report
    d. Environmental Investigation Report

B. The Contract Documents are available on the project website: http://www.mpwsp.org/procurement-opportunities.

### 1.02 WORKSITE

A. This project is for a new potable water pipeline that connects the Transfer Pipeline transmission main from the California American Water (CAW) desalination plant to the Castroville Community Services District (CCSD) potable water system at their well #3.

B. The project site is a linear pipeline alignment, approximately 19,000 linear feet (3.6 miles) long, in unincorporated Monterey County. There is also some valving and instrumentation at several locations along the pipeline. The pipeline is to be installed primarily in Transportation Agency of Monterey County (TAMC) right-of-way (ROW), except for a limited portion around and under the Monte Road Bridge where the pipeline crosses over the Salinas River that will be in the Monterey County ROW. A thorough site visit and inspection of the alignment should be performed by all bidders.

C. The pipeline is generally located within road or rail right-of-ways. The Limits of Work for the project are described by Temporary Construction Easements provided by each community/agency and are typically the full-width of the right-of-way. However, each community/agency will set restrictions on the use of the right-of-way. The CONTRACTOR shall confirm the limits of work with each community and acquire the necessary permits to conduct the work prior to mobilization. All worksites shall be returned to existing conditions or better upon demobilization.

D. At this time CAW is in the process of acquiring easements from TAMC. There are no easement agreements with private property owners. The CONTRACTOR shall stay off property that is not a public or TAMC ROW. Adjacent growers lease a portion of the TAMC ROW over the pipeline for planting crops. A copy of this lease is provided in an appendix. To the extent possible, CONTRACTOR and CAW will endeavor to work with these growers to schedule the pipeline installation to minimize interference with their operations.

E. There are several special construction areas of the pipeline as shown in project plans and in the table below.

| Special Construction Approach | Site Name | Pipeline Location | Approx. Distance | Diameter |
|---|---|---|---|---|
| Jack and Bore | Crossing under Railroad in TAMC ROW | Dole Driveway | 140 feet | 12-inch Ductile Iron Pipe in 24-inch Casing |
| Cased Pipe, Night Work | Crossing Caltrans ROW | Merritt St/Hwy 183 at Del Monte Avenue | 155 feet | 8-inch Ductile Iron Pipe in 20-inch Casing |
| Pipe Hanging Under Bridge | Crossing Salinas River | Monte Road Bridge | 830 feet | 12-inch Pipe |
| Horizontal Directional Drilling (HDD) | Crossing Under Tembladero Slough | TAMC ROW | 500 feet | 8-inch Pipe |

## 1.03 SCOPE OF WORK

A. The Work to be done under this Contract includes all work as shown in the Contract Documents, as further divided into bid items described in Section 01025 – Measurement and Payment, and generally including the following:

1. Mobilization and demobilization to perform required Work.

2. Environmental protection and restoration measures as specified and required by the projects permits (note that the ENGINEER is still in the process of acquiring the environmental permits on behalf of CAW).

3. Construction support facilities as needed at each work site, including items such as access roads, storage and laydown areas, temporary site fencing, access control and

security provisions, worker's facilities, shops, warehousing, worker parking, offices, water treatment and disposal facilities.

4. Potholing of existing utilities.

5. Construction of the pipeline and appurtenances, pressure testing, disinfection, and startup.

6. Construction of mechanical and instrumentation equipment including flow meters, pressure regulators and release devices, vaults and concrete pads, plus startup and testing of associated power and telemetry systems.

7. Protection and monitoring of existing pipelines and other facilities during construction activities.

8. Handling, transport, disposal of surplus excavated materials encountered during construction of the facilities, with some native topsoil materials segregated and replaced.

9. Construction of new facilities required by PG&E for the new electrical service.

10. Treatment and discharge of encountered groundwater and construction water, if required.

11. Site backfill, finish grading, paving, reseeding and site restoration to restore existing conditions.

12. Coordination with CAW and CCSD to maintain delivery of water through existing facilities and minimize service interruptions.

13. Coordination with other MPWSP projects.

14. Coordination with Cities, County, State and Federal Agencies with jurisdiction over the project sites.

15. All other incidental and related work required to complete the project as shown on the Plans and specified herein.

## 1.04 DESIGN SERVICES TO BE PROVIDED BY THE CONTRACTOR

A. CONTRACTOR shall provide Final Design for the trenchless constructions on the project, based on the preliminary design in the contract documents, available geologic and geotechnical information provided with the contract documents, and any data the CONTRACTOR wishes to collect.

B. The CONTRACTOR has the option of providing the ductile iron pipe with factory-applied zinc coating or design and installation of a cathodic protection system for the metallic pipeline and appurtenances.

## 1.05 PROJECT WORK NOT IN THIS CONTRACT

A. The contract does not include construction of the desalination plant or transmission mains greater than 12 inches, or CAW distribution mains. At this time CAW is responsible for applying for the new PG&E electrical service.

B. The Owner will endeavor to advise CONTRACTOR on the known schedules of other parties performing work at or near the Worksite for this Contract and will review with CONTRACTOR the Construction Schedule to seek a mutually acceptable resolution of conflicts.

C. It shall be understood that the nature of the Work is such that the presence and activities of other parties performing work at or near the Worksite cannot be precisely anticipated, and it shall also be understood that CONTRACTOR shall have flexibility in its schedule to accommodate unexpected activities of other parties at the Worksite.

D. Cooperate with other parties performing work at or near the Worksite; and, if necessary, revise CONTRACTOR schedule to allow such work by other parties to be performed in a timely manner.

## 1.06 IDENTIFIED AGENCIES

A. The Owner has endeavored to identify agencies having jurisdiction over the Work. The list is not necessarily complete, and CONTRACTOR shall be bound by requirements of other agencies having jurisdiction over the Work.

B. The identified agencies include:

1. CALTRANS
2. County of Monterey
3. TAMC
4. CCSD
5. Monterey County Water Resources Agency (MCWRA)
6. RWQCB

## 1.07 REFERENCE SPECIFICATIONS AND CODES

A. As part of mobilization, as soon as possible but no later than 45 calendar days following Notice to Proceed, CONTRACTOR shall obtain copies of each of the individual specifications and codes referenced in these technical specifications. These publications shall be made readily available for use by the inspectors, CONTRACTOR's and SUBCONTRACTOR's staff in carrying out the QA/QC Programs specified herein and to ensure the specification and code requirements referenced in the Contract Documents are met.

## 1.08 AGENCY INSPECTIONS

A. CONTRACTOR shall allow inspection of the Worksite or work premises during business hours by jurisdictional agencies for the purpose of ensuring that the premises and the business are in compliance with the terms and conditions of the Permits and with the requirements of their Codes, standard specifications and details and other local, State, and Federal laws and regulations.

## 1.09 MEASUREMENT AND PAYMENT

A. Separate measurement or payment will not be made for work required under this Section. All costs in connection therewith will be considered incidental to the item of work to which they pertain.

****END OF SECTION****

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**TECHNICAL SPECIFICATION**
**DIVISION 1: GENERAL REQUIREMENTS**
**SECTION 01025: MEASUREMENT AND PAYMENT**

## PART 1 GENERAL

### 1.1 SECTION INCLUDES

A. This Section includes requirements for measurement and payment as they apply to the Work.

B. This Work is the construction of the following Castroville Pipeline for the Monterey Peninsula Water Supply Project.

C. Measurement methods specified in the individual Sections of these Specifications shall govern if different from the methods specified herein.

### 1.2 MEASUREMENT OF QUANTITIES

A. Measurement Standards: All Work to be paid for at a Contract price per unit of measurement will be measured by the OWNER in accordance with United States Standard Measures.

B. Measurement by Area: Measurement by area will be by the square dimension listed or indicated in the Schedule of Quantities and Prices.

C. Linear Measurement: Linear Measurement will be by the linear dimension listed or indicated in the Schedule of Quantities and Prices. Unless otherwise indicated, items, components, or work to be measured will be measured at the centerline of the item in place.

D. Lump-Sum Measurement:

1. Lump-sum measurement will be for the entire item, unit of work, structure, or combination thereof, as specified and as listed or indicated in the Schedule of Quantities and Prices with pay limits for the item of work shown on the Plans.

2. If CONTRACTOR requests progress payments for lump-sum items or amounts in the Schedule of Quantities and Prices, such progress payments will be made in accordance with a well-balanced, detailed program of payment-apportioning, prepared by CONTRACTOR and submitted to the OWNER for approval.

3. Such program for each applicable lump-sum item shall show fixed measurable quantities where possible and unit prices therefore as allocated by CONTRACTOR to the different features of the Work and major subdivisions thereof. The summation of extensions of quantities and unit prices and related costs shall equal the amount of the lump sum bid item indicated in the Schedule of Quantities and Prices.

## 1.3 ALLOWANCES

A. All Allowance Work shall be directed by the OWNER to the CONTRACTOR in writing prior to the start of work. The work shall be billed by time and materials basis or other method agreed in advance by the OWNER and shall not exceed the total approved by the OWNER.

B. Allowances specified in the Contract Documents shall cause the work so covered to be furnished and performed for such sums as acceptable to the OWNER and shall include the cost to CONTRACTOR, less any applicable trade discounts, of materials and equipment to be delivered and installed.

C. CONTRACTOR's costs for unloading, handling, labor, installation costs, overhead, profit and other expenses contemplated shall not be deducted from the Allowance but shall be included in the Contract Price.

## 1.4 SCOPE OF PAYMENT

A. The contract lump sum and unit prices paid for the various items and classifications of work shall include full compensation for furnishing all labor, materials, tools, equipment, transportation, services, and incidentals as specified in GC-56, "Compensation," and for performing all work necessary for completing the construction or installation of the item or work classification, unless stated otherwise.

## 1.5 MEASUREMENT AND PAYMENT

A. Costs for conforming to the provisions of this section will receive no separate payment from the OWNER, and the CONTRACTOR is presumed to have allocated such costs to the pay items deemed most appropriate.

B. CONTRACTOR administrative costs for performing work in this contract will receive no separate payment from the OWNER, and the CONTRACTOR is presumed to have allocated such costs to the pay items deemed most appropriates.

## 1.6 BID ITEM DESCRIPTIONS

### A. Bid Item No. 1 – Preconstruction Activities, Community Outreach & Permits (ALLOWANCE)

1. Payment for addressing preconstruction activities as directed by the OWNER. The CONTRACTOR shall assist the OWNER and ENGINEER with construction planning activities and coordination meetings with project stakeholders including but not limited to coordination, planning, resource development (local utilization, WMDVBE), and permitting activities necessary to start construction but prior to notice to proceed.

2. Permit Application Fees: The CONTRACTOR will be provided an Allowance for paying permitting fees to the following agencies: Monterey County. The allowance also includes funds for payment of any fees for access to private properties including: Monterey County Water Resources Agency, and Transportation Agency for Monterey County.

   The bid item is for payment of fees only. It is not to be used for labor or administrative costs for permit application preparation, meetings, coordination, etc. Those efforts are incidental to the work and should be included in the specific bid items for the required improvements.

3. Payment for addressing community outreach activities as directed by the OWNER. The CONTRACTOR shall assist the OWNER and Engineer with community outreach activities including but not limited to meeting attendance, presentations and discussions of construction activities and methods; information development including printed materials and electronic materials suitable for publishing on the project website.

4. Measurement shall be in accordance with the requirements for allowance type work.

### B. Bid Item No. 2 –General Overhead, Bonding and Insurance

1. Payment for project overhead including bonds, insurance, office support services, management, and other related general costs associated with executing the Work etc.

2. Payment for General Overhead will be made on an average monthly rate based on the submitted construction schedule.

### C. Bid Item No. 3 – Mobilization/Demobilization

1. The contract lump sum price paid for mobilization shall include full

compensation for furnishing all labor, materials, tools, equipment, and incidentals, for doing all the work involved in mobilization, demobilization, and setting up field trailers, complete in place, as shown on the Plans, and as specified in these technical specifications.

2. Payments for mobilization will be made as follows:

   a. When the monthly partial payment estimate of the amount earned, not including the amount earned for mobilization, is 5 percent or more of the original Contract amount, 50 percent of the contract item price for mobilization or 5 percent of the original Contract amount, whichever is the lesser, will be included in said estimate for payment.

   b. When the monthly partial payment estimate of the amount earned, not including the amount earned for mobilization, is 10 percent or more of the original Contract amount, the total amount earned for mobilization shall be 75 percent of the contract item price for mobilization or 7.5 percent of the original Contract amount, whichever is the lesser, will be included in said estimate for payment.

   c. When the monthly partial payment estimate of the amount earned, not including the amount earned for mobilization, is 20 percent or more of the original Contract amount, the total amount earned for mobilization shall be 95 percent of the contract item price for mobilization or 9.5 percent of the original Contract amount, whichever is the lesser, will be included in said estimate for payment.

   d. When the monthly partial payment estimate of the amount earned, not including the amount earned for mobilization, is 50 percent or more of the original Contract amount, the total amount earned for mobilization shall be 100 percent of the contract item price for mobilization or 10 percent of the original Contract amount, whichever is the lesser, will be included in said estimate for payment.

   e. After acceptance of the contract, the amount, if any, of the contract item price for mobilization in excess of 10 percent of the original contract amount will be included for payment of the final estimate.

3. Payment for demobilization will follow Final Completion and is assumed to be no more than 10% of the amount for mobilization.

**D. Bid Item No. 4 – Environmental Requirements, Erosion Control and SWPPP**

1. Payment for addressing site specific environmental requirements and/or restoration as described in Section 01062 Environmental Requirements 01561 SPP, Erosion and Sediment Controls and 02270 Erosion and Sediment Control.

2. Payment for this item shall be made at the contract unit price of Lump Sum.

**E. Bid Item No. 5 – Silt and Exclusion Fencing**

1. Payment for installing the Silt and Exclusion Fencing, Payment for this item of work will be full compensation for furnishing all materials, tools, labor, and equipment necessary for installing and maintaining the fence. Once the OWNER has determined that the silt or exclusion fence in an area is no longer needed, it may be removed and reused if it is in suitable condition acceptable to the OWNER. The OWNER will only pay once for installing silt or exclusion fencing at a location, unless it is for the purpose of change order work where the fencing had been previously removed.

2. Payment for this item shall be made at the contract unit price for each linear foot of silt and exclusion fencing installed.

**F. Bid Item No. 6 – Health and Safety Compliance**

1. Payment for all materials, tools, labor, and equipment necessary for development and execution of a health and safety plan for carrying out the work in a safe manner and in compliance with all relevant laws and codes. CONTRACTOR shall be aware of the potential and identified chemical hazards in the site soils and water described in the Environmental Database/Document Review Report and the Environmental Investigation Report for the project and per the General Conditions.

2. Payment for this item shall be made at the contract unit price of Lump Sum.

**G. Bid Item No. 7 – Utility Potholing**

1. Payment for locating, potholing, and if necessary backfilling and/or plating over the existing underground utilities as shown on the Plans or identified by USA markings. Payment for this item of work will be full compensation for furnishing all materials, tools, labor, and equipment necessary for potholing including but not limited to location and protection of the utility, excavation, traffic control, backfill and compaction, and restoration of grade, pavement, curbs, gutters, sidewalks, and landscaped areas.
2. Payment for this item shall be made at the contract unit price for each utility "main" or pipe requiring a pothole for installing the pipeline.

**H. Bid Item No. 8 - Staking/Surveying/As-Builts Drawings**

1. Payment for staking and surveying will be measured as a lump sum for all surveying and staking requirements, full compensation for furnishing all materials, tools, labor, and equipment necessary.

2. Payment for Staking and Surveying shall consist of:
   a. Establishing or reestablishing the project centerline, invert of existing utilities, and top of pipeline.
   b. Referencing or re-referencing all necessary control points.
   c. Running a circuit of bench levels to check or reestablish plan benchmarks.
   d. Setting other benchmarks as needed.
   e. Staking right-of-way or re-staking right-of-way where needed if it has been previously staked and performing all construction layout and reference staking necessary for the proper control and satisfactory completion of all structures, grading, paving, drainage, and all other appurtenances required for the completion of the construction work and acceptance of the project.
3. CONTRACTOR shall provide as-built drawings of all constructed improvements with surveyed coordinate locations and depths for all pipeline features and appurtenances including bends, valves, CAVs, blow offs, etc.
4. Payment for this item shall be made at the contract unit price of Lump Sum.

## I. Bid Item No. 9 - Traffic Control

1. Payment for Traffic Control will be measured as a lump sum for all labor, materials, tools, equipment, incidentals, and meeting all requirements, for doing all the work involved in providing traffic control, specified in Section 01570 – Traffic Control and in any project permits.
2. Payment for this item shall be made at the contract unit price of Lump Sum.

## J. Bid Item No. 10 – Trench Shoring

1. Payment for excavation shoring, trench and manhole shoring in accordance with Section 02160 – Excavation Support System and shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, for installation and removal of the trench and structure shoring, bracing, and sheeting system for the pipeline. It shall include compensation for any and all engineering and permit fees incurred by the CONTRACTOR for the design of the shoring system, and no additional compensation will be allowed therefor.
2. Payment for excavation shoring shall be measured as a lump sum, and include furnishing of all work required and specified in Section 02160 – Excavation Support System. Payment for shoring for jacking and receiving pits shall be made under a separate bid item.

## K. Bid Item No. 11 – Trench Dewatering

1. Payment for providing labor, materials, tools, equipment, facilities, and services as required for providing the necessary dewatering work and facilities as required and specified in Sections 02140 – Dewatering and 01150 Water Treatment and Disposal. The Project Geology Review and Investigation Reports and Hazardous Materials Investigation Reports provide information about groundwater along the alignment.

2. Payment for this item shall be made at the contract lump sum price for all dewatering required along this pipeline. Dewatering for the jack and bore work, if required, would be paid under that bid item.

## L. Bid Item No. 12 – Jack and Bore under Railroad at Dole Entry

1. Payment for providing labor, materials, tools, equipment, facilities, design, and services as required for installing the 12-inch pipeline in a casing via Jack and Bore method as shown on the project plans, including launch and receiving pits, carrier and casing pipe, grouting, heave monitoring, pipeline connections, and site restoration.

2. Payment for this item shall be made at the contract unit price per lump sum (LS).

## M. Bid Item No. 13 – Install 8” Pipe in 16" Steel Casing (Hwy 183)

1. Payment for providing labor, materials, tools, equipment, facilities, incidentals, testing, and services as required for furnishing and installing the 8” pipeline in a 16" Steel Casing pipe across Hwy 183 in the Caltrans ROW, complete in place as shown on the Plans and specifications. Construction method is open cut trench. The work is expected to take place at night as required by Caltrans.

2. Payment for this item shall be made at the contract unit price per linear foot of casing pipe.

## N. Bid Item No. 14 –Horizontal Directional Drilling (HDD) under Tembladero Slough

1. Payment for providing all labor, equipment, materials, incidentals, design and services as required for furnishing and installing 8” Fusible PVC pipe under Tembladero Slough using horizontal directional drilling , complete in place as shown on the Plans and specifications.

2. Payment for this item shall be made at the contract unit price per lump sum (LS).

**O. Bid Item No. 15 – Provide and Install 12" Ductile Iron Pipeline**

1. Payment for procuring, delivering to the project site and installing the following pipe materials:

    a. 12-inch Ductile Iron Pipe (AWWA C151) with standard gaskets
    b. 12-inch Ductile Iron Pipe (AWWA C151) for use with nitrile (NBR) gaskets (excluding the gaskets which are in a separate bid item)

2. The work includes procurement and delivery of all pipe and appurtenances including tees, bends, flanges and restraints as shown in the drawings and these specifications, not included in other bid items.

3. Work also includes transportation, storage and security of materials until time needed for installation, installation and backfill of trench and site restoration (excluding paving which is in another bid item).

4. Payment for pipe will be by the linear foot installed measured horizontally over the pipe alignment centerline, according to the stationing provided in the plans.

**P. Bid Item No. 16 – Provide and Install 8" Ductile Iron Pipeline with NBR Gaskets for CCSD Portion**

1. Payment for procuring and delivering to the project site the following pipe materials for the CCSD portion of the 8" pipeline as shown in the project drawings:

    a. 8-inch Ductile Iron Pipe (AWWA C151) with NBR gaskets

2. The work includes procurement and delivery of all pipe and appurtenances including tees, bends, flanges and restraints as shown in the drawings and these specifications, not included in other bid items.

3. Work also includes transportation, storage and security of materials until time needed for installation, installation and backfill of trench and site restoration (excluding paving which is in another bid item).

4. Payment for pipe will be by the linear foot installed measured horizontally over the pipe alignment centerline, according to the stationing provided in the plans.

**Q. Bid Item No. 17 –Provide and Install 8" Ductile Iron Pipeline with NBR Gaskets for CAW Portion**

1. Payment for procuring and delivering to the project site the following pipe materials for the CAW portion of the 8" pipeline as shown on the project drawings:

    a. 8-inch Ductile Iron Pipe (AWWA C151) with NBR gaskets

2. The work includes procurement and delivery of all pipe and appurtenances including tees, bends, flanges and restraints as shown in the drawings and these specifications, not included in other bid items.

3. Work also includes transportation, storage and security of materials until time needed for installation, installation and backfill of trench and site restoration (excluding paving which is in another bid item).

4. Payment for pipe will be by the linear foot installed measured horizontally over the pipe alignment centerline, according to the stationing provided in the plans.

**R. Bid Item No. 18 – Provide NBR Gasket for about 5063 LF of 12" Ductile Iron Pipeline**

1. Payment for procuring and delivering to the project site and installing the NBR gaskets necessary for the portion of the CAW 12" pipeline north of the Monte Rd Bridge.

2. Payment will be per each gasket installed.

**S. Bid Item No. 19 – Chain Link Fencing, Concrete Pads and Grading at Three Meter Stations**

1. Payment for providing labor, materials, tools, equipment, facilities, incidentals, testing, and services as required for installing the Chain Link Fencing, Concrete Pads, and Grading at Lapis Road Meter Station, CAW Nashua Road Meter Station, and CCSD Nashua Road Meter Station as shown in the plans and specifications. Payment for this item of work will be full compensation for installing this work complete in these three locations.

2. Payment for this item shall be made at the contract unit price of lump sum.

**T. Bid Item No. 20 –Design and Furnish Cathodic Protection for CAW Portion Metallic Pipelines and Appurtenances: Cathodic Protection System or Zinc-Coated DIP**

1. As described in the specifications, the Contractor may select whether to provide corrosion protection for the ductile iron pipe and appurtenances by either a corrosion protection system designed and installed by the Contractor, or by providing the pipe with a factory-applied zinc coating, the largest thickness available by the pipe vendor, whichever is least cost. This item is payment for this work for the CAW portion of the 12- and 8-inch ductile iron pipelines.

2. The cathodic protection system shall be designed and furnished as per Section 13110 and the plans.

3. Payment for this item of work will be full compensation for furnishing all materials, tools, labor, and equipment necessary for furnishing and installing the cathodic protection.

4. Payment for this item shall be made at the contract unit price of Lump Sum for a fully furnished, tested, functioning system.

**U. Bid Item No. 21 –Design and Furnish Cathodic Protection for CCSD Portion Metallic Pipelines and Appurtenances: Cathodic Protection System or Zinc-Coated DIP**

1. As described in the specifications, the Contractor may select whether to provide corrosion protection for the ductile iron pipe and appurtenances by either a corrosion protection system designed and installed by the Contractor, or by providing the pipe with a factory-applied zinc coating, the largest thickness available by the pipe vendor, whichever is least cost. This item is payment for this work for the CCSD portion of the 8-inch ductile iron pipelines.

2. The cathodic protection system shall be designed and furnished as per Section 13110 and the plans.

3. Payment for this item of work will be full compensation for furnishing all materials, tools, labor, and equipment necessary for furnishing and installing the cathodic protection.

4. Payment for this item shall be made at the contract unit price of Lump Sum for a fully furnished, tested, functioning system.

**V. Bid Item No. 22 – Restoration of Pavement Markings**

1. Payment for restoration of traffic controls including striping, directions, signage, crosswalks, stop bars, and reflectors after AC pavement has been replaced, for all portions of disturbed pavement in the project. Payment for this item of work will be full compensation for furnishing all materials, tools, labor, and equipment necessary for restoration of the traffic striping. This work is not specifically called out in the plans; it is the Contractor's responsibility to quantify this work by their own inspection of the project area prior to bidding.

2. Traffic striping shall be restored to existing condition of better as documented in pre-construction survey (see Section 01532).

3. Payment for this item shall be made at the contract unit price of Lump Sum.

**W. Bid Item No. 23 – Asphalt Concrete Paving**

1. Full compensation for for all labor, equipment, materials, incidentals, and

services as required, complete in place to restore asphalt concrete (AC) and aggregate base furnished and placed for pavement restoration in conjunction with potholing, trenching for underground facilities, removal and/or replacement of existing facilities, conforming AC paving for paneled crossings and driveway, embedded crossings and broken rail sections, shall be considered as included in the various contract items of work and no additional compensation will be allowed therefore. Removal of existing pavement and providing and compacting materials below the AC, such as base rock and tack seal, are included in the unit price for AC supplied.

2. Payment for this item shall be made at the unit price of Tons for all AC pavement installed confirmed per original and official load tickets.

**X. Bid Item No. 24– Lead Testing and Abatement (Caltrans)**

1. Payment for lead testing and abatement will be measured as a lump sum for all labor, equipment, materials, incidentals, and services as required, complete in place as shown on the Plans and specified, for compliance of the work at the Hwy 183 crossing with the included Caltrans requirements.
2. Lead testing and abatement are Caltrans requirements which are provided as an Appendix to these specifications. CONTRACTOR shall meet those requirements. Payment for this item shall be made at the contract unit price of Lump Sum.

**Y. Bid Item No. 25 – Soil Disposal (Non-hazardous)**

1. Payment for Soil Disposal for all labor, materials, tools, equipment, facilities, hauling, fees, analytical testing and services as required and specified in Section 02111 – Disposal of Excavated Materials for soil that cannot be reused in the project and must be disposed off-site.

2. Payment for Soil Disposal will be measured as a cubic yards (CY) and shall be determined by submittal of certified weigh tags from the landfill used for disposal.

**Z. Bid Item No. 26– Seeding (CA Native Mix)**

1. Payment for Reseeding includes all labor, materials, tools, equipment, facilities, watering, maintenance and services as required and specified in Section 02930 – Seeding for reseeding disturbed vegetated areas where directed by the OWNER.

2. Payment for this item shall be made at the contract unit price for square feet (SF) as measured in the field by the CONTRACTOR and confirmed by the OWNER.

**AA. Bid Item No. 27 –Electrical and Instrumentation Testing and Startup**

1. Payment for Electrical and Instrumentation Testing and Startup including all labor, materials, tools, equipment, facilities, and services as required and specified in as shown in the Contract Documents for both CAW and CCSD equipment and facilities.

2. Payment for this item shall be made at the contract unit price as Lump Sum for the work after all the equipment and instrumentation is tested and operating, O&M Manuals have been submitted and approved and training has been completed.

**BB. Bid Item No. 28 – Repair of Irrigation Lines and Drain Tiles (ALLOWENCE)**

1. Payment for this item of work will be full compensation for furnishing all materials, tools, labor, and equipment necessary for repair of irrigation lines and drain tiles and other utilities not marked on the plans.

2. Measurement shall be in accordance with the requirements for allowance type work.

**CC. Bid Item No. 29 – Provide and Install 12" Gate Valves**

1. Payment shall be made on the contract unit price for furnishing gate valve assembly (AWWA C-509), installed complete in place as shown on the Plans and specified in the technical specifications.

2. Payment shall be deemed full compensation for all labor, equipment, materials, and incidentals for furnishing each 12-inch gate valve, valve box and iron cover, thrust blocks and/or mechanical restraints, riser, tracer wire, and all items recommended or specified by the valve manufacturer, and all work required to install valve complete in place as specified and provided in the project plans.

**DD. Bid Item No. 30 – Provide and Install 8" Gate Valves**

1. Payment shall be made on the contract unit price for furnishing gate valve assembly (AWWA C-509), installed complete in place as shown on the Plans and specified in the technical specifications.

2. Payment shall be deemed full compensation for all labor, equipment, materials, and incidentals for furnishing each 8-inch gate valve, valve box and iron cover, thrust blocks and/or mechanical restraints, riser, tracer wire, and all items recommended or specified by the valve manufacturer, and all work required to install valve complete in place as specified and provided in the project plans.

**EE. Bid Item No. 31 – Provide and Install 2" Combination ARVs**

1. Payment shall be made on the contract unit price for each Combination ARV assembly (AWWA C-512), installed complete in place as shown on the Plans and specified in the technical specifications.

2. Combination ARVs in cages with guard posts are shown in the project detail drawings.

3. Payment shall be deemed full compensation for all labor, equipment, incidentals, and materials for furnishing combination ARV valve, tubing connection with main, fittings, curb stop, cage, utility box, enclosure, concrete slab, and all items recommended or specified by the valve manufacturer, and all work required to install air release valve complete in place as specified.

**FF. Bid Item No. 32 – Provide and Install Blowoff, Pump Out Style**

1. Payment shall be deemed full compensation for all labor, equipment, materials, and incidentals for furnishing each blowoff assembly as sizes indicated, pipes, valves, fittings, utility vault and cover, thrust blocks, tracer wire, and all items recommended or specified by the manufacturer, and all work required to install and test Pump Out Blowoffs complete in place as shown on the Plans and specified in the technical specifications..

2. Payment shall be made on the contract unit price for furnishing each blowoff assembly, installed complete in place.

**GG. Bid Item No. 33 – Provide and Install Lapis Flow Meter in Vault**

1. Payment for installation of new flow meter in vault, as described in the specifications and shown in the plans. Payment shall be deemed full compensation for all labor, equipment, materials, and incidentals for furnishing, and installing the flow meter vault. Electrical and instrumentation testing and startup are in a separate bid item.

2. Payment for this item shall be made at the contract unit price as Lump Sum

**HH. Bid Item No. 34 –Electrical and Instrumentation at Lapis Road Meter Station**

1. Payment for electrical and instrumentation work at Lapis Road Meter Station including all materials, tools, equipment, facilities, and services as required and specified in as shown in the Contract Documents. This work covers wiring, conduit, telemetry, and the solar electrical system to provide power and function to all the instruments at the station. Electrical and

instrumentation testing and startup and PLC/SCADA programming are in a separate bid item.

1. Payment for this item shall be made at the contract unit price as Lump Sum for the work.

**II. Bid Item No. 35 – Provide and Install CSIP Tie-in**

1. Payment for installation of CSIP Tie-in as shown in the plans and specifications. Tie-in includes 12" tee, 12" gate valve, 12" blind flange, and 12" x 8" reducer plus piping and appurtenances as required to complete the work.

2. Payment shall be deemed full compensation for all labor, equipment, materials, and incidentals for furnishing this item at the contract Lump Sum price for the furnished tie-in, tested and operating.

**JJ. Bid Item No. 36 – Provide and Install 8" Backflow Prevention Device**

1. Payment for installation of the above grade Backflow Prevention device as shown in the plans and specifications, including appurtenances such as valves, supports, and piping. The concrete pad is included in a separate bid item.

2. Payment shall be deemed full compensation for all labor, equipment, materials, and incidentals for furnishing this item at the contract Lump Sum price for the furnished station, tested and operating.

**KK. Bid Item No. 37 – Provide and Install CAW Nashua Pressure Regulating Station**

1. Payment for installation of the pressure regulating station in a vault as shown in the plan and specifications. The electrical and instrumentation work is provided in a separate bid item.

2. Payment shall be deemed full compensation for all labor, equipment, materials, and incidentals for furnishing this item at the contract Lump Sum price for the furnished station, tested and operating.

**LL. Bid Item No. 38 – Provide and Install Nashua Actuated Valve in Vault**

1. Payment for installation of the Actuated Valve in Vault as shown in the plans and specifications. The electrical and instrumentation work is provided in a separate bid item.
2. Payment shall be deemed full compensation for all labor, equipment, materials, and incidentals for furnishing this item at the contract Lump Sum price for the furnished valve and vault, tested and operating.

**MM. Bid Item No. 39 –Electrical and Instrumentation at CAW Nashua Road Meter Station**

1. Payment for electrical and instrumentation work at CAW Nashua Road Meter Station including all materials, tools, equipment, facilities, and services as required and specified in as shown in the Contract Documents. Work includes but is not limited to wiring, conduits, instrumentation, and the electrical and telemetry cabinet. Work not shown in the plans related to the new PG&E service is included in the PG&E allowance bid item.

2. Payment for this item shall be made at the contract unit price as Lump Sum for the work after installation. Startup testing and PLC/SCADA programming are in separate bid items.

**NN. Bid Item No. 40 – New PG&E Service at CAW Nashua Meter Station (ALLOWANCE)**

1. Payment for coordinating with PG&E, fees, installing conduit and pull boxes as required by PG&E, and all materials, tools, equipment, facilities, and services as required that is not to be performed by PG&E to provide the electrical service to the Nashua Meter Station.

2. Payment for this item shall be made at the price negotiated between the CONTRACTOR and the OWNER, consistent with the conditions for use of an allowance in the contract documents, not to exceed a total of $50,000.

**OO. Bid Item No. 41 –PLC/SCADA Programming for CAW**

1. Payment for PLS/SCADA Programming work for CAW facilities at Nashua Rd and Lapis Rd. including all materials, tools, equipment, facilities, and services as required and specified in as shown in the Contract Documents.

2. Payment for this item shall be made at the contract unit price as Lump Sum for the work after tested and operating and submittal of approved O&M Manuals.

**PP. Bid Item No. 42 – Provide and Install Nashua Flow Meter in Vault**

1. Payment for installation of the flow meter in vault at the CCSD Nashua Meter Station, as described in the specifications and as shown in the plans. Electrical and instrumentation testing and startup are in a separate bid item.

2. Payment shall be deemed full compensation for all labor, equipment, materials, and incidentals for furnishing this item at the contract Lump Sum

price for the furnished vaulted flow meter.

**QQ. Bid Item No. 43 –Electrical and Instrumentation at CCSD Nashua Road Meter Station**

1. Payment for electrical and instrumentation work including the telemetry and solar power systems at CCSD Nashua Road Meter Station including all materials, tools, equipment, facilities, and services as required and specified in as shown in the Contract Documents.

2. Payment for this item shall be made at the contract unit price as Lump Sum for the work after tested and operating.

**RR. Bid Item No. 44 –PLC/SCADA Programming for CCSD**

1. Payment for PLC/SCADA Programming work for CCSD facilities including all materials, tools, equipment, facilities, and services as required and specified in as shown in the Contract Documents.

2. Payment for this item shall be made at the contract unit price as Lump Sum for the work after tested and operating.

**SS. Bid Item No. 45 – Provide and Install Welded Steel Pipe Casing**

1. Payment for providing labor, materials, tools, equipment, facilities, incidentals, testing, and services as required for furnishing and installing the pipeline in a Steel Casing pipe including penetration and restoration of existing bridge abutment walls and connecting to the vaults on both sides of Monte Road Bridge, complete in place as shown on the Plans and specifications.

2. Payment for this item shall be made at the contract unit price for each after restoration, testing, operating and County approval.

**TT. Bid Item No. 46 – Miscellaneous Metal**

1. Payment for providing labor, materials, tools, equipment, facilities, delivery, storage, incidentals, testing, and services as required to furnish metal work for hanging and installation of pipe under the Monte Road Bridge, as shown on the Plans and specifications. Erection of the pipe hanger system is included in a separate bid item.

2. Payment for this item shall be made at the contract unit of pound. If an official measurement of the weight of the metal fixtures is not available, CONTRACTOR shall propose an approach for calculating this in their bid.

**UU. Bid Item No. 47 –12" Ductile Iron Pipeline between Seismic Joints**

1. Payment for procuring and delivering to the project site the following pipe with

appurtenances to be hung under the bridge and between the two seismic joints:

a. 12-inch Ductile Iron Pipe (AWWA C151), epoxy-coated

2. The work includes procurement and delivery of all pipe and appurtenances including tees, bends, flanges and restraints as shown in the drawings and these specifications.

3. Work also includes transportation, storage and security of materials until time needed for installation, pipe disinfection and testing.

4. Payment for pipe will be by the linear foot installed measured horizontally over the pipe alignment centerline, according to the stationing provided in the plans. AC paving, valves, installation, and pipe hangers are included in other bid items.

**VV. Bid Item No. 48 – Erect Waterline Pipe Hanger System**

1. Payment for installation of waterline pipe hanger system and pipe including concrete coring, traffic control, and site restoration. AC paving, and materials such as pipe and pipe hangers are included in other bid items.

2. Payment shall be deemed full compensation for all labor, equipment, materials, and incidentals for furnishing this item at the contract Lump Sum price for the installed pipeline, tested, operating and restored.

**WW. Bid Item No. 49 – Provide and Install PC Concrete Utility Vault**

1. Payment for installation of new concrete vault for seismic joints, as shown in the plans and described in the specifications.

2. Payment shall be deemed full compensation for all labor, equipment, materials, and incidentals for furnishing this item at the contract price for each furnished vault, tested and operating.

**XX. Bid Item No. 50 – Provide and Install Seismic Joint in Vault**

1. Payment for installation of seismic joint in vault, as shown in the plans and described in the specifications.

2. Payment shall be deemed full compensation for all labor, equipment, materials, and incidentals for furnishing this item at the contract price for each seismic joint, installed, tested and operating.

**YY. Bid Item No. 51 – Concrete Barrier 736**

1. Payment for providing labor, materials, tools, equipment, facilities, incidentals, testing, and services as required for demolition and replacement of existing concrete barrier railing, to accommodate the installation of the seismic joint vaults, as shown in the plans.

2. Payment for this item shall be made at the contract price of lump sum. It is estimated that the length of new barrier is about 11 linear feet.

**ZZ. Alternate Bid Item A – Provide All Miscellaneous Metals for Bridge in 316 Stainless Steel**

1. Payment for providing labor, materials, tools, equipment, facilities, delivery, storage, incidentals, testing, and services as required to furnish all metal work for installation of pipe on Monte Road Bridge as 316 stainless steel, instead of the materials shown on the Plans and specifications, which may be a mix of stainless steel and galvanized.

2. Payment for this item shall be made at the contract unit of pound, and will be paid in place of Bid Item 46: Miscellaneous Metal (Bridge).

**AAA. Alternate Bid Item B – Provide and Install 8" Fusible PVC Pipe for CCSD Portion**

1. Payment for procuring, installing, disinfection and testing 8-inch Fusible PVC Pipe for the CCSD portion of the project instead of DI pipe, as described in the plans and specifications. The work includes procurement and delivery of all pipe and appurtenances. Work also includes transportation, storage and security of materials until time needed for installation, installation and backfill of trench.

2. Payment for pipe will be by the linear foot installed measured horizontally over the pipe alignment centerline, according to the stationing provided in the plans. Valves are addressed separately. Installation of the 8" pipe by HDD is included in a separate bid item. This bid item replaces bid items 16: DI Pipe with NBR Gaskets and 21: Cathodic Protection for CCSD Portion, Metal Pipelines.

****END OF SECTION****

**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01050: FIELD ENGINEERING**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Providing and paying for field engineering services required for Project.

1. Survey work required in execution of Project.

2. Civil, structural and other professional engineering services specified or required to verify that Contractor's construction methods are in accordance with Contract Documents.

B. Field measurements also will be required for existing and new construction, and for siting, anchoring, embedding, aligning, and connecting work.

C. Seismic requirements: All design shall accommodate seismic load occurring simultaneously with normal loads as described in Section 01601.

### 1.02 RELATED SECTIONS

A. Section 01010: Summary of Work

B. Section 01601: Seismic Design Requirements

C. Section 01720: Record Drawings

D. Section 02200: Earthwork

### 1.03 QUALIFICATIONS OF SURVEYORS AND ENGINEERS

A. Qualified ENGINEERs or registered land surveyors, acceptable to ENGINEER and OWNER.

B. Registered professional ENGINEERs of the disciplines required for the specific service on the Project, licensed in California.

### 1.04 SURVEY REFERENCE POINTS

A. Survey control points and benchmarks in the project area are provided in Appendix B of the specifications.

B. Locate and protect control points before starting site work, and preserve all permanent reference points during construction.

1. Make no changes or relocations without prior written notice to ENGINEER.

2. Report to ENGINEER when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.

3. Require surveyor to replace Project control points which may be lost or destroyed. Establish replacements based on original survey control.

## 1.05 PROJECT SURVEY REQUIREMENTS

A. Establish a minimum of two permanent bench marks at each Work site, referenced to data established by survey control points.

1. Record locations, with horizontal and vertical data, on Project Record Documents.

B. Establish lines and levels, locate and lay out, by instrumentation and similar appropriate means:

1. Site improvements:

a. Stakes for grading, fill and topsoil placement

b. Utility slopes and invert elevations.

2. Project piping.

3. Vault locations.

4. Controlling lines and levels required for mechanical and electrical trades.

C. From time to time, verify layouts by same methods.

## 1.06 RECORDS

A. Maintain a complete, accurate log of all control, survey, and field measurement work as it progresses.

B. On completion of foundation walls and major site improvements, prepare a certified survey showing all dimensions, locations, angles and elevations of construction.

## 1.07 SUBMITTALS

A. Submit name and address of surveyors and professional ENGINEERs to ENGINEER.

B. Submit documentation to verify accuracy of field and design engineering work.

C. Submit certificate signed by registered ENGINEERs or surveyors certifying that elevations and locations of improvements are in conformance, or non-conformance, with Contract Documents.

D. Where design engineering, drawings, calculations and civil or structural construction methods and procedures are required to be submitted for review, they shall bear the stamp and signature of the responsible registered professional ENGINEER.

E. Surveys for measurement of quantities shall be reduced and plotted, necessary calculations performed and results presented in an orderly form. All plotted plans, cross sections, calculations, and recap sheets shall be submitted to the ENGINEER for review and record.

## 1.08 OTHER SURVEY REQUIREMENTS

A. Survey buried fittings location, depth and elevation prior to backfill.

****END OF SECTION****

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**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01060: REGULATORY REQUIREMENTS**

## PART 1 GENERAL

### 1.01 SUMMARY

A. This Section includes requirements for: Codes and Standards used on the MPWSP. The CONTRACTOR shall obtain copies of codes and reference standards when required by the Contract Documents. Except where noted, the most recent editions of Codes, Standards and Regulations at the time of the Contract shall apply.

B. The codes referred to shall have full force and effect as though printed in these Specifications. Nothing in the Contract Documents shall be construed to permit work not conforming to the governing code requirements.

C. Other Applicable Laws and Regulations: All applicable Federal, State, and local laws, and the latest rules and regulations of governing utility districts and the various other authorities having jurisdiction over construction and completion of the work, including but not limited to Cal-OSHA and California Labor Code, shall apply to the Contract throughout, and they shall be deemed to be incorporated by reference.

D. Related Documents and Sections include:

1. Section 01062 - Environmental Requirements
2. Section 01300 – CONTRACTOR Submittals
3. Section 02160 – Excavation Support Systems

### 1.02 CODES:

E. CONTRACTOR shall confirm all work of the Contract to meet or exceed the applicable requirements of the latest editions of the applicable codes, laws, ordinances, standards, rules and regulations, including but not limited to the following:

1. CCR Title 8, Industrial Relations
2. CCR Title 17, Public Health
3. CCR Title 19, Public Safety
4. CCR Title 24, Building Standards
    a. Part 1, California Building Standards Administrative Code
    b. Part 2, California Building Code

c. Part 3, California Electrical Code

d. Part 4, California Mechanical Code

e. Part 5, California Plumbing Code

f. Part 6, California Energy Code

g. Part 7, California Elevator Safety Construction Code (not used)

h. Part 8, California Historic Building Code

i. Part 9, California Fire Code

j. Part 10, California Code for Building Conservation

k. Part 11, NOT USED

l. Part 12, California Reference Standards Code

**1.03 STANDARDS**

A. The MPWSP shall adhere to the latest standards from the following industry organizations**:**

1. American Association of State Highway and Transportation Officials (AASHTO)
2. American Concrete Institute (ACI)
3. American Public Works Association (APWA)
4. American Society of Civil Engineers (ASCE)
5. American National Standards Institute (ANSI)
6. American Society of Mechanical Engineers (ASME)
7. American Society for Testing and Materials (ASTM)
8. American Water Works Association (AWWA)
9. Ductile Iron Pipe Research Association (DIPRA)
10. Plastics Pipe Institute (PPI)
11. Society for Protective Coating (SSPC)

## 1.04 PROJECT-SPECIFIC REQUIREMENTS

A. All work in TAMC ROW shall adhere to American Railway Engineering and Maintenance of Way (AREMA) standards. Information available at: https://www.arema.org/

B. All work in Caltrans ROW shall adhere to Caltrans standards. Information available at: http://www.dot.ca.gov/hq/esc/oe/construction_standards.html

C. Americans with Disabilities Act Guidelines. Information available at: http://www.ada.gov/2010ADAstandards_index.htm

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION (NOT USED)

****END OF SECTION****

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## PART 1 GENERAL

### 1.01 SCOPE OF WORK

A. All materials, installation, and construction shall comply with the applicable provisions of current laws, codes, the State of California, and the Federal Government, and any other applicable authority.

B. CONTRACTOR shall be responsible for all costs necessary to prevent its operations from violating any federal, state, or local governmental regulations and the requirements of the Contract Documents.

C. CONTRACTOR shall review and become familiar with project's environmental review documentation prepared under the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA). CONTRACTOR shall review and become familiar with the project's joint Final Environmental Impact Report (EIR)/Environmental Impact Statement (EIS) under NEPA, applying measures contained in its CEQA Mitigation Monitoring and Reporting Program (MMRP) and NEPA Record of Decision, which is expected to be available in early 2018. Copies of the DEIR/EIS can be made available upon request. It is the CONTRACTOR's responsibility to obtain copies and understand the mitigation requirements within final CEQA/NEPA documents and the MMRP once the Final EIS/EIR has been certified by the CEQA lead agency and a Record of Decision has been issued by the NEPA lead agency

D. CONTRACTOR shall review and comply with the conditions per the resource agency permits acquired by the OWNER when they become available. CONTRACTOR shall keep a copy of each resource agency permit in its jobsite field office. All CONTRACTOR and SUBCONTRACTORS' superintendents and forepersons shall be thoroughly familiar and compliant with the requirements of the permits. The OWNER anticipates the following environmental permits:

1. U.S. Army Corps of Engineers (USACE) Section 404 Clean Water Act for impacts to jurisdictional wetlands and Section 10 Rivers and Harbors Act for work in, on or under waters of the United States.

2. U.S. Fish and Wildlife Service (USFWS) Section 7 Endangered Species Act consultation for endangered species (e.g., Biological Opinion).

3. National Marine Fisheries Service (NMFS) Section 7 consultation for endangered species (i.e., Letter of Concurrence or Biological Opinion) and consultation on Essential Fish Habitat under the Magnuson Stevens Act.

4. State Historic Preservation Officer (SHPO) consultation and/or Tribal Historic Preservation Officer (THPO) with Section 106 of National Historic Preservation Act (NHPA)

5. National Oceanic and Atmospheric Administration (NOAA) authorization by the superintendent of the Monterey Bay National Marine Sanctuary of federal, state, and local agencies' permits within the sanctuary in accordance with NOAA's National Marine Sanctuary Program (15 CFR Part 922)

6. California Public Utilities Commission (CPUC) Certificate of Public Convenience and Necessity

7. Central Coast Regional Water Quality Control Board (RWQCB) National Pollutant Discharge Elimination System (NPDES) General Permit for Discharges of Storm Water Associated with Construction Activity under Section 402 of the Clean Water Act.

8. RWQCB Porter-Cologne Water Quality Control Act Waste Discharge Requirements

9. California Department of Fish and Wildlife (CDFW) Section 1602 Lake/Streambed Alteration Agreement.

10. CDFW and USFWS limitations near active nests per the Migratory Bird Treaty Act.

11. CDFW California Endangered Species Act Section 2081 Incidental Take Permit.

12. RWQCB 401 Water Quality Certification for the discharge of dredged or fill materials

13. RWQCB Potable Water Discharges Permit

14. California Coastal Commission (CCC) California Coastal Act Coastal Development Permit (CDP)

15. California Department of Public Health (CDPH) Permit to Operate a Public Water System

16. California Department of Transportation (Caltrans) Encroachment Permits

17. California Department of Toxic Substances Control (DTSC) hazardous waste management and disposal requirements under Title 22, Division 4.5, Chapter 11, Article 3, Soluble Threshold Limit Concentrations (STLC)/Total Threshold Limits Concentrations (TTLC)

18. California State Lands Commission (CSLC) New Land Use Lease and Amended Land Use Lease

19. California Department of Health Services Office of Drinking Water: Variance for exceptions to their regulations regarding separation requirements for water and sewer lines

20. Monterey County Public Works Department Encroachment Permit and Tree Removal Permit

21. Monterey County Health Department, Environmental Health Division Well Construction Permit and Permit to Construct Desalination facility

22. Monterey County Planning and Building Inspection Department

    a. Conditional Use Permit

    b. Grading Permit

    c. Digging and Excavation Permit

    d. Erosion Control Permit

23. Monterey Peninsula Water Management District (MPWMD) Water System Expansion Permit from Ordinance 96 of the MPWMD Board of Directors

24. Monterey Bay Unified Air Pollution Control District (MBUAPCD) Authority to Construct permit and Permit to Operate

25. Transportation Agency for Monterey County (TAMC) Encroachment Permit

E. In the event of a conflict or discrepancy between this Section and any other Specification Section, then the language of this Section will prevail.

## 1.02 RELATED DOCUMENTS AND SECTIONS

A. Section 01060 – Regulatory Requirements

B. Section 01150 – Water Treatment and Disposal

C. Section 01300 – Contractor Submittals

D. Section 01313 – Construction Schedule Constraints

E. Section 01400 – Quality Control

F. Section 01510 – Temporary Utilities

G. Section 01530 – Protection of Existing Facilities

H. Section 01561 – SPP, Erosion and Sediment Controls

I. Section 01656 – Pressure Pipeline Testing and Disinfection

J. Section 02111 – Disposal of Excavated Materials

K. Section 02270 – Erosion and Sediment Control

L. Section 02140 – Dewatering

M. Section 02200 – Earthwork

N. Section 02160 –Excavation Support Systems

O. Section 02340 – Boring and Jacking

P. Section 02413 – Horizontal Directional Drilling

Q. Section 02930 – Seeding

## 1.03 REFERENCES

A. Appendix with Maps of Preliminary Biological Surveys Performed by AECOM.

B. Appendix with Project Permits

C. Monterey Peninsula Water Supply Project Draft EIR/EIS.

D. "Pruning Guidelines" adopted by the California Department of Forestry and Fire Protection.

## 1.04 DEFINITIONS AND ABBREVIATIONS

- Avoidance Area: Work not allowed in areas shown on drawings as "Avoidance Area" without prior OWNER approval
- Best Management Practices (BMP): See Sections 01561 – SPP, Erosion and Sediment Controls and 02270 – Erosion and Sediment Control.
- California-American Water (CAW, the project Owner)
- California Code of Regulations (CCR)
- California Coastal Commission (CCC)

- California Department of Fish and Wildlife (CDFW)
- California Department of Public Health (CDPH)
- California Department of Toxic Substances Control (DTSC)
- California Department of Transportation (Caltrans)
- California Environmental Quality Act (CEQA)
- California Public Utilities Commission (CPUC)
- California Regional Water Quality Control Board (RWQCB)
- California State Lands Commission (CSLC)
- Change Order Request (COR)
- Coastal Development Permit (CDP)
- Construction Risk and Spoils Management Plan (CRSMP)
- Construction Work Limit: Area to which CONTRACTOR shall confine work activities.
- Environmental Inspector: OWNER Representative assigned as necessary to inspect the work and verify CONTRACTOR's compliance with applicable requirements. Environmental Review Officer (ERO): the Environmental Review Officer designated by the OWNER for this project.
- Environmental Impact Report (EIR)
- Federal Endangered Species Act (FESA)
- Groundwater Management Plan (GMP)
- Migratory Bird Treaty Act (MBTA) Mitigation Monitoring and Reporting Program (MMRP): The Public Resources Code requires the adoption of a reporting or monitoring program to ensure compliance during project implementation. The mitigation measures included in this project's MMRP will be identified in brackets by the resource type and mitigation number as identified in both the MMRP and FEIR (e.g., [BIO-1, AIR-4, NOI-2, CR-1a, etc.]).
- National Environmental Policy Act (NEPA)
- National Historic Preservation Act (NHPA)
- National Marine Fisheries Service (NMFS)
- National Oceanic and Atmospheric Administration (NOAA)
- National Pollutant Discharge Elimination System (NPDES)
- Leq: The level of constant sound energy that is equivalent to the time-varying sound energy over a specified time (e.g., over 15 minutes, 1 hour, or several hours). For this

project, Leq references the equivalent level of sound for a 1-hour period, unless otherwise noted.

- Lmax: The maximum A-weighted noise level recorded for a single noise event
- Monterey Bay Unified Air Pollution Control District (MBUAPCD)
- Monterey Peninsula Water Management District (MPWMD)
- Regional Water Quality Control Board (RWQCB)
- State of California Public Utility Commission: Lead agency for environmental review pursuant to the California Environmental Quality Act.
- Sensitive Resources: Biological species, cultural resources, or other resources that are to be protected from construction activities. Sensitive resources are identified in environmental permits and mitigation measures, and include, but are not limited to, wetlands, streams, riparian vegetation, California tiger salamander, migratory birds, raptors, cultural and paleontological resources.
- Soluble Threshold Limit Concentrations (STLC)
- Special-status Species: Species listed as threatened, endangered, fully-protect by the USFWS and CDFW and species of concern by CDFW. See Draft EIR for complete list.
- Specialty Environmental Monitor: OWNER Representative who will monitor resource protection or conduct surveys within a specific area of expertise (cultural, biological, or paleontological resources) where required during construction.
- Standard Construction Measures (SCM): The OWNER has established Standard Construction Measures that will be included in the project's FEIR. As applicable, CONTRACTOR required measures are included in this section and are identified in brackets (e.g., [SCM]).
- State Historic Preservation Officer (SHPO)
- Stormwater Pollution Prevention Plan (SWPPP)
- Total Threshold Limits Concentrations (TTLC)
- Transportation Agency for Monterey County (TAMC)
- Tribal Historic Preservation Officer (THPO)
- United States Fish and Wildlife Service (USFWS): Excerpts from the USFWS and/or NMFS Biological Opinion (BO) Conservation Measure (CM) and Terms and Conditions (TM) will be identified in brackets (e.g., "[BO CM 1, BO CM 22, BO TM 1 and BO TM 2a, etc.]").
- United States Army Corps of Engineers (USACE): Excerpts from the COE Section 404 permit will be identified in brackets (e.g., "[USACE 1, USACE 2, etc.]").

## 1.05 SUBMITTALS

A. General – CONTRACTOR shall make submittals to OWNER in accordance with Section 01300.

B. Prepare, submit, and implement the following plans:

1. Soil and Groundwater Management Plan – Prepare and submit plan no less than 70 days prior to commencement of construction activities. [Also see Draft EIR/EIS Mitigation Measure (MM) 4.7-2b]

2. Site-Specific Health and Safety Plan – Prepare and submit plan no less than 30 days prior to commencement of construction activities per Article 3.10D.

3. Storm Water Pollution Prevention Plan (SWPPP) – In accordance with State Water Resources Control Board NPDES General Permit for Stormwater Discharges Associated with Construction Activity (Water Quality Order 2009-0009-DWQ, NPDES No. CAS000002) Prepare and submit SWPPP no less than 70 days prior to any earthwork for review and approval by OWNER and the RWQCB in accordance with Section 01561 and 02270. Plan shall identify erosion and sediment control measures (BMPs) to protect water quality of creeks and wetlands.

4. Groundwater Dewatering Control and Disposal Plan – Prepare and submit at least 70 days prior to commencement of construction activities in accordance with this section and Section 01150 and 02140. Plan shall identify procedures for handling, treatment, and discharge of groundwater encountered during excavation.

5. Traffic Control and Safety Assurance Plan – Submit the existing or, where necessary, a new or revised plan in accordance with Section 01570 for review and approval prior to construction. Submit final plan no less than 30 days prior to construction.

6. Dust Control Plan – Prepare and submit at least 60 days prior to commencement of construction activities in accordance with Article 3.5D.

7. Emergency Response Plan – Prepare and submit 45 days prior to commencing construction activities in accordance with Article 3.8B.

8. Construction Waste Reduction and Recycling Plan – Prepare and submit 30 days prior to commencing construction activities in accordance with Article 3.8C.

9. Noise Control Plan – Submit as specified in Article 3.6D and 3.6E below.

C. The CONTRACTOR shall allow time for the following plans to be developed by OWNER or chosen Owner Representative prior to any construction related activities:

1. Habitat Mitigation and Monitoring Plan – OWNER shall develop and submit a Habitat Mitigation and Monitoring Plan (HMMP) to the appropriate resource agencies (CCC, CDFW, CCRWQCB, USACE, USFWS, and local agencies that require a habitat mitigation and monitoring plan) for approval prior to project construction.

2. Frac-out Contingency Plan - OWNER shall retain a licensed geotechnical engineer to develop a Frac-out Contingency Plan (Plan) for the Horizontal Direction Drilling (HDD) installation. The Plan will incorporate the Frac-out Plan submitted by the CONTRACTOR. CAW will submit the plan to the appropriate resource agencies (CDFW, CCRWQCB, USACE, USFWS, NMFS, and local agencies with land use jurisdiction) for approval prior to the start of construction of any pipeline that will use HDD installation.

D. Prepare and submit the following report, inventory, log, photographic, and video submittals to OWNER:

1. Construction Equipment Efficiency Plan - Using a qualified professional (i.e., construction planner/energy efficiency expert), the CONTRACTOR shall prepare a Construction Equipment Efficiency Plan that identifies the specific measures that the construction CONTRACTOR and its SUBCONTRACTORS will implement as part of project construction and decommissioning to increase the efficient use of construction equipment to the maximum extent feasible.

2. Construction Equipment Tune-Up Log – Develop a schedule of low-emissions tune-ups for all equipment and maintain a log of the performed tune-ups. Submit copy of the log to the OWNER on a monthly basis.

3. Submit report with data documenting the existing baseline 1-hour Leq and 24-hour Ldn noise levels at the adjacent residential property lines at each work area two weeks prior to mobilization.

4. Submit noise and vibration monitoring data results weekly.

5. Maintain log of noise complaints and notifications and submit to OWNER’s monthly.

6. Maintain written records of all BMPs installed, inspections, maintenance activities, corrective actions, and visual observations of offsite discharge of sediment or other pollutants. Submit to OWNERmonthly.

7. Maintain written records of all spills and cleanup activities. Submit to OWNER monthly.

8. Document testing of potable and groundwater discharges and submit to OWNER weekly.

## 1.06 QUALITY ASSURANCE

A. The OWNER will inspect and monitor CONTRACTOR's adherence to the requirements specified herein and will report on CONTRACTOR's compliance pursuant to CEQA, NEPA and regulatory agency permits.

1. Said inspection, monitoring, and reporting activities may include, but are not limited to, qualitative, quantitative and photographic observations and data collection on the impacts of noise, vibration, air quality, traffic, street pavement damage, water quality, cultural resources, biological resources, and hazardous materials.

2. CONTRACTOR shall cooperate with such inspection and monitoring activities, provide access to the Work site to establish and secure monitoring stations, and make its facilities and records available to the OWNER for performing such monitoring.

B. The OWNER will issue a Non-Compliance Notice to the CONTRACTOR for any detected non-compliance with the provisions herein and for any other environmentally objectionable acts. The CONTRACTOR shall take immediate corrective action and respond in accordance with Section 01400 – Quality Control.

## 1.07 ACCOUNTABILITY AND REMEDIAL ACTION

A. CONTRACTOR shall be held responsible for any damage to natural vegetation, wildlife, cultural resources, waters of the United States and water quality, and any other environmental resources resulting from CONTRACTOR operations, located either:

1. Outside the Work areas permitted in the Contract Documents, or

2. Inside the Work areas but clearly marked by OWNER on the Contract Drawings or in the field to indicate that avoidance of that sensitive resource is required.

B. Requirements contained in this Section are based on anticipated conditions attached to the environmental permits and agreements obtained by the OWNER. CONTRACTOR shall review and comply with conditions per the resource agency permits acquired by the OWNER when they become available. Violation of these conditions can result in monetary fines, requirements for restoration of or compensation for damage, additional environmental training, or stoppage of Work. Costs or fines resulting from non-compliance with the requirements of the Contract Documents or violation of conditions of permits and agreements shall be paid by the CONTRACTOR at no additional cost to the OWNER.

## 1.08 CHANGE REQUESTS AFFECTING ENVIRONMENTAL REQUIREMENTS

A. Should CONTRACTOR submit a Change Order Request (COR) or propose some other type of change that may affect or propose modifying some aspect of the Project's environmental requirements (i.e., CEQA requirements, permit requirements, or agency agreements), the OWNER will conduct a preliminary review of such COR or change proposal to determine whether detailed review is warranted and can be completed within the timeframe needed by the CONTRACTOR. Note that such change requests may require concurrence from a regulatory agency (e.g., US Army Corps of Engineers, US Fish and Wildlife Service, National Marine Fisheries Service, California Department of Fish and Wildlife), the State of California Public Utilities Commission (the CEQA Lead Agency), or the Monterey Bay National Marine Sanctuary, or MBNMS (the NEPA Lead Agency), and, therefore, the review process may be lengthy. Change requests may be approved, approved with conditions, or denied based on various factors.

B. Requests that will require review and concurrence from the OWNER, regulatory agencies and/or the CEQA and NEPA Lead Agencies include but are not limited to the following:

1. New access roads and truck turnaround/turnouts including road widening

2. Use of private well, deep quarry pit, or reservoir for water source

3. Use of additional or expanded staging areas or work areas, for example:

    a. Requests for use of yard or staging area that has a previously graded or otherwise improved (graveled or paved) surface.

    b. Request for use of a staging area or yard in a plowed or cultivated agricultural field.

    c. Request for use of extra workspace to store spoils, materials, or equipment outside of approved construction work limits.

C. In cases where the CONTRACTOR requests extra space outside the construction work limits shown on the drawings, such extra space shall not impinge upon the limits of sensitive resources shown on the environmental drawings or identified through field surveys.

D. Additionally, requests to obtain water from any water body, such as a farmer or rancher's pond will not be approved if the water body is in potential sensitive resource habitat (e.g., California tiger salamander).

## 1.09 ENVIRONMENTAL TRAINING PROGRAM

A. CONTRACTOR and all SUBCONTRACTOR personnel shall allow time for attending environmental training conducted by the Owner Representative prior to accessing or performing work in the project construction work limits.

B. Supervisory Level Training – All construction staff at the foreman level and above shall attend a training that will last no more than 4 hours. The training will be conducted at the project site office or as otherwise designated.

C. Crew Level Training – All other field personnel shall attend a training that will last no more than 1 hour. The training will take place at the project site office, on an ongoing as-needed basis during construction. Owner Representative will establish a schedule and may provide additional trainings with at least 8 hours' notice from CONTRACTOR that training will be needed.

D. Prior to accessing or performing work in the work limits, all CONTRACTOR personnel and their SUBCONTRACTORS shall:

1. Sign an agreement acknowledging their intent to conform to the environmental measures addressed in the training program (provided by the Owner Representative after completion of the training).

2. Display an environmental training hard hat decal at all times when working within the project construction work limits (provided by the Owner Representative after completion of the training).

3. For any CONTRACTOR or SUBCONTRACTOR personnel involved in soil-disturbing activities, an archaeological resource "ALERT" sheet will be distributed at the training by the Owner Representative and CONTRACTOR and SUBCONTRACTOR personnel shall review said sheet.

E. Owner Representative may require CONTRACTOR personnel to attend additional environmental training in response to CONTRACTOR non-compliance.

## PART 2 PRODUCTS

### 2.01 MATERIALS

A. Orange Barrier Fence: Install minimum 3 to 4 feet tall orange plastic mesh fence to prevent access to areas containing sensitive resources (e.g., around trees and historical resources to be protected) as identified by the OWNER. Attached to stakes or posts a minimum of every 6 to 10 feet or as needed to provide sturdy support.

B. Silt Fence: Install to prevent sediments in runoff from construction areas from entering wetlands, water bodies or other sensitive resource areas as identified by the OWNER. Fence shall be tightly woven geotextile materials or other approved material as specified

in Section 02270 and shown on the drawings. Install a minimum of 42 inches above ground and buried 4 to 6 inches below ground. Secure to stakes or posts a minimum of every 5 feet. Silt Fencing shall be in accordance with local and State Guidelines for Best Management Practices.

C. Fiber rolls: Erosion-control materials (e.g., wattles made of straw or rice straw) shall be certified, weed-free. OWNER approval required for all erosion control materials.

## PART 3 EXECUTION

### 3.01 TIMING AND SCHEDULE RESTRICTIONS

A. Conduct authorized tree and shrub removal during the non-breeding season (generally August 31 through February 15) to avoid impacts to for migratory birds and raptors and special-status bat species. If these activities must occur during the breeding season for special-status bats and/or birds (February 15 through August 31), Owner approval is required. If active nests or roosts are located, no-disturbance buffers may be established by the Owner in consultation with the CDFW.

B. Spoils hauling shall be limited to the hours specified below. Spoils generated outside of these times shall be held at the work area:

1. 7 a.m. to 7 p.m., Monday through Saturday

C. Pile driving and other high noise/high vibration activities shall generally be limited at all work sites to daytime hours (7 a.m. to 7 p.m.), Monday through Saturday. Pile driving and other high noise/high vibration activities on Sundays and during night time hours (7 p.m. to 10 a.m.) will be allowed only if CONTRACTOR demonstrates by a qualified vibration consultant that vibrations will not exceed 0.1 in/sec peak particle velocity (PPV) at the nearest residential receptor. Overall, nighttime construction activities are to be avoided unless authorized by the Owner. As specified below in Articles 3.6 and 3.7.

D. Noise and Vibration restrictions: As specified below in Articles 3.3, 3.6, and 3.7.

E. Flaggers or other equivalent traffic control safety measures are required during school morning arrival (7:00 to 8:00 a.m.) and afternoon release (2:00 to 3:00 p.m.) times or as otherwise directed by the Owner.

### 3.02 HYDROLOGY AND WATER QUALITY

A. Stormwater and Groundwater Dewatering Discharges

1. Stormwater and groundwater dewatering discharges shall comply with the RWQCB National Pollutant Discharge Elimination System (NPDES) General permit for storm water discharges associated with construction and land disturbance activities (Order No. 2009-0009-DWQ, as amended, NPDES No.

CAS000002). Available Online At: http://www.waterboards.ca.gov/water_issues/programs/stormwater/constpermits.shtml

2. Prepare and submit a final Stormwater Pollution Prevention Plan (SWPPP) as specified. Implement the measures identified in the SWPPP to prevent transport of sediment or other pollutants (e.g., fuels, paints, etc.) via storm water runoff to any creeks and wetlands during and after project construction.

    a. At a minimum, the SWPPP must include the following:

        1) A description of construction materials, practices, and equipment storage maintenance;

        2) A list of pollutants likely to contact stormwater and site specific erosion and sedimentation control practices;

        3) A list of provisions to eliminate or reduce discharge of materials to stormwater;

        4) BMPs for fuel and equipment storage;

        5) Non-stormwater management measures to manage pollutants generated by activities such as paving operations and vehicle and equipment washing and fueling;

        6) The requirement that the appropriate equipment, materials, and workers be available to respond rapidly to spills and/or emergencies. All corrective maintenance or BMPs must be performed as soon as possible, depending upon worker safety; and

        7) On-site post-construction controls**.**

    b. BMPs shall be consistent with approved final SWPPP and are subject to review and approval by Owner Representative and by the RWQCB. Section 01561includes recommended measures for inclusion in the CONTRACTOR's final SWPPP.

    c. Include emergency procedures to be followed in event of accidental releases of hazardous materials used or stored by project.

3. All exposed/disturbed areas shall be stabilized where sediment or other pollutants have the potential to leave the work site and enter creeks and wetlands.

4. CONTRACTOR shall regularly inspect, maintain, and repair all erosion and sediment controls. At a minimum, such inspections shall be carried out before, during, and after each storm event.

5. Erosion control matting, if used, shall be free of synthetic material, such as plastic monofilament netting.

B. Drinking Water Discharges

1. Drinking water discharges shall comply with the RWQCB Waste Discharge Requirements for the California-American Water System (Order No. Order WQ 2014-0194-DWQ, General Order No. CAG140001).

C. Any discharges to storm drains shall comply with the NPDES General Permit for WDRs for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems (MS4s) (Order No. 2013-001-DWQ, NPDES No. CAS000004) to be obtained by the CONTRACTOR (see Section 01150 – Water Treatment and Disposal).

D. Soil and Groundwater Management Plan: CONTRACTOR shall prepare and submit a Soil and Groundwater Management Plan 70 days prior to start of construction that specifies how the construction CONTRACTOR will remove, handle, transport, and dispose of all excavated material in a safe, appropriate, and lawful manner.

1. The Plan must identify appropriate procedures for handling contaminated soils and groundwater should any be encountered.

2. The Plan must identify protocols for soil testing and disposal, identify the approved disposal site, and include written documentation that the disposal site will accept the waste.

3. The Plan must identify the locations at which groundwater dewatering is likely to be required, the method to analyze groundwater for hazardous materials, and the appropriate treatment and/or disposal methods.

4. CONTRACTOR shall be solely and fully responsible for compliance with all laws, rules, and regulations applicable to the identification, transportation, and disposal of hazardous materials, including those encountered in excavated soil or dewatering effluent.

E. Groundwater Dewatering Control and Disposal Plan – Prepare and submit to the OWNER for review and approval prior at least 70 days prior to commencement of construction. The plan shall be in accordance with Section 01150 and 02140.

1. The Plan shall include but not be limited to the following:

a. Requirements to control, test, and treat the dewatering effluent as needed to minimize or avoid water quality degradation, erosion, and sedimentation in the receiving waters in conformance with the applicable RWQCB permits.

b. Identification of methods for collecting and handling water onsite for treatment prior to discharge, including locations and capacity of settling basins, treatment ponds, and/or holding tanks.

c. Identification of methods for treating water onsite prior to discharge, such as filtration, coagulation, sedimentation settlement areas, oil skimmers, pH adjustment, and other BMPs, as necessary to comply with discharge water quality requirements as specified in Section 01150 and/or applicable permits.

d. Procedures and methods for maintaining and monitoring dewatering operations to ensure that no breach in the process occurs that could result in exceedance of applicable water quality objectives.

e. Identification of discharge locations and details for erosion and scour protection/avoidance at each location.

f. Monitoring and reporting procedures in conformance with the applicable RWQCB permits identified above. At a minimum, water quality data shall be collected 50 feet upstream and 50 feet downstream of the discharge location.

2. Discharge water in a manner that does not cause erosion or scour. Any erosion and vegetation loss caused by the CONTRACTOR's activities shall be restored by CONTRACTOR, including replanting riparian vegetation. See Section 02270 and 02930 for revegetation requirements.

3. If the dewatering effluent contains contaminants that exceed the requirements of the General WDRs for Discharges with a Low Threat to Water Quality (Order No. R3-2011-0223, NPDES Permit No. CAG993001), the CONTRACTOR shall contain the dewatering effluent in a portable holding tank for appropriate offsite disposal or discharge. The CONTRACTOR will either dispose of the contaminated effluent at a permitted waste management facility or discharge the effluent, under permit, to a publicly owned treatment works such as the MRWPCA Regional Wastewater Treatment Plant.

F. During storm events, visually monitor all receiving drainage systems (e.g., creeks and storm drains) for flooding. If flooding is observed in any main or localized drainage system, decrease or cease dewatering discharges until flooding has subsided and discharge to other detention facilities (e.g., tanks) as needed.

## 3.03 PROTECTION OF CULTURAL RESOURCES

A. General Requirements

1. Unauthorized collection of prehistoric, historic, or fossil materials is strictly prohibited.

2. Training: Prior to any ground disturbing activities all CONTRACTOR personnel and SUBCONTRACTORS shall attend training conducted by the Owner Representative discussing the nature of historical, archeological, and paleontological resources and potential materials that may be encountered. [Also see Draft EIR/EIS MM 4.15-2a]

B. Historical Resources

1. Comply with DEIS/EIR Mitigation Measure 4.15-2a, Establish Archaeologically Sensitive Area, provided by the OWNER. This requires cultural resources monitoring by the OWNER during project construction in an Archaeologically Sensitive Area. If archaeological resources are encountered, the OWNER's qualified archaeological consultant can order cessation of work in the vicinity of the discovery and immediately assess the find to provide additional recommendations as necessary.

2. Install orange barrier fencing approximately 5 feet from and around the historical resources identified by the Owner Representative for protection until security improvements and pipeline connections are made as shown on drawings. Where 5 feet clearance is not feasible, the orange barrier fencing shall be installed along the face of the facility using a minimum of 3 layers of fencing to protect the facade. Orange barrier fencing shall be a minimum of four (4) feet high for visibility.

3. CONTRACTOR shall not store equipment and materials adjacent to the historical resources.

4. In advance of construction on or near the historical resources, CONTRACTOR shall meet with the OWNER to establish how construction will be conducted while protecting the historical resources.

    a. Notification: CONTRACTOR shall provide no less than 30 days notification prior to beginning improvements at all documented Archaeologically Sensitive Areas to provide OWNER's historian adequate time to document the resources.

    b. CONTRACTOR shall allow the OWNER to monitor the historical resources for damage during construction. If during construction historical

resources are inadvertently affected; CONTRACTOR shall cease work in the immediate vicinity, notify the OWNER, and resume work only at the direction of the OWNER, who will consult with an architectural historian as necessary.

C. Archaeological Resources:

CONTRACTOR shall adhere to the archaeological mitigation requirements of the Final EIR/EIS and Memorandum of Agreement with the State Historic Preservation Officer. Portions of the project may be established as Archaeologically Sensitive Areas by the Owner Representative, which would require preparation of an Archaeological Monitoring Plan and monitoring by the OWNER's archaeological consultant (Representative).

Monitoring of ground disturbance in the Archaeologically Sensitive Area will be overseen by an archaeologist who qualifies for the Secretary of Interior Standards. Construction activities within the ASA would need to be of a nature and pace that allows the archaeological monitor adequate time to inspect excavation spoils and sidewalls and halt construction in the event of an archaeological discovery. If archaeological materials are encountered, all soil disturbing activities within 100 feet of the find shall cease until the resource is evaluated. The Lead Archaeologist shall immediately notify the lead agency of the encountered archaeological resource.

If preservation in place is not feasible, the OWNER Representative shall implement an Archaeological Research Design and Treatment Plan (ARDTP). The Lead Archaeologist, Native American representatives, and the lead agency shall meet to determine the scope of the ARDTP.

D. Unanticipated Discoveries

1. If potential historical or archaeological resources, including but not limited to human remains, are discovered during construction, CONTRACTOR shall: 1) suspend all soil disturbing activities within 100 feet of the discovery, 2) immediately notify the OWNER Representative, CPUC, and MBNMS, and 3) install fencing or staking to prevent vehicles, equipment or personnel from entering the area until a Secretary of the Interior-qualified archaeologist can inspect the find and determined its significance.

2. If required by the nature of the unanticipated discovery and as directed by the OWNER, CONTRACTOR shall relocate operations and adjust the construction schedule to allow implementation of appropriate archaeological management procedures by the OWNER. If necessary, the OWNER will issue a written order to suspend work in accordance with state law and applicable mitigation measures.

3. It is assumed that 2 archeological finds will be discovered resulting in halting work in that area for 1 month each. Cost or time impacts as a result of a

suspension beyond this assumption shall be resolved by a change order in accordance with the contract documents.

4. If potential paleontological resources are discovered during construction, CONTRACTOR shall: 1) suspend all soil disturbing activities within 50 feet of the discovery; 2) immediately notify the OWNER Representative, and 3) install fencing or staking to prevent vehicles, equipment or personnel from entering the area.

5. In the event of discovery or recognition of any human remains during construction activities, such activities within 100 feet of the find shall cease and immediately notify the OWNER's Representative.

6. CONTRACTOR shall not resume work in effected area until approved by the OWNER.

## 3.04 TRAFFIC AND TRANSPORTATION

A. See Section 01570 Traffic Control for additional requirements for each area along with general mitigation requirements.

B. CONTRACTOR shall comply with all federal, state, local and any governing authority regarding their construction traffic operations.

C. Traffic Control and Safety Assurance Plan - The construction CONTRACTOR(s) shall obtain any necessary road encroachment permits prior to constructing each project component and shall comply with the conditions of approval to project implementation. As part of the road encroachment permit process, the CONTRACTOR may rely on Traffic Control Plans previously prepared by the OWNER for the pipeline alignments and submitted to affected cities and the County to obtain an encroachment permit. However, if the pipeline alignment is revised, the CONTRACTOR will be required to prepare and submit revised Traffic Control Plans via the OWNER's Representative. In that case, the CONTRACTOR shall have a registered qualified traffic engineer prepare a traffic control and safety assurance plan in accordance with professional engineering standards and submit the plan to the agencies with jurisdiction over the affected roads and recreational trails, as well as to the OWNER for review and approval. For all project construction activities that could affect the public right-of-way (e.g., roadways, sidewalks, bike paths, trails and walkways), the plan shall include measures that would provide for continuity of vehicular, pedestrian, and bicyclist traffic; reduce the potential for traffic accidents; and ensure worker safety in construction zones. Where project construction activities could disrupt mobility and access for bicyclists and pedestrians, the plan shall include measures to ensure safe and convenient access would be maintained.

A Traffic Control and Safety Assurance Plan prepared by the CONTRACTOR shall be developed on the basis of approved revisions to the detailed design plans for the project. The plan shall include, but not be limited to, the elements listed below:

**General**

1. Develop circulation and detour plans to minimize impacts on local streets. Haul routes that minimize truck traffic on local roadways and residential streets shall be used. As necessary, signage and/or flaggers shall be used to guide vehicles through the construction work areas.

2. Implement a public information program to notify motorists, bicyclists, nearby residents, and adjacent businesses of the impending construction activities (e.g., media coverage, email notices, websites). Notices of the location(s) and timing of road closures shall be published in local newspapers and on available websites to allow motorists to select alternative routes. This provision shall be implemented in conjunction with the MMRP, i.e., Draft EIR/EIS MM 4.12-1a (Neighborhood Notice).

3. Control and monitor construction vehicle movements by enforcing standard construction specifications through periodic onsite inspections.

4. Install traffic control devices where traffic conditions warrant, as specified in the applicable jurisdiction's standards (e.g., the California Manual of Uniform Traffic Controls for Construction and Maintenance Work Zones).

5. Store all equipment and materials in designated CONTRACTOR staging areas.

6. Install detour signs to direct traffic to alternative routes around the closed road segment if alternate one-way traffic flow cannot be maintained past the construction zone.

**Roadways**

1. Post detour signs along affected roadways to notify motorists of alternative routes.

2. The CONTRACTOR shall schedule construction activities to minimize impacts during heavy recreational use periods (e.g., weekends and holidays).

3. Maintain alternate one-way traffic flow past the construction zone where possible.

4. Haul routes that minimize truck traffic on local roadways and residential streets shall be used to the extent feasible.

5. Schedule truck trips outside of peak morning and evening commute hours to minimize adverse impacts on traffic flow (e.g., if agencies with jurisdiction over

the affected roads identify highly congested roadway segments during their review of the encroachment permit applications).

6. Limit lane closures during peak hours. Travel lane closures, when necessary, shall be managed such that one travel lane is kept open at all times to allow alternating traffic flow in both directions along affected two-lane roadways; the CONTRACTOR shall use steel plates for trench backfilling to restore vehicle access at the end of each workday.

7. Restore roads and streets to normal operation by covering trenches with steel plates outside of normal work hours or when work is not in progress.

8. Comply with roadside safety protocols to reduce the risk of accidents. Provide "Road Work Ahead" warning signs and speed control (including signs informing drivers of state-legislated double fines for speed infractions in a construction zone) to achieve required speed reductions for safe traffic flow through the work zone. Train construction personnel to apply appropriate safety measures as described in the Traffic Control and Safety Assurance Plan.

9. Provide flaggers in school areas at street crossings to manage traffic flow and maintain traffic safety during the school drop-off and pickup hours on days when pipeline installation would occur in designated school zones.

10. Maintain access to commercial and private driveways.

11. Coordinate with Monterey-Salinas Transit (MST) so the transit provider can temporarily relocate bus routes or bus stops in work zones as deemed necessary.

**Pedestrians and Bicyclists**

1. Perform construction that crosses on-street and off-street bikeways, sidewalks, and other walkways in a manner that allows for safe access for bicyclists and pedestrians. Alternatively, provide safe, well-marked detours to reroute affected bicycle/pedestrian traffic.

**Recreational Trails**

1. At least two weeks prior to construction, post signage along all potentially affected recreational trails; Class I, II, and II bicycle routes; and pedestrian pathways, to warn bicyclists and pedestrians of construction activities. The signs shall include information regarding the nature of construction activities, duration, and detour routes. Signage shall be composed of or encased in weatherproof material and posted in conspicuous locations, including on park message boards, and existing wayfinding signage and kiosks, for the duration of the closure period.

At the end of the closure period, the CONTRACTOR shall retrieve all notice materials.

**Emergency Access**

1. Maintain access for emergency vehicles at all times. Coordinate with facility owners or administrators of sensitive land uses such as police and fire stations, transit stations, hospitals, and schools.

2. Provide advance notification to local police, fire, and emergency service providers of the timing, location, and duration of construction activities that could affect the movement of emergency vehicles on area roadways.

3. Avoid truck trips through designated school zones during the school drop-off and pickup hours to the extent feasible, and as required in the MMRP, i.e., Draft EIR/EIS MM 4.9-1.

**Roadway Rehabilitation Program.**

1. Prior to commencing project construction, the OWNER and the affected jurisdiction(s) shall enter into an agreement detailing the preconstruction condition of all major construction access and haul routes proposed for use by project-related construction vehicles, in addition to any appropriate post-construction roadway rehabilitation requirements. Temporary detour routes may also be included, if appropriate. The construction routes identified in the rehabilitation program must be consistent with those identified in the construction Traffic Control and Safety Assurance Plan. Roads damaged by project-related construction vehicles shall be repaired to a structural condition equal to that which existed prior to construction activities.

D. Construction Worker Parking Requirements. Prior to commencing project construction, the construction CONTRACTOR(s) shall coordinate with the potentially affected jurisdictions to identify designated worker parking areas that would avoid or minimize parking displacement in congested areas of Marina, Seaside, and unincorporated Monterey County. The CONTRACTORs shall provide transport between the designated parking location and the construction work areas. The construction CONTRACTOR(s) shall also provide opportunities and incentives for workers to carpool or take public transportation to the construction work areas, including staging areas. The engineering and construction design plans shall specify that CONTRACTORS limit time of construction within travel lanes and public parking spaces and provide information to the public about locations of alternative spaces to reduce parking disruptions. [Also see Draft EIR/EIS MM 4.9-7.]

## 3.05 AIR QUALITY AND GREENHOUSE GAS EMISSIONS

A. CONTRACTOR is informed that criminal and/or civil penalties may be imposed on any person who violates any rule, regulation, permit or Order of the State Air Resources Board or Monterey Bay Unified Air Quality Management District (MBUAPCD) that is adopted to control and contain air emissions.

B. Implement the following measures to reduce Greenhouse Gas emissions:

1. Training: All CONTRACTOR personnel and SUBCONTRACTORS shall attend training conducted by the OWNER Representative discussing greenhouse gas emissions.

2. Maintain tire inflation to the manufacturers' inflation specifications on all construction vehicles and delivery trucks.

3. GHG Emissions Reduction Plan. ***Energy Conservation Technologies.*** CONTRACTOR shall have a qualified professional prepare and submit a GHG Emissions Reduction Plan (Plan) to OWNER for review prior to submittal to the CPUC and the MBNMS for approval in advance of the start of project construction activities. Once approved by the CPUC and the MBNMS, the Plan shall be implemented by the CONTRACTOR. The Plan shall include a detailed description of the carbon footprint for <u>all operational components</u> of the approved project (e.g., slant well pumping, the MPWSP Desalination Plant, transmission of source and product water, ASR system) based on manufacturer energy usage specification data for piece of equipment and the most current PG&E power system emissions factor for GHG emissions.

4. Construction Equipment Efficiency Plan. CONTRACTOR shall prepare and implement measures identified in the Construction Equipment Efficiency Plan as part of project construction to increase the efficient use of construction equipment to the maximum extent feasible. Such measures shall include, but not necessarily be limited to: procedures to ensure that all construction equipment is properly tuned and maintained at all times; a commitment to utilize existing electricity sources where feasible rather than portable diesel-powered generators; consistent compliance with idling restrictions of the state; and identification of procedures (including the use of routing plans for haul trips) that will be followed to ensure that all materials and debris hauling is conducted in a fuel-efficient manner. The OWNER shall contract a qualified professional (e.g., construction planner/energy efficiency expert) to prepare a Construction Equipment Efficiency Plan. It shall be submitted to CPUC for review and approval at least 30 days prior to the beginning of construction activities (see Draft EIR/EIS MM 4.18-1).

C. CONTRACTOR is responsible for any damage resulting from dust originating from its operations.

D. Dust Control Plan: CONTRACTOR shall prepare and implement a Dust Control Plan that includes, at a minimum, the following dust control measures and conforms to Draft EIR/EIS MM 4.10-1c:

1. Water all active construction areas at least twice daily (from non-potable sources where there is a reasonably available source of reclaimed or County Health Department-approved sub-potable water appropriate for such use); frequency should be based on the type of operation, soil, and wind exposure. All hoses used in connection with construction activities shall be equipped with a shutoff nozzle (if available, an automatic shutoff nozzle).

2. Cover and maintain at least 2 feet of freeboard on all trucks hauling soil, sand, and other loose debris on public roads.

3. Unpaved access roads, parking areas, and staging areas at construction sites shall either be paved, watered at least three times daily, or nontoxic soil stabilizers shall be applied.

4. Sweep paved access roads, parking areas, and staging areas at construction sites daily with water sweepers when not raining.

5. Sweep adjacent streets daily with water sweepers if visible soil material is carried onto adjacent public streets because of construction activities.

6. Apply hydroseed or nontoxic soil stabilizers to all inactive, previously graded areas that will inactive for 10 days or more.

7. Enclose, cover, or water twice daily exposed stockpiles (dirt, sand, etc.).

8. Limit traffic speeds on unpaved roads to 15 mph (miles per hour)

9. Install effective erosion and sediment control measures to prevent soil runoff to public roadways per Section 02270 and approved SWPPP.

10. Replant disturbed areas as quickly as possible, per Section 02930, Seeding.

11. Post a publicly visible sign that specifies the telephone number and person to contact regarding dust complaints. This person shall respond to complaints and take corrective action within 48 hours. The phone number of the MBUAPCD shall also be visible to ensure compliance with MBUAPCD rules.

12. Limit grading activities during periods of high wind (over 15 mph).

E. CONTRACTOR shall implement the following MBUAPCD measures to limit engine exhaust emissions: [Policy OS-10.9]

1. On road vehicle idling time shall be minimized and shall not exceed a five minute maximum. Additionally, off-road engines shall not idle for longer than five minutes per Section 2449(d)(3) of Title 13, Article 4.10, Chapter 9 of the California Code of Regulations. Clear signage of this requirement shall be provided for construction workers at all access points to construction areas, per Draft EIR/EIS Mitigation Measure 4.10-1b.

2. CONTRACTOR's operations shall be in accordance with Section 93115, Title 17, CCR, Airborne Toxic Control Measure for Stationary Compression Ignition Engines that specifies fuel and fuel additive requirements; emission standards for operation of any stationary, diesel-fueled, compression-ignition engines; and operation restrictions within 500 feet of school grounds when school is in session.

3. Properly tune and maintain equipment used on the project in accordance with manufacturer specifications.

4. Perform monthly low-emissions tune-ups for all petroleum fuel powered equipment used on the project.

    a. Maintain a construction vehicle maintenance log for each CONTRACTOR-owned and/or maintained vehicle indicating the date and a description of all preventative maintenance, the individual who performed the maintenance; and other information related to the vehicle. The construction vehicle maintenance and low-emissions tune-up log shall be submitted to the OWNER on a monthly basis throughout the duration of the project.

    b. Low-sulfur fuels. Low-sulfur fuels shall be used in all stationary and mobile equipment. Submit documentation of fuel usage on a monthly basis along with vehicle maintenance logs.

F. For diesel-fueled off-road construction equipment of more than 50 horsepower, the construction CONTRACTOR shall make a good faith effort to use available construction equipment that meets the highest USEPA-certified tiered emission standards. For all pieces of equipment that would not meet at least Tier 3 emission standards, construction CONTRACTOR shall provide to the CPUC documentation from two local heavy construction equipment rental companies that indicates that the companies do not have access to higher-tiered equipment for the given class of equipment. Such documentation shall be provided to the CPUC at least two weeks prior to the anticipated use of those pieces of equipment. [Also see Draft EIR/EIS MM 4.10-1a.]

G. Notification: Immediately notify OWNER of complaints related to air quality.

**3.06 NOISE**

A. This section presents noise performance standards. See Article 3.7 and Article 3.3 for additional vibration requirements.

B. In areas where there are adjacent residences within the project construction boundary, the CONTRACTOR shall retain a qualified noise consultant to document the existing baseline 1-hour $L_{eq}$ and 24-hour $L_{dn}$ noise levels at the adjacent residential property lines, if present, at each work area for a minimum of 2 weeks prior to construction and submit results to OWNER. In addition, the CONTRACTOR shall also ensure the following:

1. The CONTRACTOR shall identify the number and location of monitoring locations and relation to sensitive receptors.

2. The CONTRACTOR shall establish a schedule for ongoing monitoring and reporting of construction noise levels to meet performance standards.

3. The CONTRACTOR shall schedule tests to confirm construction noise levels and effectiveness of noise control measures prior to commencement of substantial noise-generating activities such as grading, earthmoving, demolition.

4. Monitoring shall occur at least weekly, and more often if needed, in response to complaints.

5. Monitoring records shall be provided to the OWNER at least weekly or more often if requested by the OWNER if noise complaints occur.

6. The CONTRACTOR shall not resume operations before correcting conditions that cause excessive noise or vibration, subject to approval by the OWNER. CONTRACTOR shall not be entitled to additional compensation or extension of contract time for suspended operations because of its failure to meet specified noise and vibration criteria

7. CONTRACTOR shall pay any and all fines and penalties that may be levied for violations pertaining to noise and vibration thresholds specified herein, at no additional cost to the OWNER

8. In the event that any monitoring results indicate exceedance of noise or vibration thresholds, the CONTRACTOR shall immediately notify the OWNER and local municipality of the exceedance, identify the source and cause of the exceedance, implement corrective actions, and provide documentation to the OWNER and local municipality that subsequent noise and vibration levels are within acceptable limits

C. Construction-caused noise shall not exceed the following noise thresholds or established time limits without authorization by the OWNER:

| | Exterior Noise Levels | Interior Noise Levels |
|---|---|---|
| Speech Interference | 70 dBA | 45 dBA |
| Sleep Interference | 60 dBA | 35 dBA |

The County of Monterey: Section 10.60.030 of the County's Noise Ordinance prohibits the operation at any time of day of "any machine, mechanism, device, or contrivance which produces a noise level exceeding 85 dBA, measured fifty feet" from the noise source. This ordinance is only applicable to noise generated within 2,500 feet of any occupied dwelling unit. The County should require ambient sound levels to be less at night (10 p.m. to 7 a.m.) than during the day.

| Nighttime Only | Standard (dBA) |
|---|---|
| Nighttime hourly equivalent sound level (Leq) | 45 |
| Maximum level (Lmax) | 65 |

Note: In the event the measured ambient noise level exceeds the applicable noise level standard, the applicable standard shall be adjusted to equal the ambient noise level.

D. Noise Control Plan for Nighttime Pipeline Construction. The CONTRACTOR shall submit a Noise Control Plan for all nighttime pipeline work to the OWNER for review and approval 60 days prior to the commencement of project construction activities. The Noise Control Plan shall identify all feasible noise control procedures to be implemented during nighttime pipeline installation in order to reduce noise levels to the extent practicable at the nearest residential or noise sensitive receptor. At a minimum, the Noise Control Plan shall require use of moveable noise screens, noise blankets, or other suitable sound attenuation devices be used to reduce noise levels during nighttime pipeline installation activities below 60 dBA Leq [see Draft EIR/EIS MM 4.12-1c]. The Noise Control Plan for nighttime construction shall also include, but is not limited to, the following nighttime construction noise controls:

1. Operation of equipment requiring the use of back up beepers shall be minimized near sensitive receptors to the extent feasible during nighttime construction work hours between 10 p.m. to 7 a.m. If nighttime work requires backwards movement and the use of backup alarms results in the exceedance of noise level thresholds specified herein, CONTRACTOR shall implement alternative methods such as the use of "smart" alarms, radar activated backup alarms, or administrative controls such as use of a spotter to direct the backing operation and planning activities to minimize backwards movement. Backup warning alarms shall comply with Cal-OSHA requirements (Title 8, CCR). Alternatively, or in

conjunction with the above, obtain approval from Cal/OSHA to use alternative systems with lower noise levels, such as those listed below.

a. "Smart" alarms with an audible range of 77 to 97 A-weighted decibels (dBA), which limit the warning signal to 5 dBA over ambient noise levels.

b. Radar presence-sensing alarms, which identify objects in the reversing path of a truck;

c. "bbs-tek" broadband backup alarm system, which uses a broadband sound instead of a more noticeable single-frequency sound.

d. Strobe lights instead of audible alarms (particularly for night use).

E. Noise Controls: CONTRACTOR shall implement effective noise control measures, as necessary, during construction activities (including mobilization and demobilization) to maintain noise levels below the specified noise thresholds. CONTRACTOR shall be responsible for ensuring that all implemented noise and vibration control measures are installed and used correctly. Control measures include but are not limited to the following:

1. General Noise Control For Construction Equipment [e.g., per Draft EIR/EIS MM 4.12-1b]: The construction contractor(s) shall assure that construction equipment with internal combustion engines have sound control devices at least as effective as those provided by the original equipment manufacturer. No equipment shall be permitted to have an unmuffled exhaust. The CONTRACTOR will ensure that best available controls techniques including mufflers, intake silencers, ducts, engine enclosures and acoustically attenuating shields or shrouds for all construction-noise equipment and trucks are used.

a. Impact tools (e.g., jack hammers, pavement breakers, and rock drills) used for project construction shall be hydraulically or electrically powered wherever possible to avoid noise associated with compressed air exhaust from pneumatically powered tools. Where use of pneumatic tools is unavoidable, an exhaust muffler shall be placed on the compressed air exhaust to lower noise levels by up to approximately 10 dBA. External jackets shall be used on impact tools, where feasible, in order to achieve a further reduction of 5 dBA. Quieter procedures shall be used, such as drills rather than impact equipment, whenever feasible. Piles shall be installed using drilled methods wherever feasible. Pile driving using impact or vibratory methods shall be prohibited except for locations and times specifically approved in writing by OWNER.

b. The construction CONTRACTOR(s) shall locate stationary noise sources as far from nearby receptors as possible, and shall muffle and enclose

them in temporary sheds, incorporate noise barriers, or implement other noise control measures to the extent feasible. If they must be located near receptors, adequate muffling, (such enclosures) shall be installed to ensure noise thresholds specified herein are not exceeded. Enclosure openings shall be faced away from sensitive receptors. The noise controls shall be sufficient to reduce noise levels during construction activities to below the threshold of 70 dBA Leq.

c. Sound barrier material shall have a minimum surface density of pound per square foot (psf) and a minimum sound transmission class (STC) rating of 25. Sound barrier design shall be prepared by the CONTRACTOR's qualified noise consultant and shall be subject to review and approval by the OWNER prior to erection.

d. Materials stockpiles as well as staging and parking areas shall be located as far as feasible from sensitive receptors.

e. If construction is within 100 feet of school classrooms or childcare facilities, CONTRACTOR shall schedule construction activities during the summer break, on weekend or school vacation days, to the extent feasible, avoiding weekday hours when schools are in session. If construction must occur within the school session hours, construction-caused interior noise levels in any classroom shall not exceed the 70 dBA speech interference level criterion.

f. Design and construct temporary noise barriers at locations indicated on the Contract Drawings and/or as required to meet specified noise criteria.

2. For nighttime well drilling and development activities within 500 feet of residences, the line of sight between the drill rig and nearby sensitive receptors shall be blocked by portable acoustic barriers and/or shields to achieve the optimal reduction in noise levels.

3. Perform construction equipment maintenance and repair during daytime hours, when feasible. If nighttime repair is necessary to maintain operations during the nighttime hours, hammering and other high level noise activities shall be performed in such a way that a sound barrier shields the repair activity from the line of sight to nearby residences.

4. For tunneling activities at night, implement noise mitigation measures such as quiet ventilation fans, line power instead of generators, temporary sound barriers, restrict heavy equipment operation, and minimize activities requiring use of trucks (and therefore backup alarms), as necessary to meet specified noise thresholds.

F. The CONTRACTOR shall notify residents and other sensitive receptors within 300 feet of a daytime construction area and within 900 feet of nighttime construction areas of the construction location, nature of activities, and schedule, in writing, at least 14 days prior to the commencement of construction activities. The notice shall be posted along the proposed pipeline alignments, near the proposed facility sites, and at nearby recreational facilities. The OWNER shall designate a Construction Disturbance Coordinator who would be responsible for responding to construction complaints. The coordinator shall determine the cause of the complaint and ensure that reasonable measures are implemented to correct the problem. A contact number for the Construction Disturbance Coordinator shall be conspicuously placed on construction site fences and included in the notice. Prior to distributing the notice to nearby residences, the CONTRACTOR shall first submit the notice for review and approval to the MRWPCA, and City and County Staff as may be required by local regulations. This measure shall be implemented in conjunction with the noticing provisions in Section 3.4. [Also see Draft EIR/EIS MM 4.12-1a]. The CONTRACTOR shall ensure the following occurs:

1. If the local municipality informs the CONTRACTOR of noise or vibration complaints received, the CONTRACTOR shall inform the OWNER. In coordination with the OWNER, the CONTRACTOR shall modify any construction activities that generate excessive noise or vibration levels

2. If CONTRACTOR receives any noise or vibration complaints directly, CONTRACTOR shall immediately notify the OWNER.

3. OWNER will inform CONTRACTOR of noise complaints received and CONTRACTOR, in coordination with the OWNER, shall modify any construction activities that generated the excessive noise levels.

4. CONTRACTOR shall monitor noise and vibration at the construction site and adjoining buildings using acceptable equipment and methods. Monitoring shall be sufficient to measure potential building damage and effects on occupants, property and sensitive equipment.

5. The CONTRACTOR will suspend operations when noise or vibration complaints are received, damage or disturbance to adjoining property or occupants has been reported, and noise or vibration exceeds specified limits. CONTRACTOR shall restrict use of equipment causing noise or vibration disturbances so that specified limits are not exceeded.

G. Drilling CONTRACTOR Noise Measures. CONTRACTOR shall ensure that drill rigs (including jack and bore and HDD equipment) located within 500 feet of noise-sensitive receptors be equipped with noise reducing engine housings or other noise reducing technology and the line of sight between the drill rig and nearby sensitive receptors shall be blocked by portable acoustic barriers and/or shields to reduce noise levels such that drill rig noise levels are no more 60 dBA at 50 feet.

## 3.07 VIBRATION

This Article presents vibration performance standards. See Article 3.3 for additional requirements.

A. Construction caused vibration, as measured at the nearest receptor, shall not exceed the following thresholds:

| | Maximum Peak Particle Velocity (PPV), inches per second (in/sec) |
|---|---|
| Adverse human reaction (applicable all times) | 0.1 |
| All other structures (applicable all times) | 0.3 |
| Historic Buildings and Structures (applicable all times) | Refer to Article 3.3F vibration thresholds and for additional requirements. |

Note:
The vibration criteria is based on continuous or frequent intermittent sources, including impact pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.

B. Vibration Reduction Measures. Construction practices shall be utilized that do not generate vibration levels at the closest sensitive land uses above 0.1 in/sec PPV. The following measures, at a minimum, shall be employed to ensure this threshold is met:

1. Vibration monitoring shall be conducted for the first 500 feet of pipeline construction for each segment to confirm vibration levels do not exceed the above vibration threshold. If vibration levels exceed the limits of this mitigation measure, then construction practices shall be modified to use smaller types of construction equipment, operate the equipment in a manner to reduce vibration, or use alternate construction methods, and monitoring shall continue for an additional 200 feet or until construction practices meet the required vibration levels. The monitoring in this mitigation measure shall be repeated if the construction methods change in a manner that would increase vibration levels, or when structures are closer to the limits of construction than previous vibration monitoring have confirmed is below the vibration thresholds .

2. Smaller vibratory rollers shall be used to minimize vibration levels during repaving activities where needed to meet vibration limits.

3. Sheet pile driving for trenchless pipeline installation shall be conducted during per Draft DIR/EIS MM 4.12-3.

## 3.08 AESTHETIC RESOURCES

A. It is recommended that the CONTRACTOR is to maintain a clean and orderly construction site [also see Draft EIR/EIS MM 4.14-1].

B. The CONTRACTOR should allow time for CAW to implement site-specific nighttime construction lighting measures, including the use of light shields, directing lights downward, and using the minimum wattage necessary. With implementation of these measures, the temporary light impacts associated with nighttime construction of subsurface slant wells would be reduced to less-than-significant levels.

## 3.09 UTILITIES

A. Implement requirements in Section 01530 Protection of Existing Facilities.

B. Implement the following measures to avoid conflicts with existing utilities and, should they occur, respond in an appropriate and timely manner: [also see Draft EIR/EIS MM 41.3-1a/b]

1. Notify the OWNER at least two weeks in advance of any potential utility service disruption to allow OWNER to notify residents and businesses two to four days in advance of potential utility service disruption.

2. Prior to excavation, locate overhead and underground utilities that may be encountered during excavation work prior to opening an excavation.

3. Notify utility OWNER prior to excavation.

4. When a project excavation is within the approximate location of a subsurface utility, the Operator or its CONTRACTOR shall determine the exact location of the underground utility by safe and acceptable means, including with the use of hand tools and modern techniques.

5. To safeguard employees from potential accidents related to underground utilities the following would be implemented:

    a. While any excavation is open, protect, support, or remove underground utilities as necessary to safeguard employees.

    b. Provide weekly updates to OWNER and construction workers regarding the planned excavations for the upcoming week, and to specify when construction will occur near a high-priority utility (e.g., pipelines carrying petroleum products, oxygen, chlorine, or toxic or flammable gases; natural gas pipelines greater than 6 inches in diameter or with normal operating pressures greater than 60 pounds per square inch gauge; and underground electric supply lines, conductors, or cables that have a potential to ground more than 300 volts that do not have effectively grounded sheaths).

c. OWNER's construction managers shall hold regular tailgate meetings with construction staff on days when work near high-priority utilities occurs to review all safety measures—including those identified in the MMRP and in construction specifications—regarding such excavations.

d. The CONTRACTOR shall designate a qualified Health and Safety Officer that shall specify a safe distance to work near high-priority utilities. Excavation near such utility lines shall not be authorized until the designated Health and Safety Officer confirms and documents in the construction records that: (1) the line was appropriately located in the field by the utility OWNER using as-built drawings and a pipeline-locating device, and (2) the location was verified by hand by the construction CONTRACTOR. [Also see Draft EIR/EIS MM 4.13-1c.]

6. Develop an Emergency Response Plan prior to commencing construction activities. The Emergency Response Plan shall outline procedures to follow in the event of a leak or explosion. The emergency response plan shall identify the names and phone numbers of staff at the potentially affected utilities that would be available 24 hours per day in the event that construction activities cause damage to or rupture of a high-risk utility. The plan shall also detail emergency response protocols, including notification, inspection, and evacuation procedures; any equipment and vendors necessary to respond to an emergency (such as an alarm system); and routine inspection guidelines. [Also see Draft EIR/EIS MM 4.13-1d.]

7. Notify the utility company and the local fire departments any time damage to a gas utility line results in a leak or suspected leak, or whenever damage to any utility results in a threat to public safety. [Also see Draft EIR/EIS MM 4.13-1e.]

8. Promptly work with the utility provider to reconnect any disconnected utilities if encountered and impacted as soon as it is safe to do so. [Also see Draft EIR/EIS MM 4.13-1f.]

C. Implement Construction Waste Reduction and Recycling plan

1. The construction CONTRACTOR(s) shall prepare a Construction Waste Reduction and Recycling Plan identifying the types of debris the proposed project will generate and the manner in which those waste streams will be handled. In accordance with the California Integrated Waste Management Act of 1989, the plan shall emphasize source reduction measures, followed by recycling and composting methods, to ensure that construction and demolition waste generated by the project is managed consistent with applicable statutes and regulations. In accordance with the California Green Building Standards Code and local regulations, the plan shall specify that all trees, stumps, rocks, and associated vegetation and soils, and 50 percent of all other nonhazardous construction and

demolition waste, be diverted from landfill disposal. The plan shall be prepared in coordination with the Monterey Regional Waste Management District and be consistent with Monterey County's Integrated Waste Management Plan. Upon project completion, OWNER shall collect the receipts from the CONTRACTOR(s) and submit them to the CPUC as documentation that the waste reduction, recycling, and diversion goals have been met. [Also see Draft EIR/EIS MM 4.13-2.]

## 3.10 BIOLOGICAL RESOURCES

A. Lead biologist: Prior to initiation of construction, CAW and/or representatives of CAW shall retain a qualified Lead Biologist to oversee compliance with avoidance and minimization measures for all special-status species and sensitive habitats. The Lead Biologist shall be onsite, or shall appoint qualified biologists and/or qualified biological monitors to be onsite, during all fencing and ground disturbance activities. Only the Lead Biologist and/or qualified biologists may lead protocol surveys and relocate special-status species, as authorized by the resource agencies with jurisdiction over these species [also see Draft EIR/EIS MM 4.6-1a].

B. Training: Prior to any work (i.e. equipment mobilization, vegetation clearing or site grading) all CONTRACTOR field personnel, including SUBCONTRACTORS, shall attend mandatory environmental training developed and presented by the Lead Biologist on each federal and state-listed species, as well as other special-status wildlife and plant species and sensitive natural communities that may be encountered during construction activities, including but not limited to California tiger salamander, Western pond turtle, burrowing owls, and other sensitive species. The training will include a description, representative photographs, and legal status of each special-status species and the penalties for not complying with biological mitigation requirements. The training will also address noxious weed control. If new construction personnel are added to the project, CONTRACTOR shall require each new person to receive training before they start working [also see Draft EIR/EIS MM 4.6-1b].

C. Notification: Provide four weeks notification to the OWNER prior to the start of mobilization to enable OWNER Specialty Environmental Monitor to perform required biological surveys as described below.

D. Restrictions on in-channel work in stream channel and any other surface drainages encountered: See 3.01D.

E. Construction work area limits: Confine all project activities to the designated work area limits as shown in Appendix H: Maps of Preliminary Biological Surveys Performed by AECOM and provide for the following:

1. Before construction begins, CONTRACTOR shall clearly stake and flag, or fence-off construction work area limits to ensure no grading or other activities occur outside of the approved limits.

2. During construction, OWNER Representatives (e.g., QA Inspectors, Environmental Inspectors, and Specialty Environmental Monitors) will inspect and verify that construction equipment and associated activities remain within the designated work area limits.

3. Requests for use of additional work area outside of the designated work area limits: Subject to formal review and approval by OWNER Representative and applicable regulatory agencies as specified in Article 1.08.

F. General Avoidance and Minimization Measures [also see Draft EIR/EIS MM 4.6-1c]:

1. All personnel, equipment, project-related vehicles, and materials shall stay within the designated construction work area limits and shall not go outside these boundaries.

2. Project-related vehicles shall observe the posted speed limit on hard-surfaced roads and a 15- mile-per-hour speed limit on unpaved roads.

3. Provide closed garbage containers for the disposal of all food-related trash items (e.g., wrappers, cans, bottles, food scraps). All garbage shall be collected daily from the project site and placed in a closed container that shall be emptied at least weekly at an approved offsite disposal site.

4. CONTRACTOR shall ensure that any areas used for staging, laydown, material storage, equipment storage, job trailers, employee parking, or other project-related support activities are located away from jurisdictional areas, sensitive communities, and protected from stormwater run-off using temporary perimeter sediment barriers such as berms, silt fences, fiber rolls, covers, sand/gravel bags, and straw bale barriers.

5. CONTRACTOR shall store all potential contaminants on impervious surfaces, plastic ground covers, or in secondary containment to prevent any spills or leakage from contaminating the ground, and locate them at least 100 feet from adjacent habitat where practicable.

6. Personnel shall not feed or otherwise attract wildlife to the project area.

7. No pets or firearms shall be allowed in the construction work limits.

8. Vehicle or equipment maintenance shall be performed in the designated staging areas.

9. Standard best management practices (such as setbacks and use of silt fences and fiber rolls) shall be employed to prevent loss of habitat due to erosion.

10. Excavated soils shall be stockpiled in disturbed areas lacking native vegetation. Stockpile areas shall be marked by the Lead Biologist to define the limits where stockpiling can occur.

11. Fueling of construction equipment shall take place within existing paved areas, and at least 50 feet from drainages (including streams, creeks, ditches, culverts, or storm drain inlets) and native habitats.

12. Prior to the start of construction at any proposed facility site where special-status amphibians, reptiles and mammals have a moderate or high potential to occur, the construction work area boundary shall be fenced with a temporary exclusion fence to prevent special-status wildlife from entering the site during construction (see Table 4.6-6 for the list of special-status species that could be significantly impacted at each project facility site).

13. All construction pipes, culverts, or similar structures that are stored at a construction site for one or more overnight periods and with a diameter of 4 inches or more shall be inspected for special-status wildlife before the pipe is subsequently buried, capped, or otherwise used or moved in any way.

14. To prevent the inadvertent entrapment of special-status wildlife during construction, all excavated, steep-walled holes or trenches more than 2 feet deep shall be covered with plywood or similar materials at the close of each working day, or escape ramps constructed of earth fill or wooden planks shall be positioned within the excavations to allow special-status wildlife to escape on their own.

15. All temporarily disturbed areas shall be returned to pre-project conditions or better.

G. Noxious Weed Control:

1. Construction equipment must arrive to the project clean and free of soil, seed, and plant parts to reduce the likelihood of introducing new weed species.

2. Any imported fill material, soil amendments, gravel etc., required for construction and/or restoration activities that would be placed within the upper 12 inches of the ground surface shall be free of vegetation and plant material.

3. Imported erosion-control materials shall be certified weed free.

4. CONTRACTOR shall stockpile the first 6 inches of topsoil (12 inches in agricultural areas) removed during excavations and shall subsequently replace the topsoil during re-establishment of disturbed project areas.

5. Use of pesticides or herbicides is prohibited without OWNER approval.

H. Sensitive Resource Fencing:

1. Install fencing around sensitive resources. Provide no less than 2 weeks' notice to the OWNER prior to fence installation. OWNER Environmental Inspector and/or Specialty Environmental Monitor shall be on-site during fence installation. If authorized by applicable permits, OWNER will relocate sensitive species encountered during fence installation.

2. Fencing shall be installed 1 to 2 weeks prior to construction activities, including mobilization of any equipment or materials (including mobile offices). Fencing shall be located as shown on the construction drawings and as marked in the field (with pin flags) by the OWNER Environmental Inspector and/or Specialty Environmental Monitor.

   a. Wildlife exclusion fencing shall be installed along the perimeter of the construction work area limits where required. Fence shall be buried 6 inches deep, unless otherwise specified by OWNER as specified by USFWS and CDFW.

   b. Orange barrier fencing shall be installed within the work area to exclude trees, protect historical resources, and delineate avoidance areas that shall be left undisturbed.

   c. Silt fence shall be installed along edges of the work areas in the vicinity of wetlands, stream channels, or other open water bodies, and other work areas where erosion may occur.

3. Construction personnel, construction-related activities, vehicle/equipment operation, material and equipment storage, and other surface-disturbing activities are prohibited within the fenced sensitive resource areas.

4. CONTRACTOR shall furnish, install, and maintain fencing during construction and remove fencing when construction is complete.

I. Topsoil Salvage

1. Salvage, at a minimum, the top 6 inches of soil (12 inches in agricultural areas or areas containing organic-rich topsoil) during grading, blading, trenching, or other

earth moving activities. Stockpile topsoil separately from subsoils, and protect it from erosion until reused for restoration.

2. Salvaged topsoil shall be used for restoration and revegetation of temporarily disturbed areas by restoring the topsoil to the approximate location from where it was removed after backfilling with subsoil and before seeding. See Section 02930 for restoration and revegetation requirements. Restoration shall be conducted in conformance with the terms of the Habitat Mitigation and Monitoring Plan (HMMP) prepared per the MMRP, e.g., Draft EIR/EIS MM 4.6-1n.

J. Vegetation Protection

1. Minimize vegetation removal to the minimum area necessary to safely complete the project.

2. Prune or trim trees only where necessary for construction clearance. Pruning of trees shall be subject to OWNER approval and where approved shall be carried out in conformance with the "Pruning Guidelines" adopted by the California Department of Forestry and Fire Protection.

3. Avoid and minimize impacts on native mature trees or protected trees (as defined by local municipality tree ordinances) by implementing the following measures:

   a. Install orange barrier fencing where designated by OWNER's qualified arborist or Specialty Environmental Monitor.

   b. Install and maintain orange barrier fencing outside the dripline of all trees that are to be retained and that are within 50 feet of any grading, road improvements, underground utilities, or other development activity.

      For native trees on slopes, install silt fence at the upslope side of the protective fencing to prevent soil from drifting down over the root zone (if work will be performed upslope of the trees).

      CONTRACTOR equipment, vehicles, personnel, materials, and spoils shall not encroach into areas where orange barrier fencing has been installed to protect native mature trees.

K. Stream and Wetland Protection

1. Notification: OWNER is responsible for notifying CDFW within 5 working days of beginning work within a stream zone or area covered in the CDFW Section 1602 Streambed Alteration Agreement. CONTRACTOR shall notify OWNER within 10 working days so that OWNER can notify CDFW. In addition, CONTRACTOR shall notify OWNER 10 days prior to completion of work within

the stream zone or area covered in the CDFW Section 1602 Streambed Alteration Agreement so that notification can be provided to CDFW.

2. Avoid construction activities in saturated or ponded wetlands and streams shown on construction drawings and as designated in the field to the maximum extent feasible. The area of disturbance for construction shall be minimized in such areas.

3. Install silt fence adjacent to all wetlands and drainages to be avoided within 50 feet of any proposed construction activity.

4. To minimize the degradation of wetland soils and vegetation where avoidance is infeasible, protective practices such as use of geotextile cushions and other materials (e.g., timber pads, prefabricated equipment pads, geotextile fabric) or vehicles with balloon tires shall be employed in saturated conditions (e.g., when there is noticeable rutting due to saturated conditions and mixing of topsoil and subsoil).

5. Stabilize exposed slopes by implementation of appropriate erosion control measures immediately upon completion of construction activities.

6. Stabilize banks for stream channels using approved materials and methods in areas where disturbed during installation or removal of the temporary and permanent bridges. Use biodegradable materials (such as jute or coir mats) where deemed feasible and effective.

7. Placement of any soil, fill, construction debris, or other non-permanent, non-required material below the ordinary high-water mark of any stream or in any wetland area is strictly prohibited. Should any debris or soils be inadvertently deposited below the ordinary high-water mark of stream channels or wetland in the work area, such materials shall be immediately removed and set back at least 10 feet from all drainages and wetlands in the project area.

8. CONTRACTOR shall maintain a copy of the CDFW Section 1602 Streambed Alteration Agreement in their possession at the work site.

9. To the extent feasible, and subject to the approval of the OWNER Representative, CONTRACTOR shall use vegetable-based biodegradable hydraulic fluids in all equipment working in close proximity to streams or wetlands.

L. Wildlife Protection

1. CONTRACTOR personnel is prohibited from handling any and all wildlife on-site due to potential for it to be a special-status species which only agency approved staff are authorized to handle.

2. Any CONTRACTOR employee who inadvertently injures or kills a designated special-status species or who finds one dead, injured, or entrapped shall immediately report the incident to the OWNER. The OWNER will notify the appropriate resource agencies.

    a. If any special-status species are found by CONTRACTOR personnel or the OWNER Specialty Environmental Monitor within the work area, CONTRACTOR shall cease construction activities in the immediate vicinity and notify the OWNER Specialty Environmental Monitor. CONTRACTOR shall not resume work until approved by the OWNER. This may require waiting until the animal moves on its own, if possible, or handling and relocation by the Specialty Environmental Monitor if allowed by permit. As required, CONTRACTOR shall redirect work activities to avoid areas in the immediate vicinity of identified species.

    b. If a federally or state listed species is in immediate danger of being injured or killed, the OWNER Environmental Inspector and Specialty Environmental Monitor have the authority to halt construction activities until the species has been relocated out of the construction area and released into nearby suitable habitat.

    c. CONTRACTOR shall install one or more escape ramps (constructed of earth fill or wooden planks) in all excavated areas more than 2 feet deep at the end of each day to prevent entrapment and potential injury or mortality of wildlife, especially any special-status amphibian, reptile, or mammal species. If escape ramps cannot be provided, then holes or trenches shall be covered with plywood or other hard material at the end of the work day.

    d. CONTRACTOR personnel and subcontract personnel shall check under parked vehicles or equipment prior to moving for the presence of salamanders, frogs, snakes, or other sensitive species. CONTRACTOR shall immediately notify OWNER Representative if species are discovered. Vehicles and equipment shall not be moved if an animal is discovered until the animal moves on their own or is relocated by the approved Specialty Environmental Monitor.

    e. CONTRACTOR shall trim or remove trees and shrubs during the nonbreeding season (generally February 15 and August 31 for most birds) where feasible to avoid loss of active nests and potential mortality of special-status and non-special status migratory birds and special status bats. Where not feasible, CONTRACTOR shall notify OWNER at least 2 weeks in advance of trimming and tree removal.

M. Pre-construction Biological Surveys by the OWNER Specialty Environmental Monitor

1. The following information is included for information purposes for the CONTRACTOR. CONTRACTOR is not responsible for performing pre-construction biological surveys. CONTRACTOR is required to provide notification to OWNER of mobilization as specified so that OWNER can schedule the biological surveys accordingly.

2. OWNER shall perform pre-construction biological surveys. CONTRACTOR shall not initiate work activities at the project site, including equipment mobilization, until OWNER has provided formal written clearance to proceed.

3. Pre-construction surveys will be conducted for the following species:

    a. Smith's blue butterfly: OWNER shall conduct up to three surveys during the summer months of the host plants near the work area for larval caterpillars to determine the use of this area by the butterflies. If the caterpillars are found, OWNER shall monitor the work area from May through September for the butterfly. If Smith's blue butterflies are observed flying within the work area, grading and initial activities shall stop until the butterflies have left the area. At OWNER direction, activities that do not include movement of soil or vehicles may continue, including operation of the dewatering wells after installation. [Also see Draft EIR/EIS MM 4.6-1f.]

    b. Western pond turtle: Not more than 2 weeks prior to the onset of work activities (including equipment mobilization) and for 2 days immediately prior to commencing work, a Specialty Environmental Monitor will survey suitable aquatic habitat and upland habitat in the project area for western pond turtle. Surveys of creeks or ponds will include the water, bank, and associated riparian habitat within the project area and 1,500 feet of the project area. If individuals or eggs/nests are found, CONTRACTOR shall install exclusion fencing at the edge of the project boundary at the OWNER's direction to exclude turtles from entering the work area

    c. California tiger salamander: Not more than 2 weeks prior to the onset of work activities (including equipment mobilization) and immediately prior to commencing work, the Specialty Environmental Monitor will survey upland habitat in the primary study area suitable for California tiger salamanders and suitable refuge or burrow/aestivation sites. As feasible, refuge/burrow areas identified will be temporarily fenced with wildlife exclusion fencing by the CONTRACTOR at the OWNER's direction and avoided. At locations where avoidance is not feasible, the burrows will be excavated by hand by OWNER's special environmental monitor prior to construction. If a burrow is occupied, the individual animal will be moved to a natural burrow within 0.25 mile of the project area. Excavation and

relocation will only be conducted as authorized by the USFWS and CDFW. [Also see Draft EIR/EIS MMs 4.6-1n and 4.6-1o]

d. California red-legged frog: Not more than 2 weeks prior to the onset of work activities (including equipment mobilization) and immediately prior to commencing work, the Specialty Environmental Monitor will survey upland habitat in the primary study area suitable for California red-legged frog and suitable refuge or burrow/aestivation sites. As feasible, refuge/burrow areas identified will be temporarily fenced with wildlife exclusion fencing by the CONTRACTOR at the OWNER's direction and avoided. At locations where avoidance is not feasible, the burrows will be excavated by hand prior to construction. If a burrow is occupied, the individual animal will be moved to a natural burrow within 0.25 mile of the project area. Excavation and relocation will only be conducted as authorized by the USFWS and CDFW. [Also see Draft EIR/EIS MMs 4.6-1n and 4.6-1o]

e. Burrowing owl: Two weeks prior to ground-disturbing activities, Specialty Environmental Monitor will survey the project area and a 1,650-foot-wide buffer zone around it for burrowing owl burrows. If burrowing owls are detected, the following measures will be implemented:

   From February 15 through August 31 (nesting season) occupied burrows within a buffer zone determined by disturbance level will not be disturbed. CONTRACTOR shall install orange barrier fencing to delineate buffer zone if it overlaps work limits. [Also see Draft EIR/EIS MM 4.6-1h.]

f. Migratory birds and raptors: No more than 1 week prior to initiation of construction activities during the breeding season for migratory birds and raptors (i.e., between February 15 and August 31), Specialty Environmental Monitor will conduct nesting-bird surveys within 500 feet of the project site for raptors and 100 feet for migratory birds.

   If active raptor nests and/or migratory bird nests are detected, trees shall not be trimmed or removed until after the breeding season (February 15 through August 31).

g. If active raptor nests and/or migratory bird nests are detected during the breeding season, OWNER will establish, in consultation with the USFWS and CDFW an appropriate no-disturbance boundary that shall be observed until the end of the nesting season or the young have fledged (usually late-June through mid-July. [Also see Draft EIR/EIS MM 4.6-1i.]

h. Special Status Bats: No more than 1 week prior to initiation of construction activities, OWNER will survey the project area for active roosts.

If special-status bats or evidence of bats are found, trees shall not be removed until after the breeding season (February 15 through August 15).

If active bat roosts are detected during the breeding season, OWNER will establish, in consultation with the USFWS and CDFW, an appropriate no-disturbance boundary that shall be observed until the end of the nesting season or the young have fledged (usually late-June through mid-July). [Also see Draft EIR/EIS MM 4.6-1l.]

N. Specialty Environmental Monitoring by the OWNER during Construction

1. The following information is included for information purposes for the CONTRACTOR. Specialty Environmental Monitoring will be performed by the OWNER Representative.

2. CONTRACTOR is responsible for notifying OWNER in advance of working in areas where environmental monitoring is required as specified below and as shown on the Drawings.

3. Specialty Environmental Monitoring will be conducted as follows:

a. Specialty Environmental Monitor will monitor construction activities at the beginning of each work day (daily) during initial ground disturbing activities (vegetation removal, grading, and excavation) and during the rainy season. Unless the work activities require constant monitoring during the work day due to OWNER permit conditions, the Specialty Environmental Monitor will not necessarily stay onsite for the entire day. When not onsite, the Specialty Environmental Monitor will remain on-call in case animals are discovered and need to be moved. As specified above, CONTRACTOR shall immediately contact OWNER Representative in this event.

b. Once all initial ground-disturbing activities are completed, Specialty Environmental Monitor will perform routine checks of the project area at least once a week or more often if needed for the duration of construction. Environmental Inspector(s) and Specialty Environmental Monitor(s) will check to verify that perimeter fences are in good order, trenches are being covered if left open overnight (or escape ramps are being provided), project personnel are conducting checks beneath parked vehicles prior to their movement, that no individual animals are located outside or inside

the construction fencing, and that all other required biological protection measures are being complied with.

O. Habitat Restoration

1. See Section 02930-Seeding, the Habitat Mitigation and Monitoring Plan (to be provided), Biological Opinions (to be provided), MMRP and Appendix H: Maps of Preliminary Biological Surveys Performed by AECOM.

## 3.11 HAZARDS AND HAZARDOUS MATERIALS

A. CONTRACTOR shall adhere to all local, state, and federal regulations related to the use, transport, handling, and disposal of hazardous materials. See Sections 01060 and 02111 for additional requirements.

B. Environmental Site Assessment: The OWNER has prepared an Environmental database/Document Review Report for the pipeline corridors. This is provided in the contract documents. This report identifies potential locations where hazardous material contamination may be encountered during pipeline construction. The CONTRACTOR shall become familiar and shall comply with the content and recommendations of this report. The recommendations have been incorporated into Section 02111.

C. Soil and Groundwater Management Plan: CONTRACTOR shall develop and implement a Soil and Groundwater Management Plan that includes a materials disposal plan specifying how the construction CONTRACTOR will remove, handle, transport, and dispose of all excavated material in a safe, appropriate, and lawful manner. The plan must identify protocols for soil testing and disposal, identify the approved disposal site, and include written documentation that the disposal site will accept the waste. This plan shall be submitted to the CPUC for review and approval prior to commencement of construction.

As part of the Soil and Groundwater Management Plan, the CONTRACTOR shall develop a groundwater dewatering control and disposal plan specifying how contaminated groundwater (dewatering effluent), if encountered, will be handled and disposed of in a safe, appropriate and lawful manner. The plan must identify the locations at which groundwater dewatering is likely to be required, the method to analyze groundwater for hazardous materials, and the appropriate treatment and/or disposal methods.

If the dewatering effluent contains contaminants that exceed the requirements of the General WDRs for Discharges with a Low Threat to Water Quality (Order No. R3-2011-0223, NPDES Permit No. CAG993001), the CONTRACTOR shall contain the dewatering effluent in a portable holding tank for appropriate offsite disposal or discharge. The CONTRACTOR can either dispose of the contaminated effluent at a permitted waste management facility or discharge the effluent, under permit, to a publicly

owned treatment works such as the MRWPCA Regional Wastewater Treatment Plant. [Also see Draft EIR/EIS MM 4.7-2b.]

D. Site-Specific Health and Safety Plan: A CONTRACTOR Site-Specific Health and Safety Plan shall be prepared by a qualified health and safety professional in accordance with applicable laws, rules, and regulations, and in accordance with 29 CFR 1910.120. This plan shall be submitted to the CPUC for review prior to commencement of construction. The Health and Safety Plan shall include the following:

1. Designation of a trained, experienced site safety and health supervisor that is responsible for developing and enforcing the site health and safety plan.

2. A summary of all potential risks to construction workers and maximum exposure limits for all known and reasonably foreseeable site chemicals (the HSP shall incorporate and consider the information in all available existing Environmental Site Assessments and remediation reports for properties within ¼-mile using the EnviroStor Database).

3. Measures to protect construction workers and the general public by including engineering controls, monitoring, and security measures to prevent unauthorized entry to the construction area and to reduce hazards outside the construction area.

4. Specified personal protective equipment (PPE) and decontamination procedures, if needed, to be implemented in accordance with state and federal regulations if prescribed exposure levels are exceeded, for review by the OWNER prior to the start of construction.

5. Emergency procedures, including route to the nearest hospital.

6. Procedures to be followed in the event that evidence of potential soil or groundwater contamination is encountered, such as soil staining, noxious odors, debris, or previously unreported tanks or wells. These procedures shall be in accordance with hazardous waste operations regulations and specifically include, but are not limited to, the following: immediately stopping work in the vicinity of the unknown hazardous materials release, notifying Monterey County Department of Environmental Health, and retaining a qualified environmental firm to perform sampling and remediation. [Also see Draft EIR/EIS MM 4.7-2a.]

   Review of CONTRACTOR's Site-Specific Health and Safety Plan by the OWNER shall not be construed as approval of the adequacy of CONTRACTOR's health and safety professional, the CONTRACTOR's Site-Specific Health and Safety Plan, or any safety measure taken in or near the construction site. CONTRACTOR shall be solely and fully responsible for compliance with all laws, rules, and regulations applicable to the health and safety of persons during the performance of construction work.

E. The project SWPPP specified in Section 01561 shall contain provisions to prevent transport of hazardous materials to surface waters.

F. CONTRACTOR shall implement fire-prevention measures, including smoking in disturbed areas only and disposing of cigarette butts in waste bins, parking in non-vegetated areas, and compliance with the requirements of the California PRC, beginning with Section 4427.

G. Procedures for evaluation, handling, stockpiling, storage, testing, and disposal of excavated material shall be as specified in Section 02111 and as follows.

1. Excavated trench spoils shall be inspected by CONTRACTOR and OWNER prior to initial stockpiling. Spoils that are visibly stained and/or have a noticeable odor shall be stockpiled separately for characterization.

2. Materials excavated from potentially hazardous work areas shall be stockpiled separately and be examined for evidence of building materials, debris, signs of underground storage tanks, and other indication of hazardous materials.

3. All separately stockpiled excavation spoils suspected of containing hazardous materials shall be sampled and characterized as follows:

a. As directed by the OWNER and in accordance with RWQCB requirements if intended to still be placed at the designated on-site disposal areas.

b. In accordance with landfill disposal requirements and as specified in Section 02111.b.

H. Prior to demolition of structures, CONTRACTOR shall retain a qualified environmental professional to perform a hazardous building materials survey.

1. If lead, asbestos, or other hazardous building materials are present, applicable federal and state construction worker health and safety regulations shall be followed during abatement activities.

a. Asbestos-containing materials shall be abated by a certified asbestos abatement contractor in accordance with the regulations and notification requirements of the MBUAPCD

b. Lead-based paint shall be removed by a qualified lead abatement contractor and disposed of in accordance with existing hazardous waste regulations.

## 3.12 GEOLOGY, SOILS AND SEISMICITY

A. CONTRACTOR shall ensure that any areas used for staging, laydown, material storage, equipment storage, job trailers, employee parking, or other project-related support activities are located away from jurisdictional areas, sensitive communities, and protected from stormwater run-off using temporary perimeter sediment barriers such as berms, silt fences, fiber rolls, covers, sand/gravel bags, and straw bale barriers.

B. CONTRACTOR shall store all potential contaminants on impervious surfaces, plastic ground covers, or in secondary containment to prevent any spills or leakage from contaminating the ground, and locate them at least 100 feet from adjacent habitat where practicable.

C. CONTRACTOR shall immediately contain any spillage of pollutants or construction material in accordance with the project SWPPP. The contaminated area shall be cleaned and any contaminated materials properly disposed of. In case of a spill, the CONTRACTOR shall notify the Lead Biologist.

D. Wherever feasible, CONTRACTOR shall salvage a minimum of 12" of topsoil (or if there is less than 12 inches of topsoil initially, as much as practicable) during grading and earthmoving activities. Topsoil shall be stockpiled separately from subsoil, and protected from erosion (e.g., covered or watered). CONTRACTOR shall amend the soil if needed by using composting additives and prepare it prior to reuse for post-construction restoration of temporarily disturbed areas. CONTRACTOR shall be responsible for providing all composting additives. The CONTRACTOR shall seek approval for the stockpile areas from the applicable jurisdictional agency.

E. For project components in agricultural lands, the CONTRACTOR shall conduct excavations in a manner that minimizes adverse impacts on crop productivity. The CONTRACTOR shall separately stockpile surface and subsurface soil layers and subsequently used these layers to backfill excavations. CONTRACTOR shall restore the appropriate location to pre-construction soil profile. CONTRACTOR would seek approval for stockpile locations prior to construction activity.

F. The CONTRACTOR shall measure soil densities prior to the start of construction activities to avoid over compaction backfill the surface soil (roughly the upper 3 feet of soil) to within 5 percent of the original density. The CONTRACTOR shall evaluate if the uppermost 3 feet of soil needs to be ripped to achieve the appropriate soil density. Ripping may also be used in areas where vehicle and equipment traffic has compacted the topsoil layers, such as along construction access roads and staging areas. Prior to ripping the CONTRACTOR shall consult with the OWNER.

G. The CONTRACTOR shall inspect existing agricultural drainage systems to ensure they function as necessary throughout the construction period so that agricultural uses are not disrupted.

H. The CONTRACTOR shall incorporate all necessary requirements of the final geotechnical report into the construction plans and enforce them.

## 3.13 AGRICULTURAL RESOURCES

A. The CONTRACTOR shall incorporate the following measures into construction plans and specifications for all construction activities located in farmland areas to minimize adverse impacts on farmland:

1. CONTRACTOR shall notify affected property OWNERs at least 90 days prior to initiating construction activities that have the potential to interfere with agricultural operations.

2. CONTRACTOR shall minimize the extent of the construction disturbance, including construction access, in agricultural areas to the maximum extent feasible.

3. During Contractor excavation and other earthmoving activities in designated farmland areas, the surface and subsurface soil layers shall be stockpiled separately when trenches are excavated. Segregated topsoil and subsoil shall be maintained and kept separated by the CONTRACTOR throughout all construction activities, and these soils shall subsequently be used to backfill excavations and shall be returned to its appropriate location in the soil profile.

4. To avoid over-compaction of the top layers of soil, soil densities shall be measured by the CONTRACTOR prior to the start of construction activities, and surface soil (roughly the upper 3 feet of soil) shall be backfilled to within 5 percent of the original density.

5. If necessary, following construction activities, the uppermost 3 feet of soil shall be ripped by the CONTRACTOR to achieve the appropriate soil density (within 5 percent of the original). Ripping may also be used in areas where vehicle and equipment traffic has compacted the topsoil layer.

6. Existing agricultural drainage systems shall be inspected by the CONTRACTOR before and after construction to ensure they function as needed.

7. Disturbed areas shall be restored by the CONTRACTOR to pre-construction conditions following construction, or as specified in conditions of applicable permits.

**END OF SECTION**

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**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01090: REFERENCE STANDARDS**

## PART 1 GENERAL

### 1.01 GENERAL

A. **Titles of Sections and Paragraphs:** Captions accompanying specification sections and paragraphs are for convenience of reference only, and do not form a part of the Specifications.

B. **Applicable Publications:** Whenever in these Specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date that the WORK is advertised for bids shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth herein or shown on the Drawings shall be waived because of any provision of, or omission from, said standards or requirements.

C. **Specialists, Assignments:** In certain instances, specification text requires (or implies) that specific work is to be assigned to specialists or expert entities, who must be engaged for the performance of that work. Such assignments shall be recognized as special requirements over which the CONTRACTOR has no choice or option. These requirements shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the WORK; also they are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of contract requirements remains with the CONTRACTOR.

### 1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to or exceed the requirements of applicable codes and the applicable requirements of the following documents.

B. References herein to "Building Code" or "Uniform Building Code" shall mean Uniform Building Code of the International Conference of Building Officials (ICBO). Similarly, references to "Mechanical Code" or "Uniform Mechanical Code," "Plumbing Code" or "Uniform Plumbing Code," "Fire Code" or "Uniform Fire Code," shall mean Uniform Mechanical Code, Uniform Plumbing Code and Uniform Fire Code of the International Conference of the Building Officials (ICBO). "Electric Code" or "National Electric Code (NEC)" shall mean the National Electric Code of the National Fire Protection Association (NFPA). The latest edition of the codes as approved by the Municipal Code and used by the local agency as of the date that the WORK is advertised

for bids, as adopted by the agency having jurisdiction, shall apply to the WORK herein, including all addenda, modifications, amendments, or other lawful changes thereto.

C. In case of conflict between codes, reference standards, drawings, and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the ENGINEER for clarification and directions prior to ordering or providing any materials or furnishing labor. The CONTRACTOR shall bid for the most stringent requirements.

D. References herein to "OSHA Regulations for Construction" shall mean **Title 29, Part 1926, Construction Safety and Health Regulations,** Code of Federal Regulations (OSHA), including all changes and amendments thereto.

E. References herein to "OSHA Standards" shall mean **Title 29, Part 1910, Occupational Safety and Health Standards,** Code of Federal Regulations (OSHA), including all changes and amendments thereto.

F. **Applicable Standard Specifications**: References in the Contract Documents to "Standard Specifications" or SSPWC shall mean the Standard Specifications for Public Works Construction, Latest Edition.

G. Applicable Safety Standards: References herein to "Cal-OSHA" shall mean State of California, Department of Industrial Relations, Construction Safety Orders, as amended to date, and all changes and amendments thereto.

### 1.03 REGULATIONS RELATED TO HAZARDOUS MATERIALS

A. The CONTRACTOR shall be responsible that all work included in the Contract Documents, regardless if shown or not, shall comply with all EPA, OSHA, RCRA, NFPA, and any other Federal, State, and Local Regulations governing the storage and conveyance of hazardous materials, including petroleum products.

B. Where no specific regulations exist, chemical, hazardous, and petroleum product piping and storage in underground locations shall be installed with double containment piping and tanks, or in separate concrete trenches and vaults, or with an approved lining which cannot be penetrated by the chemicals, unless waived in writing by the OWNER.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION (NOT USED)

**END OF SECTION**

**TECHNICAL SPECIFICATIONS**
**DIVISION 01: GENERAL REQUIREMENTS**
**01150: WATER TREATMENT AND DISPOSAL**

## PART 1 GENERAL

### 1.1 SUMMARY

A. This Section specifies minimum requirements for collecting, handling, treating, sampling, testing, and disposing of all groundwater and storm water encountered in construction of the facilities. Water treatment and disposal shall be in accordance with all applicable permits, regulatory requirements, and requirements specified in Section 01062, Environmental Requirements. Water treatment and disposal shall be implemented for the following:

1. Groundwater inflows into excavations.
2. Groundwater discharged from surface dewatering wells.
3. Wet weather surface flows entering the construction work areas.
4. Incidental water utilized by the Contractor during the course of construction.
5. Water used for pressure testing and disinfection.

B. Related Sections:

1. Section 01062 – Environmental Requirements
2. Section 01300 – Submittal Procedures
3. Section 01561 – Stormwater Pollution Prevention, Erosion and Sediment Control
4. Section 02140 – Dewatering
5. Section 02111 – Disposal of Excavated Materials

C. Design Criteria:

1. Design treatment processes to reduce contaminants in the discharged water to the levels specified in the applicable permits, NPDES Waste Discharge Requirements Order, and applicable discharge water quality requirements.
2. Design and select the water treatment system, capacity, and materials as necessary to satisfactorily treat all discharged water including groundwater inflows and water resulting from the construction process. Treatment shall include removal of suspended solids, oil, grease, and other contaminants introduced by or resulting from construction operations including but not limited to the following:

a. Contaminants derived from cementitious products

b. Chemical grouts

c. Contaminants generated by the excavation process and muck handling systems

d. Oil, grease, and other hydrocarbons from equipment.

D. Sampling: Take samples as specified to verify water quality before discharge. Sample receiving waters upstream and downstream of discharge points. The Contactor is responsible for all sampling and chemical analysis of samples.

E. Minimum Discharge Water Quality Requirements: Except as may be amended or modified by applicable permits, the following minimum water quality requirements shall be complied with at all times:

1. pH: between 6.5 and 8.5

2. Turbidity: Increase above background levels no greater than 10 percent if background level is greater than 50 NTU and no greater than 5 NTU if background level is less than 50 NTU.

3. Temperature: Increase no more than 5 degrees Fahrenheit above natural receiving water temperature.

4. Free of coloration that causes nuisance or adversely affects beneficial uses.

5. Free of floating materials, including solids, liquids, foams, and scum in concentrations that cause nuisance or adversely affect beneficial uses

6. Free of oils, greases, waxes, and other materials in concentrations that cause visible films or coatings on the surface of the water or on objects in the water or that adversely affect beneficial uses.

7. Free of toxic substances in concentrations that are harmful to aquatic organisms.

## 1.2 SUBMITTALS

A. General:

1. Make submittals in accordance with Section 01300.

B. Qualifications:

1. California Licensed Civil Engineer designing water handling and treatment facilities. Minimum 5 years of experience designing similar systems.

2. Water Quality Testing laboratory. Appropriately certified, qualified, and experienced with the required testing methods.

C. Working Drawings for handling, treating, measuring and disposing of water from work areas. Submit Drawings and operations plans describing details of procedures, processes, and criteria required, including, but not limited to, the following:

1. Proposed general layout and location of water handling and treatment facilities at each site.

2. Handling facilities, holding basins, and a schedule for installation of the facilities at each location.

3. Methods and equipment proposed for treating, measuring and disposing of inflow groundwater, and removing the treatment facilities when they are no longer needed.

4. Details for each work area shall include:

a. Location, depth, and size of tanks, retention basin(s), treatment ponds; and retention time, if applicable.

b. Sizes and locations of each discharge point including energy dissipation facilities at discharge point to prevent erosion.

c. Types, capacities and numbers of pumps, generators and standby units.

d. Calculations demonstrating the adequacy of the water handling and treatment system design including verification of capacity of receptor for discharge.

e. Methods for monitoring water quality to check compliance with regulatory requirements prior to discharge.

f. Detailed method statement for the collection of water inflows, conveyance of water to the treatment point, treatment of water, and discharge of the water from each area. The processes described for each work area shall include estimated inflow rates, means and methods of treatment including use of any chemicals and flocculants, retention times required, and statements of water quality achieved using each process, chemical consumption, cleaning of retention ponds or tanks, and any other significant aspect of water handling and treatment.

D. Provide copies of all materials submitted for permit compliance including field and laboratory water quality results.

E. Notify the Owner and Engineer immediately if discharge water quality at any site exceeds 80 percent of allowed limits for any monitoring parameter.

## 1.3 QUALITY ASSURANCE

A. Retain the services of a qualified supplier, subject to review and approval by Engineer, to design and furnish the required treatment facilities.

B. Provide qualified personnel, subject to review and approval by Engineer, to install, maintain, and operate the required treatment facilities.

C. Provide the services of an Independent Testing Laboratory, subject to review and approval by Engineer, to sample, test, and verify that the chemical and physical condition of the discharge and receiving water at each location complies with specified requirements.

D. Preconstruction Meeting:

1. Hold a meeting to review water treatment and disposal plans for each site at least 5 days but not more than 30 days prior to furnishing, installing and operating water collection, treatment, and discharge facilities.

2. Review and discuss the following items:

    a. Scope of the work to be performed.

    b. Construction methods and constraints overview.

    c. Equipment operating parameters.

    d. Safety procedures.

    e. Quality Control procedures and Quality Assurance requirements.

    f. Reporting requirements.

    g. Other issues as may be raised by either party.

## 1.4 REQUIREMENTS

AECOM has reviewed the records of suspected and confirmed hazardous waste sites along the pipeline route. AECOM has also performed an environmental field investigation of soils along the pipeline route. AECOM does think it likely that the Contractor will encounter hazardous soils and possibly contaminated groundwater in the pipeline trench excavation. Contractors are directed to AECOM's Environmental database/Document Review for the pipeline corridor (2017) and Environmental Investigation Report (in preparation). In addition,

storm water that may enter the trenches may accumulate contaminants from the street surfaces and adjacent farms. As a result, it should be assumed that water pumped out of trenches shall be assumed to contain contaminants and shall be treated to remove them as described in this section unless water quality testing indicates that the dewatering water is clean. Water quality testing for suspected contaminants shall follow the same assumptions for contaminants present as is described in Section 02111 - Disposal of Excavated Materials.

A. Potable water used for pressure testing and disinfection shall be assumed to be free of contaminants with the exception of any added disinfectant (such as chlorine). The Contractor shall dechlorinate any water from disinfection procedures to acceptable limits prior to disposal.

B. Disposal options, see Section 3.03 I.

## PART 2 PRODUCTS

### 2.1 WATER FOR PRESSURE TESTING AND DISINFECTION

A. Water will be provided by CAW for use on the project. Arrangements shall be made with CAW for securing a meter to track water use and identifying withdrawal locations.

## PART 3 EXECUTION

### 3.01 GENERAL

A. Adequacy of Operations: Ensure that water control operations are adequate to protect the integrity of the work in progress and the finished product, to protect adjacent structures and facilities, and to satisfy discharge water quality required for the project.

B. Demonstrate the proposed system for handling, treating and disposing of groundwater, including backup power systems, and verify that adequate equipment, people and materials are provided.

C. Integrate the water collection, handling, treatment, and disposal facilities with the work in progress, and protect adjacent structures and facilities.

D. Follow hazardous material, and health and safety procedures when transporting, storing, and using chemicals or other hazardous materials for any water treatment processes.

### 3.02 EQUIPMENT AND RESOURCES

A. Provide sufficient, qualified personnel and equipment as follows:

1. Pumping equipment and machinery in good working condition.

2. Competent workmen available for manual operation, maintenance, and supervision of the treatment system.

B. Maintain a supply of chemicals, flocculants, and other materials needed for the proposed treatment system.

## 3.03 DISCHARGING WATER FROM THE SITE

A. Water shall be disposed of without damage to the construction works, receiving waters, or adjacent property.

B. Discharged water shall not cause the capacity of receiving water bodies to be exceeded including during storm events.

C. Discharged water shall have excess energy dissipated via approved means so that it does not cause erosion of the receiving water body.

D. All water discharged from the site shall comply with the criteria specified in Section 01062 and applicable regulations governing discharged water quality.

E. Discharge to State or City owned storm drain or sanitary sewer facilities shall be subject to restriction and permit by the facility owners. Contractor shall pay any fees and perform and pay for any required water quality testing required for discharge to storm drain or sanitary facilities.

F. Discharge water that does not comply with the quality standards stipulated in applicable permits and in Section 01062 shall be treated or subject to offsite disposal.

G. Contractor shall be solely responsible for any and all fines or penalties resulting from non-compliant discharges.

H. Based on analytical results, collected groundwater may be used for dust control. Application of groundwater as dust control is to be done in a manner which would prevent direct skin exposure or accidental ingestion.

I. The Contractor may discharge water that they have demonstrated to be clean according to the applicable permit conditions to the following discharge locations:

1. CAW owned ASR Well Site 2 washwater pond

2. Monterey Peninsula Water Management District (MPWMD) owned ASR Well Site 1 washwater pond (pending MPWMD approval)

3. Monterey Regional Water Pollution Control Agency (MRWPCA) recharge pond (pending MRWPCA approval) at the end of the Salinas Valley Return Pipeline

4. Lake El Estero, City of Monterey (pending City of Monterey approval)

5. Dust control application

6. Any other locations that meet all regulations and are approved in advance by the Owner.

## 3.04 HANDLING OF WATER ENCOUNTERED DURING TRENCH EXCAVATION

A. When groundwater is encountered and dewatering activities are performed, all water shall be stored in tanks prior to testing and discharge.

B. During construction, remove and treat all water inflows to excavations. Provide pumps, sumps, water discharge lines, other water handling facilities as needed, and water storage and treatment facilities at each site, as appropriate. Treat, store, and discharge groundwater and surface water inflows for each site in addition to water used for construction purposes at Engineer approved locations only.

## 3.05 FIELD QUALITY CONTROL

A. Water Quality Testing:

1. Any groundwater samples collected shall be analyzed by a state certified lab. The samples shall be analyzed for metals, TPH-g, TPH-d, and VOCs.

2. Any groundwater samples collected shall be given a unique sample ID, stored on ice, and transported to a state certified lab under proper chain of custody.

3. Sample discharge and receiving waters according to permit conditions which at a minimum include:

   a. At no greater than the intervals specified in Section 01062 and in applicable discharge permits.

   b. Immediately upstream of the discharge point.

   c. Downstream of the discharge point a sufficient distance to allow for mixing with receiving waters.

4. Keep complete records showing the date, time, and location of each test, the quantity of discharge, and the analytical results as well as the records specified in Section 01060.

a. Notify the Engineer immediately of any test that finds the water to be non-conforming.

b. Submit copies of the results of those tests, together with written details of the actions being taken to remedy the non-conformance.

**END OF SECTION**

**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01300: CONTRACTOR SUBMITTALS**

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## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. List of material sources.

B. Submittal requirements.

### 1.02 RELATED SECTIONS

A. General Conditions – 6.16 Shop Drawings and Samples

B. Project progress schedules and status reports are specified in Section 01311 – Construction Schedule.

C. Submittals related to the CONTRACTOR's quality program are specified in Section 01400 - Quality Control.

D. Submittals required to complete the Contract closeout are specified in Section 01700 – Project Closeout.

E. Preparation and submission of project record documents are specified in Section 01700- Project Closeout.

F. Preparation and submission of equipment and systems operation and maintenance manuals and training plan are specified in Section 01730 - Operation and Maintenance Data.

### 1.03 LIST OF MATERIALS SOURCES:

The CONTRACTOR shall submit to the ENGINEER a list of the CONTRACTOR's sources of materials. The list shall be submitted in sufficient time to permit proper inspections and testing of materials to be furnished from such listed sources in advance of their use.

### 1.04 SUBMITTAL REQUIREMENTS

A. Schedule of Submittals: Within ten calendar days after the effective date of Notice to Proceed, the CONTRACTOR shall submit a completed submittal schedule and list of products for all items requiring the ENGINEER's review and approval, as follows:

1. Submittals, including description of the item and name of manufacturer, trade name and model number.

2. Specification reference.

3. Intended submission/resubmission date(s).

4. Order release date.

5. Lead time to delivery/anticipated delivery date(s).

6. Highlight any items that require expedited review to meet the project schedule.

These schedules shall be presented in a form acceptable to the ENGINEER in both electronic and hard copy versions and shall be updated and sent to the ENGINEER on a monthly basis. Identify all submittals that are required by the Contract Documents and determine the date on which each submittal will be submitted in conformance with the schedules specified in Section 01311 – Construction Schedule.

B. Professional Seal Required: Submittals involving engineering design services, when required by the Contract Documents or by governing codes and regulations, such as shoring and underpinning, excavation support structures, falsework for concrete, corrosion control system design, and load and design calculations, shall be sealed and signed in blue ink by a professional engineer, currently registered in the State of California, for the discipline involved.

C. Review Period:

1. Prepare submittals sufficiently in advance so that approval may be given before commencement of related work.

2. Allow 30 calendar days after receipt by the ENGINEER for review of each submittal, including resubmittals.

3. The CONTRACTOR shall be responsible for determining whether or not certain governmental entities and utility districts require longer review periods. When longer review periods are required, the CONTRACTOR shall schedule the Work accordingly, so that the Work and project progress schedules are not adversely impacted.

D. Submittal Delivery: Ship submittals prepaid or deliver by hand directly to the ENGINEER.

E. Transmittal Form: Accompany submittals with an OWNER-furnished transmittal form in duplicate containing the following information:

1. The CONTRACTOR's name, address, and telephone number;

2. Submittal number and date;

3. Contract title and number;

4. Supplier's, manufacturer's, or SUBCONTRACTOR's name, address, and telephone number; and

5. Subject identification, including Contract Drawing and Specification reference.

F. Changes in Approved Submittals: Changes in approved submittals will not be allowed unless those approved submittals with changes have been resubmitted and approved, in the same manner as the original submittal.

G. Supplemental Submittals: Supplemental submittals initiated by the CONTRACTOR for consideration of corrective procedures shall contain sufficient data for review. Make supplemental submittals in the same manner as initial submittals.

## 1.05 CONTRACTOR'S RESPONSIBILITIES

A. CONTRACTOR's Review and Approval:

1. Each submittal shall be reviewed, stamped, and signed as reviewed and approved by the CONTRACTOR prior to submission. The CONTRACTOR's approval shall indicate review and approval with respect to the following responsibilities:

2. The CONTRACTOR shall be responsible for:

   a. The correctness of the drawings, for shop fits and field connections, and for the results obtained by the use of such drawings.
   b. Verification of catalog numbers, and similar data.
   c. Determination and verification of field measurements and field construction criteria.
   d. Checking and coordinating information in the submittal with requirements of the Work and of the Contract Documents.
   e. Determination of accuracy and completeness of dimensions and quantities.
   f. Confirmation and coordination of dimensions and field conditions at the site.
   g. Safety precautions.
   h. Errors or omissions on submittals.
   i. Coordination and performance of work of all trades.
   j. Identification of deviation(s) from Contract requirements.

3. The CONTRACTOR shall coordinate each submittal with the requirements of the Work, placing particular emphasis upon assuring that each submittal of one trade is compatible with other submittals of related work. Ensure submittal is complete with all relevant data required for review.

4. The CONTRACTOR shall stamp, initial or sign the submittal, certifying:

    a. Dimensional compatibility of the product with the space in which it is intended to be used.
    b. Review of submittals for compliance with Contract requirements.

5. Do not start work for that requires approval by the ENGINEER until submittals have been returned to the CONTRACTOR with official indication that approval has been granted by the ENGINEER.

6. If the submittal is designated to be sent to the ENGINEER for information, approval by the designated approval authority shall take place before submission to the ENGINEER.

7. Approval of drawings and associated calculations by the ENGINEER shall not relieve the CONTRACTOR from the responsibility for errors or omissions in the drawings and associated calculations, or from deviations from the Contract Documents, unless submittals containing such deviations were submitted to the ENGINEER and the deviations were specifically called to the attention of the ENGINEER in the letter of transmittal and within the submittal, and approved specifically by the ENGINEER as a Contract change.

8. Approval of the CONTRACTOR’s submittal by the ENGINEER shall not relieve the CONTRACTOR of any responsibility, including responsibility for accuracy and agreement of dimensions and details.

B. Review by the ENGINEER**:** One marked up reproducible set of drawings, one copy of product data, and one sample will be returned to the CONTRACTOR.

C. Distribution of Submittals after Review: Distribute prints or copies of approved submittals, bearing the ENGINEER's or designated approval authority's stamp and signature, to the CONTRACTOR's field office and the ENGINEER's field office; to affected and concerned SUBCONTRACTORs, Suppliers, and fabricators; and to affected and concerned members of the CONTRACTOR's workforce.

## 1.06 ENGINEER'S REVIEW

A. Submittals will be reviewed for conformance with requirements of the Contract Documents. Review of a separate item will not constitute review of an assembly in which the item functions. Nether review nor approval shall relieve the CONTRACTOR from CONTRACTOR’s responsibility for accuracy of submittals, for conformity of submittals to requirements of Contract Documents, for compatibility of described product with other provided products and the rest of the system, or for prosecution and completion of the Contract in accordance with the Contract Documents.

B. Submittals shall be understood as being made for approval, unless otherwise specified, for example, as being made for information, record, or review. The ENGINEER will indicate its reviews of submittals and the action taken (approvals and non-approvals) by means of its review stamp. The review stamp will be affixed by the ENGINEER, the action block will be marked, and the stamp will be signed in blue ink and dated.

1. Approval of the submittal by the ENGINEER does not relieve the responsibilities of the professional ENGINEER who originally signed and sealed the submittal or the responsibilities of the CONTRACTOR to meet the Contract requirements..

C. The review-stamp action-block marks will have the following meanings:

1. The mark APPROVED is an acceptance, and means that the submittal appears to conform to the respective requirements of the Contract Documents; that fabrication, assembly, manufacture, installation, application, and erection of the illustrated and described product may proceed; and that the submittal need not be resubmitted.

2. The mark APPROVED AS NOTED - RESUBMISSION NOT REQUIRED is an acceptance, and means that the submittal appears to conform to the respective requirements of the Contract Documents upon incorporation of the reviewer's corrections, and that fabrication, assembly, manufacture, installation, application, and erection of the illustrated and described product may proceed. Submittals so marked need not be resubmitted unless the CONTRACTOR challenges the reviewer's exception within 7 calendar days. All noted changes will be reflected in the as-built drawing by the CONTRACTOR.

3. The mark LIMITED APPROVAL – RESUBMISSION REQUIRED is an approval except for the work impacted by the notes and comments, and means that the submittals requires corrections to conform to the respective requirements of the Contract Documents. Fabrication, assembly, manufacture, installation, application, and erection of the illustrated and described product may proceed at the Contract's risk only for the elements of work not impacted by and changes required to incorporate the reviewer's corrections. The noted work cannot proceed until verification by the ENGINEER that the review's correction have been properly incorporated in the submittal.

4. The mark NOT APPROVED - RESUBMISSION REQUIRED is a disapproval, and means that the submittal requires corrections to conform to the respective requirements of the Contract Documents, and that fabrication, assembly, manufacture, installation, application, and erection of the illustrated and described product may not proceed until incorporation of the reviewer's corrections and verification by the ENGINEER that the reviewer's corrections have been properly incorporated in the submittal.

5. The mark REJECTED – RESUBMISSION REQUIRED is a disapproval, and means that the submittal is deficient to the degree that the reviewer cannot correct the submittal with a reasonable degree of effort, has not made a thorough review of the submittal, and that the submittal needs revision and is to be corrected and resubmitted.

6. The mark NOT REVIEWED is acknowledgement of receipt and means that the submittal is for information and record purposes only.

D. Review stamps or other approval methods of the various designated approval authorities may not be the same as those of the OWNER. The CONTRACTOR shall work with the various designated approval authorities and shall obtain approvals in the clearest and most straightforward manner possible.

**PART 2 PRODUCTS – NOT USED**

**PART 3 EXECUTION – NOT USED**

**END OF SECTION**

**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01301: SCHEDULE OF VALUES**

## PART 1 GENERAL

### 1.01 GENERAL

A. This Section defines the process whereby the Schedule of Values shall be developed.

### 1.02 SUBMITTAL REQUIREMENTS

A. Submit within thirty 30 consecutive calendar days after Notice to Proceed.

B. The CONTRACTOR shall submit a preliminary Schedule of Values for the major components of the WORK at the Preconstruction Conference in accordance with Section 01010 - Summary of Work. The listing shall include, at a minimum, the proposed value for the following major WORK components:

1. Provide a detailed cost breakdown for each Bid Item listed in the Schedule of Bid Prices, covering all items of Work by classification, in accordance with the Construction Specifications Institute 16 Division format (1988 Edition) as represented by the Specifications Table of Contents.
2. Provide a breakdown of each lump sum item into all identifiable separate components of work as specified and as shown on the Drawings, and for each component list amounts for labor, material, equipment, fixed cost elements, incidental expenses, and overhead and profit.
3. Allocate all overhead and profit across all of the work activities in the Schedule of Values based only on the pro rata value of each work activity and without regard to the type of work, timing, or other considerations. Overhead and profit shall not be listed as separate items.
4. Identify separate line items for each component of work as noted above including but not limited to each item of temporary work, all components of Mobilization and Demobilization, final cleaning, all major submittals such as operations and maintenance manuals, and start-up testing.

C. Incorporate all executed change orders into the Schedule of Values and allocate value as required by this Section.

### 1.03 COORDINATION

A. Coordinate the preparation of the schedule of values with Contractor’s progress schedule.

1. The Schedule of Values shall be developed utilizing resource loading of the Progress Schedule as specified in Section 01311: Construction Schedule.
2. The Contractor shall prepare and submit a detailed Schedule of Values to the OWNER Representative coordinated with the Baseline CPM Progress Schedule submittal.

3. An unbalanced Schedule of Values providing for early overpayment to Contractor on lump sum work will not be accepted.

B. Coordinate the preparation of the Schedule of Values with Contractor's Application for Payment.

1. The Schedule of Values shall be coded to the Schedule of Bid Prices in sufficient detail to facilitate continued evaluation of progress payment applications and submitted to the OWNER Representative for approval prior to the first Application for Payment.
2. In addition to construction work items that have definable quantity scope values, the Schedule of Values shall include other discrete items of work including but not limited to mobilization, administration, material procurement, final cleaning, operations and maintenance manuals, start-up, and adjusting and testing. The Schedule of Values shall indicate each item's relationship to activities in the Baseline CPM Progress Schedule.

C. The Schedule of Values shall be coded such that the sum of the Schedule of Values roll up to and are in balance with each lump sum bid item.

D. The Schedule of Values shall be updated to reflect all approved Change Orders prior to the next scheduled submission of the Monthly Schedule update and Application for Payment.

## 1.04 REVIEW AND ACCEPTANCE

A. The OWNER Representative shall review and return Contractor's Schedule of Values with comments within ten (10) working days of its receipt. Contractor shall make corrections requested by the OWNER Representative and resubmit for approval within five (5) working days.

B. Final acceptance by the OWNER Representative shall indicate only consent to the Schedule of Values as a basis for preparation of applications for progress payments, and shall not constitute an agreement as to the value of each indicated item.

C. No payments for any bid item other than Mobilization shall be made nor shall the OWNER Representative accept any change order requests until the detailed Schedule of Values is submitted and accepted as required herein.

## 1.05 PROJECT-SPECIFIC REQUIREMENTS

A. Mobilization

1. The maximum amount included in the Schedule of Values for Mobilization as specified in Section 01013 shall be 5 percent of the total original Contract Price.

2. Mobilization payments will be processed as follows:

   a. 40 percent of the Schedule of Values amount for Mobilization will be paid in consideration of the Contractor's furnishing of performance and payment bonds and specified insurance, and shall be included with the first Application for Payment.

   b. When 5 percent of the total original Contract Price is earned from other Schedule of Value items, excluding Mobilization, an additional 40 percent of the Schedule of Values amount for Mobilization amount shall be included in the next scheduled Application for Payment.

   c. When 10 percent of the total original Contract Price is earned from other Schedule of Value items, excluding payments for Mobilization, the remaining (20) percent of the Schedule of Values amount for Mobilization shall be included in the next scheduled Application for Payment.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION (NOT USED)**

****END OF SECTION****

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**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01311: CONSTRUCTION SCHEDULE**

## PART 1 GENERAL

### 1.01 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this Section.

B. General Conditions

1. Preliminary Schedules
2. Progress Schedule
3. Section 01010 - Summary of Work.
4. Section 01062 – Environmental Requirements
5. Section 01300 – Contractor Submittals
6. Section 01313 – Construction Schedule Constraints

### 1.02 DESCRIPTION OF WORK

A. This section describes preparation and submittal of the Project Schedule. The project schedule is critical in that this project is complex and the OWNER has specified an accelerated schedule for completing construction. It is critical for the CONTRACTOR to design a schedule that they can meet since construction of the desalination plant and storage of rarely available wet year water is dependent on the timely completion of this project.

### 1.03 QUALITY ASSURANCE

A. Scheduler: CONTRACTOR's personnel or consultant specializing in Scheduling with three (3) years minimum experience in scheduling construction work of a complexity comparable to this project, and having use of computer facilities capable of delivering a detailed graphic printout within 48 hours of request.

### 1.04 FORMAT

A. Schedule: Format to be determined by CONTRACTOR.

B. Scale and Spacing: Time scale using units of approximately one week. Allow spacing for notations and revisions

## 1.05 SCHEDULES

A. The progress schedule to be prepared by CONTRACTOR pursuant to American Institute of Architects(AIA) Document A201 (latest version as supplemented) shall consist of a Schedule as described herein. The Schedule shall be based on the precedence diagramming method with no lead and/or lag time. Preparation of the Schedule is solely the responsibility of the CONTRACTOR; senior management personnel shall actively participate in its development. The Schedule shall consist of a detailed network, mathematical analyses, and network diagrams.

B. The network diagram shall show the order and interdependence of activities and the sequence in which the work is to be accomplished as planned by CONTRACTOR. The basic concept of a network diagram shall be followed to show how the start of a given activity is dependent on the completion of preceding activities and its completion restricts the start of following activities.

C. The substantial and final completion dates for the work which is shown in the complete Schedule shall be those detailed in the Contract documents.

D. Activities contained in the schedule and the mathematical analyses, and shown on the schedule, shall include:

1. Construction activities, which shall have a minimum duration of one work day and a maximum duration of fifteen work days. The activity shall be descriptive of the work to be performed. If, in the opinion of CONTRACTOR, a task requires greater than fifteen work days to perform, that task shall be broken into two or more logically discrete activities, each with durations equal to or less than fifteen work days. The definition "start" or "finish" are not acceptable.

2. Submittal, review and approval of samples of materials and shop drawings. A minimum of 10 working days or two (2) working weeks per sheet of drawings to be reviewed, whichever is greater, shall be scheduled for review and approval of submittals by Architect.

3. Fabrication, installation and testing of special materials or equipment.

4. Activities of User, including delivery and installation of OWNER-provided equipment and furnishings, substantial completion, punch list, and closeout requirements, or of ENGINEER or others that affect progress of the work.

E. The schedule shall show the duration of each activity in work days. Update monthly to show actual progress of each activity.

F. Related activities shall be grouped in the schedule. The activities on the critical path shall be highlighted. Weekends, holidays and other non-work periods shall be indicated. Where float or slack exists, the activities shall be shown at the earliest times they can be completed.

## 1.06 SUBMITTALS

A. A preliminary schedule defining the work during the first sixty (60) days following the Notice to Proceed shall be submitted to OWNER within 10 days following Notice of Award.CONTRACTOR's general approach for the balance of the contract shall also be indicated. The format of this submittal and the information provided therein shall be in accordance with Paragraphs 1.04 and 1.05 of this section.

B. The complete Schedule shall be submitted to OWNER within 30 days following the Notice to Proceed.

C. Documents to be submitted shall include:

1. Three copies of the proposed schedule.

D. CONTRACTOR shall submit, as part of its monthly Application for Payment, a report of the actual construction progress by updating the Schedule and the report required in Subparagraph 1.05 of this section. All approved contract changes shall be included in this report. This report shall be submitted in the format and medial described in Paragraph 1.05 of this section.

1. The report shall show the activities or portions of activities completed during the reporting period and their total value as basis for the CONTRACTOR's request for payment. The report shall state the percentage of the work actually completed and scheduled as of the report date and the progress along the critical path in terms of days ahead or days behind the mutually acceptable schedule dates. If the work is behind schedule, progress along other paths with negative float or slack shall also be reported

2. CONTRACTOR shall submit a narrative report with the updated Schedule which shall include a description of current and anticipated problem areas, current and anticipated delaying factors, the impact of these areas and factors, and actions taken or proposed to correct these areas and factors.

## 1.07 UPDATING SCHEDULE

A. If CONTRACTOR thereafter desires to make changes in its method of operating or scheduling, it shall notify the OWNER in writing, stating the reasons for the proposed change. If the OWNER considers these changes to be of a major nature it may require CONTRACTOR to revise and submit, at no increase in the Contract Sum or Contract

Time, all of the affected portion of the Schedule to show the impact of the requested change on the balance of the work. Such a submittal shall undergo the review and acceptance process defined in Section 1300. A change may be considered to be of a major nature if the time estimated to be required or actually used for an activity, the network logic, or sequence of activities varies from the original Schedule to a degree that there is reasonable doubt regarding the Contract Completion Date. Changes affecting activities with adequate slack time shall be considered as minor changes, except that an accumulation of minor changes may be considered a major change when their cumulative effect might affect the Contract completion date. Out of sequence operations by the CONTRACTOR without prior notification to the OWNER may be considered a "de facto" change of a major nature by the OWNER.

## 1.08 DISTRIBUTION

A. Following joint review, distribute copies of updated schedules to CONTRACTOR's project site file, to Subcontractors, Suppliers, ENGINEER and OWNER.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections shown in schedules.

## PART 2 PRODUCTS – NOT USED

## PART 3 EXECUTION – NOT USED

**END OF SECTION**

**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01313: CONSTRUCTION SCHEDULE CONSTRAINTS**

## PART 1 GENERAL

### 1.01 THE REQUIREMENT

A. Work shall be scheduled, sequenced, and performed in a manner which minimizes disruption to the public and to the operation and maintenance of existing facilities and farmland along the pipeline alignments.

B. The CONTRACTOR shall perform the Work in compliance with project permits, easements, and agreements and in coordination with utility and other agencies and other contractors working in adjacent Project Areas.

C. The CONTRACTOR shall incorporate the construction and schedule constraints of this Section in preparing the construction schedules required under Section 01311 – Construction Schedule.

D. Related Sections and Documents

1. General Conditions: Article 7 – Other Work at The Site

### 1.02 PROJECT CONSTRAINTS

A. Environmental Constraints: There are environmental requirements described in Section 01062 that may affect the construction schedule. In particular is the pre-construction nesting bird survey that must be performed by the OWNER within 14 days of construction occurring in an area between February 1 and August 31.

B. Project Water: CAW will provide potable water for the project from the sources described in this section. Potable project water is available from metered fire hydrants within the California-American Water (CAW) service area and from the ASR wells along General Jim Moore Boulevard only. The CAW service area is south of Military Avenue in Seaside and west of General Jim Moore Boulevard. It does not include the City of Marina or the area of unincorporated Monterey County north of Marina where this project is located. At this time it is unclear when water will be available from the Transfer Pipeline at the south end of the project, since this is likely dependent on startup of the desal plant. Water may be available from the CCSD water system at the north end of the project. These limited sources have the potential to constrain the CONTRACTOR's ability to pressure test the water lines and may affect how the CONTRACTOR chooses to sequence pipeline construction. See also Section 01656.

C. Disposal of Project Water: There is the potential in this project for disposing of large quantities of water from disinfection and pressure testing of water lines. As described in Section 01150, alternatives for disposal of project water besides hauling it off in trucks is limited in the project area. The CONTRACTOR may decide to sequence the work to take advantage of the few alternatives for direct disposal of project water.

D. Private Driveways and Bridge: The pipeline alignment crosses the driveways of the Dole packing plant on Monte Road and a private driveway north of the Monte Road Bridge. North of Nashua Rd., the pipeline alignment is along dirt roads used by the agricultural community to access fields along the railroad ROW. The CONTRACTOR is required to install the pipeline under the bridge from the bridge itself, impacting traffic on the bridge. The CONTRACTOR shall conduct outreach and coordinate the project schedule with the local community, including Monterey County, the local Farm Bureau, and Dole.

E. Application for PG&E Service: The OWNER will be applying for a new PG&E service to provide power to part of the project. OWNER is not responsible for PG&E delays on providing power or other project requirements to the project.

## 1.03 AGRICULTURE

A. Monterey County and the pipeline alignment in particular is an active commercial farming area. The agricultural operations may have activities that could impact the project schedule, and affect access and health and safety, such as pesticide spraying, irrigation, harvesting, etc. The growers have lease agreements with TAMC to farm on the east and west edges of the TAMC ROW north of Nashua Rd. The pipeline will be installed under the west edge, which is currently generally plated with crops from about May to mid October. The main lease agreement with Eagle Creek Pacific is provided in an appendix. Eagle Creek in turn leases their land to various growers. The Contractor shall conduct outreach and coordinate the project schedule with the local community and farmers, including Monterey County, and the local Farm Bureau to avoid interfering with planted crops to the extent possible.

## 1.04 OUTAGE REQUESTS

A. Modifications to existing facilities, the construction of new facilities, and the connection of new to existing facilities may require the temporary outage or bypass of existing treatment processes or facilities. This is particularly true for the CCSD tie-in at the north end of the pipeline. In such cases, the CONTRACTOR shall coordinate Work with the OWNER (and CCSD as needed) as described below. The CONTRACTOR shall submit a detailed outage plan and time schedule for all construction activities which will make it necessary to remove a tank, pipeline, channel, electrical circuit, equipment, structure, road, or other facilities from service.

B. The outage plans shall be submitted to the OWNER for acceptance a minimum of 2 weeks in advance of the time that such outages are required. The outage plans shall be coordinated with the construction schedule and shall meet the restrictions and conditions of this Section. The outage plan shall describe the length of time required to complete the operation; any necessary temporary power, controls, instrumentation, or alarms required to maintain control, monitoring, and alarms for the affected processes; and the manpower, plant, and equipment which the CONTRACTOR shall provide in order to ensure proper

operation of associated units. All costs for preparing and implementing the outage plans shall be the responsibility of the CONTRACTOR as part of the Work.

C. The Outage Request shall be accompanied by a contingency plan describing how to return facilities to operation should the Outage Request work not be able to be completed with the allotted time. The CONTRACTOR shall perform a "dry run" in advance of beginning Outage Request work to confirm that all necessary labor, equipment and materials are available to accomplish the Work.

D. The CONTRACTOR shall not begin an alteration affecting existing facilities until specific written approval has been granted by the OWNER in each case.

E. The OWNER will coordinate the CONTRACTOR's planned procedure with the affected facility personnel. The OWNER has the authority to modify any proposed shutdown procedures if such procedures would adversely impact operations.

F. The OWNER shall be notified in writing at least one week in advance of the required outage if the schedule for performing the work has changed or if revisions to the outage plan are required. The CONTRACTOR shall provide written confirmation of the shutdown date and time 2 working days prior to the actual shutdown.

## 1.05 TEMPORARY CONNECTIONS

A. The making of connections to existing facilities or other operations that interfere with the operation of the existing facilities shall be thoroughly planned in advance, and all required equipment, materials, and labor shall be on hand at the time of undertaking the connections. Work shall be completed as quickly as possible and with as little delay as possible, and shall proceed continuously (24 hours a day and seven days a week) if necessary to complete modifications and/or connections in the minimum time.

B. The cost of any temporary facilities and night, weekend, or holiday work and overtime payments required during process interruptions shall be included in the price of the Work.

C. Temporary piping shall be located to minimize interference with CONTRACTOR's construction facilities and OWNER's operation and maintenance existing facilities. Unless otherwise indicated, each temporary pipeline shall be of the same size as its connection to the existing or permanent facility at the downstream end of the pipeline. Piping materials shall be suitable for the material being conveyed and be as required in the Contract Specifications.

D. When temporary electrical power, controls, instrumentation, or alarms are required for routine continuous operations of existing or new equipment, the CONTRACTOR shall provide the necessary equipment and appurtenances. Prior to installing said equipment and appurtenances, CONTRACTOR shall furnish a submittal on the proposed components and installation for OWNER's review and approval.

E. A plan showing the size and location of the temporary facilities and piping shall be submitted to the OWNER at the same time as the outage plan required under this Section. All costs for design, provision, operation, and removal of temporary facilities and piping shall be the responsibility of the CONTRACTOR.

## 1.06 SCHEDULE CONSTRAINTS

A. General: It is the CONTRACTOR's responsibility to coordinate and plan the construction activities to integrate each schedule constraint into performance of the overall work.

B. The listing of schedule constraints in 1.02 does not mean that all constraints or special conditions have been identified. The list does not substitute for the CONTRACTOR's coordination and planning for completion of the Work within the Contract Times.

C. Refer to Paragraph 1.02 – Project Constraints for items that affect the construction schedule.

## PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION - NOT USED

**END OF SECTION**

**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01400: QUALITY CONTROL**

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## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Source of materials.

B. Work quality.

C. Manufacturer's specifications and instructions.

D. Specialist applications/installer.

E. Manufacturer's field services.

F. Finish tolerances.

G. ENGINEER's monitoring.

H. ENGINEER's inspections and tests.

I. CONTRACTOR's quality testing.

J. Test reports.

K. Quality control audits.

L. Certificates of compliance.

M. Special inspections.

### 1.02 MEASUREMENT AND PAYMENT

A. Separate measurement or payment will not be made for work required under this Section. All costs in connection with the work specified herein will be considered to be included with the related item of work in the Bid Schedule of the Bid Form, or incidental to the Work.

### 1.03 SUBMITTALS

A. General: Refer to Section 01300 – CONTRACTOR Submittals, for submittal requirements and procedures.

B. Within five days after completion of testing performed by or for the CONTRACTOR, submit test results of such tests to the ENGINEER. Identify test reports with the information specified for submittals in Section 01300 – CONTRACTOR Submittals, and additionally, the name and address of the organization performing the test, and the date of the tests.

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## 1.04 SOURCE OF MATERIALS

A. In accordance with Section 01300 – CONTRACTOR Submittals, the CONTRACTOR shall notify the ENGINEER in writing of the sources from which the CONTRACTOR proposes to obtain materials requiring OWNER approval, certification, or testing.

## 1.05 WORK QUALITY

A. Shop and field work shall be performed by mechanics, crafts-persons, artisans, and workers skilled and experienced in the fabrication and installations of the work involved. The work shall be performed in accordance with the Contract Documents and the reviewed and accepted Shop Drawings.

B. Work shall be erected and installed plumb, level, square, and true, or true to indicated angle, and in proper alignment and relationship to the work of other trades. Finished Work shall be free from defects and damage.

## 1.06 MANUFACTURER'S SPECIFICATIONS AND INSTRUCTIONS

A. Unless otherwise indicated or specified, manufactured materials, products, processes, equipment, systems, assemblies, and the like shall be erected, installed, or applied in accordance with the manufacturer's instructions, directions, or specifications. Said erection, installation, or application shall be in accordance with printed instructions furnished by the manufacturer of the material or equipment concerned for use under conditions similar to those at the jobsite.

B. Any deviation from the manufacturer's printed installation instructions and recommendations shall be explained and acknowledged as correct and appropriate for the circumstances, in writing, by the particular manufacturer. The CONTRACTOR will be held responsible for installations contrary to the respective manufacturer's installations and recommendations.

## 1.07 SPECIALIST APPLICATOR/INSTALLER

A. Materials, equipment, systems, and assemblies requiring special knowledge and skill for the application or installation of such materials, equipment, systems, or assemblies shall be applied or installed by the specified product manufacturer or its authorized representative or by a skilled and experienced SUBCONTRACTOR qualified and specializing in the application or installation of the specified product.

B. The installation SUBCONTRACTOR shall be approved by the product manufacturer, as applicable.

## 1.08 MANUFACTURER'S FIELD SERVICES

A. The CONTRACTOR shall have the manufacturer of a product, system, or assembly that requires special knowledge and skill for the proper application or installation of such product, system, or assembly provide appropriate field or job service at no additional cost to the OWNER. The CONTRACTOR shall have the manufacturer inspect and approve the application or installation work.

B. The CONTRACTOR shall make all necessary arrangements with the manufacturer of the products to be installed to provide onsite consultation and inspection services to assure the correct application or installation of the product, system, or assembly.

C. The manufacturer's authorized representative shall be present at the time any phase of this work is started.

D. The CONTRACTOR shall have the manufacturer inspect and approve all surfaces over which, or upon which, the manufacturer's product will be applied or installed.

E. The CONTRACTOR shall have the manufacturer's representative make periodic visits to the site as the work progresses as necessary for consultation and for expediting the work in the most practical manner.

## 1.09 ENGINEER'S MONITORING

A. The ENGINEER will perform surveillance inspection of the CONTRACTOR's on-site construction activities. Surveillance inspection consists of a review, observation, or inspection of CONTRACTOR personnel, material, equipment, processes, and test results, performed at random or at selected stages of the construction operations. The purpose of surveillance inspection is to determine if an action has been accomplished or if documents have been prepared in accordance with selected requirements of the Contract Documents.

B. The CONTRACTOR shall provide access to the Work and shall furnish the ENGINEER reasonable facilities for obtaining such information as may be necessary to be fully informed of the quality and progress of the Work.

C. Surveillance inspection does not take the place of the CONTRACTOR's quality programs or assume any responsibility for such programs or the quality of the Work. The CONTRACTOR shall establish its own quality program, perform the required inspections, and provide the necessary documentation to assure that acceptable quality has been achieved. The CONTRACTOR is responsible for specifying and controlling the quality of work performed by its SUBCONTRACTORs.

## 1.10 ENGINEER'S INSPECTIONS AND TESTS

A. The ENGINEER may perform inspections and tests as necessary to determine the CONTRACTOR's compliance with Contract requirements. The ENGINEER may perform such additional inspections and tests as it deems necessary to verify compliance with Contract requirements.

B. For inspections and tests by the ENGINEER, the ENGINEER will provide the services of a qualified testing laboratory, soils ENGINEER, or inspector, selected and paid for by the OWNER.

C. The OWNER-employed testing laboratory will supervise the preparation and selection of samples required for testing.

D. The CONTRACTOR shall provide such facilities and assistance as the testing laboratory may require for obtaining the necessary samples.

## 1.11 CONTRACTOR'S QUALITY CONTROL TESTING

A. Scope: The CONTRACTOR shall perform quality control inspections and tests as necessary to ensure compliance with Contract requirements.

B. Testing Services:

1. Quality control testing is the testing of materials prior to their delivery from a manufacturer, or during construction, such as soils compaction tests, load tests, concrete tests during placement, concrete strength tests, pipe leakage tests, and such other tests as are specified in the various Sections of the Specifications to ensure compliance with the Contract Documents. The CONTRACTOR shall assume full responsibility for quality control testing and shall give sufficient notice to the ENGINEER to permit the ENGINEER to witness the tests. Quality control testing shall be at the expense of the CONTRACTOR and shall be performed by a CONTRACTOR-employed independent testing firm.

C. Laboratory Tests: All laboratory testing shall be performed by an independent, qualified testing laboratory approved by the ENGINEER. The selected laboratory shall employ the proper equipment and qualified testing personnel for the testing specified in these Specifications. The CONTRACTOR shall obtain the ENGINEER's approval of the testing equipment and personnel. The ENGINEER may monitor the operations to ensure that tests are being performing in accordance with approved procedures and in compliance with these Specifications.

D. Qualification of Laboratory Testing Personnel: Personnel performing laboratory tests shall be qualified for such work by virtue of prior experience and training.

E. Testing Equipment: Testing equipment shall be in satisfactory operating condition, of adequate capacity and range, and accurately calibrated. Testing equipment shall be calibrated in accordance with national standards which are certified by the National Institute of Standards and Technology. Testing equipment shall be calibrated at the frequency recommended by the equipment manufacturer.

## 1.12 TEST REPORTS

A. Test reports shall include the following information:

1. Actual test results compared with the Contract requirements and identification of all non- conforming items.

2. Calibration Certificates.

B. The ENGINEER will make available to the CONTRACTOR copies of all test reports of tests performed by the ENGINEER.

## 1.13 QUALITY CONTROL AUDITS

A. The ENGINEER may perform quality control audits of the CONTRACTOR's, SUBCONTRACTOR's, and Supplier's quality records and performance. The CONTRACTOR shall ensure that all quality control records and places of work are open and available to the ENGINEER for inspection. The ENGINEER will give 30 days notice of intention to audit specific activities or installations.

B. The CONTRACTOR, SUBCONTRACTOR, or Supplier being audited shall be available during the audit as required by the audit team.

## 1.14 CERTIFICATES OF COMPLIANCE

A. The CONTRACTOR may use certificates of compliance for certain materials and products in lieu of the specified sampling and testing procedures. Submit any certificates required for demonstrating proof of compliance of materials with specification requirements with each lot of material delivered to the Work. The lot so certified shall be clearly identified by the certificate. Certificates shall be signed by an authorized representative of the producer or manufacturer and shall state that the material complies in all respects with Contract requirements.

B. The Contract Schedule specified in Section 01311 - Construction Schedule, shall indicate the date scheduled for the submittal of certificates. In the case of multiple shipments, each of which shall be accompanied by a certificate of compliance, the scheduled date on the Project CPM Schedule shall indicate the initial submittal only.

C. The certificate of compliance shall be accompanied by a certified copy of test results or shall state that such test results are on file with the producer or manufacturer and shall be

furnished to the OWNER on request. In addition to the identifying information specified for submittals in Section 01300 – CONTRACTOR Submittals, the name and address of the organization performing the tests, the date of the tests, and the quantity of material shipped.

D. Materials used on the basis of a certificate of compliance may be sampled and tested by the ENGINEER at any time. The fact that material is used on the basis of a certificate of compliance shall not relieve the CONTRACTOR of its responsibility for incorporating material in the Work which conforms to the requirements of the Contract, and any such material not conforming to such requirements will be subject to rejection, whether in place or not.

E. The OWNER reserves the right to reject a certificate of compliance and require submittal and execution of sampling and testing procedures described herein.

### 1.15 SPECIAL INSPECTONS

A. Any special inspections required shall be executed by an independent inspection organization, not affiliated with the CONTRACTOR or its regular quality control organization.

## PART 2 PRODUCTS – NOT USED

## PART 3 EXECUTION – NOT USED

****END OF SECTION****

**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01505: MOBILIZATION**

## PART 1 GENERAL

### 1.01 SUMMARY

A. This Specification Section outlines those responsibilities of the CONTRACTOR that are scheduled to be performed for both mobilization and demobilization.

B. Related Sections:

1. Section 01010 – Summary of Work
2. Section 01060 – Regulatory Requirements
3. Section 01062 – Environmental Requirements
4. Section 01300 – CONTRACTOR Submittals
5. Section 01530 – Protection of Existing Facilities
6. Section 01700 – Closeout Procedures

### 1.02 WORKSITE

A. This project is for a pipeline with an alignment through several local communities and other government agencies. The pipeline is generally located within road or rail right-of-ways. The Limits of Work for the project are described by Temporary Construction Easements provided by each community/agency and are typically the full-width of the right-of-way. However, each community/agency will set restrictions on the use of the right-of-way. The CONTRACTOR shall confirm the limits of work with each community and acquire the necessary permits to conduct the work prior to mobilization. All worksites shall be returned to existing conditions or better upon demobilization.

### 1.03 CONTRACTOR'S RESPONSIBILITIES

A. Mobilization shall include the obtaining of permits, preparing and furnishing specified submittals, moving onto the Site all equipment necessary for the Work; furnishing and erecting plants, temporary buildings, and other construction facilities; and implementing security requirements; all as required for the proper performance and completion of Work.

B. Prior to the mobilization of all plant, equipment, offices or temporary facilities to the Site, the CONTRACTOR and OWNER Representative shall jointly perform a site survey of the existing conditions per the requirements of Section 01530.

C. Mobilization shall include, but not be limited to, the following work items:

1. Attendance at pre-construction meeting.

2. Signatures on all Contract Documents necessary to proceed.

3. Delivery of all required pre-construction submittals, including reservoir and water treatment plant methodology shut-down plan, construction schedule, CPM schedule, submittal schedule, joint survey to establish authenticity of possible claims, schedule of values, and others as specified.

4. Mobilizing and moving onto site the CONTRACTOR's plant, equipment, tools, materials and labor required for the first 30 days of work.

5. Providing the CONTRACTOR's Project Manager, Project Superintendent, Project Engineer and Site Safety Representative at the Project site full time.

6. Obtaining and paying for all required permits, insurance, and bonds.

7. Installing temporary construction power, wiring, and lighting facilities.

8. Developing and installing construction water supply, including fire protection system, and paying any required deposit.

9. Providing on-site sanitary facilities and potable water facilities.

10. Arranging for and erection of CONTRACTOR's work and storage yards and any required on-site and off-site parking areas.

11. Posting all OSHA-required notices and establishing safety programs as defined in CONTRACTOR's Cal-OSHA approved Safety Program.

12. Fabricating and erecting project signs, construction area signs, traffic handling and detour signs, and temporary traffic control devices.

13. Preparing and submitting Site Specific CONTRACTOR Health and Safety Plan.

14. Providing onsite communication facilities, including telephones.

15. Constructing and implementing safety and security features.

16. Installing erosion control measures, and other environmental protection measures such as environmental fencing as Specified in Section 01062, indicated in the Drawings, and/or covered in applicable permits.

17. All other incidental work of a general and administrative nature as specified in the Contracting Requirements and General Requirements and not covered under separate bid items.

D. Demobilization shall include, but not be limited to, the following work items:

1. Demobilizing and removal of the CONTRACTOR's facilities and equipment.

2. Removing all project signs from project site, and removing all construction area signs, traffic handling and detour signs, and temporary traffic control devices from project vicinity.

3. Removing all temporary construction facilities and other equipment and utilities from the site as CONTRACTOR's property within 10 calendar days after Final Completion. Cleanup of all debris and restoring the site as specified.

4. Furnishing all required equipment installation certification forms, warranty documents and Operations and Maintenance (O&M) data and manuals and spare parts, special tools and keys.

5. Coordinate and attend O&M meeting and hand-off meeting.

6. Performing all required training sessions.

7. Performing and submitting all manufacturer installation checkouts.

8. Preparing and submitting all final documents, including certified payroll, and other records of payments to suppliers and subcontractors, and lien releases/claims waivers needed to close the contract within the time requirements.

9. Furnishing the CONTRACTOR's Final Updated Construction Drawings (Record Drawings).

10. Finishing all punch list work within the time requirements.

11. Successfully completing Startup and Testing.

12. Performing final site cleanup and restoration as required.

13. Providing signoffs from affected property owners and permitting agencies confirming that their requirements have been met.

14. Completing all specified close-out requirements.

15. Requesting final payment.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION (NOT USED)**

**END OF SECTION**

**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01510: TEMPORARY UTILITIES**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Temporary electrical facilities.

B. Temporary water.

C. Temporary heat.

D. Temporary bath rooms.

### 1.02 RELATED SECTIONS

Not Used

### 1.03 REFERENCES

A. State of California, Department of Transportation (Caltrans), Standard Specifications: Section 86 Signals, Lighting and Electrical Systems

### 1.04 TEMPORARY ELECTRICAL FACILITIES

A. Electrical Services: Provide and maintain during the course and progress of the Work all electrical power and wiring requirements to facilitate the work of all trades and services associated with the Work. Electrical power shall be provided at the CONTRACTOR's expense. The CONTRACTOR shall request the utility company to install temporary power poles in locations required. All temporary wiring, feeders, and connections shall be furnished by the CONTRACTOR, as required.

B. Falsework Lighting: Falsework lighting shall comply with the requirements of Caltrans Standard Specifications, Article 86-6.11, "Falsework Lighting." The CONTRACTOR shall submit a plan of the proposed falsework lighting installations in accordance with the submittal requirements of Section 01300 – CONTRACTOR Submittals.

### 1.05 TEMPORARY WATER

A. Provide temporary water service as required for the Work, at the CONTRACTOR's expense. Closest availability of water shall be determined by the CONTRACTOR and shall be approved by authorities having jurisdiction before making the connection.

B. Provide temporary piping or hose to carry water to every point where needed. All water used shall be potable water, unless otherwise approved by the jurisdictional authority for a specific purpose.

## 1.06 TEMPORARY HEAT

A. Provide, at the CONTRACTOR's expense, temporary heat as necessary for drying out the station facilities and other structures, curing of concrete, the proper installation of materials, and the protection of the Work, materials, and workers against injury from dampness and cold.

B. Fuel, equipment, and methods of heating shall be approved by the jurisdictional fire marshal before using.

## 1.07 TEMPORARY BATH ROOMS

A. CONTRACTOR shall provide temporary bathrooms for project team members including the CONTRACTOR's staff, Owner, Engineer, and Official Project Stakeholders visiting the project site(s).

B. CONTRACTOR shall provide portable toilets and wash stations within 0.5 mi. of the active work area.

## PART 2 PRODUCTS – NOT USED

## PART 3 EXECUTION

## 3.01 CLEANUP

A. Remove all materials and equipment as a part of final cleanup.

**END OF SECTION**

**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01520: SECURITY**

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. This Section describes the security requirements for high risk projects to reduce the risk of theft and vandalism to Owner and CONTRACTOR property.

### 1.02 RELATED SECTIONS

A. Project progress schedules and status reports are specified in Section 01311 – Construction Schedule.

B. Section 01300 – CONTRACTOR Submittals

C. Section 01550 – Site Access and Storage

D. Section 01590 – Field Offices

### 1.03 MEASUREMENT AND PAYMENT

A. Separate measurement or payment will not be made for work required under this Section. All costs in connection with the work specified herein will be considered to be included with the related item of work in the Bid Schedule of the Bid Form, or incidental to the Work.

### 1.04 SUBMITTAL REQUIREMENTS

A. Schedule of Submittals: Within thirty calendar days after the effective date of Notice to Proceed or before start of Work at the jobsite, whichever occurs first, the CONTRACTOR shall submit for the ENGINEER's review and approval, as follows:

1. CONTRACTOR shall provide a security plan to the OWNER via the ENGINEER at the start of Work to establish necessary coordination between OWNER, property owners, and municipalities. The security plan must include a definition of work, list of employees and SUBCONTRACTOR employees that will be on the jobsite, a list of contact numbers and security measures that the CONTRACTOR intends to take during the Work. The OWNER will sign off on the security plan. Correspondence shall continue with OWNER on a need by need basis until the Acceptance of Work. The CONTRACTOR shall maintain and submit the security plan on a monthly or as needed basis for approval as determined by the ENGINEER.

2. The CONTRACTOR shall provide the Engineer with an inventory of assets that will be stored at the Work site. Project assets include tools, machines, vehicles, and construction materials of value. Asset inventory shall include the cost of asset, serial numbers or other unique identifiers, photographs, replacement

costs, planned storage locations and the quantity of materials stored at Work site. The CONTRACTOR shall provide updates as major inventory changes occur or as requested by the ENGINEER.

## 1.05 CONTRACTOR'S RESPONSIBILITIES

A. The CONTRACTOR shall prepare and maintain a weekly written roster of all personnel, including subcontractors that are performing work on the jobsite. The CONTRACTOR shall be prepared to provide updated rosters to ENGINEER or OWNER upon request.

B. CONTRACTOR shall report crime and attempted crime that occurs within Work area to OWNER immediately. A formal report shall be made to the ENGINEER. CONTRACTOR and SUBCONTRACTORs employees shall cooperate with OWNER during an investigation.

C. If criminal acts persist or if risk is deemed high enough as determined by the ENGINEER, a survey of the Work area shall be jointly conducted by the OWNER, ENGINEER and the CONTRACTOR to identify existing threats to Work site security. Owner shall provide the ENGINEER and CONTRACTOR with a set of written or verbal recommendations based on the threat assessment. The CONTRACTOR shall put in a good faith effort in implementing OWNER recommendations.

D. When the CONTRACTOR is not present or performing Work, no assets (regardless of value) shall be left unsecured at the Work site. Materials vulnerable to theft, such as cables, tools and equipment, shall be secured in a locked storage facility. Daily removal of scrap material shall be performed.

E. A locked, physical perimeter shall be established around the storage area. The CONTRACTOR shall post Project Name and after hours contact information in such a manner as to be plainly visible from inside and outside of the construction area.

F. Entry doors to storage areas and fenced gates shall be properly secured with a high grade, anti-cut lock. During nonbusiness hours, heavy equipment shall be disabled to prevent unauthorized use and, if applicable, shall be parked in front of the doors of temporary storage containers to serve as a barricade.

G. If criminal activity persists or if risk is deemed high enough, the Engineer at his discretion may direct the CONTRACTOR to hire private security and/or implement electronic surveillance at no additional cost to the Owner.

## 1.06 PRIVATE SECURTY

A. If private security forces are provided due to high risk or repeated incidents, the CONTRACTOR shall provide security services that comply with the following requirements.

1. Security guards must be employed by licensed private patrol operators.

2. The CONTRACTOR through the Engineer shall provide Owner with the company name, contact information and the specific date, time and location of private patrols.

3. Security guards shall be in uniform and drive a marked company vehicle while on patrol.

4. Security guards must possess a valid security guard registration and carry it with them at all times while on duty.

## PART 2 PRODUCTS

### 2.01 ELECTRONIC SURVEILLANCE

A. If electronic surveillance is provided due to high risk or repeated incidents, the CONTRACTOR shall provide electronic surveillance that meets the following requirements.

1. The electronic surveillance equipment shall be a mobile surveillance unit (MSU) consisting of multiple cameras as required to provide video coverage of vulnerable areas of the worksite.

2. Cameras shall be high resolution (minimum 720p), color, and low light cameras.

3. Upon detection of any movement, a remote alarm shall be generated and video shall be recorded until movement has ceased. The video shall be retained for a minimum of 7 days. Recorded video and related information shall be provided to Owner upon request.

4. The MSU alarm shall be live off-site monitored 24 hours per day, 7 days a week. Any movement shall be promptly evaluated and if appropriate, result in prompt notification of the Owner.

5. The MSU shall be self-powered or CONTRACTOR shall provide the necessary power.

## PART 3 EXECUTION – NOT USED

**END OF SECTION**

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**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01530: PROTECTION OF EXISTING FACILITIES**

## PART 1 GENERAL

### 1.1 GENERAL

A. The CONTRACTOR shall protect all existing utilities and improvements not designated for removal and shall restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than prior to such damage or temporary relocation, all in accordance with the Contract Documents.

B. The CONTRACTOR is responsible for determining the location and timing of potholing and shall secure Encroachment permits for those activities, including the preparation and submittal of traffic control plans. Encroachment Permits will be required from Monterey County, affected municipalities and the Presidio of Monterey.

### 1.2 CONTRACTOR SUBMITTALS

A. CONTRACTOR shall provide Owner with copies of all materials submitted for the Encroachment permits at the time they are submitted.

B. If not shown correctly on the project plans, the CONTRACTOR shall identify the correct location and elevation of all existing utilities crossed by or adjacent to the project pipelines in the record drawings in accordance with Section 01720.

### 1.3 RIGHTS-OF-WAY

A. The CONTRACTOR shall not do any WORK that would affect any oil, gas, sewer, or water pipeline; any telephone, telegraph, or electric transmission line; any fence; or any other structure, nor shall the CONTRACTOR enter upon the rights-of-way involved until notified that the OWNER has secured authority therefor from the proper party. Copies of encroachment agreements for work in existing rights of way are included in the contract documents. The CONTRACTOR shall implement actions required by those agreements.

B. After authority has been obtained, the CONTRACTOR shall give said party due notice of its intention to begin work, if required by said party, and shall remove, shore, support, or otherwise protect such pipeline, transmission line, ditch, fence, or structure, or replace the same.

### 1.4 PROTECTION OF STREET OR ROADWAY MARKERS

A. The CONTRACTOR shall not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization. No pavement breaking or excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced. Survey markers or points disturbed by the CONTRACTOR shall be accurately restored after street or roadway resurfacing has been completed.

## 1.5 RESTORATION OF PAVEMENT

A. **General:** All paved areas including asphaltic concrete berms cut or damaged during construction shall be replaced with similar materials of equal thickness to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for in the Contract Documents or in the requirements of the agency issuing the permit. The pavement restoration requirement to match existing sections shall apply to all components of existing sections, including sub-base, base, and pavement. Temporary and permanent pavement shall conform to the requirements of the affected pavement owner. Pavements which are subject to partial removal shall be neatly saw cut in straight lines.

B. **Temporary Resurfacing:** Wherever required by the public authorities having jurisdiction, the CONTRACTOR shall place temporary surfacing promptly after backfilling and shall maintain such surfacing for the period of time fixed by said authorities before proceeding with the final restoration of improvements.

C. **Permanent Resurfacing:** This project includes significant construction activity in paved streets. The project goal is to leave the streets in better condition than they were found. This includes a milling and resurfacing program after pipeline construction is completed. See contract drawings for limits of resurfacing.

D. **Restoration of Sidewalks or Private Driveways:** Wherever sidewalks or private roads have been removed for purposes of construction, the CONTRACTOR shall place suitable temporary sidewalks or roadways promptly after backfilling and shall maintain them in satisfactory condition for the period of time fixed by the authorities having jurisdiction over the affected portions. If no such period of time is so fixed, the CONTRACTOR shall maintain said temporary sidewalks or roadways until the final restoration thereof has been made.

## 1.6 EXISTING UTILITIES AND IMPROVEMENTS

A. **General:** The CONTRACTOR shall protect underground Utilities and other improvements which may be impaired during construction operations, regardless of whether or not the Utilities are indicated on the Drawings. The CONTRACTOR shall take all possible precautions for the protection of unforeseen Utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.

B. The CONTRACTOR shall be responsible for exploratory excavations as it deems necessary to determine the exact locations and depths of all Utilities which may interfere with its work. All such exploratory excavations shall be performed as soon as practicable after Notice to Proceed and, in any event, a sufficient time in advance of construction to avoid possible delays to the CONTRACTOR's progress. When such

exploratory excavations show the Utility location as shown on the Drawings to be in error, the CONTRACTOR shall so notify the ENGINEER.

C. Utility laterals are not shown on the drawings. It is the CONTRACTOR's responsibility to locate, pothole and protect utility laterals or relocate them in accordance with the affected utility's requirements. Sewer laterals shall remain below the new potable water lines unless approved in advance by the Owner.

D. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the Utility.

E. **Utilities to be Moved:** In case it shall be necessary to move the property of any public utility or franchise holder, such utility company or franchise holder will, upon request of the CONTRACTOR, be notified by the OWNER to move such property within a specified reasonable time. When utility lines that are to be removed are encountered within the area of operations, the CONTRACTOR shall notify the ENGINEER a sufficient time in advance for the necessary measures to be taken to prevent interruption of service.

F. **Utilities to be Removed:** Where the proper completion of the WORK requires the temporary or permanent removal and/or relocation of an existing Utility or other improvement which is indicated, the CONTRACTOR shall remove and, without unnecessary delay, temporarily replace or relocate such Utility or improvement in a manner satisfactory to the ENGINEER and the owner of the facility. In all cases of such temporary removal or relocation, restoration to the former location shall be accomplished by the CONTRACTOR in a manner that will restore or replace the Utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal.

G. **OWNER's Right of Access:** The right is reserved to the OWNER and to the owners of public utilities and franchises to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the WORK of this Contract.

H. **Underground Utilities Indicated:** Existing Utility lines that are indicated or the locations of which are made known to the CONTRACTOR prior to excavation and that are to be retained, and all Utility lines that are constructed during excavation operations shall be protected from damage during excavation and backfilling and, if damaged, shall be immediately repaired or replaced by the CONTRACTOR, unless otherwise repaired by the owner of the damaged Utility. If the owner of the damaged facility performs its own repairs, the CONTRACTOR shall reimburse said owner for the costs of repair.

I. **Underground Utilities Not Indicated:** In the event that the CONTRACTOR damages existing Utility lines that are not indicated or the locations of which are not made known to the CONTRACTOR prior to excavation, a verbal report of such damage shall be made immediately to the ENGINEER and a written report thereof shall be made promptly thereafter. The ENGINEER will immediately notify the owner of the damaged Utility. If the ENGINEER is not immediately available, the CONTRACTOR shall notify the Utility owner of the damage. If directed by the ENGINEER, repairs shall be made by the CONTRACTOR under the provisions for changes and extra work contained in the front-end documents.

J. Costs of locating and repairing damage not due to failure of the CONTRACTOR to exercise reasonable care, and removing or relocating such Utility facilities not indicated in the Contract Documents with reasonable accuracy, and for equipment on the project which was actually working on that portion of the WORK which was interrupted or idled by removal or relocation of such Utility facilities, and which was necessarily idled during such work will be paid for as extra work in accordance with the provisions of Section 3 of the General Conditions.

K. **Approval of Repairs:** All repairs to a damaged Utility or improvement are subject to inspection and approval by an authorized representative of the Utility or improvement owner before being concealed by backfill or other work.

L. **Maintaining in Service:** Unless indicated otherwise, oil and gasoline pipelines, power, and telephone or the communication cable ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the WORK shall remain continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the ENGINEER are made with the owner of said pipelines, duct, main, irrigation line, sewer, storm drain, pole, or wire or cable. The CONTRACTOR shall be responsible for and shall repair all damage due to its operations, and the provisions of this Section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.

## 1.7 TREES OR SHRUBS WITHIN STREET RIGHTS-OF-WAY AND PROJECT LIMITS

A. **General:** Except where trees or shrubs are indicated to be removed, the CONTRACTOR shall exercise all necessary precautions so as not to damage or destroy any trees or shrubs, including those lying within street rights-of-way and project limits, and shall not trim or remove any trees unless such trees have been approved for trimming or removal by the jurisdictional agency or OWNER. Existing trees and shrubs which are damaged during construction shall be trimmed or replaced by the CONTRACTOR or a certified tree company under permit from the jurisdictional agency and/or the OWNER. Tree

trimming and replacement shall be accomplished in accordance with the following paragraphs.

B. **Trimming:** Symmetry of the tree shall be preserved; no stubs or splits or torn branches left; clean cuts shall be made close to the trunk or large branch. Spikes shall not be used for climbing live trees. Cuts over 1-1/2 inches in diameter shall be coated with a tree paint product that is waterproof, adhesive, and elastic, and free from kerosenes, coal tar, creosote, or other material injurious to the life of the tree.

C. **Replacement:** The CONTRACTOR shall immediately notify the jurisdictional agency and/or the OWNER if any tree or shrub is damaged by the CONTRACTOR's operations. If, in the opinion of said agency or the OWNER, the damage is such that replacement is necessary, the CONTRACTOR shall replace the tree or shrub at its own expense. The tree or shrub shall be of a like size and variety as the one damaged, or, if of a smaller size, the CONTRACTOR shall pay to the owner of said tree a compensatory payment acceptable to the tree or shrub owner, subject to the approval of the jurisdictional agency or OWNER. The size of the tree or shrub shall be not less than 1-inch diameter nor less than 6 feet in height. Planting of replacement trees and shrubs shall be in accordance with the recommendations of the nursery furnishing the plants. Unless otherwise indicated, the CONTRACTOR shall water and maintain the replacement trees and shrubs for 6 months after planting.

## 1.8 LAWN AREAS

A. Lawn or landscaped areas damaged during construction shall be repaired to match the pre-construction condition to the satisfaction of the land owner and the OWNER.

## 1.9 NOTIFICATION BY THE CONTRACTOR

A. Prior to any excavation in the vicinity of any existing underground facilities, including all water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications, or television cables; all traffic signal and street lighting facilities; and all roadway and state highway rights-of-way, the CONTRACTOR shall notify the respective authorities representing the owners or agencies responsible for such facilities not less than 3 days nor more than 7 days prior to excavation so that a representative of said owners or agencies can be present during such work if they so desire. The CONTRACTOR shall also notify the regional notification center at 1-800-642-2444 at least 2 days, but no more than 14 days, prior to such excavation.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION (NOT USED)

**END OF SECTION**

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**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01532: SITE CONDITION SURVEYS**

## PART 1 GENERAL

### 1.01 THE REQUIREMENT

A. The CONTRACTOR shall conduct thorough pre-construction and post-construction Site conditions surveys of the entire Project. Site conditions surveys shall consist of digital photographs and/or video in a common format.

### 1.02 CONTRACTOR SUBMITTALS

A. Photographs, and other data of the preconstruction conditions shall be submitted to the ENGINEER for record purposes prior to, but not more than three weeks before, commencement of any construction activities.

B. A complete set of all photographs and survey data of the post-construction conditions shall be completed and submitted prior to final inspection by the OWNER and ENGINEER.

C. The surveys shall be submitted as 2 sets of compact disks (one for Owner, one for Engineer).

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

### 3.01 PHOTOGRAPHS

A. CONTRACTOR, as a minimum, shall document pre- and post-construction conditions by preparing photographs of the following:

1. Roadways used to access the Site or haul materials and equipment to the Site.

2. Work areas, including actual work sites, materials processing and stockpiling areas, access corridors, disposal areas, and staging areas.

3. Any work completed by other contractors at the Site that will be connected to or otherwise affected by the WORK.

4. Driveways, sidewalks, and buildings which might be affected by the WORK.

**END OF SECTION**

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**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01550: SITE ACCESS AND STORAGE**

## PART 1 GENERAL

### 1.01 HIGHWAY LIMITATIONS

A. The CONTRACTOR shall make its own investigation of the condition of available public and private roads and of clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress to the site of the WORK. It shall be the CONTRACTOR's responsibility to construct and maintain any haul roads required for its construction operations.

### 1.02 TEMPORARY CROSSINGS

A. **General**: Continuous, unobstructed, safe, and adequate pedestrian and vehicular access shall be provided to fire hydrants, commercial and industrial establishments, churches, schools, parking lots, service stations, motels, fire and police stations, and hospitals. Safe and adequate public transportation stops and pedestrian crossings at intervals not exceeding 300 feet shall be provided. The CONTRACTOR shall cooperate with parties involved in the delivery of mail and removal of trash and garbage so as to maintain existing schedules for such services. Vehicular access to residential driveways shall be maintained to the property line except when necessary construction precludes such access for reasonable periods of time.

B. **Temporary Bridges**: Wherever necessary, to maintain vehicular crossings, the CONTRACTOR shall provide suitable temporary bridges or steel plates over unfilled excavations, except in such cases as the CONTRACTOR shall secure the written consent of the responsible individuals or authorities to omit such temporary bridges or steel plates, which written consent shall be delivered to the ENGINEER prior to excavation. All such bridges or steel plates shall be maintained in service until access is provided across the backfilled excavation. Temporary bridges or steel plates for street and highway crossing shall conform to the requirements of the authority having jurisdiction in each case, and the CONTRACTOR shall adopt designs furnished by said authority for such bridges or steel plates, or shall submit designs to said authority for approval, as may be required.

C. **Street Use:** Nothing herein shall be construed to entitle the CONTRACTOR to the exclusive use of any public street, alleyway, or parking area during the performance of the WORK hereunder, and it shall conduct its operations to not interfere unnecessarily with the authorized work of utility companies or other agencies in such streets, alleyways, or parking areas. No street shall be closed to the public without first obtaining permission of the ENGINEER and proper governmental authority. Where excavation is being performed in primary streets or highways, one lane in each direction shall be kept open to traffic at all times unless otherwise indicated. Toe boards shall be provided to retain excavated material if required by the ENGINEER or the agency having jurisdiction over the street or highway. Fire hydrants on or adjacent to the WORK shall be kept

accessible to fire-fighting equipment at all times. Temporary provisions shall be made by the CONTRACTOR to assure the use of sidewalks and the proper functioning of all gutters, storm drain inlets, and other drainage facilities.

D. **Traffic Control:** For the protection of traffic in public or private streets and ways, the CONTRACTOR shall provide, place, and maintain all necessary barricades, traffic cones, warning signs, lights, and other safety devices in accordance with the requirements of the "Manual of Uniform Traffic Control Devices, Part VI - Traffic Controls for Street and Highway Construction and Maintenance Operations," published by U.S. Department of Transportation, Federal Highway Administration (ANSI D6.1).

1. The CONTRACTOR shall take all necessary precautions for the protection of the WORK and the safety of the public. Barricades and obstructions shall be illuminated at night, and all lights shall be kept burning from sunset until sunrise. The CONTRACTOR shall station such guards or flaggers and shall conform to such special safety regulations relating to traffic control as may be required by the public authorities within their respective jurisdictions. Signs, signals, and barricades shall conform to the requirements of Cal-OSHA and Subpart G, Part 1926, of the OSHA Safety and Health Standards for Construction.

2. The CONTRACTOR shall submit traffic control plans in accordance with Section 01570 – Traffic Control. The CONTRACTOR shall remove traffic control devices when no longer needed, repair all damage caused by installation of the devices, and shall remove post settings and backfill the resulting holes to match grade.

E. **Temporary Street Closure:** If closure of any street is required during construction, the CONTRACTOR shall apply in writing to the City Engineer and any other jurisdictional agency at least 30 days in advance of the required closure. A Detour and Traffic Control Plan shall accompany the application.

F. **Temporary Driveway Closure**: The CONTRACTOR shall notify the owner or occupant (if not owner-occupied) of the closure of the driveways to be closed more than one eight-hour work day at least 3 working days prior to the closure. The CONTRACTOR shall minimize the inconvenience and minimize the time period that the driveways will be closed. The CONTRACTOR shall fully explain to the owner/occupant how long the closure will take and when closure will start.

## 1.03 CONTRACTOR'S WORK AND STORAGE AREA

A. The CONTRACTOR shall construct and use a separate storage area for hazardous materials used in constructing the WORK.

1. For the purpose of this paragraph, hazardous materials to be stored in the separate area are all products labeled with any of the following terms: Warning, Caution, Poisonous, Toxic, Flammable, Corrosive, Reactive, or Explosive. In addition, whether or not so labeled, the following materials shall be stored in the separate area: diesel fuel, gasoline, new and used motor oil, hydraulic fluid, cement, paints and paint thinners, two-part epoxy coatings, sealants, asphaltic products, glues, solvents, wood preservatives, sand blast materials, and spill absorbent.

2. Hazardous materials shall be stored in groupings according to the Material Safety Data Sheets.

3. The CONTRACTOR shall develop and submit to the ENGINEER a plan for storing and disposing of the materials above.

4. The CONTRACTOR shall obtain and submit to the ENGINEER a single EPA number for wastes generated at the Site.

5. The separate storage area shall meet all the requirements of all authorities having jurisdiction over the storage of hazardous materials.

6. The separate storage area shall be inspected by the City Hazardous Materials Management Division in which is resides prior to construction of the area, upon completion of construction of the area, and upon cleanup and removal of the area.

7. All hazardous materials which are delivered in containers shall be stored in the original containers until use. Hazardous materials which are delivered in bulk shall be stored in containers which meet the requirements of authorities having jurisdiction.

## 1.04 PARKING

A. The CONTRACTOR shall:

1. The CONTRACTOR shall direct its employees to park in areas as directed by the ENGINEER.

2. Traffic and parking areas shall be maintained in a sound condition, free of excavated material, construction equipment, mud, and construction materials. The CONTRACTOR shall repair breaks, potholes, low areas which collect standing water, and other deficiencies.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION (NOT USED)**

**END OF SECTION**

**TECHNICAL SPECIFICATIONS**
**DIVISION 01: GENERAL REQUIREMENTS**
**01561: STORMWATER POLLUTION PREVENTION, EROSION AND SEDIMENT CONTROL**

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## PART 1 GENERAL

### 1.01 SCOPE OF WORK

A. CONTRACTOR shall prepare and submit a site-specific SWPPP (SWPPP) for the Project. CONTRACTOR shall prepare the SWPPP using the template provided by the California Stormwater Quality Association available at http://www.cabmphandbooks.com/Construction.asp. CONTRACTOR shall submit the SWPPP to the OWNER Representative for review, approval, and forwarding to appropriate agencies, as necessary, no less than 70 day prior to any earthwork.

B. CONTRACTOR shall perform all necessary erosion control and storm water management measures in compliance with all federal, state and local regulations for erosion control and pollution prevention, including all requirements set forth in the SWPPP. Requirements for erosion control and disposal of surface water during construction may include, but are not limited to, construction of sedimentation ponds, ditches, culverts, silt fences, straw wattles, pumping, draining and other measures required for the removal or exclusion of water from the excavations, stockpile, and other incidental work areas.

C. CONTRACTOR shall implement the SWPPP and apply best management practices (BMPs) to effectively perform erosion control and storm water management to prohibit the entry of pollutants from the construction Site into surface waters or storm drains. CONTRACTOR will be fully responsible for compliance with, execution and implementation of the SWPPP and related requirements of the Construction General Permit. CONTRACTOR's preparation of the SWPPP, its compliance with, execution and implementation of the SWPPP, and its compliance with the Construction General Permit as set forth in the Contract Documents is incidental work and is deemed included in CONTRACTOR's Total Bid Price.

D. CONTRACTOR shall be responsible for all injury to persons or damage to property on or off the OWNER’s land due to surface or drainage water not properly controlled and disposed of as specified in the SWPPP, the Construction General Permit, and this Section.

E. CONTRACTOR will be responsible for all delays and costs, assessments, fines, and penalties levied against the OWNER by any local, state, or federal agency resulting from CONTRACTOR's failure to fully comply with and/or fully execute and implement the SWPPP and related requirements of the Construction General Permit. CONTRACTOR's responsibility includes completion of all clean-up operations and paying for all associated costs resulting from CONTRACTOR's non-compliance that causes damages to surface waters including reservoirs, creeks, etc.

## 1.02 RELATED SECTIONS

A. Document 00800/APA: Permits and Agreements to be Obtained by the OWNER

B. Section 01062: Environmental Requirements

C. Section 01300: Submittal Procedures

D. Section 02052: Site Preparation, Clearing Grubbing and Stripping

E. Section 02140: Dewatering

F. Section 02200: Earthwork

G. Section 02270: Erosion and Sediment Control

## 1.03 NOT USED

## 1.04 REGULATORY REQUIREMENTS

A. The Clean Water Act, as amended in 1972, prohibits the discharge of pollutants into the waters of the United States from storm water. No debris, soil, ash, silt, sand, cement or concrete, or washing thereof, oil or petroleum products or other organic materials from CONTRACTOR's operation shall be allowed to enter or be placed where it may be washed by rainfall or runoff directly into creek or other waters of the United States.

B. As part of the permitting process for working within a creek or waterway, the OWNER will obtain a 404 permit from the U.S. Army Corps of ENGINEERs, a 1602 Streambed Alteration Agreement from California Department of Fish and Game, and a 401 Certification from the Regional Water Quality Control Board (RWQCB), as applicable. See Document 00800/APA for a listing of Permits and Agreements to be obtained by the City.

C. National Pollution Discharge Elimination System (NPDES) General Construction Permit for Waste Discharge Requirements for Discharges of Storm Water Runoff Associated with Construction Activity (General Permit).

D. CONTRACTOR shall comply with all provisions of the Limited and Full SWPPPs, including but not limited to the following requirements:

1. CONTRACTOR shall attempt to divert any clean storm water away from construction activities. In areas where storm water cannot be diverted, erosion control BMPs to effectively prohibit the entry of pollutants from construction Site

into any creek or storm drain shall be utilized. Trap eroded sediments on site using basins or other devices. CONTRACTOR shall use temporary sediment barriers near the creeks and drainage swales to prevent sediment, excavated spoil, construction materials, or fluid spills from construction equipment from entering the creeks, drainage swales, or drainage canals. If the pollutants or sediments from the construction Site enter the creeks, drainage swales, or drainage canals, the pollutants and sediments shall be removed immediately.

2. CONTRACTOR shall allow areas of infiltration as long as the areas are controlled and do not produce uncontrolled runoff. Avoid concentrating runoff into one area.

3. CONTRACTOR shall maintain excavations free of standing accumulated water. Protect exposed and excavated areas or arrange for dewatering.

4. CONTRACTOR shall install erosion and sediment control measures adjacent to aquatic habitat to prevent sediment from entering these areas.

5. CONTRACTOR shall install erosion and sediment control measures on slopes adjacent to streams and wetlands to prevent sediment from entering these areas.

6. CONTRACTOR shall provide, operate, and maintain pumping equipment as needed to control water at the Site.

7. If hazardous material spills occur in the temporary storage areas or at the Site, CONTRACTOR shall immediately notify the OWNER Representative and, at CONTRACTOR's expense, contain and clean up the spill. CONTRACTOR shall identify containment areas for such materials, and provide for disposal of the materials, their containers, and pavement or soil that may be contaminated with fuel, hydraulic fluid, or oil in accordance with all applicable laws and regulations.

8. Prevention of other non-storm discharge such as slurries from concrete or mortar mixing, equipment cleaning, fueling, and maintenance operations/chemical spills, etc. Measures to be implemented for the cleanout of concrete trucks during concrete placement operations shall be included in the SWPPP. Washout of concrete trucks shall not be allowed to drain into creeks or other bodies of water.

9. Water from equipment washing shall not be discharged to the creeks, drainage swales, or drainage canals or allowed to percolate into the ground. CONTRACTOR shall not sweep, grade, or flush surplus materials, rubbish, or debris into drainage swales or drainage canals.

10. To the extent practical, fueling, maintenance, and parking of vehicles and vehicle maintenance equipment shall not be performed within 50 feet of any creek, drainage canal, or drainage swale.

11. Establish inspection, maintenance, and reporting program for the implemented control measures.

12. CONTRACTOR shall refer to Section 01062 for additional measures to be included in the SWPPP.

E. Under no circumstances shall a creek or natural waterway be disturbed, filled in, dammed or altered.

F. CONTRACTOR shall report any serious sediment release immediately to the OWNER Representative so that the appropriate public agencies are notified.

## 1.05 SWPPP AMENDMENTS; ANNUAL COMPLIANCE CERTIFICATION

A. When changes in the SWPPP are required during the course of the Project, the CONTRACTOR shall prepare and certify an amendment to the SWPPP and submit it to the OWNER Representative for review. CONTRACTOR shall prepare an amendment to SWPPP when one or more of the following conditions exist:

1. Whenever there is a change in construction or operations which may affect the discharge of pollutants to surface waters, groundwater(s), or a municipal separate storm sewer system; or

2. If any of the conditions of the General Permit is violated or the general objective of reducing or eliminating pollutants in storm water discharges has not been achieved. If the RWQCB determines that a Construction General Permit violation has occurred, the SWPPP shall be amended and the amended provisions implemented within 14 calendar days after notification by the RWQCB; or

3. Annually, prior to the defined rainy season, if required by the Project's Contract Documents; or

4. When deemed necessary by the OWNER Representative or resource agency.

B. CONTRACTOR shall include the following information with each proposed amendment to a SWPPP:

1. Describe who requested the proposed amendment.

2. Describe the location of the proposed change.

3. Describe reason for change.

4. Describe the new BMP proposed.

C. All proposed amendments to a SWPPP shall be submitted electronically to the OWNER Representative in accordance with Section 01300. All proposed amendments shall include a completed SWPPP Certification and Approval form signed by CONTRACTOR.

D. CONTRACTOR shall insert all approved amendments into the CONTRACTOR's onsite SWPPP. CONTRACTOR shall also record all approved amendments in the SWPPP amendment log located in the appropriate SWPPP.

E. In no event will CONTRACTOR be entitled to increases in the Contract Sum or the Contract Time for SWPPP amendments and resulting Work caused by CONTRACTOR's failure to comply with the Construction General Permit, the SWPPP, or the requirements set forth in this Section.

F. By June 15 of each year, CONTRACTOR shall submit a completed Annual Certification of Compliance form to the OWNER Representative stating compliance with the terms and conditions of the Construction General Permit and the SWPPP, as appropriate. CONTRACTOR shall insert a copy of each completed and signed Certification of Compliance form into CONTRACTOR's onsite SWPPP.

## PART 2 PRODUCTS

### 2.01 MATERIALS

A. Use certified, weed free, natural/biodegradable imported erosion control materials (e.g. straw wattles, hay bales).

B. Fiber or sediment roll consisting of biodegradable (plastic monofilament netting shall not be allowed because of potential entanglements of wildlife in these materials) fibers.

C. Erosion control mat (plastic monofilament netting shall not be allowed because of potential entanglements of wildlife in these materials).

D. Filter fabric

## PART 3 EXECUTION

### 3.01 EROSION AND STORM WATER CONTROL

CONTRACTOR shall maintain a copy of the SWPPP at the Site and shall abide by all SWPPP requirements contained therein.

A. In company with the OWNER Representative, visit the Site to agree on the areas for site-specific erosion and sedimentation control measures and temporary stockpiling of soil to be implemented during construction.

B. Designated areas for stockpiling of CONTRACTOR's materials shall be away from creeks or other bodies of water. Stockpile areas will be located along rights-of-way as shown on the Contract Drawings.

C. CONTRACTOR shall protect all exposed and graded areas from wind and water erosion until soil stabilization has been achieved.

D. CONTRACTOR shall divert water away from slope where indicated on the Drawings.

E. CONTRACTOR shall provide for the continuous uninterrupted control of surface water during the construction period. Precipitation statistics are available from (http://cdec.water.ca.gov/ ). Control measures shall also be provided as required to comply with the SWPPP.

F. Control and disposal of water shall be accomplished in a manner that will prevent erosion and shall maintain the stability and integrity of excavated slopes, bottom of excavation, ditches, pipes, culverts and adjoining utilities, structures, facilities, roads, and land areas. Appropriate erosion and sediment control measures shall be in place before start of work subject to the approval of the City Representative. Trench excavations shall not be used as drainage ditches.

G. Install erosion and silt control devices where indicated on the Drawings or as directed by the OWNER Representative. Erosion control devices shall not be removed without the approval of the OWNER Representative. CONTRACTOR shall monitor weather forecasts and shall install erosion control devices when the rain forecast exceeds a probability of 40 percent. Silt fences, check berms, ponds, basins or other devices shall be checked and repaired or replaced after each rainstorm. CONTRACTOR shall correct all deficiencies in runoff and erosion control measures within 24 hours of when the deficiency is identified.

H. Retain existing vegetation to the extent feasible to minimize surface area of exposed soil.

I. Fit grading to the surrounding terrain. Time grading operations to minimize soil exposure in the rainy season.

J. Cover the soil piles with waterproof tarps to prevent erosion and dust blowoff. Install sandbags and straw bails around perimeter of tarps.

K. Trap any sediment runoff to downhill road, embankment, or creek with vertical filter fabric, staked straw bales, or sediment rolls. Direct runoff away from disturbed areas of construction.

L. Install filter fabric/ or straw wattles around inlet drains.

M. Discharge of wastewater used to wash the concrete trucks or other equipment into the creeks will not be allowed.

N. No debris, soil, ash, silt, sand, cement or concrete, oil or petroleum products, or other organic materials from the construction operations would be allowed to enter or be placed where it may be washed by rainfall or runoff directly into a creek.

## 3.02 CLEAN UP AND DISPOSAL

A. Remove all erosion and sediment control devices and material, equipment, and temporary structures used for the control and disposal of water from the Site once Work is completed.

B. Grade Site and remove unused soil as CONTRACTOR’s property from Site as soon as possible.

C. Arrange to have the catch basins cleaned if sediment enters the storm water system.

**END OF SECTION**

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**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01570: TRAFFIC CONTROL**

## PART 1 GENERAL

### 1.01 SUMMARY

A. This Specification Section sets forth the minimum requirements for traffic routing, traffic control, and site access during construction.

B. Related Traffic Control Requirements:

1. Caltrans

2. County of Monterey

C. Design Criteria:

1. All traffic control work shall be performed in accordance with specifications and standards of the entities listed above, as applicable and as supplemented herein.

2. Traffic control plans shall implement devices conforming to the latest edition of the Federal Highway Administration "Manual on Uniform Traffic Control Devices for Streets and Highways" (FHWA MUTCD), as amended for use in California.

### 1.02 SCOPE OF WORK

A. The CONTRACTOR shall verify and update if necessary the Traffic Control Plan prepared for Caltrans for the Hwy 183 crossing (provided in Appendix E), and prepare new traffic control plans for the following project work areas:

1. Work crossing Del Monte Blvd. at Lapis

2. Work on the Monte Road Bridge

3. Work at CCSD Well #3 in Del Monte Ave.

4. Other work the CONTRACTOR feels will impact traffic on public roads.

B. The CONRTACTOR shall construct, operate and maintain traffic control in conformance with the requirements in this section. The required traffic control work shall be in place prior to the start of the construction work of the CONTRACTOR and/or any of the SUBCONTRACTORs. The Traffic Control Plans must clearly depict the sequence of the construction operation(s), the construction to be performed and the traveled way that will be utilized by all movement of traffic during each phase of construction. Multiple phases of construction will require a separate traffic control plan for each different construction phase or operation.

C. The CONTRACTOR shall provide for the protection of the traveling public, pedestrians and workers within the area covered by the limits of construction, at all times when the area is affected by construction facilities or activities.

D. The CONTRACTOR shall engage a qualified specialty SUBCONTRACTOR to perform all traffic control/routing work. The SUBCONTRACTOR shall provide all material, labor, equipment and service required for traffic control. This SUBCONTRACTOR shall also furnish the following:

1. Traffic Control Supervisors

    a. The traffic control supervisors shall direct the traffic crews and/or perform the traffic control work whenever there is work in the street, sidewalk, path or any other public right of way. When work is being performed at multiple sites, separate supervisors shall be designated for each site. Separate supervisors shall be designated to provide coverage when work is being performed for multiple shifts at a given site.

    b. The traffic control supervisors shall possess a minimum of five years experience in traffic control supervision. At least one supervisor shall be present at the job site during all traffic control operations and whenever the CONTRACTOR's activities impact the public roadway.

2. Traffic Crew

    a. The SUBCONTRACTOR shall provide sufficient traffic crews to implement and maintain the Traffic Control work. A Traffic Crew shall be comprised of at least two persons and each crewmember shall have a minimum of one year experience in Traffic Control on similar scale projects, and shall have passed a Flagger Training Course given by the American Traffic Safety Services Association or another institution acceptable to the OWNER.

3. The Traffic Crew shall:

    a. Assist the Traffic Supervisor in re-striping, flagging and setting up all traffic signs and other traffic control devices in accordance with the Approved Traffic Control Plans and Traffic Detour Plans. The required traffic control work shall be in place prior to the start of the construction work of the General CONTRACTOR and/or any of the SUBCONTRACTORs.

    b. Be on site especially during nights, weekends, and holidays, as required by the OWNER Representative in setting up and/or correcting the traffic

control devices, during the CONTRACTOR's actual working hours or as directed by the OWNER Representative.

E. The CONTRACTOR shall so conduct his operations as to cause the least possible obstruction and inconvenience to the public and area residents, and shall have under construction no greater duration or amount of work, than he can prosecute properly with due regard to the rights of the public and area residents. The CONTRACTOR shall ensure all streets, and intersections remain open to traffic and maintain access to public and private properties to the greatest extent possible by constructing the work in stages.

F. The CONTRACTOR shall furnish, install, relocate to provide for lane shifting, remove, store, maintain (including covering and uncovering as required), move to new locations, replace when damaged or missing and dispose of all traffic signs and traffic control devices and features necessary for safety and convenience of the general public and area residents. All workers and work shall be safeguarded, where, and as required by conditions at the site of the work and in addition to the requirements specified herein, with various signage and barricades, including but not limited to the following:

1. Traffic signs and parking prohibition signs
2. Barricades with flashers
3. Delineators
4. High level warning devices
5. Solar Powered Flashing arrow signs
6. Pedestrian barricades
7. Temporary and permanent pavement markings
8. Flag persons
9. Excavation plating/bridging, including any temporary plating and bridging required by the CONTRACTOR's operations

G. The CONTRACTOR shall provide traffic lanes and routing of vehicular and pedestrian traffic, as specified herein, in a manner that will be safe and will minimize traffic congestion and delays.

## 1.03 APPLICABLE CODES AND STANDARDS

A. In addition to compliance with this specification, the CONTRACTOR shall comply with all applicable requirements of the latest editions of the following:

1. California Vehicle Code

2. Standard Specifications and Plans, Department of Transportation, State of California (Caltrans Standard Specifications and Caltrans Standard Plans) except as modified herein

3. Manual of Uniform Traffic Control Devices (MUTCD)

4. California Manual of Uniform Traffic Control Devices (CA MUTCD)

5. Other Applicable Government Regulations

## 1.04 SUBMITTALS

A. The CONTRACTOR shall submit the following and obtain approval from the OWNER Representative before starting work on the project. Approval by the County of Monterey, and Caltrans will also be required as applicable for each work site:

1. Traffic Control Plans - an electronic version on a compact disc and one printed version to each jurisdiction.

2. CONTRACTOR Storage/Staging Plans

3. Schedules of Traffic diversion and control

4. Specifications for proposed materials, equipment and devices

5. Resumes for traffic control supervisors, traffic crew, and certified Flag persons.

6. Names and telephone numbers of persons responsible for providing 24-hour emergency maintenance services

B. The CONTRACTOR shall submit all documents identified above in 1.04 (A) to the respective agencies noted below, as applicable. However, it is the CONTRACTOR's responsibility to verify the contact information for each agency at the time of submittal.

County of Monterey–Resource Management Agency
Department of Public Works – Encroachment
168 W. Alisal Street, 2nd Floor
Salinas, CA 93901-2438

Encroachment Permit Engineer
California Department of Transportation District 5
50 Higuera Street
San Luis Obispo, CA 9340

## 1.05 TRAFFIC CONTROL PLANS

A. The Traffic Control Plans shall be prepared, signed and stamped by a qualified and experienced Civil Engineer or Traffic Engineer (Registered in the State of California). The attached Traffic Control Plans may be used unless there are changes to the location of the construction area depicted. The CONTRACTOR shall submit separate Traffic Control Plans adequate for approval by affected jurisdictions for each phase of work including

pavement restoration work, before the start of each particular phase of work. The plans shall include an affidavit signed by the licensed engineer who prepared the plan attesting that he/ she has personal knowledge of the traffic conditions in the work areas.

B. The above mentioned Traffic Control Plans for each phase shall be submitted at least 90 days prior to the particular phase, except for the first submission which shall be made no later than 21 days after NTP and 10 days prior to commencing the work. Complete traffic control and detour plans shall be submitted within ten (10) working days of the Notice to Proceed date for the Contract. A submittal shall consist of four (4) copies on white paper of each drawing. Maximum drawing size shall be 36" X 24".

The CONTRACTOR shall submit the plans to/through the OWNER Representative and the affected jurisdiction for approval, and shall allow 21 calendar days in his/her schedule for the OWNER Representative and jurisdiction to review and respond to the traffic control plans. No work shall be allowed on the streets without approved Traffic Control Plans. Failure of the CONTRACTOR to comply will result in penalties as administered by the local municipality.

C. Each Traffic Control Plan shall show the following minimum information, as applicable and as needed to describe the proposed traffic control measures:

1. Street and traffic lane layout (sidewalk, street and traffic lanes etc.); outline of the work under construction

2. Label all taper/transition lengths and widths, delineator spacing and sign spacing.

3. Provide a safe path of travel for pedestrians, in addition to signs and barricades to direct pedestrians through or around the construction work zone.

4. Existing striping, pavement markings and traffic signs, and a description of what is to be removed/covered prior to installation of temporary striping and signage, and what will be restored after the construction is completed.

5. Location and description of traffic control devices proposed for the protection of the work area, excavation, workers, equipment, pedestrians, vehicles, and property.

6. Other proposed changes and provisions for removal, relocation, or temporary installation of:

    a. Traffic signs.

    b. Transit stops.

c. Barricades, chain link and/or plywood fence, temporary K- Rail, crash cushions (sand barrels), etc.

d. Solar operated flashing arrow signs (required for each lane closure).

7. Safe path of travel for passengers using public transit, from/to loading platform to/from the sidewalk.

D. The CONTRACTOR is solely responsible for all permits and fees required to acquire any new Encroachment Permits if identified later due to changes in the design or required by the agency for any unforeseen reason.

## 1.06 PARKING AND STORAGE PLAN

A. The CONTRACTOR shall submit plans for material storage and equipment parking, for each area of the work, along with the respective Traffic Control Plans. For materials storage and equipment parking, the CONTRACTOR shall comply with all local requirements.

B. No construction equipment and material storage, including but not limited to pipes, pipe-fittings, steel bars, shoring, backfill, asphalt mix etc. shall be allowed on any sidewalk, street or property, except as shown on the approved Plans for various phases of construction.

C. The CONTRACTOR shall provide his/her own yard for the storage of pipes, pipe fittings, steel bars, shoring, etc. The proposed areas for storage of materials or equipment shall be included in the Plans.

D. The CONTRACTOR shall be responsible for ensuring that only CONTRACTOR's vehicles, clearly identified with the name of the CONTRACTOR on each side of each vehicle, may be parked in the construction area.

E. Employees of the CONTRACTOR, SUBCONTRACTORs, and suppliers shall not park their vehicles within the active construction area when they are currently working and where public access is prohibited. The CONTRACTOR shall provide parking for their employees at a site, which will not impact local public parking and transport employees between the parking area and the work.

## 1.07 RESUME AND CERTIFICATES OF FLAG PERSONS

The Flag Persons shall have a minimum experience of one year of utilizing manual traffic controls on similar construction projects. The Flag Persons shall have passed The Flagger Training Course offered by National Safety Council Western Region Office, (800) 621-7619 or institutions acceptable to the OWNER Representative. The Flag Persons must

have valid certification. The CONTRACTOR shall submit the resumes of at least four Flag Persons to the OWNER Representative for review and approval.

## 1.08 QUALIFICATIONS

A. The SUBCONTRACTOR performing traffic control shall have a minimum of 5 years' experience performing traffic control in California. The SUBCONTRACTOR performing the traffic control work shall possess a current C-31 Construction Zone Traffic Control license issued by the California CONTRACTOR State License Board.

B. The traffic control supervisors shall each have a minimum of 5 years' experience in traffic control. The traffic control supervisors shall be certified as a Traffic Control Supervisor by the American Traffic Safety Services Association or another institution acceptable to the OWNER Representative.

# PART 2 PRODUCTS

## 2.01 GENERAL

A. All traffic signs, barricades, delineators, flashing arrow signs and other traffic control devices shall conform to the requirements of the California Manual on Uniform Traffic Control Devices (Part 6, Temporary Traffic Control), Standard Plans, and Standard Specifications for traffic control systems. The MUTCD and the California MUTCD are available on the internet at the following web sites:

http://mutcd.fhwa.dot.gov
http://www.dot.ca.gov/hq/traffops/signtech/mutcdsupp

B. All barricades shall have flashers. The flashers shall be maintained in good operating condition at all times by the CONTRACTOR. Cones, pylons, barricades, or posts used in diversion of traffic during hours of darkness shall be illuminated.

C. All signs shall be reflectorized.

## 2.02 DELINEATORS

Delineators for lane taper areas or for the separation of traffic from other work, shall be either reflectorized traffic cones minimum 28 inches high, or reflectorized portable tubular delineators minimum 36 inches high.

## 2.03 TAPE FOR TEMPORARY STRIPING

A. Tape for temporary striping shall be either of the following types, or an OWNER Representative-approved equivalent:

1. Advanced Traffic-Marking, ATM Series 200

2. Swarco Industries, “Director 2”

B. Cutting and spacing of the tape for the temporary striping shall be as follows:

1. Crosswalk and STOP line: Three strips 4 inch wide to mark 12 inches wide crosswalk or limit lines.

2. Striping across intersections and lines for left and/or right turn lanes: Two strips 4 inches wide to mark 8 inches wide guidelines.

3. Double yellow centerline: 2-4 inches wide, 3 inches apart.

4. Other striping: 4 inches wide.

## 2.04 TEMPORARY REFLECTIVE PAVEMENT MARKERS

A. The temporary reflective pavement markers shall be one of the following types:

1. Temporary Overlay Markers (Types Y and W) manufactured by Davidson Traffic Control Products, 3110 70th Avenue East, Tacoma, Washington 98424, telephone (253) 284-8400.

2. Swareflex Pavement Markers (Models 3553, 3554, Cat Eyes Nos. 3002 and 3004), manufactured by Swareco and distributed by Servtech Plastics Inc. 1711 South California Street, Monrovia, CA 91016, telephone (626) 359-9248.

3. Safe-Hit Temporary Pavement Markers manufactured by Safe Hit Corporation, 132 N. El Camino Real #291, P.O. Box 291, Encinitas, CA 92024 (760) 295-2699.

## 2.05 PAVEMENT MARKERS AND ADHESIVE

A. Non-reflective Markers shall conform to Section 85-1.04 “Non-Reflective Pavement Markers", of Caltrans Standard Specifications.

B. Reflective Pavement Markers shall conform to Section 85-1.05, “Reflective Pavement Markers,” of Caltrans Standard Specifications.

C. Adhesive of the above pavement markers shall conform to Section 85-1.055 “Adhesives”, of Caltrans Standard Specifications.

## 2.06 PAVEMENT MARKINGS

The thermoplastic and glass beads for the permanent pavement markings shall conform to Section 84-2.02, "Materials", of Caltrans Standard Specifications.

## 2.07 NON-SKID METAL PLATING:

Metal plating and any metal bridging shall be coated via a blasting process with Integrated 750 HS (formerly 7300 Magna-Prime) Amido-Amine Epoxy, manufactured by Courtaulds Coatings (Division of International), 400 South 13th Street, P.O. Box 4139, Louisville, KY 40201-1439; Fax (502) 588-9316 or equal. Plating shall be coated in accordance with the coating manufacturer's instructions, and installed and maintained in such a manner as to provide a non-skid surface with no edges or corners sticking up, and with no bouncing or shifting.

# PART 3 EXECUTION

## 3.01 GENERAL

A. Furnish, install, construct, maintain, and remove detours, road closures, signs, barricades, K-rail, fences, gates, flag men, radios, flares, miscellaneous traffic devices, drainage facilities, paving, and such other items and services as are necessary to adequately safeguard the public from hazard and inconvenience.

B. During the duration of a detour, cover all signs not in accordance with the traffic control plan. Relocate existing signs to provide visibility from all relocated traffic lanes.

C. All such work shall comply with the ordinances, directives, and regulations of authorities with jurisdiction over the public roads in which the construction takes place and over which detoured traffic is routed by the CONTRACTOR.

## 3.02 CONTROL OF ACCESS

A. Post signs and barricades at all local road closure/work area access locations to prevent any public vehicular access during all working and non-working hours for the duration of the work.

B. Control/detour traffic at all locations in conformance with the approved Traffic Control Plans for each site.

C. Provide access for the OWNER and the OWNER Representative to all areas of the construction site at all times.

D. Provide uninterrupted access for the OWNER recreational facilities adjacent to the well sites.

## 3.03 VEHICULAR TRAFFIC

A. Traffic Lane and Parking Requirements

The CONTRACTOR shall provide the minimum number of lanes to satisfactorily accommodate vehicular traffic. Vehicular/ pedestrian access to properties in the project site area shall be maintained at all times.

The width of a traffic lane shall be measured from center to center of striping, or to the face of curb, or center of channelizer or delineator, as applicable.

1. The CONTRACTOR shall maintain the required travel way for vehicles in any public street, or right of way, and a minimum width of 5 feet of clear sidewalk, or full sidewalk at locations where the sidewalk is less than 5 feet wide for the pedestrians, at all times.

2. All existing traffic movements at the intersections shall be maintained by bridging and/or phasing.

3. No street closure shall interfere with the access of emergency vehicles including those of Police and Fire Departments and ambulances. Local access and detour plan shall be maintained at all times

## 3.04 SPECIAL INSTRUCTIONS

A. The CONTRACTOR shall separate the construction area and staging areas from the traffic lanes by barricades and delineators and shall plate over the trenches after working hours.

B. The CONTRACTOR shall provide flag persons to control the traffic, as shown on the approved traffic control plans or as directed by the OWNER Representative. The number of flag persons required shall depend on the phase of work, traffic conditions, etc.

C. The CONTRACTOR shall use hot asphalt concrete to provide longitudinal and/or transverse transitions with a slope of 1:18 between the newly constructed concrete base, manhole, etc. and existing pavement (whenever the difference in the grade of the pavement and the concrete base, manhole, etc. exceeds 3/4 of an inch) by the end of the work shift or before opening the lanes to traffic.

D. Any existing crosswalks and STOP lines that are removed or damaged by the work activity shall be restored with temporary retroflective tape.

## 3.05 PROHIBITION OF PARKING

A. The CONTRACTOR shall not prohibit stopping in parking lanes except where and when necessary to gain access to the work or to provide the required lanes. The CONTRACTOR shall maintain the signs on a continual basis and shall replace damaged or missing signs daily, and shall remove the signs immediately after they are no longer needed.

B. The CONTRACTOR shall coordinate with the local agencies for the posting of the required signs for the prohibition of parking. The CONTRACTORs shall post the signs at least 72 hours in advance of the effective date and time.

C. If "Tow-Away – No Stopping" signs are to remain in place for less than 5 days, such signs may be attached to Type II barricades, placed at 25 ft. centers. The CONTRACTOR shall post the signs only in the area where they are actually working. Parking shall not be prohibited in the area where there is no construction activity. The name and contact telephone number of the CONTRACTOR shall be shown on all signs.

D. When a vehicle is removed from a street at the request of the CONTRACTOR and a post-storage hearing determines that as a result of the CONTRACTOR's improper posting of the required signs, reasonable grounds did not exist for removal, the CONTRACTOR shall reimburse the appropriate authority for the cost incurred in storage and towing. The failure of the CONTRACTOR to provide reimbursement or to agree to assume all liability for any improper posting shall result in the Police Department's denial of any future requests by that CONTRACTOR for removal of vehicles in violation.

## 3.06 MASS TRANSIT VEHICLES

The CONTRACTOR shall NOT impede public transit operations at any time. The CONTRACTOR shall familiarize himself with the routes of the coach lines that operate within the limits of the work. The lanes made available for traffic shall be located so as to include an adequate and allowable travel path for the coach lines.

In the event that the work requires any transit stops to be relocated or routes to be rerouted, the CONTRACTOR shall contact the transit agency impacted at least 10 days in advance of work.

## 3.07 TRIMMING OF TREES

At least (2) weeks prior to start of work in any particular block, the CONTRACTOR shall to coordinate with the OWNER Representative the requirement to trim any trees that will be in conflict with the construction job itself, with construction equipment, or with the traveling public during construction. The CONTRACTOR shall not detour any traffic onto any lane until all tree branches that may interfere with the traveling public have been addressed. The CONTRACTOR will not be allowed to trim any trees without a written approval and supervision from the appropriate authority including, as required the

retention of an approved arborist if the authority requires it. The CONTRACTOR will perform all necessary trimming of trees, as directed, at no additional cost to the OWNER.

## 3.08 TEMPORARY CONSTRUCTION AND TRAFFIC SIGNS

A. The signs and equipment shall conform to the requirements of the California Manual on Uniform Traffic Control Devices (CA MUTCD).

B. The CONTRACTOR shall be familiar with the California MUTCD and the Special Provisions of the Contract. The CONTRACTOR, before starting any work which will affect the normal flow of traffic, shall furnish, install where and as necessary, or directed, and maintain, temporary signs, mounted on barricades or other suitable supports.

C. The CONTRACTOR shall, as a minimum, furnish and make available to the site the following signs and equipment in sufficient quantities to maintain required traffic control:

1. Barricades, as required by Section 21 of the State of California *Vehicle Code* and as specified in the California MUTCD Part 6 - Temporary Traffic Controls, in sufficient amount to safeguard the public and the workers.

2. “TOW-AWAY - NO PARKING” “signs as herein specified;

3. Traffic cones and/or delineators and/or temporary reflectorized removable tape to delineate traffic lanes as required to guide and separate traffic movements, as directed by the OWNER Representative.

4. High level warning flag units, in advance of traffic approaching the work, each displaying three- (3) flags mounted at a minimum height of 8 feet (2.4m).

5. “ROAD WORK AHEAD” signs, Code W20-1, size 48" x 48" (122cm x 122cm) placed in conspicuous locations, in advance of the work, and facing approaching traffic, as directed by the OWNER Representative.

6. “END ROAD WORK” signs, Code G20-2, size 36”x18” (90cm x 45cm) placed near the end of the termination area or as directed by the OWNER Representative.

7. “RIGHT/LEFT LANE CLOSED AHEAD” " signs Code C20 (RT/LT), size 48" x 48" (122cm x 122cm), placed as directed by the OWNER Representative.

8. “ROAD CLOSED” signs, Code R11-2, size 48"x30" (122cm x 76cm), placed as directed by the OWNER Representative.

9. “ROAD CLOSED TO THRU TRAFFIC” signs, Code R11-4, 60"x30" (152cm x 76cm), placed as directed by the OWNER Representative.

10. “ROAD CLOSED AHEAD” signs, Code W20-3, 48"x48" (122cm x 122cm), placed as directed by the OWNER Representative.

11. “NO PED CROSSING SYMBOL” and “USE CROSSWALK (RIGHT OR LEFT ARROW)” signs, Code R9-3a and R9-3b (RT/LT), size 18" x 18" (46cm x 46cm) and 18" x 12" (46cm x 30cm), placed as directed by the OWNER Representative.

12. “FLAGGER SYMBOL” signs, Code C9A, size 48" x 48" (122cm x 122cm) placed as directed by the OWNER Representative.

13. “ROUGH ROAD” signs, Code W-33, size 30" x 30" (76cm x 76cm) placed as directed by the OWNER Representative.

14. “DETOUR AHEAD” signs, Code W20-2, size 48" x 48" (122cm x 122cm) placed as directed by the OWNER Representative.

15. “DETOUR” and “END DETOUR” signs, Code M4-8, M4-10 (RT/LT) and /or SC-3, size 48" x 18" (122cm x 45cm) placed as directed by the OWNER Representative.

16. “Street Name” signs, size 48" x 18" (122cm x 46cm) placed with items 14 and 15, as directed by the OWNER Representative.

17. “TWO WAY TRAFFIC SYMBOL” signs, Code W-6-3, size standard 48" (122cm), placed as directed by the OWNER Representative.

18. “BE PREPARED TO STOP” signs, Code W3-4, size standard 48” x 48” (122cm x 122cm) placed as directed by the OWNER Representative.

19. “NO LEFT OR RIGHT TURN SYMBOL” signs, Code R3-1 and R3-2, size 30” (76cm), placed as directed by the OWNER Representative.

20. “BIKE LANE” and “END” signs, Code R-81 (CA) and R-81B (CA) placed as directed by the OWNER Representative.

21. “ROAD WORK/SPEED LIMIT” signs, Code C17 (CA), size 24” X 24” placed as directed by the OWNER Representative.

22. “TRUCKS ENTERING EXITING” signs, Code C44 (CA), size 48” X 48” placed as directed by the OWNER Representative.

23. Flashing arrow signs, Type II conforming to Section 12-3.03 of Caltrans Standard Specifications dated July 1992, except as modified herein and placed as shown on the approved Traffic Control Plans. A flashing arrow sign is required for each lane closure. The CONTRACTOR shall use Solar Operated Flashing Arrow signs.

24. All signs installed by the CONTRACTOR shall employ the use of Type III Graffiti proof sheeting on aluminum signs and Type IV for roll-up signs. This sheeting can be obtained from the following sources approved by Caltrans:

    TYPE III 3M High Intensity
    3M Center, Building 42-6E-37
    Saint Paul, Minnesota 55144-1000
    1-888-364-3577

    TYPE IV Reflexite Vinyl Microprism
    Reflexite
    P.O. Box 1200
    315 South Street
    New Britain, Connecticut 06050
    1-800-654-7570

25. The actual number and type of signs to be placed shall be as shown on the approved traffic control plans or as directed by the OWNER Representative.

All signs and/or temporary striping shall be reflectorized. Signs shall be installed so that the bottom of the sign is at least 8 feet above the sidewalk or pavement or as directed by the OWNER Representative.

## 3.09 TRAFFIC CONTROL

A. Traffic Coordination with Others

1. In order to maintain a continuous flow of traffic, including truck traffic hauling materials and equipment, the CONTRACTOR shall coordinate the traffic control work with his sub-CONTRACTORs and other CONTRACTORs working in the same adjacent area.

2. All proposed traffic control changes shall be subject to approval of the OWNER Representative and/or local agency.

B. Traffic Control Flag Persons

1. Flaggers, flagging procedures (signaling), flagger stations and flagger control, shall conform to the requirements of California MUTCD Part 6 Temporary Traffic Controls.

2. The CONTRACTOR shall ensure that flaggers are trained in the proper fundamentals of flagging traffic before being assigned as flaggers.

3. The flaggers shall be used in each situation when the CONTRACTOR's equipment or vehicle backs up into a travel lane, or intermittently occupies a traffic lane, or enters from the work area into a traffic lane, or where required for traffic control, as directed by the OWNER Representative.

## 3.10 MAINTENANCE OF TRAFFIC

A. The CONTRACTOR shall cause the least possible interference with traffic and shall not obstruct nor close any roadway to vehicular or pedestrian traffic, except in the immediate vicinity of the work.

B. Those parts of public streets, ways and sidewalks that are occupied by the CONTRACTOR shall be immediately vacated and returned to public use when CONTRACTOR’s use thereof is no longer necessary for the prosecution of the work.

C. The CONTRACTOR, except as hereinafter provided, shall not impede, at any time, free access for vehicles and pedestrians to warehouses, stores, service stations, dwellings, garages and other properties in the vicinity of the work and on adjacent streets, including those properties fronting on streets allowed or stipulated by the Specifications to be closed to through vehicular traffic. CONTRACTOR shall provide for such local access by phasing his operations, bridging, or employing other procedures approved by the OWNER Representative.

D. The CONTRACTOR shall obtain written permission of each affected property or business owner, or responsible building or business manager, for any proposed period of prohibition or impediment of such access. Prohibition or impediment of access to any building or property for which the OWNER Representative does not have a copy of the specified-signed permission will not be allowed.

E. To assure their immediate and unhampered use at all times, access to fire hydrants shall not be impaired by the CONTRACTOR. No debris, materials or equipment shall be placed within 10 feet of any fire hydrant.

## 3.11 DIVERTING OF VEHICULAR TRAFFIC

A. When closing one or more lanes to vehicular traffic or to otherwise divert such traffic from its normal paths, the CONTRACTOR shall clearly delineate temporary centerlines separating two-way traffic and dividing lines for other temporary traffic lanes, by employing cones, barricades, flags, reflectors, or other approved methods or devices.

B. Placing of devices shall commence sufficiently in advance of the obstruction or other cause of the diverting of traffic to minimize congestion and shall enable traffic to enter, traverse and leave the site of the work without abrupt or unwarranted changes in direction. Unless otherwise specified or approved, each temporary traffic lane shall be not less than 10 feet clear width.

C. When a detour is necessary for full or partial roadway closure, all detour signs needed for the required traffic control must be in place before the roadway can be closed for construction. Failure to comply with this requirement shall result in liquidated damages associated with improper lane closure.

D. High rise warning flag units, each displaying three flags mounted at the minimum height of 8 feet, to provide advance warning for traffic approaching the work, will be required in all cases where motorists' visibility of the work is limited or obscured.

## 3.12 RELOCATION AND REMOVAL OF EXISTING PERMANENT TRAFFIC CONTROL SIGNALS AND SIGNS

A. The CONTRACTOR shall be familiar with all existing permanent traffic signs and other traffic control devices within and adjacent to the project limit. The CONTRACTOR shall survey the site thoroughly to get all pertinent information of the signs in the construction area, including but not limited to sign type, message, location, orientation, number of faces (double sided or single sided), and reflectivity. The CONTRACTOR shall pay particular attention to the signs that will likely be damaged, removed or relocated during construction.

B. CONTRACTOR shall not interfere with or obstruct existing traffic signal installations intended to remain in operation during construction activities. The CONTRACTOR shall temporarily relocate all traffic control, street name, and other City signs, as required for the prosecution of the work, and shall satisfactorily maintain such signs in place at all times. The CONTRACTOR shall similarly relocate, or remove and salvage as OWNER property, the standards for such signs. The CONTRACTOR shall salvage standards in their entirety, and shall remove all concrete therefrom.

C. The temporary relocation of each arterial "STOP" or other traffic regulatory sign shall be done immediately upon its removal, and to a location as close as possible to the original position of such sign, or where directed by the OWNER Representative.

D. The CONTRACTOR shall remove, and salvage as OWNER property, existing arterial "STOP" or other signs superseded by traffic signals installed by him, immediately upon being notified by the OWNER Representative that such signals will remain in operation.

E. The CONTRACTOR shall reinstall any traffic signs removed or relocated during construction to local standards.

## 3.13 PAVING MARKINGS

A. Temporary Pavement Markings

1. After each day's work the CONTRACTOR shall furnish and install temporary pavement delineation, which shall be maintained by the CONTRACTOR until the permanent markings are installed.

2. The CONTRACTOR prior to construction shall survey each street and inventory all existing pavement markings including marking type and material used. The pavement markings shall include, but not be limited to traffic striping, crosswalks, stop lines, messages and raised pavement markers.

3. Temporary pavement delineation of lane lines and centerlines shall consist of temporary reflective pavement markers placed at longitudinal intervals of not more than 24 feet apart. The temporary pavement markers shall be the same color as the markings they replace.

4. Surfaces on which temporary pavement delineation is to be applied shall be cleaned of all dirt and loose material and shall be dry when the pavement markers are applied.

5. Temporary pavement delineation shall be applied in accordance with the manufacturer's instructions. Butyl adhesive pads shall be used to apply temporary reflective pavement markers to the top layer of permanent surfacing or existing surfacing.

B. Permanent Pavement Markings

1. The CONTRACTOR shall furnish all material and labor to replace all permanent thermoplastic stripes and pavement markings damaged or removed by its operations.

2. Reflective and non-reflective markers shall be placed in accordance with Section 85-1.06 of the State Specifications and to State Standard Plans.

3. Thermoplastic pavement markings shall be placed in accordance with Section 84-2.04 of the State Specifications and State Standard Plans.

4. Any pavement markings removed or damaged by the CONTRACTOR's operation shall be replaced within 30 days of permanent pavement restoration. All temporary pavement markings shall be removed according to manufacturer's specification and to the satisfaction of the OWNER Representative prior to restoring the permanent markings.

## 3.14 CROSSWALKS AND SIDEWALKS

A. All crosswalks shall be kept open at all times, unless a substitute temporary crosswalk is provided or otherwise approved by the OWNER Representative.

B. R9-3A and R9-3B, "NO PED CROSSING, USE CROSSWALK" and "USE CROSSWALK (L/R)" signs shall be placed at each end of a temporarily closed crosswalk.

C. Whenever a temporary crosswalk is provided outside of the existing crosswalk, such temporary crosswalks shall be clearly defined by signs, striping, pedestrian bridges or plates. The minimum width of the temporary crosswalk shall be 10 feet measured between the outside edges of the striping tape. The CONTRACTOR shall provide access to mobility and visually impaired persons at all temporary and/or permanent crosswalks at all times by providing accessible temporary curb ramps.

D. The CONTRACTOR shall provide temporary pedestrian signals at temporary crosswalks to be located at 15 feet or more from the existing crosswalk with existing pedestrian signals.

E. No obstruction or openings of any kind shall be allowed in portions of sidewalks accessible to pedestrians.

F. Portions of sidewalk closed to pedestrians shall be delineated by a continuous line of pedestrian barriers. Barriers shall not have legs or other parts projecting into pedestrian ways and shall meet the requirements for the visually impaired persons.

## 3.14 TRUCK ROUTES

A. The CONTRACTOR shall ensure that all trucks and equipment associated with the project travel only on the truck routes designated by the local agencies. The CONTRACTOR shall not permit any trucks, or equipment associated with this project to be driven on non-truck route local streets except to use the shortest route to and from the project sites. In the event truck routes are not designated by a local agency, the CONTRACTORs shall use the local arterials to the projects sites.

B. The CONTRACTOR is solely responsible for all permits and fees required to operate extralegal size, weight, or load vehicles associated with this project.

## 3.15 MAINTENANCE AND REPAIR/RESTORATION

A. Installed traffic control devices and other materials, shall be maintained and kept in good repair and working order until no longer required.

1. Visually ensure that all traffic control devices are installed in accordance with the approved working drawings.

2. Periodically during construction, verify that all traffic control devices are visible and functional.

3. Replace such devices that are lost or damaged, to such an extent as to require replacement, regardless of the cause of such loss or damage.

4. When and where flagmen or radio controllers are an essential part of the traffic control plan (such as during working hours) they shall remain in effect until the plan indicates they are no longer necessary (such as after the construction site has been closed down for the night).

B. Maintain a 24-hour per day emergency service to remove, install, relocate, and maintain warning devices.

1. Furnish to the authority having jurisdiction names and telephone numbers of 3 persons responsible for this emergency service.

2. In the event these persons do not promptly respond or the authority having jurisdiction deems it necessary to call out other forces to accomplish emergency service, the CONTRACTOR will be held responsible for the cost of such emergency service.

C. All site access security provisions, including manning with proficient personnel and adequate communications, shall be applied on a continuous 24 hours per day, seven days per week basis throughout duration of construction.

**END OF SECTION**

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**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01580: PROJECT SIGNS**

## PART 1 GENERAL

### 1.01 SUMMARY

A. This Section includes requirements for installing Project Identification Signs and for removal and disposal of these signs following completion of the Work.

### 1.02 RELATED SECTIONS

A. Section 01300 – Contractor Submittals

B. Section 01600 - Products, Materials, Equipment and Substitutions

C. Section 02200 - Earthwork

### 1.03 SYSTEM DESCRIPTION

A. Contractor shall post a Project Identification Signs at each active work site and at the Contractor's construction trailer.

B. A sign shall also be placed every 2 miles along the alignment.

C. Details of Project Identification Sign construction and legends are shown on figures appended to this Section, titled:

1. Sign Assembly Detail.

D. Where sign is to be posted at an active work site, the Project Sign shall be secured in a way as to prevent it from being stolen, on the project fencing, where it is visible to the public.

E. Size of signs will be as shown on appended figure unless variance is required to meet special or local requirements; however, proportions of signs to be maintained.

F. Mount signs on freestanding fixed posts painted white.

G. Supports:

1. For each sign, provide at least two posts of size shown on appended figures.

2. Provide attachment devices, fasteners, and other necessary hardware and materials.

H. Painting: Both sides and all edges.

I. Content: At a minimum the project sign shall include the following:

1. Project name.

2. Contractor name, Contractor logo, contact phone number and after hours contact number

3. Owner name, Owner logo, contact number and after hours contact number (to be provided by Owner)

4. Estimated Project Construction Period (to be provided by Owner).

J. Upon completion of work under contract, Project Identification Signs, shall become the property of Contractor and shall be removed and legally disposed.

## 1.04 SUBMITTALS

A. Submittals' General Requirements: Refer to Section 01300 – Contractor Submittals and Section 01600 - Products, Materials, Equipment and Substitutions.

B. Shop Drawings: For each Project Identification Sign show and describe:

1. Panel with the specified text, logos, and other painted features.

2. Supports, attachment, and installation details.

3. Materials of construction and the type of paint and colors.

# PART 2 PRODUCTS

## 2.01 MATERIALS

A. Sign Panels: Standard waterproof exterior grade plywood sheets.

B. Paint: Exterior gloss enamel with a clear graffiti-proof coating.

C. Supports: Douglas Fir construction grade.

# PART 3 EXECUTION

## 3.01 INSTALLATION

A. Construct and erect signs, at locations selected by the Contractor for Owner review. Prior to excavating post holes, follow the procedures for locating existing utilities and potholing specified in Section 02200, Earthwork.

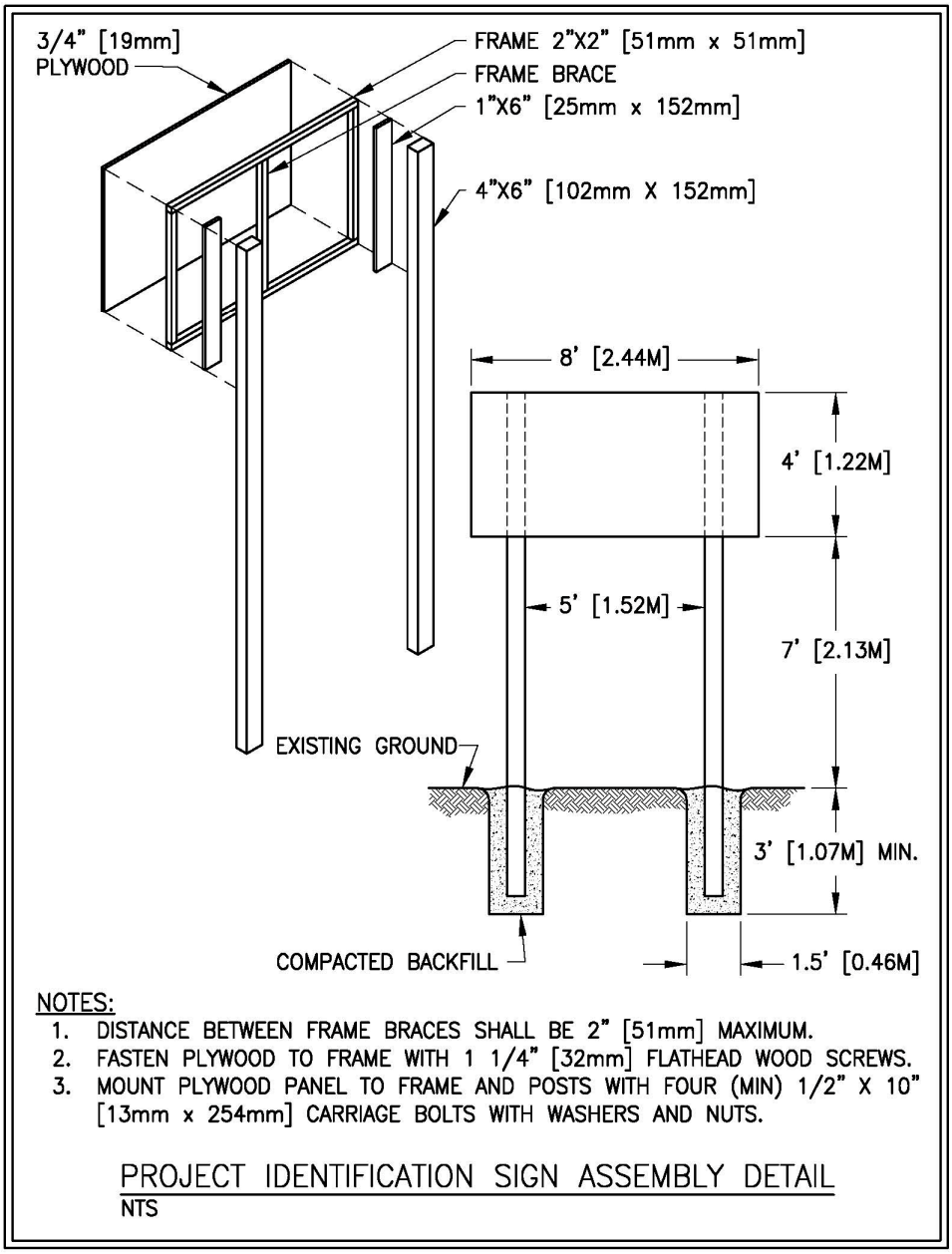
B. Excavate post holes by hand, except power equipment may be used if it is determined that there are no utility facilities in the area of the proposed post holes.

## 3.02 MAINTENANCE

A. Signs shall be kept clean and in good repair by the Contractor.

## 3.03 REMOVAL

A. Remove and dispose of Project Identification Signs after project completion only when directed by the Owner**.**




**END OF SECTION**

**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01590: FIELD OFFICES**

## PART 1 GENERAL

### 1.1 SUMMARY

A. This Specification Section covers the general requirements pertaining to:

1. CONTRACTOR's Field Office and Sheds

B. Related Documents and Sections

1. Section 01025 – Measurement and Payment
2. Section 01510 – Temporary Utilities
3. Section 01300 – Contractor Submittals
4. Section 01700 - Project Closeout

### 1.2 GENERAL REQUIREMENTS

A. CONTRACTOR shall provide and maintain a field office as specified herein including all specified furnishings, equipment and services during the entire period of construction until final completion.

B. CONTRACTOR shall provide and pay for temporary utility connections and services as required to support the field office, including sanitary sewer, potable water, power (electricity) and communication (telephone and internet) services for the entire period of construction until final completion.

C. All required field offices shall be equipped and furnished as specified herein, and shall be ready for use for meetings with the OWNER within 30 calendar days following Notice To Proceed.

D. All office, furnishing, tools and equipment specified herein shall be for the CONTRACTOR's use, with access provided when requested by the OWNER for any meetings.

E. The location of the CONTRACTOR's field office may be at the parcel for the OWNER's desalination plant on the east end of Charles Benson Road or at CCSD Well #3 [*CAW to confirm*]. The location of the trailer and parking areas on the parcel shall be proposed by the CONTRACTOR for review by the OWNER.

F. CONTRACTOR is responsible for obtaining all required permits for the CONTRACTOR's field offices including all associated temporary facilities.

G. Materials, installation, maintenance and removal of CONTRACTOR's field office shall comply with all applicable specifications and regulatory requirements, and shall be paid for by the CONTRACTOR.

H. CONTRACTOR shall remove field offices and construction facilities, including associated equipment and utilities, from the site as CONTRACTOR's property, within 14 calendar days after CONTRACTOR's Application for Final Payment has been approved by the OWNER, or when its use is no longer required as determined by the OWNER. CONTRACTOR shall restore the site occupied by said field offices to the original or better condition. All furnishings and equipment as specified herein will be returned to the CONTRACTOR for removal from the field office.

## PART 2 PRODUCTS

### 2.1 FIELD OFFICE

A. The Field Office shall be a trailer type mobile structure. The field office shall have the following features, to provide facilities for CONTRACTOR and OWNER to have meetings:

1. The area of the field office shall be as specified, including a ADA ramp at trailer entrance(s).

2. The office shall have as a minimum:

   a. A conference table with chairs for at least 10 people, with a conference call phone line.

   b. Potable water and sanitary sewage service.

   c. Cellular reception (or telephone service if out of cell range).

   d. One (1) T-1 internet data line, or equivalent in capacity, plus appropriate network outlets and secure wifi.

   e. Seismic restraint system.

   f. Adequate lighting and outlets.

   g. One restroom with flushable toilet, washbasin, and running potable water.

h. Graveled parking space for at least 5 (five) parking spaces vehicles adjacent to the Field Office.

i. Twice weekly wastewater holding tank pump-out and maintenance service.

B. CONTRACTOR shall maintain the Field Office and appurtenances in good repair and appearance as accepted by the OWNER. The CONTRACTOR shall furnish and pay for regular janitorial services at least once a week. This will include collection and removal of refuse from site. Field Office shall be swept, dusted, vacuumed and mopped, and waste receptacles emptied. Toilet facilities shall be sanitized and cleaned. Dispensers and continuous supply of toilet paper, seat covers, soap and paper towels shall be furnished for restroom facility.

C. CONTRACTOR shall provide including all assembly, installation and hookup, one new copy machine (with service contract) that can stack feed, collate, copy double sided, reduce and enlarge, make both 8.5x11 and 11x17 copies, and as well as print, scan and e-mail. CONTRACTOR shall pay for all maintenance, service, service contract and supplies to keep the copier working. Copier/printer shall be capable of at least 10 pages per minute (b/w).

D. In addition, CONTRACTOR shall provide all paper and toner supplies for 50 color/black/white prints per work day the duration of the project as needed by the OWNER, and shall ensure that those supplies include recycled, post-consumer content.

## 2.2 TOOLS AND OTHER EQUIPMENT

A. CONTRACTOR shall provide the following new tools and equipment:

1. First aid kit in accordance with Cal OSHA requirements.

2. One (1) wall mounted fire extinguisher, 10 lb. Size, effective against Class A, B and C fires, for each trailer office.

## PART 3 EXECUTION (NOT USED)

**END OF SECTION**

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**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01600: PRODUCTS MATERIALS EQUIPMENT AND SUBSTITUTION**

## PART 1 GENERAL

### 1.01 DEFINITIONS

A. The word "Products," as used in the Contract Documents is defined to include purchased items for incorporation into the WORK, regardless of whether specifically purchased for the project or taken from CONTRACTOR's stock of previously purchased products. The word "Materials," is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to form WORK. The word "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, and other like items). Definitions in this paragraph are not intended to negate the meaning of other terms used in the Contract Documents, including "specialties," "systems," "structure," "finishes," "accessories," "furnishings," special construction," and similar terms, which are self-explanatory and have recognized meanings in the construction industry.

B. Neither "Products" nor "Materials" nor "Equipment" includes machinery and equipment used for preparation, fabrication, conveying, and erection of the WORK.

C. Related Sections

1. General Conditions – 6.05

### 1.02 QUALITY ASSURANCE

A. **Source Limitations:** To the greatest extent possible for each unit of WORK, the CONTRACTOR shall provide products, materials, and equipment of a singular generic kind from a single source.

B. **Compatibility of Options:** Where more than one choice is available as options for CONTRACTOR's selection of a product, material, or equipment, the CONTRACTOR shall select an option which is compatible with other products, materials, or equipment. Compatibility is a basic general requirement of product, material and equipment selections.

### 1.03 PRODUCT DELIVERY AND STORAGE

A. The CONTRACTOR shall deliver and store the WORK in accordance with manufacturer's written recommendations and by methods and means that will prevent damage, deterioration, and loss including theft. Delivery schedules shall be controlled to minimize long-term storage of products at the Site and overcrowding of construction spaces. In particular, the CONTRACTOR shall ensure coordination to ensure minimum holding or storage times for flammable, hazardous, easily damaged, or sensitive materials to deterioration, theft, and other sources of loss.

## 1.04 TRANSPORTATION AND HANDLING

A. Products shall be transported by methods to avoid damage and shall be delivered in undamaged condition in manufacturer's unopened containers and packaging.

B. The CONTRACTOR shall provide equipment and personnel to handle products, materials, and equipment, including those furnished by OWNER, by methods to prevent soiling and damage.

C. The CONTRACTOR shall provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.

## 1.05 STORAGE AND PROTECTION

A. Products shall be stored in accordance with manufacturer's written instructions and with seals and labels intact and legible. Sensitive products shall be stored in weather-tight climate controlled enclosures and temperature and humidity ranges shall be maintained within tolerances required by manufacturer's recommendations.

B. For exterior storage of fabricated products, products shall be placed on sloped supports above ground. Products subject to deterioration shall be covered with impervious sheet covering and ventilation shall be provided to avoid condensation.

C. Loose granular materials shall be stored on solid flat surfaces in a well-drained area and shall be prevented from mixing with foreign matter.

D. Storage shall be arranged to provide access for inspection. The CONTRACTOR shall periodically inspect to assure products are undamaged and are maintained under required conditions.

E. Storage shall be arranged in a manner to provide access for maintenance of stored items and for inspection.

## 1.06 MAINTENANCE OF PRODUCTS IN STORAGE

A. Stored products shall be periodically inspected on a scheduled basis. The CONTRACTOR shall maintain a log of inspections and shall make the log available on request.

B. The CONTRACTOR shall comply with manufacturer's product storage requirements and recommendations.

C. The CONTRACTOR shall maintain manufacturer-required environmental conditions continuously.

D. The CONTRACTOR shall ensure that surfaces of products exposed to the elements are not adversely affected and that weathering of finishes does not occur.

E. For mechanical and electrical equipment, the CONTRACTOR shall provide a copy of the manufacturer's service instructions with each item and the exterior of the package shall contain notice that instructions are included.

F. Products shall be serviced on a regularly scheduled basis, and a log of services shall be maintained and submitted as a record document prior to final acceptance by the OWNER in accordance with the Contract Documents.

## 1.07 PROPOSED SUBSTITUTIONS OR "OR-EQUAL" ITEM

A. Whenever materials or equipment are indicated in the Contract Documents by using the name of a proprietary item or the name of a particular manufacturer, the naming of the item is intended to establish the type, function, and quality required. If the name is followed by the words "or equal" indicating that a substitution is permitted, materials or equipment of other manufacturers may be accepted if sufficient information is submitted by the CONTRACTOR to allow the ENGINEER to determine that the material or equipment proposed is equivalent or equal to that named, subject to the following requirements:

1. The burden of proof as to the type, function, and quality of any such substitution product, material or equipment shall be upon the CONTRACTOR.

2. The ENGINEER will be the sole judge as to the type, function, and quality of any such substitution and the ENGINEER's decision shall be final.

3. The ENGINEER may require the CONTRACTOR to furnish additional data about the proposed substitution.

4. The OWNER may require the CONTRACTOR to furnish a special performance guarantee or other surety with respect to any substitution.

5. Acceptance by the ENGINEER of a substitution item proposed by the CONTRACTOR shall not relieve the CONTRACTOR of the responsibility for full compliance with the Contract Documents and for adequacy of the substitution.

6. The CONTRACTOR shall pay all costs of implementing accepted substitutions, including redesign and changes to WORK necessary to accommodate the substitution.

B. The procedure for review by the ENGINEER will include the following:

1. If the CONTRACTOR wishes to provide a substitution item, the CONTRACTOR shall make written application to the ENGINEER on the "Substitution Request Form."

2. Unless otherwise provided by law or authorized in writing by the ENGINEER, the "Substitution Request Form(s)" shall be submitted within the 35-day period after award of the Contract.

3. Wherever a proposed substitution item has not been submitted within said 35-day period, or wherever the submission of a proposed substitution material or equipment has been judged to be unacceptable by the ENGINEER, the CONTRACTOR shall provide the material or equipment indicated in the Contract Documents.

4. The CONTRACTOR shall certify by signing the form that the list of paragraphs on the form are correct for the proposed substitution.

5. The ENGINEER will evaluate each proposed substitution within a reasonable period of time.

6. As applicable, no shop drawing submittals shall be made for a substitution item nor shall any substitution item be ordered, installed, or utilized without the ENGINEER'S prior written acceptance of the CONTRACTOR'S "Substitution Request Form."

7. The ENGINEER will record the time required by the ENGINEER in evaluating substitutions proposed by the CONTRACTOR and in making changes by the CONTRACTOR in the Contract Documents occasioned thereby.

C. The CONTRACTOR's application shall address the following factors which will be considered by the ENGINEER in evaluating the proposed substitution:

1. Whether the evaluation and acceptance of the proposed substitution will prejudice the CONTRACTOR's achievement of Substantial Completion on time.

2. Whether acceptance of the substitution for use in the WORK will require a change in any of the Contract Documents to adapt the design to the proposed substitution.

3. Whether incorporation or use of the substitution in connection with the WORK is subject to payment of any license fee or royalty.

4. Whether all variations of the proposed substitution from the items originally specified are identified.

5. Whether available maintenance, repair, and replacement service are indicated. The manufacturer shall have a local service agency (within 50 miles of the site) which maintains properly trained personnel and adequate spare parts and is able to respond and complete repairs within 24 hours.

6. Whether an itemized estimate is included of all costs that will result directly or indirectly from acceptance of such substitution, including cost of redesign and claims of other contractors affected by the resulting change.

7. Whether the proposed substitute item meets or exceeds the experience and/or equivalency requirements listed in the appropriate technical specifications.

D. Without any increase in cost to the OWNER, the CONTRACTOR shall be responsible for and pay all costs in connection with proposed substitutions and of inspections and testing of equipment or materials submitted for review prior to the CONTRACTOR's purchase thereof for incorporation in the WORK, whether or not the ENGINEER accepts the proposed substitution or proposed equipment or material. The CONTRACTOR shall reimburse the OWNER for the charges of the ENGINEER for evaluating each proposed substitution.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION (NOT USED)

**END OF SECTION**

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## PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section includes seismic design criteria for all nonstructural components and nonbuilding structures, including their supports and anchorage.

B. Components and structures include, but are not limited to:

1. Process and plumbing pipe, conduits and raceways, tanks, and pipe supports and hangers.

2. Anchorage of all other mechanical and electrical equipment and components except equipment and components that meet one of the following criteria:

a. Ip = 1.5 – Essential Facilities

b. Flexible connections between the components and associated ductwork, piping and conduit are provided and components are mounted at 4 ft or less above a floor or roof level and weigh 400 lb or less.

3. Flexible connections between the components and associated ductwork, piping and conduit are provided and components weigh 20 lb or less or, for distribution systems, weighing 5 lb/ft or less.

4. Architectural components.

5. Pre-engineered canopies.

6. Other structures or items as specified or indicated on the Drawings.

1.2 SUBMITTALS

A. Complete shop drawings including anchor bolt and base plate settings.

B. Design calculations signed and sealed by a professional civil or structural engineer registered in the State of California for project records.

1.3 REFERENCE STANDARDS

A. California Building Code (CBC) 2013

B. American Society of Civil Engineers (ASCE) 7-10

C. American Concrete Institute (ACI) 318-08

1.4 SYSTEM DESCRIPTION

A. Design Requirements: Design in accordance with the California Building Code, the criteria herein, and the attached response spectra. Components shall be restrained or anchored such that the component forces are transferred to the

structure.

1. Tanks with their anchorage and anchorage and other supports for equipment and components shall be designed to conform to the requirements set forth in CBC, and ASCE 7-10 using the following modifications and parameters:

    a. Soil Site Class: C.

    b. Spectral Response Accelerations: SDS = 1.06 g. SD1 = 0.56 g.

    c. Risk Category: IV Ie = 1.5, Ip = 1.5

    d. Response modification factor (R): ASCE 7 Tables

2. Anchorage and other support for equipment and components shall be designed to maintain integrity and functionality after being subjected to a seismic load.

    a. The minimum horizontal seismic force applied to equipment, tank, or component in any direction.

    b. In addition to the horizontal seismic forces, a concurrent vertical seismic force of 0.2 $S_{DS}$ times the component weight shall be applied to the equipment, tank or component.

    c. Neglect vertical effects where inclusion of vertical loads results in a less conservative design.

3. Use cast-in anchors or post-installed anchors for resisting seismic forces.

    a. Anchors shall be designed in accordance with Appendix D of ACI 318 and/or the relevant ICC evaluation reports assuming cracked concrete. Post-installed anchors shall have current ICC evaluation reports suitable for use in cracked concrete.

    b. Cast-in anchors or headed studs shall be used whenever possible. Expansion anchors shall not be used for critical fastening such as extreme vibrating conditions and impact loads.

    c. Adhesive anchors shall not be used in areas that could experience high temperatures to support emergency egress elements of the structures, or in overhead applications. Cast-in anchors shall not be wet set into concrete or grout.

    d. Seismic forces shall be resisted by direct bearing on the fasteners used to resist seismic forces. Do not use connections which rely on friction from gravity to resist seismic forces.

**PART 2 - PRODUCTS (NOT USED)**

**EXECUTION (NOT USED)**

**END OF SECTION**

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**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01640: DEMOLITION AND RECONSTRUCTION**

## PART 1 GENERAL

### 1.01 THE REQUIREMENT

A. The CONTRACTOR shall demolish and reconstruct existing civil, landscaping, and structural facilities as indicated, in accordance with the Contract Documents.

### 1.02 COORDINATION

A. The CONTRACTOR shall carefully coordinate the WORK in areas where existing facilities are interconnected with new facilities and where existing facilities remain operational. The WORK as indicated is not all inclusive, and the CONTRACTOR shall be responsible to perform the reconstruction indicated plus that which can be reasonably inferred from the Contract Documents as necessary to complete the Project. The Specifications and Drawings identify the major facilities that shall be demolished and reconstructed, but auxiliary utilities such as water, air, chemicals, drainage, lubrication, fluid power, electrical wiring, controls, and instrumentation are not necessarily shown.

B. The CONTRACTOR shall note that the Drawings used to indicate demolition and reconstruction are based on record drawings of the existing facilities. These record drawings have been reproduced to show existing conditions and to clarify the scope of WORK as much as possible. Prior to bidding, the CONTRACTOR shall conduct a comprehensive survey at the Site to verify the correctness and exactness of the Drawings, the scope of WORK, and the extent of auxiliary utilities.

C. While demolition and reconstruction are being performed, the CONTRACTOR shall provide adequate access for the continued operation and maintenance of equipment and treatment processes. The CONTRACTOR shall erect and maintain fences, warning signs, barricades, and other devices around the reconstruction as required for the protection of the CONTRACTOR's employees and the OWNER's personnel. The CONTRACTOR shall remove such protection when reconstruction activities are complete, or as work progresses, or when directed by the ENGINEER.

### 1.03 CONTRACTOR SUBMITTALS

A. Demolition and reconstruction activities and procedures, including operational sequence, shall be submitted to the ENGINEER for approval. The procedures shall provide for safe conduct of the WORK, careful removal and disposition of materials and equipment, protection of existing facilities which are to remain undisturbed, coordination with existing facilities to remain in service, and timely disconnection and reconnection of utility services. The procedures shall include a detailed description and time schedule of the methods and equipment to be used for each operation and the sequence of operation. A storage plan for salvaged items shall be included.

## 1.04 DEMOLITION

A. Existing pavement, structures, equipment, piping, utilities, and related appurtenances such as anchors, supports, and hardware indicated or required to be demolished as part of the WORK shall be removed and disposed of unless otherwise indicated. Removal of buried structures, utilities, and appurtenances includes the related excavation and backfill as required. Removed items shall be disposed of offsite by the CONTRACTOR.

## 1.05 REHABILITATION

A. Existing civil, landscaping, and structural WORK disturbed or damaged by reconstruction activities shall be repaired or rehabilitated to existing or better than existing conditions.

B. Damaged items shall be repaired or replaced with new items to restore items or surfaces to a condition equal to and matching that existing prior to damage.

## 1.06 DISPOSAL

A. The CONTRACTOR shall be responsible for the offsite disposal of debris resulting from reconstruction in compliance with local, state, and federal codes and requirements.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

## 3.01 GENERAL

A. The CONTRACTOR shall coordinate demolition and reconstruction WORK with the OWNER and ENGINEER. Unless otherwise indicated, the CONTRACTOR shall be responsible for the sequence of activities. WORK shall be performed in accordance with applicable safety rules and regulations.

B. The CONTRACTOR shall verify that any utilities connected to structures, equipment, and facilities to be removed, relocated, salvaged, replaced, or abandoned are rendered inoperable, replaced with new utilities, or adequately bypassed with temporary utilities before proceeding with demolition and reconstruction.

C. The CONTRACTOR shall take precautions to avoid damage to adjacent facilities and to limit the WORK activities to the extent indicated. If reconstruction beyond the scope indicated is required, the CONTRACTOR shall obtain approval from the ENGINEER prior to commencing.

## 3.02 PROTECTION OF EXISTING FACILITIES

A. Before beginning any reconstruction, the CONTRACTOR shall carefully survey the existing facilities and examine the Specifications and Drawings to determine the extent

of reconstruction and coordination with the WORK. Existing facilities not subject to reconstruction shall be protected and maintained in accordance with Section 01530 - Protection of Existing Facilities. Damaged existing facilities shall be repaired to the previous condition or replaced at no additional cost to the OWNER.

B. Persons shall be afforded safe passages around areas of demolition.

C. Structural elements shall not be overloaded. The CONTRACTOR shall be responsible for shoring, bracing, or adding new supports as may be required for adequate structural support as a result of WORK performed under this Section. The CONTRACTOR shall remove temporary protection when the WORK is complete or when so authorized by the ENGINEER.

D. The CONTRACTOR shall carefully consider bearing loads and capacities before placement of equipment and material on Site. In the event of any questions as to whether an area to be loaded has adequate bearing capacity, the CONTRACTOR shall consult with the ENGINEER prior to the placement of such equipment or material.

## 3.03 DISPOSAL

A. Demolition and removal of debris shall minimize interference with roads, streets, walks, and other adjacent occupied or used facilities which shall not be closed or obstructed without permission from the OWNER. Alternate routes shall be provided around closed or obstructed traffic ways.

B. Site debris, rubbish, and other materials resulting from reconstruction operations shall be legally removed and disposed of. Structures and equipment to be demolished shall be cleaned prior to demolition and the wash water properly disposed of. No trace of these structures shall remain prior to placing of backfill in the areas from which structures were removed.

C. Refuse, debris, and waste materials resulting from demolition and clearing operations shall not be burned.

## 3.04 OCCUPANCY AND POLLUTION CONTROL

A. Water sprinkling, temporary enclosures and other suitable methods shall be used to limit dust and dirt rising and scattering in the area. The CONTRACTOR shall comply with government regulations pertaining to environmental protection.

B. Water shall not be used if it creates hazardous or objectionable conditions such as ice, flooding, or pollution.

## 3.05 CLEANING

A. During and upon completion of WORK, the CONTRACTOR shall promptly remove tools and equipment, surplus materials, rubbish, debris, and dust and shall leave areas affected by WORK in a clean, approved condition.

B. Adjacent structures shall be cleaned of dust, dirt, and debris caused by reconstruction, as directed by the ENGINEER or governing authorities, and adjacent areas shall be returned to condition existing prior to start of WORK.

**END OF SECTION**

**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01656: PRESSURE PIPE TESTING AND DISINFECTION**

## PART 1 GENERAL

### 1.01 SUMMARY

A. The CONTRACTOR shall test and disinfect potable water pipelines and appurtenant piping, in accordance with the Contract Documents.

B. The CONTRACTOR shall be responsible for obtaining permits for discharging excess testing and disinfection water and dechlorination of such water if required to satisfy permit limits.

C. RELATED SECTIONS

1. Section 01150 – Water Treatment and Disposal

### 1.02 REFERENCES

A. American Water Works Association Standards and Guidelines, including:

1. AWWA B301, Liquid Chlorine
2. AWWA B300, Hypochlorites
3. AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances
4. AWWA C651, Disinfecting Water Mains
5. AWWA M23, PVC Pipe – Design and Installation

### 1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 – Contractor Submittals.

B. Furnish:

1. A testing plan and schedule, including method for water conveyance, control, disposal, and disinfection shall be submitted in writing for approval.
2. Name of certified bacteriological testing laboratory.
3. Resume of experienced technician, if liquid chlorine is proposed.

## PART 2 PRODUCTS

### 2.01 MATERIAL REQUIREMENTS

A. All test equipment, chemicals for chlorination, temporary valves, bulkheads, and other water control equipment, and choice of disinfectant shall be as determined by the

CONTRACTOR. No materials shall be used which would be injurious to the WORK for future conveyance of potable water.

B. Chlorine for disinfection may be in the form of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets.

1. Liquid chlorine shall be in accordance with the requirements of ANSI/AWWA B301 - Liquid Chlorine, and shall be used only when each of the following conditions are satisfied:

a. Appropriate gas flow chlorinators and ejectors are used.

b. An experienced technician directly supervises.

c. Appropriate safety practices are observed.

2. Sodium and calcium hypochlorite shall be in accordance with ANSI/AWWA B300 - Hypochlorites.

C. Dechlorination agents may be sodium bisulfate, sodium sulfite, or sodium thiosulfate.

## PART 3 EXECUTION

### 3.01 GENERAL

A. Water for testing and disinfecting water pipelines will be furnished by the OWNER; however, the CONTRACTOR shall convey the water from the OWNER-designated source to the points of use.

B. All pressure pipelines shall be tested; those for potable water shall be disinfected. All chlorinating and testing operations shall be performed in the presence of the ENGINEER.

C. Disposal of flushing water and water containing chlorine shall be by methods acceptable to the ENGINEER.

D. Disinfection operations shall be scheduled as late as possible during the Contract Time to maximize the degree of sterility of the facilities at the time the WORK is accepted by the OWNER. Bacteriological testing shall be performed by a certified testing laboratory accepted by the OWNER or ENGINEER. Results of the bacteriological testing shall be satisfactory with the State Department of Health or other appropriate regulatory agency.

### 3.02 HYDROSTATIC TESTING OF PIPELINES

A. Perform hydrostatic pressure tests in accordance with AWWA C600. The test pressure will be based on the anticipated operating pressure for that section of pipeline.

B. Contractor may, at his option, completely or partially backfill the trench over the center portion of each pipe section to be tested. However, owner may direct the Contractor to completely backfill the trench if local traffic or safety conditions require.

C. Pipeline 30-inches diameter and larger shall be visually inspected that all debris has been removed prior to flushing.

D. Prior to hydrostatic testing, pipelines shall be flushed or blown out as appropriate. The CONTRACTOR shall test pipelines in sections. Sections to be tested shall be defined by isolation valves in the pipeline. Where such valves are not present, the CONTRACTOR shall install temporary bulkheads or plugs for the purpose of testing. Sections that do not have isolation valves shall be tested in approximate one-mile segments. Sections that have a zero leakage allowance may be tested as a unit. No section of the pipeline shall be tested until field-placed concrete or mortar has attained an age of 14 Days. The test shall be made by closing valves when available or by placing bulkheads and filling the line slowly with water. The CONTRACTOR shall be responsible for ascertaining that test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to or movement of the adjacent pipe. Unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test to avoid movement and damage to piping and equipment. Remove or protect any pipeline-mounted devices that may be damaged by the test pressure. The CONTRACTOR shall provide sufficient temporary taps in the pipelines to allow for trapped air to exit. After completion of the tests, such taps shall be permanently plugged. Care shall be taken that air release valves are open during filling.

E. 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 release valves at a reasonable velocity. The air within the pipeline shall be allowed to escape completely. The differential pressure across the orifices in the air release valves shall not be allowed to exceed 5 psi at any time during filling. 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 to allow the escape of air from air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the ENGINEER shall be taken. The test pressure for yard piping shall be as indicated on the Piping Schedule measured at the lowest point of the pipeline section being tested. No pressure test will be required for a reservoir overflow line.

F. Conduct a leakage test concurrently with the pressure test. Leakage is defined as the volume of water that must be supplied into the pipeline being tested to maintain pressure within ±5 psi of the test pressure, after the pipeline is filled and purged of air. The maximum leakage for yard piping shall be as indicated on the table below. Pipe with welded joints shall have no leakage. Exposed piping shall show no visible leaks and no pressure loss during the test. Visible leaks that appear during testing shall be repaired in a manner acceptable to the ENGINEER. In the case of pipelines that fail to pass the leakage test, the CONTRACTOR shall determine the cause of the leakage, shall take

corrective measures necessary to repair the leaks, and shall again test the pipeline, repeating as necessary until the pipeline passes.

**Allowable Leakage per 1000 ft. of Pipeline (gph)**

| Avg. Test Pressure *psi* | Nominal Pipe Diameter—*in.* | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 24 | 30 | 36 | 42 | 48 | 54 | 60 | 64 |
| 450 | 0.43 | 0.57 | 0.86 | 1.15 | 1.43 | 1.72 | 2.01 | 2.29 | 2.58 | 2.87 | 3.44 | 4.30 | 5.16 | 6.02 | 6.88 | 7.74 | 8.60 | 9.17 |
| 400 | 0.41 | 0.54 | 0.81 | 1.08 | 1.35 | 1.62 | 1.89 | 2.16 | 2.43 | 2.70 | 3.24 | 4.05 | 4.86 | 5.68 | 6.49 | 7.30 | 8.11 | 8.65 |
| 350 | 0.38 | 0.51 | 0.76 | 1.01 | 1.26 | 1.52 | 1.77 | 2.02 | 2.28 | 2.53 | 3.03 | 3.79 | 4.55 | 5.31 | 6.07 | 6.83 | 7.58 | 8,09 |
| 300 | 0.35 | 0.47 | 0.70 | 0.94 | 1.17 | 1.40 | 1.64 | 1.87 | 2.11 | 2.34 | 2.81 | 3.51 | 4.21 | 4.92 | 5.62 | 6.32 | 7.02 | 7.49 |
| 275 | 0.34 | 0.45 | 0.67 | 0.90 | 1.12 | 1.34 | 1.57 | 1.79 | 2.02 | 2.24 | 2.69 | 3.36 | 4.03 | 4.71 | 5.38 | 6.05 | 6.72 | 7.17 |
| 250 | 0.32 | 0.43 | 0.64 | 0.85 | 1.07 | 1.28 | 1.50 | 1.71 | 1.92 | 2.14 | 2.56 | 3.21 | 3.85 | 4.49 | 5.13 | 5.77 | 6.41 | 6.84 |
| 225 | 0.30 | 0.41 | 0.61 | 0.81 | 1.01 | 1.22 | 1.42 | 1.62 | 1.82 | 2.03 | 2.43 | 3.04 | 3.65 | 4.26 | 4.86 | 5.47 | 6.08 | 6.49 |
| 200 | 0.29 | 0.38 | 0.57 | 0.76 | 0.96 | 1.15 | 1.34 | 1.53 | 1.72 | 1.91 | 2.29 | 2.87 | 3.44 | 4.01 | 4.59 | 5.16 | 5.73 | 6.12 |
| 175 | 0.27 | 0.36 | 0.54 | 0.72 | 0.89 | 1.07 | 1.25 | 1.43 | 1.61 | 1.79 | 2.15 | 2.68 | 3.22 | 3.75 | 4.29 | 4.83 | 5.36 | 5.72 |
| 150 | 0.25 | 0.33 | 0.50 | 0.66 | 0.83 | 0.99 | 1.16 | 1.32 | 1.49 | 1.66 | 1.99 | 2.48 | 2.98 | 3.48 | 3.97 | 4.47 | 4.97 | 5.30 |
| 125 | 0.23 | 0.30 | 0.45 | 0.60 | 0.76 | 0.91 | 1.06 | 1.21 | 1.36 | 1.51 | 1.81 | 2.27 | 2.72 | 3.17 | 3.63 | 4.08 | 4.53 | 4.83 |
| 100 | 0.20 | 0.27 | 0.41 | 0.54 | 0.68 | 0.81 | 0.95 | 1.08 | 1.22 | 1.35 | 1.62 | 2.03 | 2.43 | 2.84 | 3.24 | 3.65 | 4.05 | 4.32 |

## 3.03 DISINFECTING PIPELINES

A. **General:** Potable water pipelines except those appurtenant to hydraulic structures shall be disinfected in accordance with the requirements of ANSI/AWWA C651 - Disinfecting Water Mains, using the Continuous-Feed Method.

B. **Scheduling:** Coordinate scheduling with OWNER due to restrictions on availability of source water.

C. **Sources of Water:** Water for disinfection and testing may be provided by the OWNER.

D. **Chlorinating Valves:** During the application of chlorine, position valves so that the chlorine solution in the main being treated will not flow into water mains in active service. All valves and other appurtenances in the section treated shall be operated from closed to full open to closed while the pipeline is filled with the heavily-chlorinated water.

E. **Sampling Ports:** The CONTRACTOR shall provide sampling ports along the pipeline as defined on AWWA C651. Taps may be made at manways and air valves to help facilitate the spacing requirement.

F. **Final Flushing:** After the applicable retention period, the heavily chlorinated water shall be flushed from the pipeline until chlorine measurements show that the concentration in the water leaving the pipeline is no higher than that generally prevailing in the system or is acceptable for domestic use. Do not keep heavily chlorinated water in contact with the pipe for more than 24 hours after the applicable retention period. Any release of

chlorinated water shall comply with federal, state, and local regulation and the permits for the project. Chlorine in excessive amounts shall be treated before discharge. Refer to Specification 01150 for water disposal requirements.

## 3.04 CONNECTIONS TO EXISTING SYSTEM

A. New water mains and appurtenances must be completely installed, flushed, disinfected and satisfactory bacteriological sample results received prior to permanent connections being made to the active distribution system. Connection disinfection procedures shall conform to AWWA C651. Thorough flushing shall be started as soon as the connection is completed and shall be continued until discolored water is eliminated.

**END OF SECTION**

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**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01660: EQUIPMENT TESTING AND PLANT STARTUP**

## PART 1 GENERAL

### 1.01 GENERAL

A. Equipment testing and startup are prerequisites to satisfactory completion of the contract requirements and shall be completed within the Contract Times. This section applies to field testing of the mechanical components in the project and placing all the pipelines into operation after testing of the individual components. Field testing of the electrical components is covered in Section 16010 – Electrical General Provisions. Testing of the pipelines is covered under Section 01656 – Pressure Pipeline Testing and Disinfection.

B. The startup of a transmission pipeline is a complex operation requiring the combined expertise of the CONTRACTOR, manufacturers' representatives, subcontractors, the ENGINEER, and the OWNER. The CONTRACTOR shall be responsible for coordinating all parties for a successful startup: the ENGINEER and OWNER will be available for technical and operational advice prior to and during startup.

C. Testing and startup activities shall be scheduled according to Construction Schedule.

D. The 7-day test and the 8-day test shall start prior to midday on a Monday, Tuesday, or Wednesday. Testing periods shall not include holidays, based on the OWNER's calendar.

### 1.2 SUBMITTALS

A. **Schedule:** The schedule for testing and startup shall be submitted per Section 01300.

B. **Testing and Startup Plan:** Not less than 45-days prior to startup, submit for review a detailed Testing and Startup Plan. The Plan shall include schedules for manufacturers' equipment certifications, list of OWNER and CONTRACTOR-furnished supplies, electrical testing, and detailed schedule of operations to achieve successful system testing, startup, and performance and acceptance testing. The Plan shall include test checklists and data forms for each item of equipment and shall address coordination with the OWNER's staff. The CONTRACTOR shall revise the Plan as necessary based on review comments.

C. Records and Documentation

1. Equipment Installation Certification: Where required by the specifications, submit documentation from manufacturer's representative that the equipment has been properly installed and lubricated, is in accurate alignment, is free from undue stresses from connecting piping and anchoring, and has operated satisfactorily under full load conditions.

2. Records of testing and startup as indicated below.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

### 3.1 EXECUTION

A. **Prerequisites:** The following shall be completed before testing and startup begins.

1. Furnish all Technical Manual information required by the Contract Documents.

2. Provide all safety equipment, emergency shower and eyewash units, fire extinguishers, protective guards and shields, emergency repair kits, safety chains, handrails, gratings, safety signs, and valve and piping identification required by the Contract Documents. Devices and equipment shall be fully functional, adjusted, and tested.

3. Manufacturer's certifications of proper installation have been accepted.

4. Leakage tests, electrical tests, and adjustments have been completed.

5. The ENGINEER has approved the CONTRACTOR's Testing and Startup Plan.

6. Functional verification of the individual instrumentation loops (analog, status, alarm, and control) from the field devices to the workstation display screen.

7. Adjustment of the pressure switches, flow switches, timing relays, level switches, vibration switches, temperature switches, RTD monitors, pressure regulating valves, and all other control devices to the settings determined by the ENGINEER or the equipment manufacturer.

8. Functional verification of the individual interlocks between the field-mounted control devices and the motor control circuits, control circuits of variable-speed controllers, and packaged system controls.

B. Supplies

1. The CONTRACTOR shall furnish:

   a. Chemicals

   b. Oil and grease

   c. Other necessary materials not listed for the OWNER to furnish

2. The OWNER will furnish:

    a. Water

    b. Power

C. **Records of Testing and Startup:** The CONTRACTOR shall maintain the following during testing and startup and submit originals to ENGINEER prior to acceptance:

1. Lubrication and service records for each mechanical and electrical equipment item
2. Hours of daily operation for each mechanical and electrical equipment item
3. Equipment alignment and vibration measurement records
4. Logs of electrical measurements and tests
5. Instrumentation calibration and testing logs and alarms
6. Testing and validation of SCADA inputs, outputs, logic functions, status indications,
7. Factory and field equipment settings
8. Log of problems encountered and adjustments made
9. Other records, logs, and checklists as required by the Contract Documents

## 3.2 SYSTEM TESTING

A. After individual equipment items have been tested and certified as required by the Technical Specifications, tests of systems comprised of single or multiple equipment items with appurtenant equipment and instruments and controls shall be conducted. All items of equipment shall be tested as part of a system to the maximum extent possible.

B. The CONTRACTOR shall demonstrate the manual and automatic modes of operation to verify proper control sequences, software interlocks, proper operation of software logic and controllers, etc. System testing shall include the use of water, to simulate the actual conditions of operation.

C. All systems testing activities shall follow the detailed test procedures and checklists in the Testing and Startup Plan. Completion of systems testing shall be documented by a report.

D. The CONTRACTOR shall system test the utility, chemical feed, safety equipment, and other support systems before testing the process system.

E. Furnish the ENGINEER at least 10 days written notice confirming the start of system testing. The OWNER's staff will observe systems testing.

F. The CONTRACTOR shall arrange for manufacturer's representative to revisit the Site as often as necessary to correct malfunctions to the ENGINEER's satisfaction.

G. Each system shall be tested for a continuous, 7-day, 24-hour/day period. If any system malfunctions during the test, the item or equipment shall be repaired and the test restarted at time zero with no credit given for the elapsed time before the malfunction.

## 3.3 STARTUP AND ACCEPTANCE TESTING

A. The CONTRACTOR shall notify OWNER 14 days prior to startup. OWNER shall start up the transmission piping systems including mechanical and PLC/SCADA equipment and operate it at varying rates without malfunction for a continuous 8-day, 24 hour/day acceptance test period. If any equipment item, sub system, or system malfunctions during the test period, the item shall be repaired and the test restarted at time zero with no credit given for the elapsed time before the malfunction.

B. Defects in material or workmanship which appear shall be promptly corrected. Time lost for wiring corrections, control point settings, or other reasons which interrupt the test may, at the judgment of the ENGINEER, be cause for extending the test period an equal amount of time.

C. Acceptance testing shall not begin until all leakage tests, instrumentation tests and adjustments, electrical tests and adjustments, equipment field tests, disinfection, and system tests have been completed to the satisfaction of the ENGINEER.

D. The CONTRACTOR shall furnish the services of manufacturer's representatives, if necessary, to correct equipment malfunctions.

E. During acceptance testing, the CONTRACTOR shall:

1. Lubricate and maintain all equipment in accordance with the manufacturers' recommendations.

2. Clean or replace strainers, screens, and filter elements.

**END OF SECTION**

**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01700: PROJECT CLOSEOUT**

## PART 1 GENERAL

### 1.01 FINAL CLEANUP

A. The CONTRACTOR shall promptly remove from the vicinity of the completed WORK, all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the WORK by the OWNER will be withheld until the CONTRACTOR has satisfactorily performed the final cleanup of the Site.

### 1.02 CLOSEOUT TIMETABLE

A. The CONTRACTOR shall establish dates for equipment testing, acceptance periods, and on-site instructional periods (as required under the Contract). Such dates shall be established not less than one week prior to beginning any of the foregoing items, to allow the OWNER, the ENGINEER, and their authorized representatives sufficient time to schedule attendance at such activities.

### 1.03 TECHNICAL MANUAL SUBMITTAL

A. The CONTRACTOR's attention is directed to the condition that one percent of the Contract Price will be retained from any monies due the CONTRACTOR as progress payments, if at the 75 percent construction completion point, the approved Technical Manual complying with Section 01300 has not been submitted. The aforementioned amount will be retained by the OWNER as the agreed, estimated value of the approved Technical Manual. Any such retention of money for failure to submit the approved Technical Manual on or before the 75 percent construction completion point shall be in addition to the retention of any payments due to the CONTRACTOR under Section 7 of the General Conditions.

### 1.04 FINAL SUBMITTALS

A. The CONTRACTOR, prior to requesting final payment, shall obtain and submit the following items to the ENGINEER for transmittal to the OWNER:

1. Written guarantees, where required.

2. Technical Manuals and instructions.

3. New permanent cylinders and key blanks for all locks.

4. Maintenance stock items; spare parts; special tools.

5. Bonds for roofing, maintenance, etc., as required.

6. Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.

7. Completed record drawings.

8. Mill certificates for casing materials

9. Certificates of inspection and acceptance by local governing agencies having jurisdiction.

## 1.05 MAINTENANCE AND GUARANTEE

A. The CONTRACTOR shall comply with the maintenance and guarantee requirements contained in Section 7 of the General Conditions.

B. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as a part of such required repair work, and any repair or resurfacing constructed by the CONTRACTOR which becomes necessary by reason of such settlement shall likewise be considered as a part of such required repair work unless the CONTRACTOR shall have obtained a statement in writing from the affected private owner or public agency releasing the OWNER from further responsibility in connection with such repair or resurfacing.

C. The CONTRACTOR shall make all repairs and replacements promptly upon receipt of written order from the OWNER. If the CONTRACTOR fails to make such repairs or replacements promptly, the OWNER reserves the right to do the WORK and the CONTRACTOR and its surety shall be liable to the OWNER for the cost thereof.

## 1.06 BOND

A. The CONTRACTOR shall provide a bond to guarantee performance of the provisions contained in Paragraph "Maintenance and Guarantee" above, and Section 7 of the General Conditions.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION (NOT USED)

**END OF SECTION**

**TECHNICAL SPECIFICATIONS**
**DIVISION 1: GENERAL REQUIREMENTS**
**01720: RECORD DRAWINGS**

## PART 1 GENERAL

### 1.01 DESCRIPTION

A. CONTRACTOR shall provide and maintain on the jobsite one complete set of prints of all Plans which form a part of the contract. Immediately after each portion of the work is installed, indicate all deviations from the original design shown on the Plans either by additional sketches or marked in red ink thereon and reviewed by OWNER's Representative. Upon completion of the job, deliver this record set to the OWNER's Representative.

B. The CONTRACTOR shall supply the OWNER Representative with GPS or surveyed points of all installed buried structures, piping, appurtenances and equipment. This information, along with an electronic copy of the record drawings (CAD and PDF format) shall be submitted to the OWNER upon completion of the project.

C. Record GPS location of any abandoned facilities (i.e. end of pipe).

D. Record drawings shall be submitted with final request of progress payment.

E. Make the record drawings available for review by OWNER in CONTRACTOR's field office.

F. Protect the record set from damage or loss.

G. Related Documents and Sections include:

1. General Conditions: 6.12 Record Documents

### 1.02 DETAILED REQUIREMENTS

A. The CONTRACTOR shall provide Record Drawings which shall clearly show all differences between the contract Work as drawn and as installed for all concealed construction, as well as construction added to the Contract, which is not indicated on the Contract Drawings.

B. Concealed shall mean construction installed underground or in an area which cannot be readily inspected by use of access panels, inspection plates or other removable features.

C. Show all changes in the Work, or Work added on the Record Drawings in a contrasting color.

D. In showing changes in the Work, or added Work, use the same legends that are used on the Contract Drawings. Indicate exact locations by dimensions and exact elevations. Give dimensions from a permanent point.

E. Record by marking on the Drawings all changes in the Work which occur during construction, including adding approved change orders.

F. Show locations by key dimensions, depths, elevations of all underground lines, conduit runs, sensor lines, valves, capped ends, branch fittings, pull boxes, etc.

G. Record information on how to maintain and/or service concealed Work.

H. CAD files shall be in AUTOCAD format, latest version.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

### 3.01 GENERAL

A. Deliver the marked record set of Drawings to the OWNER prior to acceptance of the Work.

B. Confirm measurements with OWNER Representative before backfilling any new facilities.

C. Photograph all buried facilities, prior to backfill.

D. OWNER will provide CAD files of conformed drawing set. CONTRACTOR will edit these to create record drawings in CAD and pdf format electronic files.

****END OF SECTION****

## PART 1 GENERAL

### 1.01 DESCRIPTION

A. CONTRACTOR shall provide operation and maintenance data in the form of instructional manuals for use by the City's personnel for:

1. All equipment and systems.

2. All valves, actuators, gates and related accessories.

3. All instruments and control devices.

B. CONTRACTOR shall be responsible for providing O&M training to City Operations Staff.

C. Operation and Maintenance Data Manuals shall be submitted with last pay request.

D. Definitions:

1. Operation and Maintenance Data:

a. The term "operation and maintenance data" includes all product related information and documents which are required for preparation of the operation and maintenance manual. It also includes all data, which must accompany said manual as directed by current regulations of any participating government agency.

b. Required operation and maintenance data includes, but is not limited to, the following:

1) Complete, detailed written operating instructions for each product or piece of equipment including: equipment function; operating characteristics; limiting conditions; operating instructions for startup, normal and emergency conditions; regulation and control; and shutdown.

2) Complete, detailed written preventive maintenance instructions as defined below.

3) Recommended spare parts lists and local sources of supply for parts.

4) Written explanations of all safety considerations relating to operation and maintenance procedures.

5) Name, address and phone number of manufacturer, manufacturer's local service representative, and Subcontractor or installer.

6) Copy of all approved Shop Drawings, and copy of warranty bond and service contract as applicable.

2. Preventive Maintenance Instructions:

a. The term "preventive maintenance instructions" includes all information and instructions required to keep a product or piece of equipment properly lubricated, adjusted and maintained so that the item functions economically throughout its full design life.

b. Preventive maintenance instructions include, but are not limited to, the following:

1) A written explanation with illustrations for each preventive maintenance task.

2) Recommended schedule for execution of preventive maintenance tasks.

3) Lubrication charts.

4) Table of alternative lubricants.

5) Trouble shooting instructions.

6) List of required maintenance tools and equipment.

E. Submittals:

1. General: CONTRACTOR shall submit the operations and maintenance data to the Engineer within 30 days after approval of the final Shop Drawing.

2. Number of Copies: Six of each item.

3. Letter of Transmittal: Provide a letter of transmittal with each submittal and include the following in the letter:

a. Date of submittal.

b. Contract title and number.

c. CONTRACTOR's name and address.

d. A list of the attachments and the Specification Sections to which they relate.

e. Reference to or explanation of related submittals already made or to be made at a future date.

4. Format Requirements:

   a. CONTRACTOR shall use 8-1/2 inch by 11 inch paper of high rag content and quality. Larger drawings or illustrations are acceptable if neatly folded to the specified size in a manner, which will permit easy unfolding without removal from the binder. Provide reinforced punched binder tab or provide fly-leaf for each product.

   b. All text must be legible typewritten or machine printed originals or high quality copies of same.

   c. Each page shall have a binding margin of approximately 1-1/2 inches and be punched for placement in a three ring looseleaf or triple post binder. Provide binders not less than one inch or more than 2-1/2 inches thick. Identify each binder on the spine and outside front cover with the following:

      1) Title "OPERATING AND MAINTENANCE INSTRUCTIONS".

      2) Title of Project.

      3) Identity of building, structure or area as applicable.

      4) Identity of general subject matter covered.

   d. CONTRACTOR shall use dividers and typewritten indexed tabs between major categories of information such as operating instructions, preventive maintenance instructions, or other. When necessary, place each major category in a separate binder.

   e. CONTRACTOR shall provide a table of contents for each binder.

   f. CONTRACTOR shall identify products by their functional names in the table of contents and at least once in each chapter or Section. Thereafter, abbreviations and acronyms may be used if their meaning is explained in a table in the back of each binder. Use of model or catalog numbers or letters for identification is not acceptable.

**PART 2 MATERIALS (NOT USED)**

**PART 3 EXECUTION (NOT USED)**

****END OF SECTION****

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**TECHNICAL SPECIFICATIONS**
**DIVISION 2: SITE WORK**
**02052: SITE PREPARATION, CLEARING, GRUBBING, AND STRIPPING**

## PART 1 - GENERAL

1.01 SUMMARY

A. The CONTRACTOR shall furnish all labor, services, supervision, material, tools, trucks, equipment and all other appurtenances necessary to safely perform the work as shown on the Contract Drawings and as specified herein.

1. Site preparation shall consist of all clearing and related work necessary to prepare the Contract site for construction operations.

2. Vegetation and trees shall be protected from damage incident to site preparation and construction, as specified in Section 01062 and other applicable sections.

3. Noise and dust control shall be implemented as specified in Sections 01055 and 01062.

4. The restoration of landscape, sprinkler system, sidewalks, curbs, underground utilities, and any asphalt road disturbed by construction activities shall be considered incidental to the work specified herein.

5. The CONTRACTOR is advised to inspect the site for estimating purpose prior to bidding for the work under this contract.

B. Related Sections:

1. Section 01060 - Regulatory Requirements.

2. Section 01062 - Environmental Requirements.

3. Section 01150 - Water Treatment and Disposal.

4. Section 01530 - Protection of Existing Facilities.

5. Section 01640 – Demolition and Reconstruction.

6. Section 02111 - Disposal of Excavated Materials.

7. Section 02270 - Erosion and Sediment Control.

C. Definitions:

1. Drip Line: The limits established by the outermost tips of the branches of comprising a single plant, bush or tree, or group thereof, projected to the ground in plan view.

2. Clearing: The removal of materials including trees, tree stumps, brush, other vegetation, rocks, concrete rubble, trash, and debris.

    a. Clearing shall consist of cutting, removing, and disposing of all objectionable material from the ground surface, such as trash, trees, brush, logs, stumps, weeds, grasses, and obstructions of any kind, natural or artificial. Trees, shrubs, and vegetation designated to remain shall not be removed or disturbed. Trees and shrubs adjacent to work areas shall be protected from damage.

    b. Work shall be performed in such a manner as to remove all evidence of the objects' presence from the surface. Clearing shall also include the removal and disposal of trash piles and rubbish from the work site created prior to and during the duration of the work.

3. Equipment: Includes existing valves or abandoned pipelines.

4. Grubbing: Grubbing shall consist of cutting, removing, and disposing of all objectionable material found below the ground surface, including natural or artificial obstructions. Trees, stumps and roots below the surface requiring removal shall be removed completely from the ground.

5. Stripping: Stripping shall consist of the removal of the top 12 inches of soil after clearing and grubbing have been completed, or as required by the OWNER's Representative.

6. Tree Specialist: Horticulturist or licensed tree surgeon.

7. Vegetative materials: General term applied to any portion of a plant, bush, or tree.

1.02 SUBMITTALS

A. Working Drawings and Methods Statements:

1. CONTRACTOR shall submit a detailed clearing, grubbing and stripping plan. The plan shall include proposed temporary construction haul routes, traffic flows, number and types of equipment, and sequence of work. Include in the plan, the proposed methods of disposal of cleared vegetation and stockpiling of topsoil. The plan should also include but is not limited to:

    a. Extents of zones to be cleared, grubbed, and stripped and identify each work item to be performed within the zones depicted

b. Show layout, type, and location of barriers for trees to be protected.

c. Show location and indicate size of each tree to be pruned. For each tree, the Tree Specialist shall describe the extent of the pruning process and indicate the anticipated impacts to the tree from the pruning process and any construction activities.

d. Show location and indicate size of trees to be cleared and grubbed. Identify the trees to be removed. For any additional trees proposed by CONTRACTOR to be cleared and grubbed, provide:

(1) Information on the location, size and species of each tree to be disturbed or removed. Describe the anticipated impacts to construction if the tree remains in place and any feasible alternatives to removal.

(2) Information on the location, size and species of each tree to be pruned. The Tree Specialist shall describe the extent of the pruning process and indicate the anticipated impacts to the tree from the pruning process and any construction activities.

2. Submit a Recycling Program plan describing recycling to the extent possible for any trees, tree stumps, brush, other vegetation, rocks, concrete rubble, trash, metals, and debris.

3. Submit pre-construction photographs for existing structures and facilities located above or adjacent to the new construction and which may be affected by the work as necessary to fully document pre-construction conditions.

4. Submit Excavated Material Disposal Plan describing disposal of excavated materials in accordance with Section 02111.

B. Quality Control:

1. Qualifications:

a. Tree Specialist.

2. Certifications:

a. Certification by Tree Specialist that the tree limbs proposed to be cut due to interference with CONTRACTOR operations will not injure the tree.

b. Permit from local authorities to proposed pruning of tree limbs as required.

3. Recordkeeping:

    a. Assign each tree a number and log the extent of clearing, pruning, repairs, and replacement for each of the trees. The Tree Specialist shall, on at least a semiannual basis and at the completion of the Work, monitor the health and assess the impacts of construction for each of the trees. Assessments shall be placed in the log according to number and description of tree.

4. Notifications:

    a. If any tree becomes damaged during construction, notify the City Representative before the end of the work shift.

    b. Notify City Representative of any state or federally listed animal species encountered on the work sites.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Tree Specialist: Name and credentials of horticulturist or licensed tree surgeon to be retained by CONTRACTOR in the event of any injury to vegetation.

1.04 JOB CONDITIONS

A. CONTRACTOR shall inspect all existing features and conditions at the job site including access and satisfy itself as to the extent of work that needs to be done, regardless of the completeness of details shown on the Drawings.

B. Regulatory Requirements:

1. Comply with the requirements of Section 01062 Environmental Requirements.

2. Conform to Monterey County Standard specifications, Latest Edition.

3. Conform to the Standard Specification of Department Of Transportations, State of California, Latest Edition.

4. Most strict specification will take precedence.

5. Conform to applicable State and Local Code requirements and with all applicable State and local ordinances or regulations.

    a. CAL and Federal-OSHA Regulations.

b. American National Standards Institute "Safety Requirements for Demolition", ANSI AID.G (latest edition).

C. Comply with Section 01150, "Water Treatment and Disposal."

D. Comply with the requirements of Section 01530, "Protection of Existing Facilities."

E. CONTRACTOR shall verify existing conditions and make provisions as required so that no work would interfere with drainage, electrical and communication services with other facilities.

F. CONTRACTOR shall operate warning lights during hours from dusk to dawn each day and as otherwise required when constructing near public right-of-way.

G. Comply with all requirements of Section 02270, "Erosion and Sediment Control."

## PART 2 - PRODUCTS

2.01 EQUIPMENT

A. The use of diesel or gasoline powered equipment inside potable water facilities and within permit-required confined spaces will not be allowed for water quality and personnel safety reasons. The use of propane-powered equipment with special air scrubbers will be allowed. All hydraulic equipment shall use vegetable oil based fluids or other NSF 61 approved for potable water. Ventilation and lighting must be provided, where required.

B. CONTRACTOR shall furnish all materials, tools, equipment, devices, appurtenances, temporary fences, and barricades, etc., as required for performing the site clearing, demolition and other miscellaneous work.

## PART 3 - EXECUTION

3.01 GENERAL

A. Clearing, grubbing, and stripping operations shall be conducted with minimum interference with roads, and adjacent facilities. Roads and adjacent facilities shall not be obstructed without approval from the City and other authorities having jurisdiction.

B. Stockpile the top 6 inches of topsoil in vegetated areas for use in subsequent landscaping in accordance with Sections 01062 "Environmental Requirements" and 02200, "Excavation, Backfilling, and Compaction."

C. Dispose off non-recycled materials removed during clearing and grubbing to an off-site location. Burning of materials to be cleared and grubbed on-site is not allowed. CONTRACTOR shall stake out all work areas designated for clearing, grubbing, and stripping by survey. CONTRACTOR shall be responsible for the accuracy, maintenance and observation of all lines and elevations.

1. The location, limits, and methods to be used for clearing, grubbing, and stripping shall be reviewed with the OWNER Representative prior to start of work.

2. CONTRACTOR shall review with the OWNER Representative all trees greater than 4 inches in diameter at a distance of 36 inches above the ground to be removed or trimmed.

D. Do not disturb areas outside the construction limits. Protect areas outside the construction limits from CONTRACTOR operations.

E. Do not utilize vegetation as anchorages or for other purposes.

F. Prior to cutting or removing tree limbs or roots have a Tree Specialist inspect and approve cut or removal.

G. Assume all responsibility for injuries to, or death of vegetation arising from CONTRACTOR operations.

3.02 PREPARATION

A. Contact Local, State and Federal agencies responsible for air, noise and water quality control regulations to determine all applicable standards to be followed during construction operations.

B. Examine the areas and conditions under which the work in this section will be performed. Correct conditions detrimental to the timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected with OWNER Representative's approval.

C. In company with the OWNER Representative, visit the site and verify the extent of clearing and demolition to be performed under this Contract before proceeding with the prescribed work.

D. Protect trees indicated to be protected from damage or injury by erecting protective barriers around the trees at least one foot outside the drip line as directed by the Tree Specialist.

E. Coordinate the removal of protective barriers with demolition and final cleanup.

F. Traffic: CONTRACTOR shall conduct site clearing and demolition operations and removal of debris to ensure minimum interference with roads, streets, walks, and other adjacent facilities. Streets, walks or other facilities shall not be closed or obstructed without prior permission from authorities having jurisdiction. CONTRACTOR shall provide alternate routes around closed or obstructed traffic ways as required by governing regulations or conditions.

G. Protection: CONTRACTOR shall provide fencing or other protection for safe passage of persons around the affected area of vegetation.

H. Provide, erect and maintain temporary barriers such as fencing. All holes shall be barricaded and covered after normal working hours.

I. Contact serving utilities and arrange for relocation of items interfering with construction.

J. Locate, identify and protect existing structures, utilities, drainage and irrigation systems, and equipment that are to remain from damage. If utility is damaged, immediately notify the City Representative and the utility OWNER for corrective action.

K. Maintain egress and access at all times.

L. Protect all trees and plant materials that are to remain. Water trees and plant materials that are to remain for the duration of the contract. CONTRACTOR shall replace at its own expense any tree and/or plant material that is damaged as a result of construction or lack of irrigation.

M. CONTRACTOR shall provide temporary construction fence and other forms of traffic protection control before beginning demolition.

3.03 DUST AND WATER RUN-OFF CONTROL AND REMOVAL

A. Prevent air-borne dust from dispersing into the atmosphere. Keep work sprinkled with clean water to minimize dust. Provide hoses and water connections for this purpose. Any water run-off should be kept away from drinking water appurtenances.

3.04 CLEARING

A. Clear, grub, and strip within the limits of excavation and grading indicated.

1. Vegetative materials not designated to be protected.

2. Trash piles, surficial rubbish, and fencing, including fence-post footings.

B. Remove cleared, grubbed, and stripped materials that are not to be recycled from the project site and dispose in accordance with all applicable laws, codes, and ordinances.

C. Recycle tree trunks and limbs to the extent possible.

D. Except as otherwise directed by OWNER Representative, cut, grub, and dispose of concrete, paving, base, vegetation, rubbish, debris and any objectionable material encountered within the limits required for construction. Areas outside the limits of clearing shall be protected. Provide temporary barricades or protection or secure the area from damage.

E. If suspected hazardous materials are encountered, immediately notify City Representative. Handle and remove suspected materials in accordance with Sections 02111 and applicable local, state and federal regulations.

F. Any removed meters, valves and covers during construction shall be delivered to the California-American Water Corporation Yard, Pacific Grove, California.

G. Conduct operation with minimum interference to public or private access. Maintain protected egress and access at all time. Ensure safety of persons and adjacent property against damage by falling debris or other causes in connection with this work.

H. CONTRACTOR shall cease operation immediately if adjacent structures or facilities appear to be in danger. Notify OWNER Representative and do not resume operation until directed. Repair any damages caused by CONTRACTOR to adjacent structures and as directed by the OWNER Representative at no cost to the OWNER.

I. Keep vibration to a minimum to avoid damaging the remaining structure/lining.

J. Storage areas shall be cleared before use.

K. If the sites have been surveyed and staked prior to start of the work, use all means necessary to protect the benchmarks, survey stakes and monuments. If damaged during construction, the replacement of the damaged survey monuments and benchmarks will be at CONTRACTOR's expense.

3.05 REPAIR AND REPLACEMENT

A. Repair injured trees:

1. The term "injuries" in this context shall comprise any bruising, scarring, or breaking of roots, trunks, or branches.

2. Repair or treat injured vegetation as recommended by and under the direction of the Tree Specialist.

B. Plant replacement trees as directed by OWNER Representative.

3.06 RESTORATION, CLEAN UP AND DISPOSAL

A. Remove from site surplus material and debris during the course and at completion of the worksite as CONTRACTOR's property and dispose of in accordance with applicable Federal, State and Local Codes, Ordinances and Regulations. Burning or burying of waste material on site is prohibited.

B. Cleanup any spillage from haul routes and adjacent areas.

C. Restore utility service to normal operation.

D. Remove equipments, temporary protection and barriers and debris.

**END OF SECTION**

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**TECHNICAL SPECIFICATIONS**
**DIVISION 2: SITE WORK**
**02111: REUSE OR DISPOSAL OF EXCAVATED MATERIALS**

## PART 1 GENERAL

### 1.01 REQUIREMENTS

A. This section of the specification provides requirements for the on- and off-site reuse of excavated soils or off-site disposal of soil that cannot be reused because: it is surplus, it is contaminated, or it does not meet the project's geotechnical requirements.

B. This specification also provides requirements for recycling of asphalt and concrete rubble and metal waste. CONTRACTOR shall reuse or recycle soil, asphalt and concrete rubble, and metal to the maximum extent possible. Off-site disposal is the last resort. Off-site disposal can be used only after demonstrating to the Owner's Representative that the soil or other excavated materials cannot be reused or recycled.

C. AECOM has reviewed records of suspected and confirmed hazardous waste sites and hazardous chemicals application practices along the pipeline route. Although no hazardous waste sites were identified, AECOM does think it likely for CONTRACTOR to encounter hazardous soils in the pipeline trench excavation due to historic pesticide/herbicide application and aerially deposited lead. Contractors are directed to AECOM's Environmental Database/Document Review for the Castroville pipeline corridor (2017).

D. In most areas the pipeline trench will be excavated to a depth of eight-feet below ground surface and four-feet wide. This will allow for bedding sand for the three-foot diameter pipeline and four feet of cover soil on top of the pipeline. The upper six inches of topsoil in vegetated areas shall be reserved is a separate local stockpile(s) for reuse as top cover to preserve the seeds of native plants, except in the Caltrans right of way (ROW). See the specific instructions for the Caltrans ROW below.

E. Soil in Non-Caltrans ROW Areas: CONTRACTOR shall excavate and side cast the soil from ground surface to four feet in depth alongside of the trench. This soil shall be reused as fill in the excavation where feasible without analytical testing. Soil from one property or municipality may be reused without testing only in that property or municipality. The exception to this requirement for the reuse of soil is detailed below for visibly contaminated or odoriferous soil. The soil from four feet in depth to the final trench depth shall be excavated and trucked to a local Materials Classification Area (MCA) for stockpiling, sampling, analysis, and characterization for on- or off-site reuse or off-site disposal. In general, the cleanest soil that does not meet the Project's geotechnical criteria will be surplus and shall be preferentially disposed of off-site.

F. If any soil from the pipeline trench excavation is visibly contaminated or odoriferous, that soil shall be excavated and stockpiled separately on plastic at the

nearest MCA, for sampling, analysis, characterization and profiling for off-site disposal.

G. Caltrans ROW Soil Characterization:

1. Limited excavation will be conducted in the Caltrans ROW. It will mostly consist of trenching in streets under Highway 101 Caltrans overpasses. An elevated (above ground) section of pipeline will also be constructed in the Caltrans ROW. The soil from the pipe bridge foundation must be stockpiled, sampled, analyzed, and characterized. Soil in the Caltrans ROW will only be reused for backfill if it meets the geotechnical and chemical criteria specified in the Caltrans specifications, provided in the aerially deposited lead (ADL) plan in Appendix I.

2. Excavated soil from the Caltrans ROW will be tested for ADL. Soil that is hazardous waste must be disposed of off-site as California or federal hazardous waste, as applicable. The Caltrans/Department of Toxic Substances Control ADL soil variance mentioned in the Caltrans specifications attached to the ADL Plan does not apply to this project's soils.

3. The soil from the ROW may be sampled and analyzed in one of two ways. First, the soil shall be sampled in-situ with an AECOM approved workplan that includes sampling and analysis at multiple depths per sampling location with the data being statistically evaluated to Caltrans reuse specifications or for off-site disposal. Typically the samples would be collected at the following depths: 0-6inches, 6-12 inches, 12-18 inches, 18-24 inches and at three foot intervals to the bottom of the expected excavation at each location. Second, the soil may be stockpiled, separate from non-Caltrans soils, in an MCA and sampled as follows; one 4-point composite sample will be collected for every 250 cubic yards of soil.

H. Soil in Incorporated City Roadways Where Native Soil Will Not Be Reused: In areas where the soil from ground surface to four feet in depth cannot be reused due to geotechnical characteristics or if the excavation is in City Streets where the host City will not allow reuse, all the excavated soil from that area shall be taken to an MCA for stockpiling, sampling, analysis, and characterization for on- or off-site reuse or off-site disposal. In locations where jack and bore methodology will be used to install the pipeline under a freeway, all the resulting soil shall be taken to the MCA for stockpiling, sampling, analysis, characterization for on- or off-site reuse or off-site disposal.

## 1.02 SUMMARY

I. This Section specifies the requirements for:

1. Training requirements, handling, and transport of excess spoils from the trench excavations and jack and bore tunnel locations.

2. Reuse of soil along the pipeline ROW and/or at the specified on-site reuse areas. This includes side casting of excavated soil for reuse in the trench as backfill where allowed by local ordinance

3. On-site temporary stockpiling and management of selected excavated materials in MCAs.

4. Sampling, testing, characterization, profiling, and material classification by CONTRACTOR.

5. On-site reuse of soil, if needed. Reuse of stockpiled soil requires that the soil meet reuse requirements.

6. Off-site disposal of excavated soil determined to be unsuitable for onsite reuse due to geotechnical requirements and/or lack of reuse capacity along the pipeline corridor.

7. Off-site disposal of water treatment wastes.

J. Related Sections:

1. Section 01060 – Regulatory Agency and Utility Requirements.

2. Section 01150 – Water Treatment and Disposal

3. Section 01560 – Temporary Environmental Controls.

4. Section 01062 - Environmental Requirements

5. Section 02200 – Earthwork.

6. Section 02125 – Trench Structure Excavation and Backfill.

K. Definitions:

1. Hazardous Material: Refer to Section 01062.

2. Material Classification Area (MCA): Sites to be established and used by CONTRACTOR as staging areas for sampling and testing of excess soil in

order to determine if the soil can be reused on- or off-site or must be disposed of off-site as a non-hazardous or hazardous soil.

3. Suspect Soil: Potentially contaminated excavated material, suspected or observed to be contaminated (e.g. due to the known occurrence of contamination in the vicinity of the excavation area, or the presence of observable staining or odors, or other factors leading to a reasonable suspicion of possible contamination).

4. Asphalt and concrete rubble: asphalt or concrete removed from streets etc. from the excavation of the pile line trench.

5. Metals – Metals waste, if any, will be recycled.

L. Design Criteria:

1. Segregation Bins for MCAs:

a. Prevent cross contamination to take place between spoil piles.

2. Establish stockpile locations and heights as shown on approved submittals and based on proposed construction methods.

3. Confine work to areas within the construction limits indicated on the Drawings.

M. Performance Requirements:

1. CONTRACTOR shall obtain lease agreements for the MCA on developed property so as not to harm local endangered plant species

2. Soil stockpiles will be sampled, analyzed, characterized for on- or off-site reuse, or profiled for off-site disposal in accordance with all applicable regulations.

3. CONTRACTOR will segregate soil with visible contamination or odor and place this material on plastic sheeting. This soil will be sampled, analyzed, characterized, and profiled for off-site disposal.

4. CONTRACTOR shall provide 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) trained staff with current 8-hour annual updates to manage California and federal hazardous wastes soils, if any.

5. CONTRACTOR will recycle: asphalt and concrete rubble and metal wastes.

6. CONTRACTOR will develop and submit to AECOM a Lead Compliance Plan for work in the Caltrans ROW.

7. MCA:

    a. No MCAs are provided by the owner. CONTRACTOR to make all arrangements to secure an adequate number of MCAs. CONTRACTOR's use of the MCAs shall comply with the project documents including Section 01062 Environmental Requirements.

    b. The MCAs shall be of the size and arrangement required to maintain satisfactory progress during construction. Evaluate MCA space and stockpile for logistics of stockpiling, sampling, material classification, and hauling of soil for reuse or off-site disposal.

    c. Once a stockpile is sampled it shall be posted with signs to prevent additional soil from being added to the stockpile. If additional soil is added, previous sampling and analyses is invalidated and must be repeated at CONTRACTOR's expense.

    d. Segregate and stockpile suspect materials within the MCA to prevent cross-contamination of materials until classifications have been completed. Suspect materials shall be stored on plastic sheeting or in roll-off bins.

    e. Sample, analyze, characterize and profile the segregated suspect spoil piles for off-site disposal to comply with all applicable laws, codes, regulations, Section 01110, and as specified herein.

    f. Determine the appropriate classification for suspect materials as Class I, Class II, or Class III materials.

    g. The MCAs shall be maintained to control dust emissions. At a minimum the following dust control measures shall be used.

        (1) Stockpiles shall be covered nightly.

        (2) The MCAs shall be watered daily, or more frequently as needed, to control dust. No visible dust will be generated from vehicular traffic or other sources.

        (3) Rumble strips shall be installed for all exiting traffic to prevent track-out. Rumble strips shall be cleaned daily or more frequently as needed to keep them clean.

h. CONTRACTOR will develop a project Stormwater Pollution Prevention Plan (SWPPP) for the MCAs, and manage stormwater in compliance with all applicable regulations. Reference Section 01561.

8. Refer to Section 01110 for additional requirements.

9. Follow any specific haul routes required by the jurisdictions issuing the Encroachment permits for transporting excavated soil.

10. Haul routes used for transport to offsite disposal areas shall be subject to all applicable regulatory and permit requirements. Loads of California and federal hazardous wastes must be transported by a licensed hazardous waste transporter.

11. Refer to Section 01060 and 01062 for limitations on soils hauling times and other permit and regulatory constraints.

## 1.03 REFERENCES

A. Bay Area Air Quality Management District (BAAQMD) Regulations.

B. California Air Resources Board (ARB): Section 93106, Asbestos Airborne Toxic Control Measure for Surfacing Applications.

C. California Code of Regulations (CCR): Title 8 and Title 22.

D. AECOM Document Review for CalAM Water Conveyance Pipeline Project, Monterey County 2015

E. Caltrans Specifications

## 1.04 SUBMITTALS

A. Working Drawings and Methods Statements:

1. Work plan for locating, sizing, constructing, and maintaining segregation bins and stockpiles within the MCAs. Include details for the design criteria of the segregation bins. Demonstrate that cross-contamination of spoil piles does not occur. Seepage and flow of water from decanting the soils shall be controlled and treated prior to discharge or transported off-site for disposal. Describe the erosion control measures and the storm and wind protection measures for the stockpiles.

2. Include in the work plan a list of equipment proposed used for loading, hauling, spreading, moisture conditioning, disking, scarifying, and compacting for soil to be reused on-site. For the compaction equipment proposed, sufficient data and drawings shall be furnished for verification of the requirements specified in this section.

3. CONTRACTOR-furnished MCA:

    a. Site layout and stockpile capacity.

    b. Name, address, telephone number, and contact name of property owner.

4. Work Plan describing proposed transportation and disposal activities for each class of material to be disposed of at landfills. CONTRACTOR shall submit haul tags, landfill receipts and manifests after disposal is accepted.

5. Plans with soil data for proposed disposal of soil at off-site fill areas (see paragraph 3.03 B below).

6. Quality Control:

    a. Means and methods for performing required activities at the MCA, including the layout and types of physical and protective barriers.

    b. Details for loading, transporting, and disposing of materials, including:

        (1) Proposed haul routes and haul times from the project to the MCAs, from the project to the soil reuse or disposal sites, and from the MCA to the soil reuse or permanent disposal sites.

        (2) Methods for controlling and removing spillage, tracking of materials, and dust anywhere offsite.

        (3) Samples will be collected and labeled with unique project specific numbers and placed on ice for submittal to a State of California certified environmental analytical laboratory under chain-of-custody procedures.

7. Certifications:

    a. Environmental permits to transport all materials.

    b. State-licensed transporter for hazardous material, as required by state and federal regulations.

c. State-licensed disposal facility for hazardous material, as required by state and federal regulations.

d. Permits for proposed haul routes from governing jurisdictions.

e. Certificates demonstrating 40-hour HAZWOPER training for personnel handling hazardous waste or soils.

8. For Contractor-provided stockpiling facilities offsite:

a. Permits from applicable governing jurisdictions.

b. Name, address, telephone number, and contact name for each disposal site used.

c. Lease or agreement with the property owner.

9. Daily Records: Submit no later than the end of the work day following the performance of the work truck counts for the transportation of all excavated materials grouped by haul destination and comprising material hauled from:

a. The project site.

b. Contractor-furnished stockpile facilities offsite.

c. The MCAs.

10. Notifications: Immediately upon receiving a complaint from any source.

## 1.05 QUALITY CONTROL

A. Quality control testing shall be performed by CONTRACTOR. Corrective measures shall be made by CONTRACTOR until conformance is achieved.

B. Preconstruction Meeting:

1. Hold a meeting at least 5 days but not more than 30 days prior to commencing excavation requiring the offsite disposal of materials.

2. Review and discuss the following items:

a. Construction methods and constraints overview.

b. Equipment operating parameters.

c. Safety procedures.

d. Quality Control procedures and Quality Assurance requirements.

e. Reporting requirements.

f. Other issues as may be raised by either party.

## 1.06 JOB CONDITIONS

**A.** Refer to the project Geotechnical Report for information on the soils anticipated to be encountered in the project area.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

## 3.01 GENERAL

A. Provide barriers, stakes, and colored flagging to:

1. Maintain controlled access to the MCAs

2. Indicate the work area limits.

3. Prevent impacts to land outside work areas.

4. Furnish and install barriers to segregate MCA stockpiles for sampling and classification.

## 3.02 STOCKPILING

A. Remove, handle, segregate, and store suspected hazardous material as hazardous until the CalAM Representative has reviewed the required laboratory analysis and determined the appropriate classification.

B. Do not commingle materials from different areas of work until materials have been classified.

## 3.03 TESTING AND DISPOSAL REQUIREMENTS

A. All suspect material shall be tested and classified as specified herein and in accordance with applicable permits and landfill disposal regulations, as applicable.

B. CONTRACTOR may make arrangements with local landowners for accepting the trench spoils as clean fill. These areas are referred to as "off-site fill areas". In order for material to be cleared for placement in either landfills or off-site fill areas, the following criteria must be met:

1. Concentrations of suspected regulated chemicals, including Title 22 Metals, Total Petroleum Hydrocarbons: as gasoline (TPH-g), as diesel (TPH-d) and motor oil (TPH-mo), and Volatile Organic Compounds (VOCS) shall not exceed their respective criterion of the latest version of the Environmental Screening Levels (ESLs) for commercial/industrial use sites, as defined by the US EPA. The ESLs are available at the following website: https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/esl.html

2. If the soil was excavated from agricultural areas, Chlorinated herbicides and pesticides shall be analyzed for and shall not exceed their respective criterion of the latest version of the USEPA Region IX Regional Screening Levels (ESLs) for commercial/industrial sites.

3. If CONTRACTOR makes arrangements for delivering soil to off-site fill areas, CONTRACTOR shall first submit to the Owner for review and approval, documentation of the soil sampling results, soils volumes and destination.

## 3.04 HAULING

A. Maintain haul routes free of track out, see Section 01561 and 02270.

B. Perform hauling in accordance with permit requirements.

**END OF SECTION**

**TECHNICAL SPECIFICATION**
**DIVISION 2: SITE WORK**
**SECTION 02140: DEWATERING**

## PART 1 GENERAL

### 1.01 SUMMARY

A. This specification section includes the following items of work:

1. Lowering the water table and intercepting seepage which would otherwise emerge from the slopes or bottoms of excavations.

2. Disposing of pumped water.

### 1.02 DEFINITIONS:

1. Groundwater: Groundwater denotes all water below the existing ground surface.

2. Perched Water: Perched water denotes unconfined groundwater within the work area that is separated from the underlying main body of groundwater by unsaturated material.

3. Surface Water: Surface water is all water that enters the work area at or above the ground surface, from either natural or artificial sources, including precipitation.

4. Infiltration Water: Reservoir water and groundwater that enters the tower work area due to incomplete upstream valve closure or seepage through the existing tower structure.

### 1.03 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition available on the date of the Notice Inviting Bids shall be used.

B. American Water Works Association:

1. Water Wells (AWWA A100).

C. California Department of Water Resources:

1. Water Well Standards: State of California, Bulletin 74-81 (with Supplemental Bulletin 74-90).

## 1.04 SUBMITTALS

A. Submit in accordance with Section 01300, CONTRACTOR Submittals at least 60 days in advance of the relevant work commencing or materials being ordered, unless noted otherwise.

B. Submit dewatering plan for excavations including drawings and complete design data for the proposed dewatering system, showing the equipment and methods that CONTRACTOR proposes to use to dewater the excavations, and to control and remove surface water and perched water. The data provided shall include, but not be limited to, the following:

1. Design calculations.

2. Size, depth and location of dewatering wells, well points, sumps, drains, observation wells, and piezometers.

3. The capacities and locations of pumping units.

4. Size and location of collection headers, discharge lines and holding ponds.

5. The proposed methods of installation of the dewatering equipment, including filters packs.

6. The proposed methods of controlling and removing surface water and perched water from within excavations.

7. If employed, discharge treatment and handling systems and facilities for disposal of dewatering water not stored or used on site.

8. Contingency plans, including backup equipment and emergency contact information.

C. Submit weekly log of dewatering operations as described in Article 3.03.

## 1.05 QUALITY ASSURANCE

A. Acceptance Criteria:

1. The work specified herein shall conform to the requirements of the documents listed below. In the event of any conflict between the documents, or the documents and these specifications, such conflict shall be immediately referred to OWNER’s Representative for written resolution. OWNER’s Representative's interpretation shall govern.

2. Storm Water Pollution Prevention Plan (SWPPP) for the project as specified in Sections 01561, "SPP, Erosion and Sediment Control" and 02270, Erosion and Sediment Control.

3. Preconstruction Meeting:

   a. Hold a meeting with OWNER's Representative prior to beginning construction of the work specified under this Section. Review and discuss the following items:

      1) Scope of work to be performed.

      2) Construction methods and constraints overview.

      3) Equipment operating parameters.

      4) Safety procedures.

      5) Reporting requirements.

      6) Other issues as may be raised by either party.

   b. Testing: Results of discharge water testing shall be in accordance with Regional Water Quality Control Board permit and Sections 01150, "Water Treatment and Disposal" and

## PART 2 PRODUCTS

### 2.01 MATERIALS

A. Grout shall be a neat cement mixture of portland cement, bentonite and water. The grout mixture shall contain bentonite and sufficient water to produce a pourable consistency. The grout mixture may be varied by OWNER's Representative. Materials for grout shall be in accordance with the following requirements:

1. Cement shall meet the requirements of ASTM C150 for Type II Portland cement. Only cement furnished in sacks shall be used.

2. Water shall be free from sulfates and organic or other particulate matter, and meet the requirements for water for concrete as specified in Section 03300, Cast-in-Place Concrete.

3. Bentonite shall be powdered premium commercial grade. Bentonite shall be hydrated with water prior to mixing it with cement. The hydrated bentonite shall be batched as a slurry in such proportions that approximately ten percent

bentonite powder, by dry weight, is used for each bag of cement, or as otherwise required by OWNER's Representative.

## 2.02 EQUIPMENT FOR DEWATERING

A. CONTRACTOR shall furnish all materials, tools, equipment, facilities, and services as required for providing the necessary dewatering work and facilities. Provide back-up equipment as necessary for replacement and for unanticipated emergencies.

B. During excavation dewatering, provide piezometers for monitoring groundwater levels and other instruments and measuring devices as required.

C. Provide equipment with sufficient capacity to accommodate dewatering operations and provide a productive work area.

D. Pumps shall be regularly maintained and kept in good operating condition with no leaks from operating fluids. CONTRACTOR shall comply with applicable local, state and federal regulations regarding contamination of water during dewatering operations.

E. A settlement and oil separation tank system manufactured by Baker Corp., or approved equal, may be required to comply with applicable local, state and federal regulations regarding discharge of infiltration water into the reservoirs.

# PART 3 EXECUTION

## 3.01 GENERAL

A. CONTRACTOR shall take all steps to become familiar with the site conditions, ground conditions, and the groundwater conditions. CONTRACTOR shall obtain the data that will be required to analyze the water and soil conditions at the site to assure that the means and methods used for the system will perform properly for the duration of the contract. Limited groundwater information is available from borings included in the following documents. Note that these reflect measurements on the date indicated and may not reflect current conditions.

B. Obtain all required permits and pay fees for dewatering and monitoring wells.

C. Excavation dewatering includes, but is not limited to, pumping, piping, draining and other measures required for the removal or exclusion of water excavation areas, throughout the entire period of time that construction work is taking place below the groundwater table. This also includes the control, treatment (if necessary), and disposal of water produced during dewatering operations.

D. CONTRACTOR's operations shall not compromise safe control and disposal of water, and CONTRACTOR shall be responsible for any damages caused as a result of its

operations. Review of the dewatering system plans by OWNER's Representative will not relieve CONTRACTOR of its responsibility for the adequacy of the systems, including responsibility for repairing any damage to the outlet structures, or damage to any part of the work caused by the operation, failure, or inadequacy of the system. CONTRACTOR shall have sole responsibility for all aspects of the dewatering system.

## 3.02 DETECTION OF MOVEMENT

A. For each existing structure that may be affected by the work, install settlement markers on each footing, building corners, wall or surrounding structures to be monitored. Settlement markers shall be capable of being read to an accuracy of 0.005 foot.

B. Take and record readings not less than once per week during performance of the dewatering work until the permanent structure is complete to the ground level.

C. Stop work; notify OWNER's Representative, and take immediate remedial action if movement of the existing structure occurs during performance of the work.

D. Upon completion of the dewatering work, take weekly readings of the measurement points for a period of 4 weeks or longer if movement persists, and report the results to OWNER's Representative.

E. The detection of movement shall be performed by a qualified licensed civil engineer or land surveyor.

## 3.03 GENERAL DEWATERING OPERATIONS

A. Perform dewatering in accordance with approved shop drawings. Advise OWNER Representative of any changes made to accommodate field conditions and, on completion of the dewatering system installation, revise and resubmit shop drawings as necessary to indicate the installed configuration.

B. CONTRACTOR shall keep an accurate and legible up-to-date log of its operations at all times, and deliver complete, legible copies of these records to OWNER's Representative weekly or at such other times as may be required. OWNER's Representative shall have the right to examine such records at any time prior to their delivery.

C. Except for equipment maintenance shutdowns, no interruption in the approved control and disposal of water, or dewatering procedures, will be permitted during excavation and construction operations. Contract shall provide continuous surveillance and maintenance of the equipment to avoid breakdowns. Personnel experienced in the operation and maintenance of pumping and other equipment shall be on site to ensure proper operation of the facilities.

D. All motors shall be electric. Except for standby power, diesel or gas generators will not be permitted.

E. Provide standby power, installed and ready to operate. The standby power shall be operated a minimum of one hour per week. Immediately repair or replace any equipment failing to perform properly. For groundwater dewatering, the standby power system shall be capable of maintaining the specified groundwater levels.

## 3.04 GROUNDWATER DEWATERING OPERATIONS

A. Organize dewatering operations to lower the groundwater level in excavations as required for prosecution of the work, and to provide a stable, dry subgrade for the prosecution of construction operations. The subgrade shall be in a firm, well-drained condition, and of adequate and uniform load-bearing nature to support construction personnel, construction materials, construction equipment, and steel reinforcing mats without tracking, rutting, heaving, or settlement. All weak, soft, saturated, or otherwise unsuitable material shall be removed and replaced with approved backfill.

B. Maintain water level at lower elevations so that no danger to structures can occur because of buildup of excessive hydrostatic pressure.

C. CONTRACTOR shall furnish all plant, labor, equipment, and materials required, and install, operate and remove the systems needed to control and remove surface and perched water in excavation areas. CONTRACTOR shall be responsible for controlling groundwater flow into excavations by constructing sumps or ditches; installing wells; pumping, or other means so that excavations are accomplished in the dry. Conduct dewatering operations to preclude free standing water at the site, and keep all temporary and final subgrade areas well-graded and drained.

D. Keep separate records for each well during drilling. Include the following information in the records for each hole.

1. Hole number or designation, and angle and direction of hole.

2. Depth of bottom of hole, screened interval, depth and type of surface seal, and size and type of pump installed.

3. Production records, which at a minimum shall consist of daily data from in-line totalizing flow meters on each well, or group of wells.

E. Install headers, discharge lines and electric lines in such manner that if a portion of the dewatering system becomes inoperative, that portion can be isolated and the remaining portion(s) of the operative dewatering system is capable of maintaining the water at the specified levels.

F. Upon completion of the dewatering operations, remove the dewatering equipment and decommission the well screens, well holes, and well points in accordance respective City and/or County Code Ordinance.

G. Prior to grouting, check each well for blockage or caving. Clear blocked or caved holes to the full depth of the original drilled hole, or to the depth of previous grouting as approved by OWNER's Representative. All casing, screen, and gravel pack shall remain in the well. Tremie grout through a pipe from the bottom of the hole upward so that the hole is completely backfilled with grout. CONTRACTOR shall at all times provide for disposal of all wash and waste water, cement bags and other debris, in accordance with all state and local regulations, and shall remove all waste grout caused by its operations.

H. Remove or seal all ditching, under drains and sumps upon completion of the dewatering, as approved by OWNER's Representative.

## 3.05 DEWATERING IN EXCAVATIONS

A. During construction, CONTRACTOR shall be responsible for the design, construction, operation, maintenance, implementation, at all times including Saturday, Sunday, holidays and during any periods of labor strikes, to provide and maintain proper equipment, facilities, and power supply to remove promptly and dispose of properly all water entering excavations.

B. Keep excavations dry so as to obtain satisfactory undisturbed sub-grade foundation condition until the structures, and/or pipes to be built have been completed to such extent that they will not be floated or otherwise damaged by allowing water to accumulate in excavations or levels to return to natural elevations.

C. Local water flow is expected from rock joints and other fractures into excavations. CONTRACTOR shall control such flows into excavations by such methods as pumping from sumps, and/or other approved methods.

D. Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in excavations and to eliminate interference with orderly progress of construction.

E. Provide and maintain ditches of adequate size to collect surface and seepage water which may enter the excavations. Divert the water into sumps and drain or pump into drainage channels or storm drains or sewers, subject to the approval of jurisdictional authorities.

F. Locate dewatering facilities where they will not interfere with utilities and construction work to be performed by others.

G. Provide settling basins or other approved facilities as required to reduce the amount of fine particles which may be carried into the drain, when the water is to be diverted into a

storm drain. If a storm drain becomes blocked or its capacity restricted due to dewatering operations, make arrangements with the jurisdictional authority and clean the drain.

H. CONTRACTOR shall carefully assess site conditions before and during shaft, tunnel, and trench excavation, so that intended improvements of ground stability is achieved during shaft and tunnel construction.

I. Prevent water accumulated in excavations from flowing down through bedding and road base materials, and resulting in softening of surfaces or sub-grade, and causing pavement failure, or misalignment and conduit failure in pipelines. Drain water to the nearest point where flow can be acceptably relieved using gravel encased perforated metal pipe and removed to a discharge pipe by pumping, when it causes such problems.

J. CONTRACTOR shall not discharge any ground water on the street, nor any sediment, debris, or pollutants into the reservoir or storm drainage and/or sewerage system. In a separated drainage system, sanitary flow or sanitary seepage shall not be allowed to flow into the storm drain system.

K. Acquire all permits and pay all fees for disposal of dewatering drainage. CONTRACTOR shall submit water disposal plans for approval by OWNER's Representative.

L. CONTRACTOR shall, at all times during construction, provide and maintain proper equipment and facilities to avoid settlement or damage to adjacent property. When dewatering the excavations, dewater from outside the structural limits and from a point below the bottom of the excavation when possible.

M. CONTRACTOR shall remove all temporary lines and related connections upon completion of the work and shall restore all facilities to conditions prior to construction, to the satisfaction of OWNER's Representative.

## 3.06 WATER DISCHARGE/CONTROL

A. CONTRACTOR shall treat and discharge water produced during dewatering operations that is not used for construction activities in accordance with approved dewatering plan and in compliance with local RWQCB permit requirements for discharge to inland surface waters and groundwater bodies.

B. Convey water discharged from dewatering operations to detention tanks provided by CONTRACTOR. The tank system shall be manufactured by Baker Corp., or approved equal, and may consist of settlement tanks, transfer pumps, sand filter and backwash tanks, if required to meet water quality standards. CONTRACTOR shall provide all piping, valving, pumping and appurtenances required conveying the discharge as specified herein. CONTRACTOR shall be responsible for cleaning all detention tanks and for the removal of all solids to disposal areas shown on the Drawings. In the event that the water disposal options being used (detention tanks, etc.) are all operating at

capacity, and maximum use is being made of dewatering water for construction activities, dispose excess dewatering water by discharging it into an area within the reservoir isolated by silt curtain(s) after it has been treated to remove pollutants and sediment in accordance with the NPDES permit for groundwater discharge.

## 3.07 DAMAGES

A. CONTRACTOR is responsible for any failure of the dewatering system or components of the system and any damages arising there from. If at any time the installation, operation, or removal of the dewatering system, or any part of the dewatering system, cause any damage to the adjacent area and/or construction site, CONTRACTOR shall immediately commence correction thereof and modify the dewatering procedure to prevent a reoccurrence.

B. Restore existing structures to the conditions equivalent to those existing prior to the start of work, including repair of any settlement-related damage.

C. Additional excavation due to insufficient dewatering shall be done at no cost to the OWNER.

**END OF SECTION**

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**TECHNICAL SPECIFICATIONS**
**DIVISION 2: SITE WORK**
**02160: EXCAVATION SUPPORT SYSTEMS**

## PART 1 GENERAL

### 1.01 WORK OF THIS SECTION

A. The work of this Section includes support of temporary open excavations by means of sheet pilings, soldier piles and lagging, structural steel walls and struts, liner plates, and timber. CONTRACTOR shall be responsible for the design and selection of methods in conformance with the design criteria as specified herein.

B. The work of this Section applies to temporary excavation support systems for demolition, and installation of buried pipelines, and boring and receiving shaft or pits.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02140 – Dewatering

B. Section 02125 – Trench and Structure Excavation and Backfill

### 1.03 QUALITY ASSURANCE

A. Support of excavation shall be designed, and Shop Drawings and calculations stamped and signed, by a Professional Engineer, licensed to practice in the State of California and experienced in the design of excavation support systems.

### 1.04 SUBMITTALS

A. The following shall be submitted in compliance with Section 01300 – CONTRACTOR Submittals and 01600 – Products, Materials, Equipment and Substitutions:

1. The proposed excavation support system for each construction component where excavation support systems will be used.

2. Arrangement and details for each excavation support system, supporting design calculations, and construction methods to be used for the installation of each system.

3. Soldier pile installation methods, connection details, bracing preloading, and jacking procedures.

4. Depths below the main excavation bottom elevation to which the support system will be installed.

5. Elevations of ground surface, struts, and shores, as applicable.

6. Permissible depth to which excavation may be carried before supports must be installed and preloaded.

7. Full excavation depth load to be carried by various support system members.

8. Bracing loads for various stages of excavation, bracing removal, and concrete placement.

9. Preloads as required.

10. Proposed sequence of strut and shore removal as applicable and as related to concrete placement and backfilling operations.

B. The above Shop Drawings shall be coordinated with other shop drawing submittals for work specified elsewhere in which support of excavation is required.

C. The proposed method of installing sheet piling including sequence of installation, template, and equipment description.

D. Contingency plan for alternative procedures to be implemented if the excavation support system is found to perform unfavorably.

## 1.05 DESIGN CRITERIA

A. Shop Drawings with supporting calculations for the various excavation support systems shall be prepared in accordance with the following criteria:

1. Design the excavation support system and all components to support the earth pressures, unrelieved hydrostatic pressures, utility loads, equipment, traffic, and construction loads including impact, and other surcharge loads in such manner as will allow the safe and expeditious construction of the permanent structures, to minimize ground movement or settlement, and to prevent damage to or movement of adjacent buildings, structures, roadways and utilities.

2. Design support members to resist the maximum loads expected to occur during the excavation and support removal stages.

3. No portion of the excavation support system's vertical face will be permitted to penetrate the design lines as indicated on the Drawings for the permanent concrete structure to be constructed within the excavation.

4. Review of CONTRACTOR'S Shop Drawings and methods of construction by the Construction Manager does not relieve CONTRACTOR of responsibility for the adequacy of the excavation support systems.

5. Design and fabrication of steel components shall conform to AISC Manual of Steel Construction.

6. Timber Support Systems and Members

   a. Basis for determination of minimum allowable working stress: UBC Chapter 25.

   b. Design calculations shall be submitted for timber support systems and lagging.

## 1.06 SAFETY

A. Except as otherwise indicated, the following codes apply to the work of this Section:

   1. Title 8, California Administrative Code, Chapter 4, Subchapter 4, Construction Safety Orders, Article 6, Excavations, Trenches, Earthwork, Section 1542, Shafts.

## 1.07 PROJECT CONDITIONS

A. Utility agencies shall be notified and caution exercised while exposing utility facilities by hand or other methods approved by utility owner.

B. If existing utility facilities interfere with the proposed method of support, the method shall be modified in a manner that will protect the facility and accommodate the proposed work. Shop Drawings shall be revised and resubmitted along with design calculations required to account for the modified support method and to show the actual location of the existing utilities.

C. Provisions shall be made for contingencies as follows:

   1. Monitor performance of support system components, for both vertical and horizontal movement, at regular intervals not to exceed 3 days.

   2. Provide contingency plan for alternative procedures to be implemented if unfavorable performance is evidenced.

   3. Keep on hand materials and equipment necessary to implement contingency plan.

D. Elements of the support system shall not be spliced unless approved by the Construction Manager.

# PART 2 MATERIALS

## 2.01 MATERIALS

A. Steel sheet piling shall be continuous interlocking type ASTM A 328 of appropriate shape and provided with at least one 2-1/2-inch-diameter handling hole on the centerline of the web located at least 6 inches from each end of the sheet pile.

B. Fabricated connections and accessories, steel H-piles, WF shapes, and other structural steel shall conform to the requirements of ASTM A 36, unless otherwise approved.

C. Concrete shall be as specified in the Specifications.

1. For encasement of steel soldier piles below the final level of excavation, 2,500 psi shall be used.

2. For encasement of soldier piles above the final level of excavation, lean concrete shall be used, the strength of which shall be adequate to protect the excavated faces of the augured hole.

D. Wood lagging shall be dimension lumber with minimum allowable stress of 1,100 psi.

1. The stress grade of the lagging shall be in conformance with the allowable stresses of the UBC, Chapter 25.

2. Lumber shall be grade marked by WWPA or WCLIB with species and grade conforming to those shown on approved Shop Drawings.

## PART 3 EXECUTION

### 3.01 GENERAL

A. The support system shall extend the main excavation bottom elevation to a depth adequate to prevent lateral movement and to adequately support applied vertical loads. In areas where additional excavation is required below the main excavation subgrade provisions shall be made to prevent movement of main excavation supports. Damage to existing utilities during installation of excavation support system shall be avoided.

B. Water control measures shall be provided in accordance with the requirements specified in Section 02140 – Dewatering.

### 3.02 SOLDIER PILES

A. Soldier piles shall be installed by pre-boring or other approved pre-excavation methods to tip elevation shown on approved Shop Drawings. Prevent prebored or other pre-excavated holes from collapsing.

B. Pre-bored hole shall be filled with lean concrete from bottom of hole to subgrade dependent upon analysis of vertical support requirements.

C. Remaining pile length shall be filled with lean concrete, completely encasing the pile.

D. Concrete shall be placed from the bottom of the hole upwards by means of a flexible pipe connected to a hopper.

## 3.03 SHEETING AND LAGGING

A. Sheeting and lagging shall be installed with no gap between the boards unless specifically approved. As installation progresses, the voids between the excavation face and the lagging or sheeting shall be backfilled with sand or soil and rammed into place. Materials such as hay or burlap shall be used where necessary to allow drainage of groundwater without loss of soil or packing material. If gaps in the lagging are allowed, the gap width between lagging boards shall be limited to 1/2 inch maximum.

B. If unstable material is encountered, suitable measures shall be taken to retain it in place or to otherwise prevent soil displacement.

C. Extend lagging down to final subgrade.

D. A sufficient quantity of material shall be on hand for sheeting, shoring, bracing, and other operations for protection of work and for use in case of accident or emergency.

## 3.04 STEEL SHEET PILING

A. Steel sheet piling may be used only where existing subsurface conditions are suitable for installation of sheet piling to the full depth of penetration required, and to proper alignment and plumbness, specified herein, without damage to the sheet piling or rupture of its interlocks. The use of steel sheet piling will not be permitted where sheeting would be required to penetrate boulders, rock or other materials which may prevent the proper installation of sheet piling.

B. Steel sheet piling shall be installed in plumb position with each pile interlocked with adjoining piles for its entire length so as to form a continuous diaphragm throughout the length of each run of wall, bearing tightly against original ground. Install sheeting to depth required for design. Exercise care during installation so that interlocking members can be extracted, if required, without injury to adjacent ground. The installation equipment shall be suitable to the type and nature of the subsurface materials anticipated to be encountered. The equipment and methods of installation, cutting, and splicing shall conform to the approved Shop Drawings.

## 3.05 INTERNAL BRACING SUPPORT SYSTEM

A. All bracing support members shall be installed and maintained in tight contact with each other and with the surface being supported.

B. Bracing members shall be preloaded by jacking the struts and shores in accordance with loads, methods, procedures, and sequence as described on the approved Shop Drawings. Coordinate excavation work with bracing installation and preloading. Use steel shims and steel wedges welded or bolted in place to maintain the preloading force in the bracing after release of the jacking equipment pressure. Use procedures so as to produce uniform

bracing member loading without appreciable eccentricities, overstressing, or support member distortion.

C. Struts shall be provided with intermediate bracing as needed to enable them to carry their maximum design load without distortion or buckling. Provide diagonal bracing as necessary to maintain the stability of the system. Web stiffeners, plates, or angles shall be provided as needed to prevent rotation, crippling, or buckling of connectors at points of bearing between structural steel members. Allow for eccentricities resulting from field fabrication and assembly.

D. Excavations shall be to a depth no more than 2 feet below the elevation of the support member about to be placed. The support member shall be installed and preloaded immediately after installation and prior to continuing excavation.

## 3.06 REMOVAL OF SUPPORT SYSTEMS

A. Where removal is required wholly or in part, such removal shall be performed in a manner that will not disturb or damage adjacent new or existing construction or utilities. Fill all voids immediately with lean concrete, or other approved means.

B. All elements of support systems shall be removed to a minimum depth of 6 feet below final ground surface. However, when a structure poured against the sheeting system extends above the 6-foot limit, removal of the sheeting system shall be to the top of the structure.

C. All damage to property resulting from removal shall be promptly repaired. The Construction Manager shall be the sole judge as to the extent and determination of the materials and methods for repair.

**END OF SECTION**

## PART 1 GENERAL

### 1.1 SUMMARY

A. This Section specifies Work including, but not limited to the following:

1. Furnishing all labor, equipment, supervision, services and materials necessary to perform all pavement cutting, demolition, excavation, backfilling, preparing subgrade, rough grading, dewatering, compacting, and hauling. Disposal of Excavated Materials is covered elsewhere.

2. Work incidental to the excavation work including obtaining permits from local authorities, constructing temporary fences, maintaining existing roads, maintaining protective devices to safeguard the public, providing detours as necessary, protecting subsurface utilities and structures, shoring of excavation, taking care of groundwater and draining of the work area, removing and replacing or relocation utilities as required and doing all other work necessary and proper for the prosecution and completion of the work under this section.

B. Related Sections:

1. Section 01300 – Contractor Submittals

2. Section 01400 - Quality Control

3. Section 01530 – Protection of Existing Facilities

4. Section 01570 - Traffic Control

5. Section 02052 - Site Preparation, Clearing, Grubbing, and Stripping

6. Section 02111 - Disposal of Excavated Materials

7. Section 02140 - Dewatering

8. Section 02160 - Excavation Support Systems

9. Section 02270 - Erosion and Sediment Control

10. Section 02340 – Boring and Jacking

11. Section 03300 - Cast-in-Place Concrete

C. Definitions:

1. Cement Slurry Backfill: Cement slurry backfill should consist of a fluid, workable mixture of water, aggregate, and cement having a 28-day unconfined compressive strength between 100 and 200 pounds per square inch.

2. Controlled Low Strength Material (CLSM): A self-consolidating, rigid-setting material to be used in backfills, fills, structural fills and elsewhere. CLSM material shall be composed of a mixture of Portland cement, aggregate, and water, with other approved admixtures.

3. Foundation subgrade shall be considered to extend over the full width and 5 feet beyond the edges of the foundations or embankments.

4. Hazardous substance is defined as any substance included in the list (Director's List) of hazardous substances prepared by the Director, California Department of Industrial Relations, pursuant to Labor Code Section 6382.

5. Pipe Base or Bedding: The pipe base or bedding shall be defined as a layer of material beginning at a height "H" above the bottom of the pipe. "H" is equal to 30 percent of the pipe diameter, or as indicated in the drawings or otherwise described in the specifications for the particular type of pipe installed. This bedding shall extend over the full trench width to the bottom of the trench. Where multiple pipes or conduits are placed in the same trench, the bedding shall extend from the highest height "H" of the pipes in the trench to the bottom of the trench and across the full width of the trench. Bedding thickness below the pipe shall be as follows unless otherwise shown in the drawings or otherwise described in the specifications for the particular type of pipe installed.

| Pipe Diameter | Thickness of Pipe Bedding Below Pipe |
|---|---|
| 16 inches and smaller | 6 inches |
| 18 inches and larger | 12 inches |

6. Pipe Zone: The pipe zone shall include the full width of trench extending from the top of the pipe base (bedding) to a horizontal level above the top of the pipe, as specified below. Where multiple pipes or conduits are placed in the same trench, the pipe zone shall extend from the top of the pipe base (bedding) for the highest pipe to a horizontal level above the top of the highest or topmost pipe. Thickness of pipe zone above the highest top of pipe shall be as follows unless otherwise shown in the drawings or otherwise described in the specifications for the particular type of pipe installed.

| Pipe Diameter | Thickness of Pipe Zone Above Top of the Pipe |
|---|---|
| 6 inches and smaller | 6 inches |
| 8 inches and larger | 12 inches |

7. Relative Compaction: The ratio, expressed as a percentage, of the in-place dry density to the laboratory maximum dry density of the same material, as determined by ASTM D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

8. Road Zone subgrade shall be considered to extend over the full width of the aggregate base course.

9. Street Zone: The street zone is the top 30 inches of the trench immediately below the pavement zone in paved areas and 12 inches on either side of the trench. Within the Contract Documents, the terms "street zone" and "road zone" are interchangeable.

10. Trench Zone: The trench zone includes the portion of the trench from the top of the pipe zone to the bottom of the street zone in paved areas or to the existing surface in unpaved areas.

11. Import Fill: Soil or soil-rock material approved by the Engineer and transported to the site by CONTRACTOR in order to raise grades or to backfill excavations. CONTRACTOR shall provide sufficient test results and written documentation that all materials brought onto the project site comply with specification requirements.

12. Engineered Fill (Structural Fill): Fill, as described in this specification and approved by the Geotechnical Engineer, which has been placed and compacted in accordance with the requirements presented in these specifications.

13. On-site Material: Soil or earth obtained from on-site excavations.

14. Excavation: Consists of the removal of material encountered to subgrade elevations. Unless otherwise indicated on the Drawings, all excavation or pipelines shall be open cut. Excavations for appurtenant structure such as but not limited to manholes, transition structures, junction structures, vaults, valve boxes, catch basins, thrust blocks, and boring pits shall be deemed to be in the category of trench excavation.

15. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below aggregate base or topsoil materials.

16. Aggregate Base: The material placed between the subgrade and surface pavement in a paving system, consisting of Caltrans Class 2 Aggregate Base.

17. Rock: Defined as material identified as Monterey Shale or Porphyritic Granodiorite of Monterey as specified in the AECOM Preliminary Transmission Mains Geotechnical Assessment Report dated October 28, 2017.

D. Design Criteria:

1. CONTRACTOR is responsible for the design, installation, maintenance and safety of temporary excavation support systems in accordance with Section 02160 - Excavation Support Systems.

E. Performance Requirements:

1. Muck and spoils used as compacted fill at the project site must comply with the requirements of Section 02111 - Disposal of Excavated Materials and as described herein.

2. Tolerances:

a. Finished subgrade shall be within a tolerance of 0.08 foot (1 inch) of the grade and cross-section indicated on the drawings, smooth and free from irregularities.

## 1.2 REFERENCE STANDARDS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition available on the date of Notice Inviting Bids shall be used.

B. American Society for Testing and Materials (ASTM):

1. C33: Standard Specification for Concrete Aggregates

2. C125: Standard Terminology Relating to Concrete and Concrete Aggregates

3. C136: Standard Test Method for Sieve Analysis of Fine and coarse Aggregates

4. C566: Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying.

5. D421: Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants

6. D448: Standard Classification for Sizes of Aggregate for Road and Bridge Construction

7. D1556: Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

8. D1557: Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/$ft^3$ (2,700 kN-m/$m^3$))

9. D2216: Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock

10. D2419: Standard Test Method for San Equivalent Value of Soils and Fine Aggregate

11. D2487: Standard Practice for Classification of Soils for Engineering Purposes

12. D2844: Standard Test Method for Resistance R-value and Expansion Pressure of Compacted Soils

13. D3744: Standard Test Method of Aggregate Durability Index

14. D4253: Standard Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table

15. D4318: Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

16. D4718: Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles

17. D6938: Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

C. Comply with requirements, standards and specifications and drawings (latest edition) of regulatory agencies, including but not limited to: California Department of Transportation (Caltrans), State of California Code of Regulations (CCR), State of California Construction Safety Orders, Latest Edition (CAL/OSHA), County of Monterey.

D. Geotechnical Reports and Assessments. These reports are available for review by CONTRACTOR. Additional soil borings and other exploratory operations shall be made by CONTRACTOR at no cost to OWNER. Submit proposed exploration locations to OWNER for review prior to performing the work.

## 1.3 SUBMITTALS

A. Working Drawings and Methods Statements:

1. Submit Working Drawings and Method Statement describing each major excavation and fill operation included in the project including but not limited to:
   a. Construction and improvements of access roads.
   b. Construction of lay-down and staging areas.
   c. Methods for excavating rock.
   d. For each pipeline, submit method of compaction of fill in pipe zone including removal sequence of shoring where used.
   e. Proposed temporary construction haul routes.
   f. Sequence of work.
   g. List of equipment.
   h. Proposed flow of excavated material to temporary stockpile and to the disposal site
2. Submit erosion and sediment control plan, as required per Section 02270 Erosion and Sediment Control. Also submit storm water pollution prevention and monitoring plan.
3. Where applicable, before starting work, submit a dewatering plan describing the basic components of dewatering including silt control and flow rate as required in Section 02140 - Dewatering.
4. Submit shoring system design calculations and drawings per Section 02160 "Excavation Support Systems", for review and approval prior to trench excavation. The Geotechnical Engineer's approval of the shoring plans shall not relieve CONTRACTOR of full responsibility for providing a safe shoring system. For shored excavation, all vertical shoring elements must be installed to their full depth and design position before starting excavation. Bracing, tiebacks, wales, and struts shall be installed as required during excavation before the excavation depth is extended below the level of such elements.
5. Submit temporary excavation slope design calculations for review and approval prior to excavation. Review of temporary excavation slopes by the Geotechnical Engineer shall not relieve CONTRACTOR of full responsibility for the safety and adequacy of temporary slope stability including responsibility for repairing

any damage to any part of the work caused by failure of a temporary slope at no additional cost to the OWNER.

6. Submit proposed exploration location plan to OWNER for review and approval prior to performing the work. All exploration, testing, and analysis shall be performed by a Registered Geotechnical Engineer retained by CONTRACTOR.

B. Submit all slope staking and record survey notes to the OWNER Representative.

C. Mix Designs: For concrete, CLSM, cement slurry, and grout mixes.

D. Test Reports: Submit test reports for backfill, bedding and foundation materials to the Geotechnical Engineer, to include but not limited to PI, sieve analysis, pH, durability index, R-value, and sand equivalent, as applicable, for import and borrow materials. Also include at least one laboratory optimum moisture-maximum dry density curve for each type of imported soil or soil-rock material per ASTM Test Method D1557, latest edition.

E. Name and qualifications of soil testing firm.

F. Gradations and sources of materials to be used for:

1. Earth fill and backfill

2. Structural backfill

3. Sand for pipe bedding and initial backfill in trenches

4. Drain rock

5. Permeable material

6. Aggregate base material

7. Aggregate subbase material

## 1.4 QUALITY ASSURANCE AND QUALITY CONTROL

A. Allow the OWNER's Geotechnical Engineer representative to observe and test each subgrade, fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with specification requirements.

B. Plan: Identify how the quality of materials and installation will be controlled (e.g. measurements, inspections, testing, etc.) in accordance with Section 01400 - Quality Control.

1. Perform field in-place density tests. CONTRACTOR shall hire a qualified testing firm to perform compaction testing of all backfilled and compacted materials in the project. . When field in-place density tests are performed using nuclear methods, make calibration checks of both density and moisture gauges at beginning of work on different type of material encountered. Number and location of tests shall be at the option of the Geotechnical Engineer.

   When Geotechnical Engineer reports that subgrade, fill, or backfill is below specified relative compaction, CONTRACTOR shall scarify and moisten or aerate, or remove and replace soil to the depth required, recompact and retest until required relative compaction is obtained.

   After grading is completed and the Geotechnical Engineer has completed observation of the work, permit no further excavation or filling, except as approved by OWNER.

2. Methods for and frequency of monitoring initial temporary excavation support elements for loosening, deformation, or distress; and means for supplementing with additional support.

3. CONTRACTOR's design submittals including calculations for trench and slope support systems shall be prepared, signed, and stamped by a civil or Structural Engineer registered in the State of California, with a minimum of 5 years of experience in design of similar type of work.

C. Notifications:

1. Notify the OWNER Representative at least 3 days in advance of completion of any structure excavation.

D. Acceptance Criteria:

1. Compaction:

   a. Unless specified elsewhere required by permitting jurisdictions, or shown on the drawings, all compacted fills on the project shall be compacted to a minimum of 90 percent relative compaction, as determined by ASTM D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

2. Moisture Content at time of compaction: Near laboratory optimum.

## 1.5 PRECONSTRUCTION MEETING

A. Jointly with OWNER's Representative, CONTRACTOR shall convene a

preconstruction conference at least 5 days, but not more than 30 days prior to beginning fills which require compaction testing.

B. Review and discuss the following items at each meeting:

1. Construction methods and constraints overview
2. Equipment operating parameters
3. Safety procedures
4. Quality Control procedures and Quality Assurance requirements
5. Reporting requirements
6. Other issues as may be raised by any party in attendance

**1.6 JOB CONDITIONS:**

A. Refer to the Project geotechnical, geologic and environmental reports for a description of anticipated conditions.

B. CONTRACTOR shall adhere to the following:

1. Verify all dimensions in the field and check all field conditions continuously during construction.
2. Excavating, filling, and grading work shall not be performed during weather conditions which might damage or be detrimental to the condition of existing ground, in-progress work, or completed work. When the work is interrupted by rain, excavating, filling, backfilling, and grading work shall not resume until the site and soil condition (moisture content) are suitable for compaction.
3. At all times during earthwork operations and until final completion and acceptance of earthwork, CONTRACTOR shall prevent the formation of airborne dust and dirt nuisance from interfering with the surrounding normal operations.
4. Perform all required removal, repair, or replacement caused by unsuitable conditions at no cost to the OWNER.
5. Use of explosives is not permitted.
6. Barricade open excavations and post warning lights.

7. Subgrade shall be free from mud, snow, ice, and deleterious material when work is resumed. Do not allow equipment to pump or rut subgrade, stripped areas, excavations, or other areas prepared for the project.

8. Use equipment adequate in size, capacity, and numbers to accomplish the work of this section in a timely manner.

9. Transport all excess soil materials by legally approved methods to disposal area approved by OWNER.

10. Acceptability of excavated foundation surfaces and compacted fill will be based upon inspection and testing. The Geotechnical Engineer will advise CONTRACTOR of any unsatisfactory conditions and shall have the authority to make sure measures are taken to comply with the Specifications, or to direct the removal of unsuitable materials and their replacement with suitable backfill. It shall be CONTRACTOR's sole responsibility to achieve the specified degree of compaction.

11. Prevention of Erosion: Comply with requirements as stated above, as specified in Section 02270, Erosion and Sediment Control, and the following:

    a. Prevent erosion of stockpiles, ditches, embankments, filled, backfilled, and graded areas until such time as permanent drainage and erosion control measures have been installed.

    b. Perform "protective grading" to provide positive drainage and to minimize ponding of surface water.

## 1.7 SEQUENCING AND SCHEDULING

A. Coordinate operations with relocation of existing utilities.

B. Install sedimentation control systems in conjunction with earthwork.

C. Install construction barriers to prevent unnecessary damage to areas outside construction limits.

## 1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Stockpile material for backfill as indicated on approved Working Drawings, and per specifications Section 02111, Disposal of Excavated Materials.

# PART 2 PRODUCTS

## 2.1 GENERAL

A. Earth Backfill and Earth Fill:

1. Unless otherwise indicated on the drawings and specifications, all fills shall be earth fill as defined herein.

2. Earth backfill and earth fill shall be excavated material that is free from organic matter, roots, debris, and rocks or other particles larger than 6-inches in greatest dimension and shall have plasticity index (PI) of not more than 15 as determined by ASTM D4318.

B. Native Earth Backfill: Street and Trench Zones

1. Native earth backfill used in street or trench zones shall conform to the requirements specified below for trench backfill materials.

2. Where the onsite materials are determined by the Geotechnical Engineer to be unsuitable, imported fill shall be provided by CONTRACTOR.

3. The street zone (or road zone) shall consist of in-situ native materials in cut areas and of earth fills in fill areas. The street zone shall be free from organic material and wet or soft clays and silts, subject to Geotechnical Engineer's approval.

C. Trench backfill materials shall meet the following requirements:

1. Trench backfill materials shall have a plasticity index (PI) of not more than eight (8) as determined by ASTM D4318.

2. Trench backfill material shall be free of wood, trash, construction debris, and organic, contaminated, or deleterious material.

3. Rock and fill material with particle sizes larger than six (6) inches shall be excluded from trench backfills. All trench backfill material shall be free from unbroken masses of earth materials that might arch or bridge and leave unfilled pockets.

D. Pipe backfill shall meet the requirements of the permitting municipality or the project drawings on private or OWNER's property.

E. CONTRACTOR shall excavate pipe trenches to sufficient widths and depths so as to place and compact pipe zone backfill to minimum relative compaction of 90 percent on a stable, dry trench bottom.

F. Where unsuitable trench invert conditions are encountered, perform additional excavation and place additional material to stabilize the subgrade, subject to Geotechnical Engineer

approval.

G. Soil backfill and bedding material adjacent to structures and pipes shall be as shown on the Drawings.

H. Concrete backfill, CLSM, or cement slurry shall be placed around pipes where shown on the drawings. Concrete backfill shall be in accordance with the requirements specified in Section 03300, Cast-in-Place Concrete.

I. Use of oversize material (greater than 6 inches in maximum dimension) in permanent fills other than permanent spoils disposal areas shall be prohibited.

J. Environmental Considerations:

1. Tunnel muck and excavation spoils used as compacted fill at the project site must comply with the requirements of Section 02111, Disposal of Excavated Materials.

2. Tunnel muck and excavation spoils used as compacted fill within 6" of any finished subgrade shall not exceed 6 inches in maximum size.

## 2.2 BACKFILL MATERIALS

A. Structural Backfill shall consist of hard, durable particles, free from clay balls, organic matter, and other deleterious substances, and conforming to the following gradation limits:

| Sieve Size | Percent Passing By Weight |
|---|---|
| 3/4 inch | 100 |
| 1/2 inch | 95 - 100 |
| 3/8 inch | 50 - 100 |
| No. 4 | 20 - 65 |
| No. 8 | 10 - 40 |
| No. 40 | 0 - 20 |
| No. 200 | 0 - 5 |

B. Sand Backfill

1. Sand backfill shall consist of granular material free from excess fines, organic matter, and other deleterious substances and conforming to the following gradation limits:

| Sieve Size | Percent Passing By Weight |
|---|---|
| 3/8 inch | 100 |
| No. 4 | 75 - 100 |

| | |
|---|---|
| No. 30 | 12 - 50 |
| No. 100 | 5 - 20 |
| No. 200 | 0 - 10 |

2. Sand shall have a minimum sand equivalent of 30 per ASTM D2419.

C. Aggregate Base Course

1. Material shall meet the requirements for Class 2 Aggregate Base, Section 26, Caltrans Standard Specifications.

2. Unless otherwise specified, the grading for either the 1-½ inch maximum or ¾-inch maximum may be used at CONTRACTOR's option. Once a grading is selected, the grading shall not be changed without the Geotechnical Engineer's approval.

D. Aggregate Subbase shall consist of hard, durable particles of crushed rock aggregate subbase material that can be compacted readily by watering and rolling to form a firm stable base. The material shall conform to the following gradation limits:

| Sieve Size | Percent Passing By Weight |
|---|---|
| 3-inch | 100 |
| 2.5-inch | 90 - 100 |
| No. 4 | 40 - 100 |
| No. 200 | 0 - 25 |

E. Drain rock shall consist of clean, hard, durable particles of stone, free of organics and other deleterious materials, crushed or screened to conform to the following gradation limits, and per ASTM C136:

| Sieve Size | Percent Passing By Weight |
|---|---|
| 1 inch | 100 |
| 3/4inch | 90 – 100 |
| ½ inch | 30 – 60 |
| 3/8 inch | 0 – 20 |
| No. 4 | 0 – 5 |

F. Permeable Material shall consist of hard, durable particles of stone, free from organics, lumps of clay, and other deleterious matter per Caltrans Standard Specifications for Class 2 Permeable Material.

G. Water for Compaction: Water shall be free of organic materials and shall have a pH of

7.0 to 9.0, a maximum chloride concentration of 500 mg/L, and a maximum sulfate concentration of 500 mg/L.

H. Filter Fabric: Manufactured from polyester, nylon, or polypropylene material; meeting the following requirements:

1. Grab tensile strength (ASTM D4632): 100 lbs minimum for a 1-inch grip.

2. Apparent Opening Size (ASTM D4751); U.S. Standard Sieve No. 100.

3. Utility filter fabric shall be MIRAFI 600X, manufactured by Mirafi Inc., Charlotte, North Carolina, or equal.

I. Perforated Underdrain Pipe and Fittings (PVC subdrains):

1. Materials shall conform to ASTM D1784, Class 1245-B or 1245-C.

2. Pipe shall be perforated PVC sewer pipe and drainpipe conforming to ASTM D2729.

3. Perforations shall be two rows of 3/8 to 1/2 inch diameter holes, 5 inches on center, with rows separated by approximately 120 degrees of arc centered at the pipe bottom.

4. Fittings and couplings shall be non-perforated fittings conforming to ASTM D2729.

J. Filter Beds for Underdrains:

1. Use either of the following, or as specified in the drawings:

a. Permeable material, as specified herein.

b. Drain rock, as specified herein, in conjunction with an outer envelope of filter fabric to form a permeable encasement around the perforated underdrain piping.

## 2.3 MIXES

A. Controlled Low Strength Material (CLSM) for Backfill – Pipe Base (bedding zone), Pipe Zone, and Street Zone:

1. CLSM shall consist of a mixture of Portland cement, aggregate, fly ash, water, and admixtures conforming to the following:

a. Portland cement: ASTM C150, Type II, maximum of 50 pounds per cubic yard.

b. Aggregate: Concrete sand, processed material from the excavation meeting the requirements of imported sand, or a combination thereof. Aggregate size shall be maximum ¾ inch per ASTM C33. The soluble sulfate content shall not exceed 0.3 percent by dry weight.

c. Water: Potable quality.

d. Fly Ash: Class C per ASTM C618, maximum of 300 pounds per cubic yard.

e. The minus No. 200 sieve fraction shall be nonplastic.

2. Proportion the CLSM to be a flowable, non-segregating, self-consolidating non-shrink slurry.

3. The unconfined compressive strength at seven days shall be a minimum of 50 and a maximum of 200 psi per ASTM D4832.

4. The temperature of the CLSM discharge into the trench shall be below 90 degrees Fahrenheit.

5. Prior to construction, perform trial mixes of the CLSM to verify placing and strength characteristics. Determine compressive strength per ASTM D4832. Notify the OWNER Representative at least one week prior to trial mix preparation.

6. Admixtures:

a. Air entraining admixtures shall be added to improve the workability and shall be in accordance with the requirements of ASTM C 260.

b. Water reducing agent shall be added to improve the workability and shall be in accordance with the requirements of ASTM C 494.

c. Any accelerating agents to be added shall be free of calcium chloride and any other materials that may be corrosive to the surrounding material. All accelerators shall be in accordance with the requirements of ASTM C 494.

d. Admixtures shall be submitted as part of the mix design.

7. Water shall be clean and potable containing less than 50 ppm of chlorides.

B. Cement Slurry Backfill:

1. Cement slurry backfill where required shall consist of 1-1/2 sacks (94 pounds per sack) Type II Portland cement added per cubic yard of imported sand, except within 6 inches of a buried flexible pipe coupling, in which case use 1/2 sack (25 pounds) hydrated lime added per cubic yard of imported sand.

## PART 3 EXECUTION

### 3.1 GENERAL

A. Prior to commencement of earthwork, CONTRACTOR shall become thoroughly familiar with site conditions. If discrepancies are found, immediately notify OWNER in writing indicating the nature and extent of differing conditions.

B. No earthwork shall be performed without physical presence or acceptance of the Geotechnical Engineer.

C. All excavation work shall be done in the dry. Excavation shall begin after groundwater has been lowered as specified in Section 02240, "Dewatering."

D. All excavation shall be performed without damage to side slope rock outside the limits of excavation shown on the Drawings, or as otherwise directed by the OWNER Representative. Any rock outside the limits of excavation which is over-excavated due to damage from excessive blasting or ripping shall be subject to implementation of remedial measures at no cost to the OWNER.

E. CONTRACTOR shall remove any loose material that may endanger workers or structures as part of the work for performing the required excavations.

F. Material outside the limits of the excavation which is unstable and constitutes potential slides, and material which comes into excavations for any reason shall be excavated and removed. CONTRACTOR shall remove unstable bottom material. Large stones, debris, and compressible soils shall be removed from excavation bottoms to a minimum depth of 12 inches.

G. Slopes and embankments shall be maintained until substantial completion and acceptance of the work. Any slides, slip outs, washouts, settlements, and subsidence that occur for any reason shall be promptly repaired, and the slope or embankment shall be refinished to the indicated lines and grades.

H. All excavation shall be conducted without damaging or removing existing structures or substructures not designated for demolition on the Drawings. Where structures or substructures are removed or damaged by CONTRACTOR, said structures or substructures shall be repaired or restored to a condition at least as good as existed

before construction of the work hereunder at no cost to the OWNER.

I. When subsurface facilities are encountered during excavation, which interfere with new construction, and such facilities are not indicated on the Drawings, the OWNER Representative shall be notified promptly for corrective determination.

J. In the preparation of foundations, the materials shall be excavated to sufficient depths to ensure removal of all loose, soft, weak, unstable, organic, or other materials not suitable as a foundation, as determined by the Geotechnical Engineer.

K. All foundation surfaces shall be firm, unyielding, and free of standing water at the time of placing materials on them.

L. Excavations for convenience of CONTRACTOR shall be subject to approval by the OWNER Representative.

M. Excavated material shall be placed at a sufficient distance from edge of excavation so as not to cause cave-ins or bank slides, but in no case closer than three feet from the edge of excavations.

## 3.2 SITE PREPARATION

A. Protect structure, utilities, sidewalks, pavements and other facilities which are to remain from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations. Set up tree protection measures prior to commencing grading or demolition.

B. Clearing and Grubbing:
   1. Remove from area of designated project earthwork all improvements and obstructions, including designated concrete curbs or slabs, asphaltic concrete, all tree and shrub roots, and buried utility and irrigation lines, and other matter determined by the Geotechnical Engineer to be deleterious.
   2. Remove from the site all trees and shrubs, unless otherwise indicated on the drawings as existing trees to be left standing.
   3. Backfill excavations left from removed structures in accordance with these specifications. Compact in accordance with requirements of these specifications.
   4. Removed material shall become property of CONTRACTOR and shall be removed from site in a legal manner, unless otherwise indicated on the drawings or specified herein.
   5. Holes resulting from removal of underground obstructions that extend below finish grades shall be cleared and backfilled with engineered fill.

## 3.3 EXCAVATION

A. Excavations shall have sheeting, shoring, and bracing conforming to OSHA requirements, the General Conditions, and all other applicable regulations, and Section

02160 Excavation Support Systems. Open cut excavations with safe cut slopes are allowable so long as they are stable and meet regulatory requirements for the materials excavated.

B. Excavation is unclassified. Perform all excavation regardless of the type, nature, or condition of the material encountered to accomplish the construction.

C. Do not operate excavation equipment within 5 feet of existing structures or newly completed construction. Excavate with hand tools in these areas.

D. After the required excavation has been completed, the Geotechnical Engineer will observe the exposed subgrade to determine the need for any additional excavation. Allow the Geotechnical Engineer a review period of at least one day before the exposed foundation is scarified and compacted or is covered with backfill or with any construction materials. It is the intent that additional excavation be conducted in all areas within the influence of roadways and structures where unacceptable subgrade materials may be found to exist as a result of the exposed subgrade:

1. Structures:

   a. Overexcavation shall include the removal of all such unacceptable material that exists directly beneath the structure or within a zone outside and below the structure defined by a line sloping at one-horizontal to one-vertical from 1 foot outside the edge of the footing or embankment.

   b. Refill all such overexcavated areas with structural backfill material, CLSM, or Cement Slurry or lean concrete fill, subject to Geotechnical Engineer's approval.

2. Roadways:

   a. Overexcavation beneath permanent roads shall include the removal of all such unacceptable material that exists directly beneath the aggregate base course at a depth of 12 inches, cut at a slope sloping away from the roadway that is sufficient to maintain the cut slope.

   b. Unacceptable material under the aggregate base shall be defined as material that does not conform to the material requirements specified in this Section.

   c. Refill overexcavated roadway areas with road zone material.

E. Limits of Foundation Excavation:

1. Excavate to the depths and widths needed to accomplish the construction. Allow

for forms, working space, structural backfill, and site grading.

2. Do not excavate for footings, slabs, or conduits below elevations indicated, unless unacceptable material is encountered and overexcavation is authorized by the OWNER Representative. Backfill overexcavations with compacted structural backfill material or lean concrete fill, subject to OWNER Representative approval. Correct cuts below grade by benching adjoining areas and creating a smooth transition. CONTRACTOR shall correct unauthorized overexcavated areas at no additional cost to the OWNER.

## 3.4 EXCAVATION IN SPECIAL LOCATIONS

A. Excavations in roads and other areas shall be conducted in accordance with the requirements set forth in encroachment permits for streets and road crossings issued to CONTRACTOR, and in accordance with other requirements as may be prescribed by the public agencies having jurisdiction thereof.

B. Road pavement and other pavement required to be removed shall be first cut vertically with a power concrete saw or other cutting device either full depth or sufficiently deep to assure a neat vertical break when the pavement within the trench width is removed.

C. Excavation for Concrete Structures:

1. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections. Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottom to required lines and grades to leave solid base to receive concrete.

2. During final excavation to subgrade level, take whatever precautions are required to prevent disturbance and remolding. Material that has become softened and/or mixed with water shall be removed.

3. When excavation for foundation has reached prescribed depth, the Geotechnical Engineer shall be notified to observe conditions. If the conditions are not satisfactory, CONTRACTOR shall over-excavate to remove the unsatisfactory material and replace it with structural backfill or lean concrete.

4. Keep foundation free of water at all times until foundation concrete is cast.

## 3.5 TRENCH EXCAVATION

A. The trench shall be excavated so that the barrel of the pipe will have an even bearing along its entire length, and with sufficient clearance provided for any necessary

operations in connection with the laying of the pipe. Bell holes shall be excavated for each pipe bell or joint.

B. The position of the pipe, with respect to the ground surface as shown on the drawings is subject to revision to any extent that the OWNER Representative may find advisable, and CONTRACTOR shall be entitled to extra payment only if the pipe is lowered by 9 inches or more. If the pipe is moved higher than the elevation shown on the drawing, no extra payment will be made.

C. Trenches for pipe shall be excavated along the alignment of the pipe centerline and to the grades shown on the drawings, or directed by the OWNER Representative.

1. Bell holes shall be provided as necessary, without additional cost to the OWNER, to permit the proper making of field joints. No additional excavation and backfill cost will be charged to the OWNER.

2. The sides of the trench shall not be closer to the outside of the pipe than indicated on the drawings.

a. The bottom, in a direction at right angles to the axis of the pipe, shall be level on each side of the center-line of the trench for a distance of at least one half the outside radius of the pipe.

b. The bottom of the trench shall be at the elevation of the grade for the bottom of the pipe, except at bell holes. At locations with soft soil, CONTRACTOR shall over excavate 12 inches of the proposed pipe invert and backfill with Class 1, Type A backfill or CDF with the approval of the OWNER Representative.

c. Should CONTRACTOR excavate at any point below the grade established for the bottom of the trench, the excess excavation should be replaced with compacted sand backfill at CONTRACTOR's expense, before the pipe is laid.

3. Trench excavations shall be such as to provide sufficient clearance for doing all necessary work around and beneath the pipe, for inspection after laying and for compacting the backfill without injuring the coating.

## 3.6 BACKFILL OF TRENCHES

A. Under the provisions of this section, CONTRACTOR shall backfill all excavated areas with the backfill as indicated on the drawings, as specified by the permitting municipalities, and as specified herein.

1. Prior to backfilling, the trench shall be cleared of all wood and debris.

2. Backfill of required types shall be as indicated on the drawings. Suitable native backfill too wet for compaction will have to be dry, mix with dry material before putting back into the trench.

3. When backfilling before the pipeline is filled under sufficient pressure to maintain its circular cross section, the interior of the pipe shall be adequately shored at approved intervals, using an approved bearing plate that will not damage the lining of the pipe. The minimum size and interval of interior shoring shall be shown in the drawings. The interior shoring of the pipe shall remain in place for not less than 3 days after completion of backfill.

4. Backfill material shall not be dropped directly on the pipe.

5. Sand Backfill: Sand for backfill shall be as specified herein.

    a. CONTRACTOR shall take all necessary precautions to prevent the distortion of the pipe cylinder during the backfilling operation.

    b. Initial backfill and bedding shall be careful packed under the haunches of pipe and brought up simultaneously on both sides so as to obviate any displacement of the pipe from its true alignment; the sand backfill shall be brought up in layers not exceeding 8 inches in thickness; thoroughly vibrated with surface vibrators of adequate power.

        1) Alternate methods of consolidation that will produce comparable results will be permitted with the approval of the OWNER Representative. The relative compaction of the compacted sand shall be not less than 90 percent or as described on the Contract Drawings.

        2) All fill material shall be moisture conditioned to slightly above optimum water content for compaction.

6. When directed by the OWNER Representative, CONTRACTOR shall use a Class 1, Type A crushed rock within the pipe zone to replace sand backfill in areas with a high ground water table. The crushed rock shall be brought up in layers not more than 8 inches thick and shall be compacted to not less than 90 percent relative compaction.

7. CONTRACTOR shall pour approximately 1-foot wide and 1-foot thick control density fill around the pipe in selected bell holes where changing bedding material is required and where directed by the OWNER Representative. The use of CLSM is to stop the runoff downstream that would create erosion.

8. The Class 2 Aggregate Base shall be brought up in layers not more than 6 inches thick and shall be compacted to not less than 95 percent relative compaction.

9. Backfill will be inspected and tested by the OWNER Representative during placement. CONTRACTOR shall cooperate with the OWNER Representative and shall provide working space for such tests in his operations. Backfill not compacted in accordance with the specifications shall be recompacted, or removed as necessary and replaced to meet specified requirements prior to proceeding with the work.

10. Fill material, which has been salvaged from trench excavation or import for use as select backfill, shall be stockpiled alongside the excavation unless otherwise directed. Material shall not be stockpiled higher than for (4) feet and shall be kept back from the trench a safe distance without damage to the shoring.

## 3.7 ADDITIONAL EXCAVATION

A. Preparation of Pipe Bedding and Pipe Zone Subgrade (Foundation):

1. For areas with unstable soil condition and/or areas having high ground water, the trench shall be over-excavated to firm material or to a maximum depth of 2 feet below the bottom of the pipe zone bedding. The material over-excavated from the trench shall be replaced with crushed rock, wrapped in geotextile, meeting the following requirements:

| Standard Sieve Size | Percentage Passing |
|---|---|
| 1 inch | 100 |
| 3/4 inch | 90-100 |
| No. 4 | 0-10 |
| No. 200 | 0-2 |

2. Crushed rock shall have a durability index of not less than 40, as measured in accordance with ASTM C33. Before the crushed rock is placed, a woven geotextile (Mirafi "600X," Amoco Fabrics and Fibers Co. "Amoco 2006," TNS Advanced Technologies "W300," or equivalent) shall be placed on the trench bottom and up the sidewalls of the trench to the springline of the pipe to prevent loss of rock into the soft subgrade. Crushed rock shall be placed in loose lifts that are no more than 1-foot thick, then compacted using vibratory techniques. The crushed rock shall be placed up to the bottom of the pipe zone and shall be firm and unyielding before pipe bedding is placed (70 percent relative density as determined by ASTM Test Methods D4253 and D4254 or 90 percent of maximum density determined by ASTM Test Method D4253).

3. The geotextile shall then be folded over the top of the crushed rock to mitigate the migration of bedding material. The pipe bedding material shall be placed and compacted over the geotextile. The pipe bedding and pipe zone backfill is required to be compacted up against the trench wall, and all voids left by the temporary support system filled.

4. Where crushed rock or sand is used for pipe zone material, a minimum 10-foot wide plug of CLSM shall be placed around the pipe at least every 300 to 400 feet to restrict the flow of groundwater along the relatively permeable pipe zone material.

B. Removal of Subsurface Obstacles:

1. CONTRACTOR may encounter subsurface obstacles such as: Man-made structures not apparent prior to the bid date and/or field conditions differing substantially from those normally encountered and recognized as inherent to the work; or existing pavement in excess or 14-inches in depth; or abandoned pavement sections below the existing pavement. CONTRACTOR shall remove such subsurface obstacles to the extent necessary to complete the work, when such excavation is directed and approved by the OWNER Representative. This work will be paid for as additional excavation in the quantity equal to the volume of subsurface obstacle removed.

2. Removal of any subsurface structures and materials will be paid for under other appropriate bid items, if such bid items exists, or will be considered as incidental work.

C. Expose Existing Mains for Connections by the OWNER:

1. CONTRACTOR shall excavate and expose existing mains as directed by the OWNER Representative for main connections and disconnection work by OWNER personnel. CONTRACTOR shall cover the excavations with steel plates, or other appropriate covers, as required. During CONTRACTOR's normal working hours, it shall remove and replace steel plates and provide traffic control to accommodate the work by the OWNER.

## 3.8 SUBGRADE PREPARATION

A. In the foundation subgrade, remove soft material encountered and replace with structural backfill. Fill holes and depressions to the required line, grade, and cross sections with structural backfill.

B. Structures to be founded on rock shall be excavated to the lines and grades indicated on the drawings. Remove all loose rock and over blast to a solid substrate. Prepare rock surfaces per the requirements of Paragraph 3.07 below.

C. After excavation of existing material or removal of unacceptable material at the exposed subgrade, scarify the final subgrade surface to a depth of 12 inches and compact to 95 percent relative compaction.

D. Remove form materials and trash from the excavation before placing any fill material adjacent to new structures. Obtain the specified compressive strength and finish of concrete work per Section 03300, "Cast-in-Place Concrete" before backfilling.

E. Do not operate earthmoving equipment within 5 feet of walls of structures. Place and compact fill or backfill adjacent to concrete walls with hand-operated tampers or other equipment that will not damage the structure.

F. At earth fill areas on rock, hand compact over blast areas and voids with earth fill in 4 inch lifts to a level surface.

## 3.9 ROCK FOUNDATION PREPARATION

A. Foundation Shaping: Remove all overhangs from foundation areas as shown on the Drawings and as determined to be required by the OWNER Representative. Shape such surfaces to the slope shown by means of drilling, barring, wedging, or light blasting. The method to be used shall be subject to approval of the OWNER Representative.

B. Foundation Cleaning: Before placing any concrete on acceptable rock foundations, clean such areas of standing or running water, mud, drummy rock, oil or other objectionable coatings, debris and loose semi-detached or unsound fragments, as required. Clean joints, fissures and seams in rock to an approved depth and to adjacent firm rock as approved. Clean all surfaces thoroughly, by air-water jets, power brooms or other means, or any combination thereof as approved. If, after cleaning, the foundation areas or any part of such area is not acceptable, excavate as required and clean again.

C. Foundation Dewatering: Dewater all foundation areas for final inspection prior to placement of concrete. Provide and install all pipes, drains and other installations necessary to produce a foundation free of running or standing water and securely fasten them in place to prevent their displacement by concrete placement. Dispose of excess water as described herein. Wet all contact areas and surfaces and remove free water from the surfaces before placing concrete. The contact area shall, as determined by the OWNER Representative, be damp but without free water at the time concrete or dental concrete is placed.

## 3.10 MAINTENANCE AND PROTECTION OF SUBSURFACE UTILITIES, OTHER STRUCTURES AND AREAS

A. Known locations of underground utilities and structures are indicated on the drawings. CONTRACTOR shall determine exact locations of underground utilities and structures

prior to pipe fabrication to allow adjustment of alignment and elevation.

B. Excavation and other work under or adjacent to underground pipes, and conduits or other structures thereto, shall be conducted and maintained in such a manner so as not to disrupt or interfere with the safe operations and use of such structures. CONTRACTOR shall prosecute the work in such a manner as not to damage any private or public property.

C. Should any such structures or property be damaged in the course of CONTRACTOR's operations, CONTRACTOR shall immediately notify the proper authorities or OWNERs, and shall arrange for the immediate repair of same in accordance with the applicable provisions of these specifications, at CONTRACTOR's expense.

D. CONTRACTOR shall maintain access to adjacent areas/property at all time and shall consider this as incidental work.

## 3.11 UNDERGROUND OBSTRUCTIONS

A. Any data shown on the drawings, or imparted to CONTRACTOR by the OWNER Representative, relative to location, dimensions, type or character of pipes, conduits, and/or other structures along or across the line of the pipe, are based on information obtained from field surveys and the OWNERs of such structures; the OWNER assumes no responsibility for the accuracy or completeness of such data, which are offered solely for the convenience of CONTRACTOR and shall be checked by CONTRACTOR to its satisfaction.

B. CONTRACTOR shall assume full responsibility and shall make no claim against the OWNER on account of any damage to any pipes, conduits and/or other structures or for any inconvenience or added cost of performing the work which may be attributed in any degree to inaccuracy of information furnished relative to the location of such structures, or for failure thereto.

C. Where pipes, conduits, or other structures or obstructions are unexpectedly encountered in the excavation of the trench, the OWNER Representative may order additional excavation or require the relocation of such portion of the trench as may be necessary for passing the obstruction. Any such additional excavation and backfill work shall be as directed by the OWNER Representative.

## 3.12 PLACING AND COMPACTING FILL MATERIAL

A. Excavated material may be used for fill providing all deleterious materials have been removed from the stockpiled material and that it meets the criteria for backfill material specified herein.

B. Earth Fill:

1. Do not exceed loose lifts of 8 inches in uncompacted thickness for general earthfill. Reduce lift thickness to no more than 4 inches if hand-operated compaction equipment is used.

2. Unless otherwise specified, compact each lift to not less than 90 percent relative compaction per ASTM D-1557, within the specified moisture content range.

3. Where fill is to be constructed on slopes steeper than 3:1, bench the fill into competent undisturbed materials as the fill progresses up the slope. Benches shall be sloped at least 2 percent into the slope and shall be of a width at least equal to the height of fill lift. All benching shall be approved by the Geotechnical Engineer.

C. Structural Backfill:

1. Place structural backfill material around piping, structures, channels, and other areas, including embankments and authorized overexcavation areas, to the lines and grades shown or specified.

2. Do not exceed loose lifts of 8 inches in thickness for structural backfill. Reduce lift thickness to no more than 4 inches if hand-operated compaction equipment is used.

3. Compact each lift of structural backfill to 95 percent relative compaction per ASTM D-1557 unless otherwise specified or shown in the drawings.

4. Stop structural backfill at least 6 inches below finished grade in all areas where topsoil is to be replaced.

D. Moisture Control:

1. During the compacting operations, maintain optimum practicable moisture content required for compaction purposes in each lift of the backfill material.

2. Maintain moisture content uniform throughout the lift. Add water to the material at the site of excavation or material stockpile. Supplement by sprinkling the backfill material.

3. At the time of compaction, the water content of the material shall be near optimum water content. Aerate material containing excessive moisture by scarifying, disking, or harrowing to hasten the drying process.

4. Add water to the backfill material or dry the material as necessary to obtain the required moisture content described herein before placing in trenches. Obtain

uniform moisture content throughout the material of each layer being compacted.

5. If the backfill material becomes saturated from rains or any other source, remove and replace the unsatisfactory material with suitable material compacted to the specified density. No additional payment will be made for removal and replacement of unsatisfactory material.

E. Where fill is to be constructed on slopes steeper than 3 to 1 (horizontal to vertical), excavate a keyway beneath the toe at the base of the fill. The keyway shall have a minimum width of 10 feet, minimum depth of 2 feet and slope at least 2 percent into the slope. Continue benching into competent material as the fill progresses up slope. All keyways and benching shall be subject to approval by the Geotechnical Engineer.

F. After pipe has been bedded, place pipe zone material simultaneously on both sides of the pipe, in maximum 8-inch lifts, keeping the level of backfill the same on each side. Carefully place the material around the pipe so that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe. Use particular care in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling.

G. When the material for the pipe zone consists of crushed rock, provide a filter fabric between the crushed rock and material being used as backfill in the trench zone, as well as on the sides of the pipe zone between the native material and the crushed rock to prevent migration of fines. Filter fabric shall not be required at trench walls where excavation is through rock, or where sand is used as the pipe zone backfill.

H. Push the backfill material carefully onto the backfill previously placed in the pipe zone. Do not permit free fall of the material until at least 2 feet of cover is provided over the top of the pipe. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe.

I. When the pipe laying is not in progress, close the open ends of pipe. Do not allow trench water, animals, or foreign material to enter the pipe.

J. Remove and dispose of all water entering the trench during the process of pipelaying. Keep the trench dry until the pipelaying and jointing are completed.

## 3.13 COMPACTING TRENCH BACKFILL

A. Backfill material shall be compacted to a minimum relative compaction in accordance with ASTM D1557 or as described on the Contract Drawings. Compact all materials in lifts not to exceed 8 inches in uncompacted thickness unless permitted otherwise in writing by the OWNER Representative. Flooding and jetting are not permitted. If compaction tests indicate that compaction or moisture content is not as specified, material placement procedures shall be modified and corrective action shall be taken by

CONTRACTOR prior to continued placement.

B. All fill material shall be moisture conditioned to near optimum water content for compaction. To minimize construction load on the pipeline, the pipe zone backfill should be placed over the pipe bedding to a minimum height of one foot above the crown of the pipe before the trench backfill is compacted with heavy equipment.

C. During compaction operation, CONTRACTOR shall provide sufficient water added during backfilling operations to prevent soil from bulking.

D. During compaction, protect the new and any existing pipes, and structural walls from displacement or damage due to the operation of compaction equipment. Do not operate earth-moving equipment within 5 feet of walls of concrete structures for the purpose of depositing or compacting backfill material. Compact backfill adjacent to concrete walls with hand-operated tampers or similar equipment that will not damage the structure.

E. CONTRACTOR's compaction tester shall perform one field density test every 300 feet of trench and at vertical intervals not to exceed 12 inches, unless the local municipalities have more stringent minimum testing standards – in which case, they would govern.

F. If, based on reports from a testing laboratory, subgrade or fills, which have been placed, are below specified requirements, provide additional compacting and retest at no cost to the OWNER.

G. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction.

H. Backfill and compacting for concrete vault construction:

1. Fill within the upper three feet below pavement, concrete structures, or slabs/concrete pads shall be compacted to 95 percent relative compaction.

2. Fill shall be placed in layers no greater than 6 inches in compact thickness, conditioned with water near or slightly above optimum, then mechanically compacted to at least 95 percent relative compaction as determined by ASTM D1557.

I. If compaction fails to meet the specified requirements, remove and replace the backfill at proper density or bring the density up to specified level by other means acceptable to the OWNER Representative. Should the compaction methods used fail to achieve the required relative compaction, revise compaction method to it.

## 3.14 PLACEMENT OF CLSM IN TRENCHES

A. The aggregate, cement, and water shall be proportioned either by weight or by volume. The water content shall be sufficient to produce a fluid, workable mix that will flow and can be pumped without segregation of the aggregate while being placed. Prepare CLSM in accordance with ASTM C94.

B. Provide batching equipment to obtain the proper weights of soil, cement, water, and admixtures. All measuring devices should be sensitive to a 2 percent variation above or below the actual weights required. Volumetric batching may be used, provided the same accuracy required for weight batching is maintained.

C. Design and operate the mixers used for mixing the CLSM so that the CLSM as discharged from the mixer is uniform in composition and consistency throughout each batch.

D. Place the CLSM such that it flows easily into all openings between the pipe and the excavated trench. In some cases, such as trenches on a slope, a stiffer mix may be required to prevent it from flowing down the trench. In this case, use vibration to ensure that the CLSM completely fills all spaces.

E. Lay the pipe on the soil pads and place the CLSM bedding as shown on the drawings. Bedding shall be placed under pipe from one side and vibrated, as necessary, so that it flows under the pipe until it appears on the other side. CLSM shall then be added to both sides of the pipe and vibrated until it completely fills the space between the pipe and the excavated trench bottom. This operation shall follow as closely behind pipelaying operations as possible. Place CLSM in such a way as to prevent uplift or buckling of the pipe. CLSM shall be deposited as nearly as practicable in its final position and must in no way disturb the pipe trench or cause foreign material to become mixed with the cement slurry.

F. Do not place backfill above the pipe until the CLSM has reached the initial set. Place and maintain a 6-inch cover of moist backfill cover until additional backfill is placed. If the ambient temperature is 50 degrees F or less, an additional 6-inch cover of backfill shall be placed over the 6-inch moist backfill cover prior to the end of the working day.

## 3.15 SITE GRADING

A. Perform earthwork to the lines and grades shown in the drawings. Shape, trim, and finish slopes to conform to the lines, grades, and cross sections as shown. Original and re-contoured drainage paths shall be maintained as shown on the drawings.

B. Remove exposed roots and loose rocks exceeding 3 inches in diameter.

C. Round tops of banks higher than 10-feet to circular curves of not less than a 6-foot radius. Neatly and smoothly trim rounded surfaces. Do not overexcavate and backfill to achieve

the proper grade.

D. Furnish and install erosion control systems as specified in Section 02270 – Erosion and Sediment Control.

## 3.16 EARTHWORK BALANCE

A. Excess site excavated material shall be disposed of off-site by CONTRACTOR at his expense in accordance with Section 02111, Disposal of Excavated Materials, emplaced as fill at the project sites, or disposed of as directed by the OWNER Representative.

## 3.17 DISPOSAL OF WATER

A. Collect and treat groundwater inflows into the project excavations and water utilized by CONTRACTOR during the course of construction. Water discharged from the project site shall conform to the requirements in Section 01150, "Water Treatment and Disposal."

## 3.18 FINAL CLEANUP

A. Perform final cleanup prior to proceeding with final erosion control measures in accordance with Section 02270, Erosion and Sediment Control.

B. If unavoidable delays occur, final cleanup shall be completed as soon as possible and always before the end of the next November seeding season, or the next recommended planting season, whichever applies.

## 3.19 ROCK EXCAVATION

A. The OWNER Representative shall determine whether encountered material is to be classified as rock. See section 1.1.C of this specification for the definition of rock material.

B. Rock which cannot be broken up and removed by ripper equipment shall be excavated and removed by drilling, chipping, sawing, flame cutting, expansive chemicals or other methods approved by the Engineer. Blasting shall not be used.

C. Pre-splitting or other acceptable methods shall be used to reduce over breakage beyond the desired excavation limits. Pre-split a periphery plane to the depth to be excavated of that particular plane; except that CONTRACTOR will not be required to pre-split to slopes flatter than one-to-one.

D. If depth of the cut is more than can be drilled from top, an 18-inch offset will be allowed in the slope to begin succeeding drilling operations. The end result shall be a relatively smooth shear plane with localized irregularities which do not exceed 2 feet behind or 1foot in front of the shear plane surface and which do not extend within the indicated lines of

excavation.

E. Material beyond or below the indicated lines on the Drawings shall be at CONTRACTOR's expense, unless directed by OWNER.

**END OF SECTION**

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**TECHNICAL SPECIFICATIONS**
**DIVISION 2: SITE WORK**
**02231: AGGREGATE BASE AND SUBBASE**

## PART 1 GENERAL

### 1.01 SUMMARY

A. This specification section includes the following items of work:

1. CONTRACTOR shall construct aggregate base or subbase, as specified, spread and compacted to the lines, grades and dimensions shown on the Plans and where directed, including preparing the subgrade and doing the required watering, shaping, smoothing and other Incidental Work.

## PART 2 PRODUCTS

### 2.01 FILL MATERIALS BASE

A. The aggregate shall be free from vegetable matter and other deleterious substances. Aggregate for aggregate base shall be classified Caltrans Class 2. The percentage composition by weight of aggregate base shall conform to ¾" maximum grading when determined by Test Method No. Calif. 202.

1. Unless otherwise specified, the aggregate base size distribution shall be in accordance with the grading specified for ¾ inch maximum

**AGGREGATE GRADING REQUIREMENTS**

| Sieve Sizes | Percentage Passing | | | |
|---|---|---|---|---|
| | 1 1/2" Maximum | | 3/4" Maximum | |
| | Operating Range | Contract Compliance | Operating Range | Contract Compliance |
| 2" | 100 | 100 | — | — |
| 1 1/2" | 90-100 | 87-100 | — | — |
| 1" | — | — | 100 | 100 |
| 3/4" | 50-85 | 45-90 | 90-100 | 87-100 |
| No. 4 | 25-45 | 20-50 | 35-60 | 30-65 |
| No. 30 | 10-25 | 6-29 | 10-30 | 5-35 |
| No. 200 | 2-9 | 0-12 | 2-9 | 0-12 |

B. The aggregate base shall also conform to the following quality requirements:

**QUALITY REQUIREMENTS**

| Test | Test Method No. California | Operating Range | Contract Compliance |
|---|---|---|---|
| Resistance (R-value)* | 301 | — | 78 Min. |
| Sand Equivalent | 217 | 25 Min. | 22 Min. |
| Durability Index | 229 | — | 35 Min. |

* The R-value requirement will be waived provided the aggregate base conforms to the specified grading and durability and has a sand equivalent value of 35 or more.

C. The aggregate shall not be treated with lime, cement or other chemicals before the Durability Index test is performed.

1. Material yielding a maximum dry density of less than 112 pounds per cubic foot when tested in the laboratory in accordance with ASTM "Standard Methods of Test for Moisture-Density Relations of Soils, Using 10-pound Rammer and 18-inch Drop," Designation D 1557, shall not be used.

2. Any rock, including red rock, meeting all the requirements of this Section will be acceptable. Such rock shall be plant processed at an approved processing plant.

D. CONTRACTOR shall perform all tests as required by this specification.

E. At least 10 working days prior to the use thereof, CONTRACTOR shall submit to the OWNER Representative a 120-pound sample of aggregate, graded as intended for use and testing report for review. This requirement shall be complied with for each aggregate and grading thereof that has not been approved. The OWNER Representative may choose to perform its own test on the sample, at no cost to CONTRACTOR, to verify and determine the acceptability of the aggregate.

## 2.02 FILL MATERIALS - SUBBASE

A. The aggregate shall be free from vegetable matter and other deleterious substances. Aggregate for subbase shall be Caltrans classified Class 3 with R-valve of no less than 40.

1. Unless otherwise specified, the particle size distribution shall be in accordance with the grading specified for 3-inch maximum size aggregate.

| Sieve Sizes | Percentage Passing 3" Maximum |
|---|---|
| 3" | 100 |
| 2-1/2" | 87-100 |
| No. 4 | 45-100 |
| No. 200 | 0-34 |

2. The subbase shall have a relative compaction ratio of 95%.

# PART 3 EXECUTION

## 3.01 SPREADING

A. Aggregate base material shall be delivered to the roadbed as uniform mixtures and each layer shall be spread in one operation.

B. At the time aggregate base is spread it shall have a moisture content sufficient to obtain the required compaction. Such moisture shall be uniformly distributed throughout the material. The material shall be spread upon the subgrade prepared by means of vehicles equipped with approved spreading devices at a uniform quantity per linear foot, which quantity will provide the required compacted thickness within the tolerances specified. Depositing and spreading shall commence at that part of the work farthest from the supply of base material and shall progress continuously without breaks, unless otherwise directed by the OWNER Representative.

C. Where the required thickness is 6 inches or less, the base material may be spread and compacted in one layer. Where the required thickness is more than 6 inches, the base material shall be spread and compacted in 2 or more layers of approximately equal thickness, and the maximum compacted thickness of any one layer shall not exceed 6 inches. Each layer shall be spread and compacted in a similar manner. Base material placed in areas inaccessible to the spreading equipment, may be spread in one or more layers by any means that will make possible the specified compaction and surface. When the subgrade for aggregate base consists of cohesionless sand and written permission is granted by the OWNER Representative, the base material may be dumped in piles upon the subgrade and spread ahead from the dumped material.

D. The base material, after spreading, shall be shaped by means of a blade grader to such thickness that after watering and compacting, the completed base will conform to the required grade and cross section within the tolerances specified. Segregation of aggregate shall be avoided and the base shall be free from pockets of coarse or fine material.

## 3.02 COMPACTING

A. Immediately following spreading, shaping and smoothing, the full width of the base material shall be watered as ordered by the OWNER Representative, and compacted by rolling with a minimum of two self-propelled reversible equipment specified as follows:

1. For initial rolling use a 3 wheel steel-tired roller, weighing not less than 12 tons distributed so that the rear wheels will apply to the surface being rolled not less than 325 pounds per linear inch of rear tire width. Rolling shall commence by covering completely the outer edge of the material. Subsequent passes shall lap at least 25 percent on previously rolled material.

2. For subsequent rollings use a pneumatic-tired roller of the oscillating type, having a width of not less than 4 feet and equipped with tires of equal size and diameter. Wobble wheel rollers will not be permitted. The tires shall be so spaced that the entire gap between adjacent tires will be covered by the tread of the following tire. The tires shall be inflated to 90 pounds per square inch minimum.

3. To compact all areas inaccessible to the rollers, use compressed air, or gas, powered tampers.

B. The foregoing equipment requirements serve as a standard of adequacy.

1. Subject to the condition that CONTRACTOR shall notify the OWNER Representative at least 10 days in advance, and shall secure approval for the use of each piece of compacting equipment other than that specified, selection thereof and obtainment of the specified compaction throughout the volume of base and the specified surface, shall be solely the responsibility of CONTRACTOR.

2. If compaction is not uniform or tests show it to be inadequate, or if the surface is unsatisfactory, the OWNER Representative may require the use of other or additional equipment.

3. Should low or high spots develop during rolling operations, such spots shall be smoothed out by blading with a self-propelled and pneumatic-tired motor grader having a wheelbase not less than 15 feet long and a blade not less than 10 feet long.

C. Aggregate base shall be watered after compaction. Water shall be applied at the rate and in the quantities proposed by CONTRACTOR and accepted by the OWNER Representative.

1. The relative compaction of aggregate base, determined by tests of the in place, field compacted base shall be not less than 95 percent of the maximum compaction at optimum moisture content determined by ASTM Methods of Test, Designation D 1556 and Method C of Designation D 1557. The tests will be conducted and evaluated in the laboratory by the OWNER at no cost to CONTRACTOR.

2. The surface of the finished aggregate base at any point shall not vary more than 0.05 foot above or below proper grade and such surface shall contain no ridges, valleys or sharp breaks.

3. Finished base that does not conform to the foregoing requirement shall be reshaped or reworked, watered and thoroughly re-compacted to conform thereto.

4. CONTRACTOR shall not allow any completed untreated rock base to be subjected to public or construction traffic, except the latter necessary to the completion of the overlying surface course.

**END OF SECTION**

**TECHNICAL SPECIFICATIONS**
**DIVISION 2: SITE WORK**
**02270: EROSION AND SEDIMENT CONTROL**

## PART 1 GENERAL

### 1.01 SUMMARY

A. This Section specifies requirements for erosion control and prevention of sediment discharge from the Work. The scope of work includes:

1. Identifying potential sources that may affect the quality of stormwater discharges.

2. Identifying non-stormwater discharges.

3. Designing, implementing and maintaining Best Management Practices (BMP) for control of erosion and sediment discharge.

B. Related Sections:

1. Section 01150 – Water Treatment and Disposal.

2. Section 01561 – SPP, Erosion and Sediment Control.

3. Section 02052 – Site Preparation, Clearing, Grubbing, and Stripping.

4. Section 02111 – Disposal of Excavated Materials.

5. Section 02160 – Excavation Support Systems.

6. Section 02200 – Earthwork.

7. Section 02125 – Trench and Structure Excavation and Backfill.

8. Section 02930 – Seeding.

C. Definitions:

1. Stormwater Pollution Prevention Plan (SWPPP): A plan prepared and implemented by CONTRACTOR prior to any clearing, grading, or excavation subject to the General Permit issued by the California State Water Resources Control Board, as specified in Section 01062 and applicable permits.

2. BMP: Measures recommended by the California Stormwater Quality Association (CASQA) for erosion control, temporary sediment control, wind erosion control, and tracking of discharge.

D. Performance Requirements:

1. CONTRACTOR shall provide erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties according to requirements of authorities having jurisdiction.

2. CONTRACTOR shall inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

3. CONTRACTOR shall prevent the discharge, or creation of a potential discharge, of any material to storm drains or waters of the State of California.

## 1.02 REFERENCE

A. CASQA, Storm water Best Management Practice Handbook, Construction.

## 1.03 SUBMITTALS

A. Working Drawings and Methods Statements:

1. Submit a list all of the construction activities and material that have the potential to contribute sediment to stormwater discharge. Describe the anticipated soil and stockpile materials at the construction site.

2. Submit a list all of the construction methods that have the potential to track sediment off-site onto haul routes and access roads. Identify BMP for control and tracking of sediment off-site during construction. Provide BMP selection details, advantages, and disadvantages.

3. Submit a vicinity map that shows outline of construction site perimeters, staging areas, access roads, major roadways, geographic features and landmarks, municipal storm sewer systems, bodies of water within and adjacent to the project vicinity, wetlands, known wells, off-site draining into the construction site, and general topography. Identify anticipated discharge locations for the work. Show the area to be disturbed by construction activities, and location of the stockpiles. Indicate locations of erosion control measures such as straw rolls, silt fences, concrete swales, detention basins, infiltration basins, sediment basins, slope protection, erosion control, landscaping, ditch lining, and energy dissipaters. Identify wheel wash, and garbage storage and pickup sites.

4. Submit working drawings that show installation details, dimensions, and materials for implementing each BMP identified on the vicinity map. Identify quantities of materials for implementing BMP to be stored on-site for ensuring adequate supply for the work. Show storage locations on the vicinity map.

5. Submit shop drawings and material data sheets for manufactured BMP measures.

6. Identify sampling and analyses strategies to detect discharge of sediment and pollutants. Provide sampling schedules for discharges that have been identified as potentially contaminated.

7. Submit detailed methods for monitoring the weather, alerting work crews, and implementing additional BMP for rainfall and/or high wind. Include provisions for weekends and holidays.

8. Provide time schedules to construct, implement, and maintain BMP for the work for the duration of construction.

B. Provide inspection schedules to ensure that each BMP measures is in place, functioning properly, and adequate for the work. Include inspection of storage and handling area for construction materials that have the potential to contribute sediment or pollutants.

## 1.04 QUALITY ASSURANCE

A. Preconstruction Meeting: CONTRACTOR shall participate in an on-site meeting with the Owner Representative not less than 2 weeks prior to implementing erosion and sediment control measures. Items to be discussed include:

1. Erosion and sediment methods to be implemented, and schedule for implementation.

2. Quality Control procedures, including inspection and maintenance protocol.

3. Reporting requirements.

B. Comply with the requirements of all applicable permits and environmental requirements specified in Section 01062 – Environmental Requirements.

## 1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Store adequate quantities of materials for implementation of each BMP as shown on the vicinity map.

B. Packaged Material:

1. Deliver packaged materials showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.

## 1.06 REJECTION AND SUBSTITUTION

A. All materials not conforming to the requirements specified herein shall be considered defective and such materials, whether in place or not, shall be rejected and be immediately removed from the site and replaced with acceptable materials.

## 1.07 SITE OBSERVATION VISITS

A. Schedule site observation visits with the Owner Representative prior to commencement of work to verify existing conditions and environmentally sensitive areas.

B. CONTRACTOR or his authorized representative shall be on site at the time of each site observation visit.

# PART 2 PRODUCTS

## 2.01 MATERIALS

A. Straw rolls: manufactured from certified weed free straw that is wrapped in tubular black plastic netting, approximately 8 inches in diameter by 25-30 feet long.

B. Silt fences.

1. Prefabricated silt fence with posts, with the following properties:

a. Materials:

1) Fabric: Type 100X - Woven Polypropylene with minimum 100 lbs/in$^2$ grab tensile strength

2) Size: Width: 4 feet minimum.

3) Description: Pre-fabricated and pre-assembled silt fence with 1-1/2 inch nominal square hardwood posts. Top edge shall be reinforced with high strength industrial tensioning belt.

4) Properties:

| Property | Test Method | Value |
|---|---|---|
| Grab Tensile Strength | ASTM D4632 | 120 lbs |
| Mullin Burst Strength | ASTM D3786 | 10% |
| Permittivity | ASTM D4491 | 0.2 sec-1 |
| Water Flow Rate | ASTM D4491 | 20 gal/min/ft$^2$ |
| UV Stability | ASTM D4355 | 70% |
| Grab Tensile Elongation | ASTM D4595 | 10% |

C. Stockpile covers: polyethylene tarps.

D. Catch basin filter fabric.

E. Geotextile filter fabric: Type 100X - Woven Polypropylene with minimum 100 lbs/in2 grab tensile strength.

F. Oil absorbent sock filters: 3M High-Capacity Petroleum Sorbent pads, rolls and rugs, or equal.

G. Hydroseed and Mulch: Per Section 02930 "-Seeding".

H. Erosion Control Fiber Matrix: Use certified, weed free, natural/biodegradable imported erosion control materials.

I. Rip Rap: Sound, angular rock fragments free of sand, dust, organic material, excessive cracks, mineral lenses or other impurities. Twenty percent by weight shall be at least 4 inches in size.

## PART 3 EXECUTION

### 3.01 GENERAL

A. Implement BMP measures prior to clearing or grading the site.

B. Protect stockpiled areas prior to forecast storm events using polyethylene covers and/or other appropriate cover systems.

C. Protect disturbed areas prior to forecast storm events using geotextile blankets, straw rolls, and/or other appropriate blanket systems.

D. Protect disturbed areas from overland sheet flow from adjacent areas prior to forecasted storm events using curbs, swales, dikes, berms, inlets, drains, and/or other appropriate stormwater diversion systems.

E. Trap any loose sediment from disturbed areas before discharging any stormwater using silt fences, filter fabric, straw rolls, and/or other appropriate sediment trapping systems.

F. Dissipate the velocity of the discharged stormwater to prevent erosion using rock, grouted rip rap, rubble, and/or other appropriate stormwater velocity dissipation systems.

G. Confine construction materials that have the potential to contribute pollutants to storage and handling areas shown on the vicinity map. Provide adequate cover from the rain and wind to these storage areas using polyethylene covers and/or other appropriate cover systems. Contain areas where liquids are stored and handled using geomembranes, sandbags, berms, dikes, and/or other liquid containment systems.

H. Confine garbage to the storage and handling areas shown on the vicinity map. Provide adequate shelter from the rain and wind using containers.

I. Protect municipal storm sewer systems shown on the vicinity map from discharge of pollutants and sediment from the construction site using sandbags dams fitted with filter fabric, oil absorbent sock filters, and/or other appropriate oil and sediment filtering systems.

J. Stabilize inactive disturbed areas as soon as feasible after the cessation of construction activities.

K. Preserve existing vegetation to the extent feasible to minimize surface area of exposed soil.

L. Preserve condition of haul routes and access roads from tracked sediment using vehicle tire washers, street sweepers, and/or other appropriate sediment tracking control systems.

M. Immediately notify the Owner Representative of any situation requiring additional erosion control devices to prevent soil erosion or sedimentation into any area beyond the project limits.

## 3.02 MAINTENANCE AND REPAIR/RESTORATION

A. Immediately repair, restore, and/or replace any low performing BMP identified in the high wind and rain storm reports. Immediately implement additional BMP in construction areas with insufficient BMP as identified in the high wind and rain storm reports. Repair, restore, and/or replace any deficiencies noted in scheduled inspections prior to forecast storm events.

B. Inspect straw rolls after significant storms. Ensure straw rolls are in contact with the soil. Replace straw rolls after 1 year or sooner if required.

C. Seed and protect any areas that remain unworked for more than 30 days or as specified in Section 01062, Environmental Requirements or in applicable permits.

D. At no time shall CONTRACTOR apply fertilizers, pesticides, or herbicides other than those specified to any of the planted or hydro seeded areas unless directed by the Owner Representative.

E. Operate and maintain storm and surface water facilities as follows:

1. Remove sediment from behind silt fences and straw rolls to prevent overtopping.

2. Prevent sediments from being flushed to the downstream system during cleaning.

3. Sediment, trash, and debris shall be removed from catch basin grate surfaces when blocking more than 20 percent of the grate surface.

4. Sediment, trash, and debris shall be removed from catch basin interiors when debris exceeds 1/3 of the depth from bottom to pipe invert.

5. Sediment, trash, and debris shall be removed from rock dams, ponds, and traps when more than 1 foot of sediment has accumulated.

F. Dust Control:

1. During dry weather conditions, take preventative measures to minimize the wind transport of soil. Use water sprinkling, temporary enclosures, and other methods to minimize dust and dirt migration.

## 3.03 MONITORING AND REPORTING

A. Monitor each BMP measure, storage and handling area for construction materials that have the potential to contribute pollutants, and areas for garbage storage and pickup during storm events involving high wind and rain to ensure that they function properly and are adequate for the work. Provide performance details for each BMP in the required reports as specified in Section 01062 and in the SWPPP.

B. Monitor construction site areas for adequacy of BMP implementation. Provide details for each area monitored in the high wind and rain storm report.

C. Monitor each municipal storm sewer system, known well, wetland, and body of water shown on the vicinity map for adequacy of BMP implementation. Provide details in the high wind and rain storm report.

## 3.04 CLEAN-UP AND DISPOSAL

A. All work areas shall be kept clean, neat and orderly at all times.

B. Remove all stockpiles from the site upon completion of the work.

C. Remove all temporary erosion and sediment control devices from the site upon completion of the work.

D. Remove all mulch and straw from paved areas.

E. Remove any detrimental plants growing in the work area not specified in the seed mix.

F. Upon completion of work, remove rubbish, trash, debris resulting from operation. Remove unused equipment and implements of service; leave worksite in neat, acceptable condition as to meet approval of the Owner Representative.

G. See Section 02930 – Seeding for hydroseeding and mulching requirements.

**END OF SECTION**

**TECHNICAL SPECIFICATIONS**
**DIVISION 2: SITE WORK**
**02274: GEOTEXTILE**

## PART 1 GENERAL

### 1.01 THE REQUIREMENT

A. CONTRACTOR shall provide geotextiles, complete and in place, in accordance with **Definitions.** The following definitions apply to the WORK of this Section:

1. Fabric: Geotextile, a permeable geosynthetic comprised solely of textiles.

2. Minimum Average Roll Value (MinARV): Minimum of series of average roll values representative of geotextile provided.

3. Maximum Average Roll Value (MaxARV): Maximum of series of average roll values representative of geotextile provided.

4. Nondestructive Sample: Sample representative of finished geotextile, prepared for testing without destruction of geotextile.

5. Overlap: Distance measured perpendicular from overlapping edge of one sheet to underlying edge of adjacent sheet.

6. Seam Efficiency: Ratio of tensile strength across seam to strength of intact geotextile, when tested according to ASTM D 4884.

7. Woven geotextile: A geotextile fabric composed of polymeric yarn interlaced to form a planar structure with uniform weave pattern.

8. Nonwoven geotextile: A geotextile fabric composed of a pervious sheet of polymeric fibers interlaced to form a planar structure with uniform random fiber pattern.

### 1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. The following standards are referenced in this Section:

| | |
|---|---|
| ASTM D | Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon-Arc Type Apparatus |
| ASTM D 4491 | Standard Test Methods for Water Permeability of Geotextiles by Permittivity |
| ASTM D 4533 | Standard Test Method for Trapezoid Tearing Strength of Geotextiles |

| | |
|---|---|
| ASTM D 4595 | Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method |
| ASTM D 4751 | Standard Test Method for Determining Apparent Opening Size of a Geotextile |
| ASTM D4833 | Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products |
| ASTM D4884 | Standard Test Method for Strength of Sewn or Thermally Bonded Seams of Sewn Geotextiles |
| ASTM D4886 | Standard Test Method for Abrasion Resistance of Geotextiles (Sand Paper/Sliding Block Method) |

## 1.03 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - CONTRACTOR Submittals.

B. Shop Drawings

1. Manufacturer material specifications and product literature.

2. Installation drawings showing geotextile sheet layout, location of seams, direction of overlap, and sewn seams.

3. Description of proposed method of geotextile deployment, sewing equipment, sewing methods, and provisions for holding geotextile temporarily in place until permanently secured.

C. Samples

1. Geotextile: One-piece, minimum 18 inches long, taken across full width of roll of each type and weight of geotextile. Label each with brand name and furnish documentation of lot and roll number from which each sample was obtained.

2. Field Sewn Seam: 5-foot length of seam, 12 inches wide with seam along center, for each type and weight of geotextile.

3. Securing Pin and Washer: 1 each.

D. Certifications

1. Certification from geotextile manufacturer that products satisfy the indicated requirements.

2. Field seam efficiency test results.

## PART 2 PRODUCTS

### 2.01 WOVEN GEOTEXTILE

A. Woven geotextile shall be composed of polymeric yarn interlaced to form a planar structure with uniform weave pattern. Products shall be calendared or finished so that yarns will retain their relative position with respect to each other.

B. Polymeric yarn shall be long-chain synthetic polymers (polyester or polypropylene) with stabilizers or inhibitors added to make filaments resistant to deterioration due to heat and ultraviolet light exposure.

C. **Sheet Edges:** Selvaged or finished to prevent outer material from separating from sheet.

D. Unseamed Sheet Width: Minimum 6 feet.

E. Nominal Weight per Square Yard: 6.

F. Physical Properties: Conform to requirements below.

| PHYSICAL PROPERTY REQUIREMENTS FOR WOVEN GEOTEXTILE | | |
|---|---|---|
| **Property** | **Requirement** | **Test Method** |
| Apparent Opening Size (AOS) | No.10 to No. 100 U.S. Standard Sieve Size | ASTM 04751 |
| Water Permittivity | 0.02 to 3.34 sec.·1 MinARV, | ASTM 04491 (Falling Head) |
| Vertical Waterflow Rate | 10 to 150 gpm/sq ft, MinARV | |
| Wide Width Strip Tensile Strength | 60 to 1,500 lb/in.-width, MinARV | ASTM D 4595 |
| Wide Width Strip Elongation | 14 to 60 percent, MaxARV | |
| Trapezoidal Tear Strength | 30 to 200 lb, MinARV | ASTM 04533 |
| Puncture Strength | 50 to 250 lb, MinARV | ASTM 04833 |
| Abrasion Resistance | 5 to 25 percent loss, 250 cycles, MaxARV | ASTM D 4886 |
| Ultraviolet Radiation Resistance | 70 to 90 percent strength retention, MinARV after 500 hours | ASTM D 4355 |

## 2.02 NONWOVEN GEOTEXTILE

A. Geotextile for pipeline trench and other excavations applications shall be non-woven geotextile as specified below.

B. Nonwoven geotextile shall be composed of a pervious sheet of polymeric fibers interlaced to form a planar structure with uniform random fiber pattern. Products shall be calendared or finished so that yarns will retain their relative position with respect to each other.

C. Polymeric yarn shall be long-chain synthetic polymers (polyester, polypropylene, or polyethylene) with stabilizers or inhibitors added to make filaments resistant to deterioration due to heat and ultraviolet light exposure.

D. **Geotextile Edges:** Selvaged or finished to prevent outer material from separating from sheet.

E. **Unseamed Sheet Width:** Minimum 6-feet.

F. **Nominal Weight per Square Yard:** 12 ounces.

G. **Physical Properties:** Conform to requirements below.

| PHYSICAL PROPERTY REQUIREMENTS FOR NONWOVEN GEOTEXTILE | | |
|---|---|---|
| **Property** | **Requirement** | **Test Method** |
| Apparent Opening Size (AOS) | No. 100 to No. 140 U.S. Standard Sieve Size | ASTM D 4751 |
| Water Permittivity | 1.2 sec.-1 MinARV | ASTM 04491 (Falling Head) |
| Vertical Waterflow Rate | 90 gpm/sq ft, MinARV | |
| Wide Width Strip Tensile Strength | 300 MinARV | ASTM D4595 |
| Wide Width Strip Elongation | 70 percent, MaxARV | ASTM D4595 |
| Trapezoidal Tear Strength | 120 lb, MinARV | ASTM D 4533 |
| Puncture Strength | 130 lb, MinARV | ASTM D4833 |
| Ultraviolet Radiation Resistance | 90 percent strength retention, MinARV after 500 hours | ASTM D4355 |

## 2.03 SEWING THREAD

A. Sewing thread shall be polypropylene, polyester, or Kevlar thread with durability equal to or greater than durability of geotextile sewn.

## 2.04 SECURING PINS

A. Securing pins shall be steel rods or bars conforming to the following:

1. 3/16-inch diameter.
2. Pointed at one end; head on other end, sufficiently large to retain washer.
3. Minimum Length: 12 inches.

B. Steel washers for securing pins shall be:

1. Outside Diameter: Not less than 1-1/2 inches.
2. Inside Diameter: 1/4-inch.
3. Thickness: 1/8-inch.

C. Steel Wire Staples

1. U-shaped.
2. 10-gauge.
3. Minimum 6 inches long.

# PART 3 EXECUTION

## 3.01 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver each roll with sufficient information attached to identify manufacturer and product name or number.

B. Handle products in manner that maintains undamaged condition.

C. Do not store products directly on ground. Ship and store geotextile with suitable wrapping for protection against moisture and ultraviolet exposure: Store geotextile in a way that protects it from elements. If stored outdoors, elevate and protect geotextile with waterproof cover.

## 3.02 LAYING GEOTEXTILE

A. Notify the ENGINEER whenever geotextiles are to be placed. Do not place geotextile prior to obtaining ENGINEER's approval of underlying materials.

B. Lay and maintain geotextile smooth and free of tension, folds, wrinkles, or creases.

## 3.03 ORIENTATION ON SLOPES

A. Orient geotextile with long dimension of each sheet parallel to direction of slope.

B. Geotextile may be oriented with long dimension of sheet transverse to direction of slope only if sheet width, without unsewn seams, is sufficient to cover entire slope and anchor trench and extend at least 18 inches beyond toe of slope.

## 3.04 JOINTS

A. Unseamed Joints

1. Unseamed joints shall be overlapped to the following dimensions unless otherwise indicated:

    a. Foundation/Subgrade Stabilization: Minimum 18 inches.

    b. Riprap: Minimum 18 inches.

    c. Drain Trenches: Minimum 18 inches, except overlap shall equal trench width if trench width is less than 18 inches.

    d. Other Applications: Minimum 12 inches.

B. Sewn seams shall be used wherever stress transfer from one geotextile sheet to another is necessary. Sewn seams, as approved by ENGINEER, also may be used instead of overlap at joints for applications that do not require stress transfer.

1. Seam efficiency shall be minimum 70 percent, verified by preparing and testing minimum of one set of nondestructive samples per acre of each type and weight of geotextile provided. Test according to ASTM D 4884.

2. Type: "J" type seams are preferred, but flat or butterfly seams are acceptable.

3. Stitch Count: Minimum 3 to maximum 7 stitches per inch.

4. Stitch Type: Double-thread chainstitch, Type 401, Federal Standard No. 751a.

5. Stitch Location: 2 inches from geotextile sheet edges, or more if necessary to develop required seam strength.

6. Sewing Machines: Capable of penetrating 4 layers of geotextile.

## 3.05 SECURING GEOTEXTILE

A. Secure geotextile during installation as necessary with sand bags or other means approved by ENGINEER.

B. Securing Pins

1. Insert securing pins with washers through geotextile, midway between edges of overlaps and 6 inches from free edges.

2. Spacing

| Slope | Maximum Pin Spacing, feet |
|---|---|
| Steeper than 3:1 | 2 |
| 3:1 to 4:1 | 3 |
| Flatter than 4:1 | 5 |

3. Install additional pins across each geotextile sheet as necessary to prevent slippage of geotextile or to prevent wind from blowing geotextile out of position.

4. Push each securing pin through geotextile until washer bears against geotextile and secures it firmly to subgrade.

## 3.06 PLACING PRODUCTS OVER GEOTEXTILE

A. Notify ENGINEER before placing material over geotextile,. Do not cover installed geotextile prior to receiving authorization from the ENGINEER to proceed.

B. If tears, punctures, or other geotextile damage occurs during placement of overlying products, remove overlying products as necessary to expose damaged geotextile. Repair damage as indicated below.

## 3.07 INSTALLING GEOTEXTILE IN TRENCHES

A. Geotextile for pipeline trench and other excavation applications shall be non-woven geotextile as per Paragraph 2.2 of this Specification Section.

B. Place geotextile in a way that will completely envelope granular material to be placed in

trench and with indicated overlap at joints. Overlap geotextile in direction of flow. Place geotextile in a way and with sufficient slack for geotextile to contact trench bottom and sides fully when trench is backfilled.

C. After granular material is placed to grade, fold geotextile over top of granular material, unless otherwise indicated. Maintain overlap until overlying fill or backfill is placed.

## 3.08 RIPRAP APPLICATIONS

A. Overlap geotextile at each joint with upstream sheet of geotextile overlapping downstream sheet.

B. Sew joints where wave runup may occur.

## 3.09 GEOTEXTILE-REINFORCED EARTH WALL APPLICATIONS

A. Sew exposed joints; extend sewn seams minimum 3-feet behind face of wall.

B. Protect exposed geotextile from damage and deterioration until permanent facing is applied.

## 3.10 SILT FENCE APPLICATIONS

A. Install geotextile in one piece or continuously sewn to make one piece, for full length and height of fence, including portion of geotextile buried in toe trench.

B. Install bottom edge of sheet in toe trench and backfill in a way that securely anchors geotextile in trench.

C. Securely fasten geotextile to a wire mesh backing and each support post in a way that will not result in tearing of geotextile when fence is subjected to service loads.

D. Promptly repair or replace silt fence that becomes damaged.

## 3.11 REPAIRING GEOTEXTILE

A. Repair or replace torn, punctured, flawed, deteriorated, or otherwise damaged geotextile. Repair damaged geotextile by placing patch of undamaged geotextile over damaged area plus at least 18 inches in all directions beyond damaged area. Remove interfering material as necessary to expose damaged geotextile for repair. Sew patches or secure them with pins and washers, as indicated above for securing geotextile, or by other means approved by ENGINEER.

## 3.12 REPLACING CONTAMINATED GEOTEXTILE

A. Protect geotextile from contamination that would interfere, in ENGINEER's opinion,

with its intended function. Remove and replace contaminated geotextile with clean geotextile.

**END OF SECTION**

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**TECHNICAL SPECIFICATIONS**
**DIVISION 2: SITE WORK**
**02340: BORING AND JACKING**

## PART 1 GENERAL

### 1.01 REQUIREMENTS

A. The CONTRACTOR shall furnish all labor, materials, equipment and services required for the installation of steel casing by boring and jacking method in accordance with the Contract Documents and as specified herein. The work also includes the installation of carrier pipe within the steel casing, and grouting of the annular spaces around the carrier pipe with controlled low strength material. The CONTRACTOR shall dispose of all excavated materials, and shall restore the work sites to the original conditions.

B. The CONTRACTOR shall investigate subsurface conditions by performing borings, recording boring logs, sampling soil or rock samples, and performing laboratory tests.

C. In the performance of the work, the CONTRACTOR shall comply with the standards and lawful requirements of the affected railway companies, public agencies, and owners of public utilities or other facilities for the safeguarding of traffic and improvements which might be endangered by the boring and jacking operations.

D. If the CONTRACTOR is not ready to place the carrier pipe in the casing at the time of completion of boring and jacking operations, the ends of the casing shall be bulkheaded.

E. The CONTRACTOR shall be responsible for maintaining the required line and grade, and for preventing any ground deformations (settlement/heave), or other damage due to the boring and jacking operations.

### 1.02 REFERENCES

A. Related Work Specified Elsewhere

Section 01300 – Contractor Submittals

Section 01656 – Pressure Pipe Testing and Disinfection

Section 02140 – Dewatering

Section 02160 – Excavation Support Systems

Section 02200 – Earthwork

Section 02445 – Geotechnical Instrumentation and Monitoring

Section 02565 – Ductile Iron Pipe

Section 02570 – Steel Pipe Mortar Lined and Mortar Coated

Section 03321 – Controlled Low Strength Material

Section 15000 – Piping, General

AREMA Standards

B. Reference Specifications, Codes, and Standards

The publications listed below form a part of this specification to the extent referenced. Where conflicts between these specifications and the referenced specification, code, or standard occur, the more restrictive specification shall govern. Where no date is given for reference standards, the latest available on the date of Notice Inviting Bids shall be used.

| | |
|---|---|
| ASTM A139 | Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipes (NPS 4 and Over) |
| ASTM A283 | Low Tensile Strength Carbon-Steel Plates. |
| ASTM C157 | Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete |
| ANSI/AWS D1.1 | Structural Welding Code. |
| ANSI/AWWA C200 | Steel Water Pipe 6 Inches and Larger. |

Tests will be made on samples retrieved from subsurface borings using the reference standards below:

| | |
|---|---|
| ASTM C136 | Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates |
| ASTM C144 | Standard Specification for Aggregate for Masonry Mortar |
| ASTM C150 | Standard Specification for Portland Cement |
| ASTM D422 | Standard Test Method for Particle-Size Analysis of Soils |
| ASTM C937 | Standard Specification for Grout Fluidifier for Preplaced-Aggregate Concrete |
| ASTM D1452 | Standard Practice for Soil Exploration and Sampling by Auger Borings |
| ASTM D2113 | Standard Practice for Rock Core Drilling and Sampling of Rock for Site Exploration |
| ASTM D2487 | Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System) |

| | |
|---|---|
| ASTM D3080 | Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions |
| ASTM D4220 | Standard Practices for Preserving and Transporting Soil Samples |
| ASTM D4318 | Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils |
| ASTM D7263 | Standard Test Methods for Laboratory Determination of Density of Soil Specimens |
| CA 532 and 643 | California Standard Test Methods for Chlorides, Sulfate, Resistivity, and pH. |
| DIB 83-04 | Design Information Bulletin No. 83-04: Caltrans Supplement to FHWA Culvert Repair Practices Manual. |

C. Geotechnical Report

The Reports listed below address geotechnical conditions in the area of the boring and jacking site. Note that these reflect measurements on the date indicated and may not reflect current conditions. The CONTRACTOR is cautioned that, should interpretations be made, opinions formed, and conclusions drawn as a result of examining these reports, those interpretations, opinions, and conclusions will be solely of the CONTRACTOR.

1. AECOM, Revised Preliminary Geotechnical Assessment Report for Transmission Mains, CAW Monterey Peninsula Water Supply Project (MPWSP), October 28, 2017.

2. AECOM Field Investigation Report (in preparation)

## 1.03 SUBSURFACE INVESTIGATION

A. Before boring and jacking operation, the CONTRACTOR may perform a subsurface exploration to obtain data required to analyze the subsurface conditions at the site to assure that the boring and jacking will be performed properly.

B. The CONTRACTOR shall obtain all permits required to conduct subsurface exploration from the municipality and/or property owner in which the investigations will be conducted.

C. All costs for conducting subsurface investigations deemed necessary by the CONTRACTOR shall be borne by the CONTRACTOR.

## 1.04 DESIGN CRITERIA

A. Any ground movements (settlement/heave) shall be limited to values that do not cause damage or distress to surface features, utilities, or improvements and as specified in Article 1.06F.

B. Design/selection of steel casing for jacking loads and acceptable fabrication tolerances is the responsibility of the CONTRACTOR. Maximum jacking loads applied to the steel casing shall not exceed 33 percent of the ultimate compressive strength of the pipe material or the maximum strength of the pipe as established by the manufacturer, whichever is lower.

C. A thrust block shall be used to transfer jacking loads to the soil behind the jacking pit. The thrust block face shall be constructed perpendicular to the proposed pipe alignment. The thrust block shall be designed to withstand the maximum jacking forces developed by the main jacks, without excessive deflection or displacement. Lateral stress applied to the soil/rock shall not exceed the allowable passive earth pressure specified herein:

| Depth to center of thrust block (feet) | 5 | 10 | 20 or deeper |
|---|---|---|---|
| Allowable passive earth pressure (psf) | 1,000 | 2,000 | 4,000 |

D. If the dry unit weight of the soil is found to be equal to or less than 95 pcf or the effective friction angle is found to be equal to or less than 32 degrees as a result of subsurface investigation, the CONTRACTOR shall design, construct, and test soil. Improvement methods for temporary applications including but not limited to:

1. Stability of pit excavations including shorings, bases, and thrust block reaction walls.

2. Stability of ground behind the launch seal at the jacking pit and the retrieval seal at the receiving pit.

3. Control of groundwater and inflows in to jacking and receiving pit excavations.

E. Provide launch and retrieval seals at all entry and exit locations. Provide ground improvement where shown on the Plans to prevent loss of ground.

## 1.05 CONTRACTOR SUBMITTALS

A. Qualifications: The name of the CONTRACTOR that will perform the boring and jacking operations and written documentation summarizing the qualifications of the firm, description of reference projects including owner's name and contact information, project superintendent, machine operators, and site safety representative shall be submitted. Provide qualifications and training records for site safety representative, personnel responsible for air quality monitoring, and licensed surveyor.

B. Subsurface Investigation: The CONTRACTOR shall keep accurate boring records, and shall deliver complete, legible copies of these records to the Owner Representative. All such records shall be preserved in good condition and order until they are delivered and accepted. Separate records shall be made for each boring. The following information shall be included in the driller's records for each boring:

1. Boring number or designation, location, inclination, total depth and elevation.

2. Boring footage at which groundwater is encountered.

3. Dates and time by boring footage when boring and sampling operations were performed.

4. Significant drilling conditions.

5. Summary of Laboratory test results.

C. Shop Drawings and detailed written descriptions: The CONTRACTOR shall submit shop drawings and detailed written descriptions of the following at least two weeks before beginning boring and jacking operations in accordance with the requirements in Section 01300 - Contractor Submittals and the following supplemental requirements as applicable:

1. Manufacturer's literature describing the boring and jacking system and all ancillary equipment.

2. Sketches prepared by a Professional Engineer registered in California showing the design and details of the jacking and receiving pits, head frame, shields, reaction blocks, arrangement of the jacks, and intended method to maintain proper grade and/or restrict movement of the carrier pipe within the casing.

3. Layout of work sites, including location of spoil storage areas.

4. Schedules of excavation, boring and jacking operation, carrier pipe installation, and backfill operation.

5. Steel casing material list including diameter, thickness, and grade of steel.

6. Welding procedures and welders' qualification records if welding is used.

7. Groundwater /water control methods.

8. Procedures and methods for the installation of the carrier pipe, including blocking details and location of blocking points.

9. Type of grout mixing and pumping equipment, proposed grout mix design and proposed grouting procedures including, maximum grouting pressure to be used in conjunction with grouting voids surrounding the steel casing (contact grouting) and annular space between the carrier pipe and the steel casing (annular grout).

10. Permits associated with the boring or jacking operations. See specification section Note that Owner will secure permits from Caltrans and TAMC (Transportation Agency for Monterey County) for boring and jacking operations as well as project environmental permits.

11. The CONTRACTOR, prior to beginning any trench or structure excavation 5 feet deep or over, shall submit to the OWNER and shall be in receipt of the OWNER'S written acceptance of the CONTRACTOR's detailed plan showing design of all shoring, bracing, sloping of the sides of excavation, or other provisions for worker protection against the hazard of caving ground during the excavation of such trenches or structure excavation. The CONTRACTOR'S attention is directed to the provisions for "Shoring and Bracing Drawings" in Section 6705 of the California Labor Code. If such plan varies from the shoring system standards established in the Construction Safety Orders of the State of California, such alternative systems plans shall be prepared by a civil or structural engineer licensed in the State of California.

D. Calculations: All calculations shall be prepared by a Professional Engineer licensed in State of California, who shall stamp and sign calculations.

1. Design calculations demonstrating that the proposed steel casing is capable of supporting the maximum stresses to be imposed during jacking. The calculations shall take into account earth and hydrostatic loads, jacking forces, and any other loads that may be reasonably anticipated during jacking. All loads shall be shown and described. Additionally, provide an estimate of the maximum jacking force expected to complete the drive, accounting for both face pressures and frictional resistance along the pipe string.

2. Calculations demonstrating that the soils behind the thrust block can transfer the maximum planned jacking forces exerted by the main jacks to the ground during pipe installation with an acceptable factor of safety of at least 2.0, without excessive deflection or displacement.

3. Design calculations demonstrating that the proposed steel casing is capable of supporting the maximum stresses to be exerted by ground, groundwater, and live load. The groundwater pressure should be calculated assuming the ground is fully saturated to the top of the ground

surface. The live load shall be 360 psf for highway and other paved surfaces and 1880 psf for TAMC railroad.

E. Certifications: The CONTRACTOR shall furnish a certified affidavit of compliance for the physical and chemical properties of all steel pipe furnished. All costs incurred in making samples for certification of tests shall be the CONTRACTOR's responsibility.

## 1.06 QUALITY ASSURANCE

A. Boring and jacking operations shall be done by a qualified CONTRACTOR with at least 5 years' experience involving work of a similar nature.

B. The CONTRACTOR shall give the OWNER a minimum of 3 days advance notice of the start of excavation or boring operations.

C. WORK shall be performed in the presence of the OWNER, unless the OWNER has granted prior approval to perform such WORK in its absence.

D. Welding Requirements: Welding procedures used to fabricate steel casings shall be prequalified under the provisions of ANSI/AWS D1.1, unless interlocking type joint is used as specified in Article 2.01A.

1. Welding procedures shall be required for, at a minimum, longitudinal and girth or special welds for pipe cylinders, casing joint welds, reinforcing plates, and grout coupling connections.

2. Casing section joints shall be butt welded, lap welded, or welded using butt straps in the field. Each end of the casing for butt welding shall be prepared by providing a 1/4-inch by 45-degree chamfer on the outside edges.

3. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local, approved testing agency not more than 6 months prior to commencing work on the casing or pipeline. Machines and electrodes similar to those used in the WORK shall be used in qualification tests. The CONTRACTOR shall be responsible for all material and bear the expense of qualifying welders.

E. Settlement Control

1. The CONTRACTOR shall establish, monitor, and maintain a system of surface settlement points located along the pipe alignment in accordance with Section 02445 Geotechnical Instrumentation and Monitoring. Settlement points shall be installed at each major utility crossing as

directed by the Owner Representative where permitted by Caltrans and the TAMC railroad within their right-of-way.

2. The settlement points shall be surveyed after each pipe section is advanced or more frequently if requested by the Owner Representative. At least one set of survey readings shall be obtained during every 8-hour work shift regardless of the pipe advance. Final surveys should take place seven days after completion of contact grouting.

3. If any movement or settlement occurs which causes or might cause damage to the existing roadway or utilities over, along or adjacent to the work, the CONTRACTOR shall immediately stop all work except that which assists in making the work secure and in preventing further movement, settlement or damage. Jacking/boring operations shall resume only after all necessary precautions have been taken to prevent further movement, settlement or damage as reviewed by the Owner Representative.

4. Damage to the roadway, railway, or utilities resulting from jacking and boring operations shall be repaired to the satisfaction of the owners of those utilities at no cost to the Owner.

F. Tolerance

1. Line and Grade Tolerances: The CONTRACTOR shall install the carrier pipe to the lines and grades shown on the Plans. The following tolerances apply to the installation of the carrier pipe.

   a. Deviation from horizontal alignment: 6 inches maximum

   b. Deviation from grade: 3 inches maximum.

2. Ground Settlement Tolerances:

   a. Railroad Tracks: 0.25 inch maximum.

   b. Non-Caltrans paved surfaces: 1.0 inch maximum

   c. Caltrans paved and unpaved surfaces:
   CONTRACTOR shall continuously monitor ground settlement in accordance with Caltrans requirements described in Section 9.1.2.3 of DIB 83-04 and shall follow corrective action if action level is reached.

## 1.07 SAFETY

A. Except as otherwise indicated, the following codes apply to the work of this Section:

1. Cal/OSHA, State of California Administrative Code, Title 8, Industrial Relations, Chapter 4, Division of Industrial Safety, Subchapter 20, Tunnel Safety Orders.

2. Occupational Safety and Health Administration (OSHA) Regulations and Standards for Underground Construction, 29 CFR Part 1926, Subpart S, Underground Construction, and Subpart P, Excavations.

## PART 2 PRODUCTS

### 2.01 MATERIALS

A. Steel Casing: The steel shall be in accordance with ASTM A283, Grade C, unless indicated otherwise. Steel casing shall be installed by direct pipe jacking to serve as continuous casing. Sections of steel casing shall be butt welded or of interlocking type joint which utilizes a machined interference locking fit that eliminates the need for butt welding of joints. Steel casing pipes should be factory coated. External coatings have to be carefully selected as to the coating can resist abrasion during jacking. Ground conditions need to be studied to estimate the coating loss due to abrasion from soil and rock.

B. Carrier Pipe: Carrier pipe shall be in accordance with Section 02565 - Ductile Iron Pipe and Section 02570 - Steel Pipe Mortar Lined and Mortar Coated.

C. Contact Grout: Grout mixture that satisfies criteria shown below shall be used for contact grouting.

1. Cement: Cement shall be Type II or Type V portland cement conforming to ASTM C150.

2. Bentonite: Bentonite shall be a commercially processed powdered bentonite, Wyoming type, such as Imacco-gel, Black Hills, or equal. Grout mixtures shall contain 2 percent of bentonite by weight of the cement.

3. Sand: Conform to ASTM C144 except where modified in the following subparagraphs:

   a. Fineness modulus: Between 1.5 and 2.0

   b. Grading requirements

| Sieve Sizes | Percentage Passing by Weight |
|---|---|
| No. 8 | 100 |
| No. 16 | 95 – 100 |
| No. 30 | 60 – 85 |
| No. 50 | 20 – 50 |

| | |
|---|---|
| No. 100 | 10 – 30 |
| No. 200 | 0 – 5 |

4. Fluidifier:

   a. Fluidifiers shall hold the solid constituents of the grout in colloidal suspension, be compatible with the cement and water used in the grouting work, contain an expansive shrinkage compensator, and comply with the requirements of ASTM C937.

   b. Use CELBEX 209X manufactured by CELTITE, Inc. or approved equal.

5. Admixtures: Other admixtures may be used subject to the approval of the OWNER to improve the pumpability, to control set time, to hold sand in suspension, and to prevent segregation and bleeding.

6. Compressive Strength: Minimum strength of 100 psi in 24 hours, 2000 psi in 28 days.

D. Grout Connections: The CONTRACTOR shall provide 2-inch grout connections on the interior of the steel casing, regularly spaced at 5 feet on center, alternating at 30 degrees from plumb on each side of the vertical centerline. Longitudinal spacing between the connections may be decreased to provide more extensive grouting, but in no case shall the spacings be exceeded.

E. Annular Backfill Grout (Cellular Concrete): Grout mixture that satisfies criteria shown below shall be used for annular backfill grouting.

1. Wet Density: Between 50 and 65 lb/cubic feet.

2. Minimum compressive strength: 200 psi at 24 hours of age.

3. Shrinkage as determined on trial mixes in accordance with ASTM C157 shall be a maximum of 0.6 percent.

## PART 3 EXECUTION

### 3.01 SUBSURFACE INVESTIGATION

A. Exploration shall include drilling and sampling soil and/or rock core borings, performing laboratory tests at each boring and jacking site.

B. Work shall include, but not be limited to, obtaining permits for drilling exploratory holes, providing all labor, equipment and supplies necessary for drilling borings and excavating

test pits, taking core samples, and supplying water to drilling sites. Drill rigs shall be suitable for accessing exploratory sites.

C. Soil boring and rock coring shall be performed in accordance with ASTM D1452 and ASTM D2113. The method shall provide good recovery of cores in hard to soft rock above and below the groundwater table.

D. List of minimum required laboratory testing is identified for each boring and jacking alignment below:

| Test | Alignment | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| | HWY 1 Crossing at Light Fighter | RR Spur Crossing by Beach Range RD | RR Crossing at Marina DR | RR Crossing at Lapis | RR Crossing at Lapis |
| Particle-Size Analysis (ASTM C136 and D422) | B | B | C | C | C |
| Plasticity Index of Soils (ASTM D4318) | B | B | C | C | - |
| Unit Weight Analysis (ASTM D7263) | A | B | C | C | C |
| Direct Shear Test (ASTM D3080) | A | B | C | C | C |

Note:

A: Two (2) tests using the samples obtained from the boring drilled near Jacking Pit and two (2) tests using the samples obtained from the boring drilled near at Receiving Pit.

B: One (1) test using the sample obtained from the boring drilled near Jacking Pit and one (1) test using the sample obtained from the boring drilled near at Receiving Pit.

C: One (1) test using the sample obtained from the boring drilled either the Jacking Pit or Receiving Pit.

## 3.02 JACKING AND RECEIVING PIT

A. Required jacking and receiving pits shall be excavated and maintained to the minimum dimensions necessary to perform the operation. These excavations shall be adequately barricaded, sheeted, braced and dewatered, as required, in accordance with the applicable portions of Section 02200 - Earthwork. Boring and jacking pits will normally be no closer than ten (10) feet from the edge of pavement, with the permitting agency having final determination of the required setback distance.

B. The CONTRACTOR shall install a concrete working slab at the bottom of jacking and receiving pit excavations.

C. Steel rails or beams, adequately supported on the bottom of the jacking pit, shall be used for placement and alignment of each piece of steel casing during installation operations.

## 3.03 BORING AND JACKING OPERATIONS

A. The CONTRACTOR shall provide adequate space within the excavation to permit the insertion of the lengths of casing to be bored or jacked. Timbers and structural steel sections shall be anchored to ensure action of the jacks in line with the axis of the casing. A bearing block, consisting of a timber or structural steel framework, shall be constructed between the jacks and the end of the casing to provide uniform end bearing over the perimeter of the casing and distribute the jacking pressure evenly.

B. Steel casing shall be installed by the boring and jacking method, with the requirements as follows:

1. The steel casing shall be jacked forward into the soil while a boring auger rotates within the steel casing to remove spoil.

2. The auger and cutting head assembly shall be removable from within the casing in the event obstructions are encountered.

3. The face of the cutting head shall be arranged to provide appropriate restriction to the free flow of soft or poor soil material. Any arrangement, which employs simultaneous boring and jacking, but does not have the above arrangement to prevent boring ahead of the leading edge of the steel casing will not be permitted.

C. Any voids created outside the casing during the advancement of the casing or due to the removal of material at the front of the casing shall be immediately filled with bentonite slurry or other suitable temporary stabilizing fluid. Such material shall maintain the borehole stability without loss of ground and displaced by cement grout when the casing installation is completed.

D. Bentonite injection and cement grout shall be placed through a grout pipe that is advanced simultaneously with the steel casing. The grout pipe must be able to be disconnected from the casing at hole-through such that it can be withdrawn as final cement grouting takes place.

## 3.04 INSTALLATION OF STEEL CASING

A. Steel casings crossing under roadways/railroads shall be located at suitable approved alignments in order to eliminate possible conflict with existing or future utilities and structures, with a minimum 60-inch depth of cover between the top of the steel casing and the surface of the roadway. For steel casing crossings under roadways/railroads, the CONTRACTOR shall comply with the regulations of said authority in regard to design, specifications, and construction. Casing installations shall be as specified in Caltrans "Utility Permit", and the American Railway Engineering Association Specification Section 5, for railroads.

B. The boring and jacking operations shall be done simultaneously, with continuous

installation, until the steel casing is in final position. Correct line and grade shall be carefully maintained. Add on sections of steel casing shall be full-ring welded to the preceding length, developing watertight, total pipe strength joints. The casing installation shall produce no upheaval, settlement, cracking, movement, or distortion of the existing roadbed or other facilities. Following placement of the carrier pipe within the steel casing, end link seals are to be installed at each open end. Said end link seals shall be suitable for restraining the external earth load, while allowing internal drainage. Casing vents shall be required as indicated on the standard construction details.

C. Steel casing holes shall be mechanically bored through the soil by a cutting head on a continuous auger mounted inside the pipe. The distance between the leading end of the first auger section and the leading end of the casing shall be as necessary to maintain a solid plug of spoil material inside the forward portion of the casing.

D. Excavated materials shall be removed from the casing as the boring or jacking operation progresses and no accumulation of excavated materials within the casing shall be permitted.

E. The steel casing shall be adequately protected to prevent crushing or other damage under jacking pressures. Backstops shall be provided for adequately distributing the jack thrust without causing deformation of the soil or other damage. Should the steel casing be damaged, such damaged portion not in the hole, shall be replaced; however, if installed, the encasement pipe shall be abandoned in place, grouted full, and suitably plugged, and an alternate installation made. An alternate installation will also be required if the casing alignment or elevation substantially deviates from the plan locations, and results in the installation being unusable, as determined by Owner Representative.

F. Contact Grouting: Immediately after completion of the boring or jacking operations, the CONTRACTOR shall inject grout through the grout connections in such a manner as to completely fill all voids outside the steel casing resulting from the boring or jacking operations. Grout pressure shall be controlled so as to avoid deformation of the steel casing and avoid movement of the surrounding ground. After completion of the grouting operations, the CONTRACTOR shall close the grout connections with cast-iron threaded plugs.

## 3.05 INSTALLATION OF CARRIER PIPE

A. Remove all loose soil and/or standing water from the steel casing prior to installation of the carrier pipe.

B. Install carrier pipe as shown on the Drawings in accordance with specified tolerances.

C. Provide pipe spacer or insulator as required to prevent floatation, movement, or damage to the pipe during installation and backfill grout placement.

D. Provide plugs or bulkheads at both ends of the casing to contain the backfill grout.

E. Backfill grout shall be pumped through a pipe or a hose. The grout shall be proportioned to flow, and shall completely fill all voids between the carrier pipe and the casing.

F. Application of Mortar Lining and Coating to Joints: Application of mortar to the interior and exterior joints shall be performed in accordance with the carrier pipe specification.

G. Testing of the Carrier Pipe: Hydrostatic testing of the carrier pipe shall be completed prior to the filling of the annular space. Hydrostatic testing shall be performed in accordance with Section 01656 – Pressure Pipeline Testing and Disinfection.

## 3.06 SITE RESTORATION AND CLEAN UP

A. Closing of Pits: After jacking equipment and excavated materials from the boring or jacking operations have been removed from the jacking pit, the CONTRACTOR shall prepare the bottom of the jacking pit as a pipe foundation. The CONTRACTOR shall remove loose and disturbed materials below pipe grade down to undisturbed earth and shall recompact the material in accordance with Section 02200 – Earthwork.

**END OF SECTION**

**TECHNICAL SPECIFICATIONS**
**DIVISION 2: SITE WORK**
**02413: HORIZONTAL DIRECTIONAL DRILLING**

## PART 1 GENERAL

### 1.01 REQUIREMENT

A. This section provides the minimum requirements for the trenchless installation of force main by horizontal directional drilling (HDD). The locations and approximate lengths of the HDD pipelines are shown on the Contract Drawings.

B. The CONTRACTOR shall furnish all labor, equipment, and materials necessary to install flexible plastic potable water pipeline by HDD. The pipe material is specified elsewhere in the project plans and specifications.

### 1.02 REFERENCES

A. Related Work

1. Section 01300 – Contractor Submittals
2. Section 02445 – Geotechnical Instrumentation and Monitoring
3. Section 02600 – Fusible PVC Pressure Pipe
4. Section 02725 – High-Density Polyethylene (HDPE) Pipe

B. American Petroleum Institute (API):

1. API Bulletin 13D, 1985. Bulleting on the Rheology of Oil-Well Drilling Fluids, Second, Edition, Dallas, Texas.
2. API Recommended Practice 13B-1, 2009. Recommended Practice for Field Testing Water-Based Drilling Fluids, Fourth Edition, Dallas, Texas.
3. API Specification 13A, 2010. Specification for Drilling Fluid Materials, Eighteenth Edition, Dallas, Texas.

C. Other Guidelines:

1. Installation of Pipelines by Horizontal Directional Drilling, Pipeline Research Committee, American Gas Association, PR-227-9424, April 1995.
2. Horizontal Directional Drilling Good Practices Guidelines, 2008, North American Society for Trenchless Technology.

3. Installation of Pipelines Beneath Levees Using Horizontal Directional Drilling, US Army Corps of Engineers, Waterways Experiment Station, Final Report, CPAR-GL-98-1, April 1998.

4. IADC Drilling Manual, 2015. Twelves Edition, Houston, Texas, International Associated of Drilling Contractors.

5. Pressure Pipeline Design for Water and Wastewater, American Society for Civil Engineers, 2nd ed., 1992.

6. Tables for Hydraulic Design of Pipes, Sewers, and Channels, D. Barr and HR Wallingford, Eighth Edition., 2006.

## 1.03 DEFINITIONS

A. Horizontal Directional Drilling: For the purposes of this specification, HDD consists of a guided, steerable system for the installation of pipes, conduits and cables in a shallow arc using a surface-launched drilling rig. The term applies to large-scale crossings in which a fluid filled pilot bore is drilled while rotating the drill string, and is subsequently enlarged by a reamer to the size required for the product pipe. The required deviation during pilot boring is provided by the positioning of a bent sub. Tracking of the drill string is achieved by using a downhole wireline survey tool, which may be augmented by using an energized wire grid at the surface.

B. Drilling Fluid/Mud: A mixture of water, bentonite, polymers, and/or other non-hazardous products, continuously pumped to the cutting head to facilitate the removal of soil cuttings, and stabilization of the bore. These fluids also cool the cutting tools and lubricate the pipe string.

C. Pilot Bore: The action of creating the first guided pass of the HDD process which is then reamed in one or more passes to the size required to allow pullback of the pipe or casing.

D. Cutterhead/Cutting Head: Any tool or system of tools on a common support which excavates at the face of a bore.

E. Pullback: That part of a horizontal directional drilling process in which the drill string is pulled back through the bore to the entry, usually installing a product pipe at the same time.

F. Pullback Loads: The tensile load (force) applied to a drill string during the pullback process.

G. Settlement Point: A point with elevation and spatial location established by survey prior to construction. The point is re-surveyed periodically to monitor ground movements. The point may be a nail, pin, subsurface settlement rod, borehole extensometer, or other device that can be readily located and surveyed.

H. Bore Plan/Drilling Work Plan: Written descriptions, together with sketches, drawings, schedules, and other documents defining CONTRACTOR'S plans and procedures for horizontal directional drilling. The submission of a Bore Plan or Drilling Work Plan, including drawings, shall be required for the sole purpose of providing the ENGINEER sufficient details to verify that the CONTRACTOR'S planned Work is in accordance with the intent of the Contract Documents.

## 1.04 DESIGN CRITERIA

A. The drilling equipment shall be capable of advancing through the geologic conditions to be encountered at the site, as described in the Preliminary Geotechnical Assessment Report (AECOM, 2017) and AECOM field investigation report (in preparation by AECOM) (the two AECOM reports) and anticipated by the CONTRACTOR. The CONTRACTOR is cautioned that, should interpretations be made, opinions formed, and conclusions drawn as a result of examining these reports, those interpretations, opinions and conclusions will be slowly of the CONTRACTOR. Before HDD, the CONTRACTOR may perform a subsurface exploration to obtain data required to analyze the subsurface conditions at the site to assure that the HDD will be performed properly. All costs for conducting subsurface investigations deemed necessary by the CONTRACTOR shall be borne by the CONTRACTOR.

B. The drilling fluid shall be designed for the geologic conditions to be encountered at the site, as described in the two AECOM reports and anticipated by the CONTRACTOR.

C. The drilling system shall include a fluid pump and separation plant that can achieve the rates of drilling fluid pumping, spoil separation, and slurry cleaning required by the CONTRACTOR to achieve planned production rates for the soils described in the two AECOM reports and anticipated by the CONTRACTOR. Shaker screens and hydrocyclones may be required for efficient separation of spoils. The CONTRACTOR is advised that the separation plant must fit within the allowable work areas shown on the plans.

D. All spoils and slurry must be contained in trucks, tanks, approved recirculation pits, or other containers at all times. Dumping of spoil or slurry on the ground, discharge into sewers, or discharge into the canal will not be permitted. All spoils will be transported and disposed of off-site at an approved disposal facility that meets all State of California and local requirements.

E. Perform work within construction easements shown on the Contract Drawings.

F. The pipeline shall be installed using the radii of curvatures and entry and exit angles shown on the Drawings, unless deviations are approved in writing by the ENGINEER.

G. Line and Grade Tolerances: The following tolerances apply to the installation of the HDD installed pipelines, at all locations between the entry and exit locations.

1. Horizontal Tolerance: Plus or minus one (1) foot.

2. Vertical Tolerance: Plus or minus one (1) foot.

H. Product pipe shall be filled with water and pressure tested prior to pullback. Product pipe shall be filled with water as it is pulled into the bore. Upon pullback completion, another pressure test shall be conducted.

I. Pipe rollers and lifters will be required to help the transition of the product pipe into the bore. The number of pipe rollers and lifters shall be determined by the CONTRACTOR and submitted as part of the work plan.

J. Surface settlement or heave of utilities and other features above the HDD centerlines and within the zone influenced by the HDD construction shall be limited to values that do not cause damage. The CONTRACTOR shall repair any damage resulting from settlement or heave caused by HDD activities at no additional cost to the OWNER. The CONTRACTOR shall backfill subsurface monitoring point casings after all drilling operations are completed (as specified in Section 02445 – Geotechnical Instrumentation and Monitoring).

K. Safety: It shall be the CONTRACTOR'S sole responsibility to see that the work is done in conformance with all applicable federal, state, and local safety requirements. Required safety equipment and procedures shall be employed by the CONTRACTOR at all times. All materials and methods of construction shall meet the applicable requirements of the County of Sacramento and OWNER Standard Specifications, and Special Provisions, and the applicable requirements of the Construction Safety Orders of the State of California Department of Industrial Relations and Division of Occupational Safety and Health. Particular attention is called to Subpart S of the Standards (29 CFR 1926/1920, published as U. S. Department of Labor Publication 207, revised October 1, 1979, and August 1, 1989. See Federal Register dated June 2, 1989, for the revised standard and commentary), and the Division 1, California Department of Industrial Relations, Chapter 4, Division of Industrial Safety, Subchapter 20, Tunnel Safety Orders. These Special Provisions shall supercede any conflicting requirements of the County of Sacramento Standard Specifications.

## 1.05 QUALITY ASSURANCE

A. Contractor Qualifications and Experience: The CONTRACTOR shall have at least three (3) years demonstrated successful experience installing pipelines using the horizontal directional drilling process on at least five (5) projects with similar diameters, installation lengths, and ground and groundwater conditions. At least three (3) of the projects must have been for 18-inch outer diameter or larger pipeline installations. These projects shall include individual bore lengths of at least 900 feet under similar soil conditions. The CONTRACTOR shall demonstrate successful completion of at least three (3) projects where product pipe was installed with horizontal directional drilling techniques. The CONTRACTOR shall furnish evidence of successful experience, including project owner, project name, location, diameter, length, depth, ground conditions, any problems encountered and how resolved, and any claims and how resolved. OWNER'S representative with address and telephone number shall be provided.

B. Qualifications and Experience of Contractor Personnel: The CONTRACTOR shall employ skilled, experienced superintendent(s) and personnel. The superintendent(s) shall have at least three (3) years' successful experience using the HDD process, on at least five (5) projects with similar diameters, pullback length, and ground conditions. The projects should be for pipelines of at least 900 feet individually installed pipe length. The CONTRACTOR shall furnish resumes of the superintendent(s) and key personnel. Personnel experience records should include project names, locations, pullback lengths, ground conditions, pipe materials, project description, project owner, engineer, and references with names, addresses, and telephone numbers. The superintendent listed in the submittal shall be on site during all construction related activities required for the HDD installation.

C. Daily Logs and Records: Daily logs and records shall be maintained by the CONTRACTOR, documenting drilling lengths, location of drill head, drilling fluid pressures and flow rates, drilling fluid losses, inadvertent returns, drilling times required for each pipe joint, any instances of retraction and re-drilling of the pilot bore or segments thereof, and any other relevant observations. The drilling fluid pressures shall be measured at the entry point and recorded at least once per drill pipe length. These records shall be maintained and provided daily to the ENGINEER. The position of the drill head shall be continuously tracked and recorded by a downhole wireline tracking locator system or approved equal. A plot of actual locations of the bore path shall be maintained and updated daily, or more frequently, as directed by the ENGINEER.

D. Advance Notice and Inspections: The CONTRACTOR shall provide at least 72 hours advance written notice to the ENGINEER of the planned inception of major drilling activities, including pilot bore launch, pre-reaming, reaming, and pipe pullback. The CONTRACTOR shall immediately notify the ENGINEER, in writing, when any significant problems are encountered or if ground conditions are construed by the

CONTRACTOR as being materially and significantly different than those represented within the Contract Documents. All work by the CONTRACTOR shall be performed in the presence of the ENGINEER, unless ENGINEER grants prior written approval to perform such work in ENGINEER'S absence.

E. Surveying Equipment and Procedures: All surveying equipment used for downhole surveying and tracking of the bore path and drill head shall be inspected and calibrated according to the equipment manufacturers' specifications prior to use. Proof of this inspection and calibration shall be provided to the ENGINEER prior to the commencement of drilling operations.

F. Pipe. The pipe will be certified by the CONTRACTOR as meeting all requirements of the specifications. The fabricated pipe will be pressure-tested by the CONTRACTOR prior to pullback and after installation is completed, in accordance with requirements specified in Section 02600 – Fusible PVC Pressure Pipe or Section 02725 – High-Density Polyethylene (HDPE) Pipe.

G. The CONTRACTOR shall allow access to the ENGINEER and shall furnish necessary assistance and cooperation to aid the ENGINEER in observations and data and sample collection, including, but not limited to the following:

1. The OWNER and/or ENGINEER shall have full access to the operator control container prior to, during, and following all HDD operations. This shall include, but not be limited to, providing visual access to real-time operator control screens, gauges, and indicators.

2. The OWNER and/or ENGINEER shall have full access to the slurry separation plant prior to, during, and following all HDD operations. This shall include, but not be limited to, full access to shaker screens, hydrocyclones, conveyor belts, and slurry and spoil holding tanks. The ENGINEER shall be allowed to collect soil samples from the shaker screens and/or spoil holding tanks of the slurry separation plant a minimum of once per installed pipe section, and whenever changes in conditions are observed or suspected.

## 1.06 SUBMITTALS

A. Submit the following in accordance with the requirements of Section 01300 – Contractor Submittals of these Specifications. Provide sufficient detail to allow the ENGINEER to judge whether or not the proposed equipment, materials, and procedures will meet the Contract requirements. The ENGINEER'S review of submitted details and data will be based on consideration of requirements for the completed work, utilities, and the possibility of unnecessary delays in the execution of the work to be constructed under this Contract. Review and acceptance of the contractor submittals by the ENGINEER shall

not be construed in any way as relieving the CONTRACTOR of its responsibilities under this Contract.

B. The CONTRACTOR shall submit for review a Horizontal Directional Drilling Work Plan with complete drawings and written description identifying details of the proposed method of construction and the sequence of operations to be performed during construction.

C. Qualifications: Submit written documentation of HDD superintendent and key personnel experience in accordance with Sections 1.5.A and 1.5.B. Submit evidence of Cal/OSHA certification for the Site Safety Representative.

D. Daily Logs: The CONTRACTOR shall submit daily logs and records in accordance with Section 1.5.C. Daily logs and records shall be provided to the ENGINEER by noon on the day following the shift for which the data or records were taken.

E. The CONTRACTOR shall provide at least 72 hours written notice of the planned inception of drilling activities as described in Section 1.5.D.

F. Shop Drawings: The CONTRACTOR shall submit all shop drawings to the ENGINEER.

1. All shop drawings shall have been reviewed and accepted by the ENGINEER prior to CONTRACTOR'S mobilization. All drawings shall be legible with dimensions accurately shown and clearly marked in English.

2. Drawings and photographs transmitted by a facsimile will not be accepted. The drawings shall include the planned equipment, equipment setup areas, pipe layout areas, any excavations or mud recirculating pits.

3. Submit calculations demonstrating that the tensile strength of the pipe is adequate to resist the expected pullback loads.

G. Schedule: At least 15 days prior to mobilization, the CONTRACTOR shall submit a detailed schedule for each HDD installation showing all major construction activities and durations, with beginning and completion dates shown. The schedule shall include:

1. One call utility locate requests and visual confirmation of all crossing utilities and all parallel utilities within ten (10) feet laterally of the bore centerline

2. Rig mobilization and setup

3. Pilot bore drilling

4. Pre-reaming and reaming

5. Layout and thermal butt-fusing of pipe

6. Pressure testing of pipe prior to pullback

7. Final reaming and pullback of pipe

8. Pressure testing of pipe after installation

9. Cleanup and restoration

This schedule shall be updated weekly, or more frequently, as directed by the ENGINEER.

H. Description of Methods, Equipment and Materials: The CONTRACTOR shall submit detailed descriptions of methods, equipment, and materials to be used for the pipeline installation. Descriptions of drilling fluid additives shall be accompanied by Materials Safety Data Sheets (MSDS) and manufacturers' descriptions and warranties. Descriptions of equipment shall include manufacturers' specifications, calibrations, appropriate drawings, photographs, and descriptions of any modifications since manufacture. All drawings and photos must be originals or clear photocopies with legible dimensions in English. Descriptions transmitted by a facsimile will not be accepted.

I. Surveying, Equipment and Procedures: The CONTRACTOR shall submit records of equipment calibrations and certifications for all equipment used for downhole surveys and tracking of the drill head. Procedures for operating the downhole survey tools shall be described in the submittal, including measures to verify the accuracy of the equipment readings.

J. Filling Methods: The CONTRACTOR shall submit methods and procedures for filling the pipe with fluid during pull back.

K. Equipment Layout: The CONTRACTOR shall submit sketches depicting the layout and locations of equipment within the rig side work area and pipe side work area, including any proposed drilling fluid containment and recirculation pits.

L. Calculations for Pullback: The CONTRACTOR shall submit calculations for pullback loads for the conditions and operating practices anticipated. These calculations shall be made and stamped by a licensed professional engineer registered in the State of California.

M. Pipe Stress Calculations: The CONTRACTOR shall submit calculations for pipe stresses expected to result from the pullback, bending, fluid buckling loads, earth loads, groundwater loads, and any other installation and service loads expected to be exerted on the pipe. All assumptions used for calculation purposes, including the radius of curvature, assumed drilling fluid weights, whether pipe is assumed to be filled or empty during pullback, and temperature shall be provided. These calculations shall be made and stamped by a licensed professional engineer registered in the State of California. The pipe thickness

must conform to the most conservative design with respect to design calculations for internal and external pressure, pullback and bending. The pipe dimension ratio (DR) shall not be greater than 11 in any case.

N. Calculations of Hydrofracture Pressure: The CONTRACTOR shall submit calculations identifying the minimum downhole that would cause hydrofracture or inadvertent drilling fluid returns to the channel. The calculation shall be made at the critical point in the alignment beneath the canal channel where the soil cover above the bore is the lowest. The calculations shall identify all parameters used and state all assumptions made in the calculations. The calculations shall be signed and stamped by a registered professional engineer in the State of California.

O. The CONTRACTOR shall submit a frac-out and surface spill contingency plan describing procedures for preventing drilling fluid losses or spills into the canal channel or fluid returns to the surface. The plan shall address observations to be made and plans for containment and cleanup, if spills or hydrofracture occur.

P. Rig Capacity: The CONTRACTOR shall submit details on the capacity of the drill rig verifying that the pullback capacity is greater than the required pullback calculated and submitted by the CONTRACTOR.

Q. Submit details on the pump and cleaning plant. Include dimensions, manufacturer's specifications, pump capacity, noise rating, and soundproofing details on the system.

1. Pump capacity should be specified for water at sea level elevation, and adjusted for actual elevation and fluid viscosity.

2. Provide details on the generator, including dimensions, noise ratings at 25 feet, and soundproofing. Confirm that the generator and other on-site equipment meets the maximum allowable noise level at 25 feet, or at the property line, whichever is less.

R. Radius of Curvature: The CONTRACTOR shall confirm that the bore can be completed using the radius of curvature designed in accordance with the specifications of the approved pipe along with calculations showing that installation stresses do not exceed allowable pipe stresses.

S. Plans for Disposal of Spoils and Drilling Fluids: The CONTRACTOR shall submit plans for disposal of waste materials resulting from the pipeline construction, including drilling fluids, cuttings, waste oil, fuel, discharge water, etc. The CONTRACTOR shall identify the disposal site and submit a letter indicating willingness and legal authority to accept the described and anticipated waste products.

T. Contingency Plans for Potential Problems: The CONTRACTOR shall submit contingency plans for remediation of potential problems that may be encountered during the drilling

operations. The contingency plans shall address the observations that would lead to the discovery of the problem and the methods that would be used to mitigate the problem. Potential problems that shall be addressed include:

1. Obstructions encountered
2. Utility strike
3. Drilling fluid pressures exceed maximum allowable pressures to avoid hydrofracture
4. Inadvertent drilling fluid returns to ground surface or surface water
5. Loss of circulation
6. Deviation from planned bore path
7. Inability to advance drill pipe
8. Hydrolock occurs or is suspected to occur
9. Drill pipe twisted off or broken off in borehole
10. Pipe collapse
11. Ground settlement of TAMC Railroad tracks or nearby roads is excessive
12. Ground settlement of existing utilities is excessive

U. Survey Measurements: Survey measurements of settlement points will be submitted to the ENGINEER by noon of the day following the shift for which the measurements were taken. Measurements will be made at least once per day, or more frequently, as directed by the ENGINEER. Survey measurements shall be accurate to the nearest 0.01 ft.

V. Protection of Adjacent Structures: Provide details on measures to be taken to monitor and protect adjacent utilities, structures, railroad tracks, and roadways, and provide details on monitoring equipment and provisions, including the layout of all settlement points and other monitoring points. Provide two copies of pre-construction survey and photographs with captions to document conditions prior to beginning HDD construction.

W. Safety Plan: The CONTRACTOR shall submit Safety Plan, including the name of the CONTRACTOR'S Site Safety Representative, emergency telephone numbers for medical facilities, and precautions for handling and disposal of any hazardous or flammable materials. The safety plan should include a code of safe practices and an emergency plan in accordance with OSHA and Cal/OSHA requirements.

X. The following shall be submitted as construction progresses and at the completion of construction.

1. Daily Logs and Records: The CONTRACTOR shall submit complete, legible, written daily logs and records as called for in Section 1.5.C of this specification and as directed by the ENGINEER, by noon of the following day to which the records correspond.

2. Variations in Plan and Profile: The CONTRACTOR shall document any variations between the actual plan and profile of the bore path and the location shown on the plans and specifications herein. The CONTRACTOR shall notify the ENGINEER immediately upon discovery of any deviations.

3. Mud Weights: The CONTRACTOR shall submit maximum expected mud and/or drilling fluid weights and densities for stabilization of the bore.

4. Submit maximum drilling and reaming rates anticipated for pilot bore and each reaming pass and confirm that pump capacity is adequate for these anticipated drilling rates for the drilling fluid weights and densities anticipated.

5. Pressure Test Records: The CONTRACTOR shall submit all pressure test records for both the pre-installation and post-installation tests.

6. Pilot Bore As-Built Profile: The CONTRACTOR shall submit an as-built profile of the pilot bore within 24 hours of completion of the pilot bore.

## 1.07 REFERENCES, CODES AND STANDARDS

# PART 2 PRODUCTS

## 2.01 PIPE

A. As described in Paragraph 1.1.A. The CONTRACTOR shall provide and install product pipe in accordance with Section 02600 – Fusible PVC Pressure Pipe or Section 02725 – High-Density Polyethylene (HDPE) Pipe.

## 2.02 WATER

A. The CONTRACTOR shall secure suitable source of water, and shall be responsible for transporting, storing, and disposing of any water required.

## 2.03 DRILLING FLUIDS

A. The CONTRACTOR shall provide Material Safety Data Sheets (MSDS) for all drilling fluids used or on site. The CONTRACTOR shall select mixture proportions to ensure bore stability, reduce drag on the pipe, and completely fill the annular space between the bore and the pipe to control settlement. Management and disposal of drilling fluids shall be the CONTRACTOR'S responsibility. Drilling fluids shall not be disposed of on-site or discharged to sanitary or storm sewers, or the canal.

## 2.04 DRILL PIPE

A. The CONTRACTOR shall provide high quality drill pipes that the CONTRACTOR has inspected and determined are adequate for the project requirements. Bent, cracked, or fatigued drill pipes shall not be used. Threads must be in good condition. The lengths of each drill pipe should be measured and recorded.

# PART 3 EXECUTION

## 3.01 GENERAL

A. The CONTRACTOR shall provide adequate control of surface water and drilling fluids drainage and runoff, and provide silt fences, hay bales, and wattles to prevent surface water or drilling fluids from entering the canal.

B. The CONTRACTOR shall not initiate directional drilling until all submittals are received, reviewed, and accepted by the ENGINEER.

C. The CONTRACTOR shall not initiate directional drilling until all required permits are obtained.

## 3.02 PROTECTION OF UNDERGROUND UTILITIES

A. The CONTRACTOR shall undertake the following steps prior to commencing drilling operations:

1. Visually confirm and stake all existing lines, cables, or other underground facilities including exposing any crossing utilities and utilities within ten (10) feet laterally of the designed drilled path.

2. Control drilling practices to prevent damage to existing utilities.

B. The CONTRACTOR shall be responsible for all losses and repairs occasioned by damage to underground utilities resulting from drilling operations.

## 3.03 WORK STAGING AREA

A. Work Staging: The CONTRACTOR shall limit his staging and work operations to the areas shown on the plans, or as otherwise accepted in writing by the ENGINEER, for storage of equipment and materials, parking, and actual pipe layout, drilling, and other work.

B. Construction Impacts: The CONTRACTOR shall maintain the work area in a manner that shall minimize adverse impacts on other public use activities. The CONTRACTOR shall

proceed with work in a safe, orderly manner, while maintaining the work site free of debris and unnecessary equipment and materials.

C. Control of Drilling Fluids: The CONTRACTOR shall follow all requirements of the Frac-Out Contingency Plan and control operational pressures, drilling mud weights, drilling speeds, and any other operational factors required to avoid hydrofracture fluid losses to formations, and control drilling fluid spillage. This includes any spillages or returns at entry and exit locations or at any intermediate point. All inadvertent returns or spills shall be promptly cleaned up. Due to the limited staging area, spoils shall not be stored on site. The CONTRACTOR shall maintain on site mobile spoil removal equipment during all drilling, pre-reaming, reaming, and pullback operations and shall be capable of quickly removing spoils. The CONTRACTOR shall immediately notify ENGINEER of any inadvertent returns or spills and immediately clean up the return or spill.

D. Combustible Materials: Combustible materials (fuel, oil, lubricants, etc.) shall be stored off-site or in a well-ventilated storage facility removed from the immediate vicinity of the drilling area by at least twenty (20) feet, and away from the adjacent water body by at least 20 feet. They shall also be provided with continuous spill containment.

E. Temporary Lighting: The CONTRACTOR shall procure and maintain all temporary lighting needed for CONTRACTOR'S operations, safety, testing, and inspection. Temporary lighting shall be removed after completion of construction.

F. Barricades, Warning Signs, and Lights: The CONTRACTOR shall, in accordance with approved Traffic and Safety Plans, erect appropriate barriers, warning lights, and signs, painted with approved colors, warnings, and graphics to ensure adequate warning to personnel and the public.

G. Site Security: The CONTRACTOR shall install an enclosure fence around the work area. The enclosure fence shall include a lockable gate and should be adequate to prevent entry of unauthorized persons.

H. Removal of Temporary Facilities: At the completion of construction, the CONTRACTOR shall remove all temporary facilities installed by the CONTRACTOR. Unused soil, aggregate, and other materials shall be removed and disposed of at approved sites. Any damage to streets, lawns, common areas, and sidewalks shall be restored to original or better conditions. All disturbed areas shall be re-vegetated.

## 3.04 MOBILIZATION

A. The CONTRACTOR shall mobilize all equipment, materials, and personnel necessary to construct the 12-inch nominal pipeline using the HDD process at the locations shown in the drawings.

1. Entry Area: The CONTRACTOR shall set up temporary workspace within the areas delineated in the plans and specifications. Appropriate precautions and best available technology (BAT) measures shall be employed by the CONTRACTOR to prevent erosion, surface drainage, and spillage of drilling fluids or other materials that could adversely impact the environmental quality of the site. To contain drilling fluids and cuttings and minimize infiltration of fluids, the CONTRACTOR shall maintain on-site appropriate equipment and materials to quickly contain and remove spills or frac-outs. Silt fences, hay wattles, hay bales and other BATs shall be used to line the work area to minimize erosion and contain any spillages or runoff. Shovels, brooms, buckets, and barrels shall be kept on-site to facilitate containment and cleanup. CONTRACTOR shall arrange for a vacuum truck or trailer unit to be available on standby and capable of responding to any spill incident within one (1) hour of the spill event's location.

2. Exit Area: The exit area shall have a drilling fluid pit for containing drilling fluids and cuttings. Silt fences, hay bales, wattles or other BATs shall be used to line the exit area to minimize erosion and runoff.

3. Pipe Layout Area: Layout area shall be free of stones, wood, debris and obstructions. Pipe rollers shall be provided by the CONTRACTOR to facilitate pipe pullback.

## 3.05 HORIZONTAL DIRECTIONAL DRILLING

A. Equipment: The CONTRACTOR shall provide all equipment, materials, and personnel necessary for completing the installation as shown on the plans and specified herein. The equipment and materials shall include but are not limited to:

1. Directional drilling rig with all ancillary equipment, including drill pipe, drilling fluid, cutting tools, reaming bits, swivels, expanders, motors, pumps, hoses, mixing equipment, drilling fluid processing equipment (cuttings separation equipment), downhole survey equipment, energized surface grid fluid pressure and flow rate monitoring equipment, spare parts, pipe handling equipment, crane, backhoe, roller, side boom tractors, control cabin, control equipment, and office equipment.

2. Drilling fluids, water, fuel, lubricant, polymers, or other additives.

3. Any other expendable or reusable materials, supplies, and equipment needed for the installation.

B. Drill Rig Capacity: The capacity of the directional drilling system used by the CONTRACTOR shall be adequate to install the specified pipeline. The system should have thrust, pullback, and torque capacities at least double, i.e., 100% greater, than the required

values of thrust, pullback, and torque calculated and submitted by the CONTRACTOR as necessary for the installation.

C. Pump Capacity: The pump used by the CONTRACTOR shall be adequate to supply the required flow rate and pressures at the anticipated drilling fluid viscosity at all times. Drilling speeds shall not exceed pump capacity.

D. Bore Tracking and Monitoring: At all times during the pilot bore the CONTRACTOR shall provide and maintain bore tracking and fluid monitoring system that is capable of accurately locating the position of the drill head in the x, y, and z axes and capable of monitoring fluid properties. The CONTRACTOR shall provide and maintain equipment that is capable of monitoring and recording drilling fluid pressures and drilling fluid flow rates. The CONTRACTOR shall record these data at least once per drill pipe length or every ten (10) feet or thirty (30) minutes, whichever is more frequent. These data shall be submitted to the ENGINEER by noon of the following day to which the data pertain.

1. Downhole and Surface Grid Tracking System: CONTRACTOR shall monitor and record x, y, and z coordinates relative to an established surface survey bench mark, from downhole survey data using downhole wireline system. Energized surface grid, or equivalent, shall be installed and used on both the north and south sides of the canal to augment the downhole wireline tracking system. The surface grid shall be laid out from water's edge to the southern edge of the rail tracks on the north side of the canal. The grid shall be installed from water's edge to exit point on the south side of the canal. The grids shall be surveyed to establish horizontal and vertical position to 0.1 feet accuracy. The data shall be continuously monitored and recorded at least once per drill pipe length or at ten (10) feet or thirty (30) minute intervals during drilling, whichever is most frequent.

2. Deviations between the recorded and design bore path shall be calculated and reported on the daily log. If the deviations exceed tolerances specified elsewhere, such occurrences shall be reported immediately to the ENGINEER. The CONTRACTOR shall undertake all necessary measures to correct deviations and return to design line and grade.

3. Drilling Fluid Pressures and Flow Rates: Drilling fluid pressures and flow rates shall be continuously monitored and recorded by the CONTRACTOR. The pressures shall be monitored at the pump. These measurements shall be made during pilot bore drilling, reaming, and pullback operations. Maximum allowable drilling speeds will be calculated for pilot boring and each reaming pass and shall not be exceeded for pilot boring or reaming passes.

4. Drilling Fluid Viscosity and Density (Mud Weight): The CONTRACTOR shall measure and record drilling fluid viscosity and density at least three (3) times per shift with at least two (2) hours between readings, using calibrated Marsh funnel

and mud balance. These measurements shall be included in daily logs submitted to the ENGINEER. The CONTRACTOR shall document modifications to the drilling fluids, by noting the types and quantities of drilling fluid additives and the dates and times when introduced. The reason for the addition of drilling fluid additives or other modifications shall be documented and reported.

E. Location of Entry and Exit Points: The CONTRACTOR shall employ licensed, experienced surveyors to locate the entry and exit points, and to establish horizontal and vertical datum for the bore and the pipe layout and fabrication areas.

F. Entry and Exit Angles: Drill entrance and exit angles shall be as shown on the Drawings, unless otherwise approved in writing by the ENGINEER.

G. Pilot Bore: The pilot bore shall follow the design path of the bore shown on the drawings.

1. Horizontal and Vertical Tolerances: Horizontal and vertical deviations shall be less than plus or minus one (1) foot from the design path centerline. The CONTRACTOR shall continuously monitor horizontal and vertical position and record the position at least once per drill pipe length, or at ten (10) feet or thirty (30) minute intervals, whichever is most frequent.

2. Radius of Curvature: The radius of curvature shall not be less than that shown on the drawings. The radius of curvature shall be calculated over the distance of three (3) drill pipe sections.

3. Entry and Exit Tolerances: The location of the entry shall be within a 3-foot circular area centered on the entry point coordinates shown in the drawings and verified by the CONTRACTOR‘S survey. The exit point shall be within a 6-foot wide by 10-foot long rectangle centered over the exit point coordinates shown on the plans and verified by the CONTRACTOR’S survey. The CONTRACTOR shall be solely responsible for all work necessary to correct excessive deviations from line and grade, including re-drilling, redesigning connections, and acquiring additional easement, at no additional cost to the OWNER and without schedule extension.

H. Pre-reaming and Reaming: The pilot bore shall be pre-reamed and reamed using equipment and methods submitted by the CONTRACTOR. The CONTRACTOR shall completely ream the bore to the final diameter selected by the CONTRACTOR.

I. Pre-Installation Pressure Test: The CONTRACTOR shall perform water pressure tests in accordance with Section 02600 – Fusible PVC Pressure Pipe or Section 02725 –High-Density Polyethylene (HDPE) Pipe prior to pipe pullback.

J. Pipe Pullback:

1. The pipe shall be installed by pulling it into the reamed bore path in a continuous operation, behind a final reaming tool selected by the CONTRACTOR.

2. The pipe shall be isolated from excessive torsional and axial stresses by a swivel device with a pre-established breakaway tensile capacity that is lower than the allowable tensile strength of the pipe.

3. The product pipe shall be inserted "wet." The pipe shall be filled with water as it enters the bore to reduce pullback loads and to ensure that adequate internal pressure is maintained at all points to counter balance collapse pressures.

4. The CONTRACTOR shall monitor and inspect pipe rollers and method for suspending pipe at entry during the pullback operation to avoid damage to the pipe.

5. The CONTRACTOR shall cease operations if the pipe is damaged and shall remove the pipe from the bore and repair the pipe using the manufacturer's recommended procedure or replace the damaged pipe before resuming installation.

6. Damage to the pipe resulting from installation is the responsibility of the CONTRACTOR, including costs for replacement and labor and materials. To confirm the integrity of the pipe upon completion of insertion and pull back, the CONTRACTOR shall perform the following test on the completed pipeline:

    a. A sphere or pig which is 3-5% smaller in diameter than the inside diameter of the pipe, and is capable of allowing water to pass through it, complete with a pulling cable on either side of sphere or pig shall be pulled through the entire length of the pipeline. If the pig or sphere cannot pass through the pipe, it shall be considered collapsed and damaged.

K. Post-Installation Pressure Test: The CONTRACTOR shall conduct a hydrostatic pressure and leakage testing of the installed pipeline. Final test shall be in accordance with Section 01656 – Pressure Pipe Testing and Disinfection. The CONTRACTOR will repair any defects discovered during this test, and repeat until the pipe passes the test.

L. Obstructions: The CONTRACTOR shall notify the ENGINEER immediately in the event that any obstruction is encountered that prevents further advancement of the drill pipe, or pullback of the pre-reamer, reamer, and/or pipe. The CONTRACTOR shall make all diligent and reasonable efforts to advance past the object by drilling slowly through the object, pulling back, and drilling along a new bore path that avoids the object, or excavating and exposing and removing the object, and all other reasonable attempts to continue the bore. The CONTRACTOR shall notify the ENGINEER of proposed measures to attempt to advance past the object, prior to initiating the attempt. If the CONTRACTOR attempts to pullback and re-drill, the CONTRACTOR shall adhere to

line and grade tolerances established in this specification section, unless the ENGINEER approves variance, in writing, prior to the CONTRACTOR'S attempt to re-drill. The CONTRACTOR and ENGINEER shall investigate the cause and together determine an appropriate response. Appropriate response may include revisions to equipment or methods, retraction and re-drilling of a portion of the bore, or abandonment of the hole. If abandonment is deemed necessary, the CONTRACTOR shall recover, to the extent practically possible, any drill pipe, product pipe, and tools in the bore, and properly abandon the bore, unless otherwise directed in writing by the ENGINEER. If the bore is abandoned, the CONTRACTOR shall pressure-grout the abandoned bore with a lean cement-sand grout mixture, or other approved materials. If the bore is abandoned, the CONTRACTOR shall be allowed to begin a second attempt to install the pipeline at an alternate location subject to approval, in writing, by the ENGINEER. The CONTRACTOR shall take all reasonable actions to complete the installation with minimal delays. The extra costs and payments associated with encountering a confirmed obstruction shall be negotiated between the OWNER and CONTRACTOR, based on reasonable time and materials. For purposes of this contract, an obstruction is defined as any hard object lying completely or partially within the design pathway of the bore and pipeline that prevents further advancement of the drill pipe, pre-reamer, reamer, and/or pipe, after all reasonable CONTRACTOR attempts to advance past the object or re-drill around the object have failed.

M. Site Restoration and Demobilization: The CONTRACTOR shall remove all equipment, materials, drilling fluids, muck, waste, and debris from the site and restore site to its original condition upon completion of the installation. Restoration and demobilization shall be completed by the CONTRACTOR within seven (7) days of the completion of the pipeline installation.

N. Settlement Monitoring: The CONTRACTOR shall monitor for settlement or heave before and during drilling operations as specified in Section 02445 – Geotechnical Instrumentation and Monitoring.

**END OF SECTION**

**TECHNICAL SPECIFICATIONS**
**DIVISION 2: SITE WORK**
**02413: HORIZONTAL DIRECTIONAL DRILLING**

## PART 1 GENERAL

### 1.01 REQUIREMENT

A. This section provides the minimum requirements for the trenchless installation of force main by horizontal directional drilling (HDD). The locations and approximate lengths of the HDD pipelines are shown on the Contract Drawings.

B. The CONTRACTOR shall furnish all labor, equipment, and materials necessary to install flexible plastic potable water pipeline by HDD. The pipe material is specified elsewhere in the project plans and specifications.

### 1.02 REFERENCES

A. Related Work

1. Section 01300 – Contractor Submittals
2. Section 02445 – Geotechnical Instrumentation and Monitoring
3. Section 02600 – Fusible PVC Pressure Pipe
4. Section 02725 – High-Density Polyethylene (HDPE) Pipe

B. American Petroleum Institute (API):

1. API Bulletin 13D, 1985. Bulleting on the Rheology of Oil-Well Drilling Fluids, Second, Edition, Dallas, Texas.
2. API Recommended Practice 13B-1, 2009. Recommended Practice for Field Testing Water-Based Drilling Fluids, Fourth Edition, Dallas, Texas.
3. API Specification 13A, 2010. Specification for Drilling Fluid Materials, Eighteenth Edition, Dallas, Texas.

C. Other Guidelines:

1. Installation of Pipelines by Horizontal Directional Drilling, Pipeline Research Committee, American Gas Association, PR-227-9424, April 1995.
2. Horizontal Directional Drilling Good Practices Guidelines, 2008, North American Society for Trenchless Technology.

3. Installation of Pipelines Beneath Levees Using Horizontal Directional Drilling, US Army Corps of Engineers, Waterways Experiment Station, Final Report, CPAR-GL-98-1, April 1998.

4. IADC Drilling Manual, 2015. Twelves Edition, Houston, Texas, International Associated of Drilling Contractors.

5. Pressure Pipeline Design for Water and Wastewater, American Society for Civil Engineers, 2nd ed., 1992.

6. Tables for Hydraulic Design of Pipes, Sewers, and Channels, D. Barr and HR Wallingford, Eighth Edition., 2006.

## 1.03 DEFINITIONS

A. Horizontal Directional Drilling: For the purposes of this specification, HDD consists of a guided, steerable system for the installation of pipes, conduits and cables in a shallow arc using a surface-launched drilling rig. The term applies to large-scale crossings in which a fluid filled pilot bore is drilled while rotating the drill string, and is subsequently enlarged by a reamer to the size required for the product pipe. The required deviation during pilot boring is provided by the positioning of a bent sub. Tracking of the drill string is achieved by using a downhole wireline survey tool, which may be augmented by using an energized wire grid at the surface.

B. Drilling Fluid/Mud: A mixture of water, bentonite, polymers, and/or other non-hazardous products, continuously pumped to the cutting head to facilitate the removal of soil cuttings, and stabilization of the bore. These fluids also cool the cutting tools and lubricate the pipe string.

C. Pilot Bore: The action of creating the first guided pass of the HDD process which is then reamed in one or more passes to the size required to allow pullback of the pipe or casing.

D. Cutterhead/Cutting Head: Any tool or system of tools on a common support which excavates at the face of a bore.

E. Pullback: That part of a horizontal directional drilling process in which the drill string is pulled back through the bore to the entry, usually installing a product pipe at the same time.

F. Pullback Loads: The tensile load (force) applied to a drill string during the pullback process.

G. Settlement Point: A point with elevation and spatial location established by survey prior to construction. The point is re-surveyed periodically to monitor ground movements. The point may be a nail, pin, subsurface settlement rod, borehole extensometer, or other device that can be readily located and surveyed.

H. Bore Plan/Drilling Work Plan: Written descriptions, together with sketches, drawings, schedules, and other documents defining CONTRACTOR'S plans and procedures for horizontal directional drilling. The submission of a Bore Plan or Drilling Work Plan, including drawings, shall be required for the sole purpose of providing the ENGINEER sufficient details to verify that the CONTRACTOR'S planned Work is in accordance with the intent of the Contract Documents.

## 1.04 DESIGN CRITERIA

A. The drilling equipment shall be capable of advancing through the geologic conditions to be encountered at the site, as described in the Preliminary Geotechnical Assessment Report (AECOM, 2017) and AECOM field investigation report (in preparation by AECOM) (the two AECOM reports) and anticipated by the CONTRACTOR. The CONTRACTOR is cautioned that, should interpretations be made, opinions formed, and conclusions drawn as a result of examining these reports, those interpretations, opinions and conclusions will be slowly of the CONTRACTOR. Before HDD, the CONTRACTOR may perform a subsurface exploration to obtain data required to analyze the subsurface conditions at the site to assure that the HDD will be performed properly. All costs for conducting subsurface investigations deemed necessary by the CONTRACTOR shall be borne by the CONTRACTOR.

B. The drilling fluid shall be designed for the geologic conditions to be encountered at the site, as described in the two AECOM reports and anticipated by the CONTRACTOR.

C. The drilling system shall include a fluid pump and separation plant that can achieve the rates of drilling fluid pumping, spoil separation, and slurry cleaning required by the CONTRACTOR to achieve planned production rates for the soils described in the two AECOM reports and anticipated by the CONTRACTOR. Shaker screens and hydrocyclones may be required for efficient separation of spoils. The CONTRACTOR is advised that the separation plant must fit within the allowable work areas shown on the plans.

D. All spoils and slurry must be contained in trucks, tanks, approved recirculation pits, or other containers at all times. Dumping of spoil or slurry on the ground, discharge into sewers, or discharge into the canal will not be permitted. All spoils will be transported and disposed of off-site at an approved disposal facility that meets all State of California and local requirements.

E. Perform work within construction easements shown on the Contract Drawings.

F. The pipeline shall be installed using the radii of curvatures and entry and exit angles shown on the Drawings, unless deviations are approved in writing by the ENGINEER.

G. Line and Grade Tolerances: The following tolerances apply to the installation of the HDD installed pipelines, at all locations between the entry and exit locations.

1. Horizontal Tolerance: Plus or minus one (1) foot.

2. Vertical Tolerance: Plus or minus one (1) foot.

H. Product pipe shall be filled with water and pressure tested prior to pullback. Product pipe shall be filled with water as it is pulled into the bore. Upon pullback completion, another pressure test shall be conducted.

I. Pipe rollers and lifters will be required to help the transition of the product pipe into the bore. The number of pipe rollers and lifters shall be determined by the CONTRACTOR and submitted as part of the work plan.

J. Surface settlement or heave of utilities and other features above the HDD centerlines and within the zone influenced by the HDD construction shall be limited to values that do not cause damage. The CONTRACTOR shall repair any damage resulting from settlement or heave caused by HDD activities at no additional cost to the OWNER. The CONTRACTOR shall backfill subsurface monitoring point casings after all drilling operations are completed (as specified in Section 02445 – Geotechnical Instrumentation and Monitoring).

K. Safety: It shall be the CONTRACTOR'S sole responsibility to see that the work is done in conformance with all applicable federal, state, and local safety requirements. Required safety equipment and procedures shall be employed by the CONTRACTOR at all times. All materials and methods of construction shall meet the applicable requirements of the County of Sacramento and OWNER Standard Specifications, and Special Provisions, and the applicable requirements of the Construction Safety Orders of the State of California Department of Industrial Relations and Division of Occupational Safety and Health. Particular attention is called to Subpart S of the Standards (29 CFR 1926/1920, published as U. S. Department of Labor Publication 207, revised October 1, 1979, and August 1, 1989. See Federal Register dated June 2, 1989, for the revised standard and commentary), and the Division 1, California Department of Industrial Relations, Chapter 4, Division of Industrial Safety, Subchapter 20, Tunnel Safety Orders. These Special Provisions shall supercede any conflicting requirements of the County of Sacramento Standard Specifications.

## 1.05 QUALITY ASSURANCE

A. Contractor Qualifications and Experience: The CONTRACTOR shall have at least three (3) years demonstrated successful experience installing pipelines using the horizontal directional drilling process on at least five (5) projects with similar diameters, installation lengths, and ground and groundwater conditions. At least three (3) of the projects must have been for 18-inch outer diameter or larger pipeline installations. These projects shall include individual bore lengths of at least 900 feet under similar soil conditions. The CONTRACTOR shall demonstrate successful completion of at least three (3) projects where product pipe was installed with horizontal directional drilling techniques. The CONTRACTOR shall furnish evidence of successful experience, including project owner, project name, location, diameter, length, depth, ground conditions, any problems encountered and how resolved, and any claims and how resolved. OWNER'S representative with address and telephone number shall be provided.

B. Qualifications and Experience of Contractor Personnel: The CONTRACTOR shall employ skilled, experienced superintendent(s) and personnel. The superintendent(s) shall have at least three (3) years' successful experience using the HDD process, on at least five (5) projects with similar diameters, pullback length, and ground conditions. The projects should be for pipelines of at least 900 feet individually installed pipe length. The CONTRACTOR shall furnish resumes of the superintendent(s) and key personnel. Personnel experience records should include project names, locations, pullback lengths, ground conditions, pipe materials, project description, project owner, engineer, and references with names, addresses, and telephone numbers. The superintendent listed in the submittal shall be on site during all construction related activities required for the HDD installation.

C. Daily Logs and Records: Daily logs and records shall be maintained by the CONTRACTOR, documenting drilling lengths, location of drill head, drilling fluid pressures and flow rates, drilling fluid losses, inadvertent returns, drilling times required for each pipe joint, any instances of retraction and re-drilling of the pilot bore or segments thereof, and any other relevant observations. The drilling fluid pressures shall be measured at the entry point and recorded at least once per drill pipe length. These records shall be maintained and provided daily to the ENGINEER. The position of the drill head shall be continuously tracked and recorded by a downhole wireline tracking locator system or approved equal. A plot of actual locations of the bore path shall be maintained and updated daily, or more frequently, as directed by the ENGINEER.

D. Advance Notice and Inspections: The CONTRACTOR shall provide at least 72 hours advance written notice to the ENGINEER of the planned inception of major drilling activities, including pilot bore launch, pre-reaming, reaming, and pipe pullback. The CONTRACTOR shall immediately notify the ENGINEER, in writing, when any significant problems are encountered or if ground conditions are construed by the

CONTRACTOR as being materially and significantly different than those represented within the Contract Documents. All work by the CONTRACTOR shall be performed in the presence of the ENGINEER, unless ENGINEER grants prior written approval to perform such work in ENGINEER'S absence.

E. Surveying Equipment and Procedures: All surveying equipment used for downhole surveying and tracking of the bore path and drill head shall be inspected and calibrated according to the equipment manufacturers' specifications prior to use. Proof of this inspection and calibration shall be provided to the ENGINEER prior to the commencement of drilling operations.

F. Pipe. The pipe will be certified by the CONTRACTOR as meeting all requirements of the specifications. The fabricated pipe will be pressure-tested by the CONTRACTOR prior to pullback and after installation is completed, in accordance with requirements specified in Section 02600 – Fusible PVC Pressure Pipe or Section 02725 – High-Density Polyethylene (HDPE) Pipe.

G. The CONTRACTOR shall allow access to the ENGINEER and shall furnish necessary assistance and cooperation to aid the ENGINEER in observations and data and sample collection, including, but not limited to the following:

1. The OWNER and/or ENGINEER shall have full access to the operator control container prior to, during, and following all HDD operations. This shall include, but not be limited to, providing visual access to real-time operator control screens, gauges, and indicators.

2. The OWNER and/or ENGINEER shall have full access to the slurry separation plant prior to, during, and following all HDD operations. This shall include, but not be limited to, full access to shaker screens, hydrocyclones, conveyor belts, and slurry and spoil holding tanks. The ENGINEER shall be allowed to collect soil samples from the shaker screens and/or spoil holding tanks of the slurry separation plant a minimum of once per installed pipe section, and whenever changes in conditions are observed or suspected.

## 1.06 SUBMITTALS

A. Submit the following in accordance with the requirements of Section 01300 – Contractor Submittals of these Specifications. Provide sufficient detail to allow the ENGINEER to judge whether or not the proposed equipment, materials, and procedures will meet the Contract requirements. The ENGINEER'S review of submitted details and data will be based on consideration of requirements for the completed work, utilities, and the possibility of unnecessary delays in the execution of the work to be constructed under this Contract. Review and acceptance of the contractor submittals by the ENGINEER shall

not be construed in any way as relieving the CONTRACTOR of its responsibilities under this Contract.

B. The CONTRACTOR shall submit for review a Horizontal Directional Drilling Work Plan with complete drawings and written description identifying details of the proposed method of construction and the sequence of operations to be performed during construction.

C. Qualifications: Submit written documentation of HDD superintendent and key personnel experience in accordance with Sections 1.5.A and 1.5.B. Submit evidence of Cal/OSHA certification for the Site Safety Representative.

D. Daily Logs: The CONTRACTOR shall submit daily logs and records in accordance with Section 1.5.C. Daily logs and records shall be provided to the ENGINEER by noon on the day following the shift for which the data or records were taken.

E. The CONTRACTOR shall provide at least 72 hours written notice of the planned inception of drilling activities as described in Section 1.5.D.

F. Shop Drawings: The CONTRACTOR shall submit all shop drawings to the ENGINEER.

1. All shop drawings shall have been reviewed and accepted by the ENGINEER prior to CONTRACTOR'S mobilization. All drawings shall be legible with dimensions accurately shown and clearly marked in English.

2. Drawings and photographs transmitted by a facsimile will not be accepted. The drawings shall include the planned equipment, equipment setup areas, pipe layout areas, any excavations or mud recirculating pits.

3. Submit calculations demonstrating that the tensile strength of the pipe is adequate to resist the expected pullback loads.

G. Schedule: At least 15 days prior to mobilization, the CONTRACTOR shall submit a detailed schedule for each HDD installation showing all major construction activities and durations, with beginning and completion dates shown. The schedule shall include:

1. One call utility locate requests and visual confirmation of all crossing utilities and all parallel utilities within ten (10) feet laterally of the bore centerline

2. Rig mobilization and setup

3. Pilot bore drilling

4. Pre-reaming and reaming

5. Layout and thermal butt-fusing of pipe

6. Pressure testing of pipe prior to pullback

7. Final reaming and pullback of pipe

8. Pressure testing of pipe after installation

9. Cleanup and restoration

This schedule shall be updated weekly, or more frequently, as directed by the ENGINEER.

H. Description of Methods, Equipment and Materials: The CONTRACTOR shall submit detailed descriptions of methods, equipment, and materials to be used for the pipeline installation. Descriptions of drilling fluid additives shall be accompanied by Materials Safety Data Sheets (MSDS) and manufacturers' descriptions and warranties. Descriptions of equipment shall include manufacturers' specifications, calibrations, appropriate drawings, photographs, and descriptions of any modifications since manufacture. All drawings and photos must be originals or clear photocopies with legible dimensions in English. Descriptions transmitted by a facsimile will not be accepted.

I. Surveying, Equipment and Procedures: The CONTRACTOR shall submit records of equipment calibrations and certifications for all equipment used for downhole surveys and tracking of the drill head. Procedures for operating the downhole survey tools shall be described in the submittal, including measures to verify the accuracy of the equipment readings.

J. Filling Methods: The CONTRACTOR shall submit methods and procedures for filling the pipe with fluid during pull back.

K. Equipment Layout: The CONTRACTOR shall submit sketches depicting the layout and locations of equipment within the rig side work area and pipe side work area, including any proposed drilling fluid containment and recirculation pits.

L. Calculations for Pullback: The CONTRACTOR shall submit calculations for pullback loads for the conditions and operating practices anticipated. These calculations shall be made and stamped by a licensed professional engineer registered in the State of California.

M. Pipe Stress Calculations: The CONTRACTOR shall submit calculations for pipe stresses expected to result from the pullback, bending, fluid buckling loads, earth loads, groundwater loads, and any other installation and service loads expected to be exerted on the pipe. All assumptions used for calculation purposes, including the radius of curvature, assumed drilling fluid weights, whether pipe is assumed to be filled or empty during pullback, and temperature shall be provided. These calculations shall be made and stamped by a licensed professional engineer registered in the State of California. The pipe thickness

must conform to the most conservative design with respect to design calculations for internal and external pressure, pullback and bending. The pipe dimension ratio (DR) shall not be greater than 11 in any case.

N. Calculations of Hydrofracture Pressure: The CONTRACTOR shall submit calculations identifying the minimum downhole that would cause hydrofracture or inadvertent drilling fluid returns to the channel. The calculation shall be made at the critical point in the alignment beneath the canal channel where the soil cover above the bore is the lowest. The calculations shall identify all parameters used and state all assumptions made in the calculations. The calculations shall be signed and stamped by a registered professional engineer in the State of California.

O. The CONTRACTOR shall submit a frac-out and surface spill contingency plan describing procedures for preventing drilling fluid losses or spills into the canal channel or fluid returns to the surface. The plan shall address observations to be made and plans for containment and cleanup, if spills or hydrofracture occur.

P. Rig Capacity: The CONTRACTOR shall submit details on the capacity of the drill rig verifying that the pullback capacity is greater than the required pullback calculated and submitted by the CONTRACTOR.

Q. Submit details on the pump and cleaning plant. Include dimensions, manufacturer's specifications, pump capacity, noise rating, and soundproofing details on the system.

1. Pump capacity should be specified for water at sea level elevation, and adjusted for actual elevation and fluid viscosity.

2. Provide details on the generator, including dimensions, noise ratings at 25 feet, and soundproofing. Confirm that the generator and other on-site equipment meets the maximum allowable noise level at 25 feet, or at the property line, whichever is less.

R. Radius of Curvature: The CONTRACTOR shall confirm that the bore can be completed using the radius of curvature designed in accordance with the specifications of the approved pipe along with calculations showing that installation stresses do not exceed allowable pipe stresses.

S. Plans for Disposal of Spoils and Drilling Fluids: The CONTRACTOR shall submit plans for disposal of waste materials resulting from the pipeline construction, including drilling fluids, cuttings, waste oil, fuel, discharge water, etc. The CONTRACTOR shall identify the disposal site and submit a letter indicating willingness and legal authority to accept the described and anticipated waste products.

T. Contingency Plans for Potential Problems: The CONTRACTOR shall submit contingency plans for remediation of potential problems that may be encountered during the drilling

operations. The contingency plans shall address the observations that would lead to the discovery of the problem and the methods that would be used to mitigate the problem. Potential problems that shall be addressed include:

1. Obstructions encountered
2. Utility strike
3. Drilling fluid pressures exceed maximum allowable pressures to avoid hydrofracture
4. Inadvertent drilling fluid returns to ground surface or surface water
5. Loss of circulation
6. Deviation from planned bore path
7. Inability to advance drill pipe
8. Hydrolock occurs or is suspected to occur
9. Drill pipe twisted off or broken off in borehole
10. Pipe collapse
11. Ground settlement of TAMC Railroad tracks or nearby roads is excessive
12. Ground settlement of existing utilities is excessive

U. Survey Measurements: Survey measurements of settlement points will be submitted to the ENGINEER by noon of the day following the shift for which the measurements were taken. Measurements will be made at least once per day, or more frequently, as directed by the ENGINEER. Survey measurements shall be accurate to the nearest 0.01 ft.

V. Protection of Adjacent Structures: Provide details on measures to be taken to monitor and protect adjacent utilities, structures, railroad tracks, and roadways, and provide details on monitoring equipment and provisions, including the layout of all settlement points and other monitoring points. Provide two copies of pre-construction survey and photographs with captions to document conditions prior to beginning HDD construction.

W. Safety Plan: The CONTRACTOR shall submit Safety Plan, including the name of the CONTRACTOR'S Site Safety Representative, emergency telephone numbers for medical facilities, and precautions for handling and disposal of any hazardous or flammable materials. The safety plan should include a code of safe practices and an emergency plan in accordance with OSHA and Cal/OSHA requirements.

X. The following shall be submitted as construction progresses and at the completion of construction.

1. Daily Logs and Records: The CONTRACTOR shall submit complete, legible, written daily logs and records as called for in Section 1.5.C of this specification and as directed by the ENGINEER, by noon of the following day to which the records correspond.

2. Variations in Plan and Profile: The CONTRACTOR shall document any variations between the actual plan and profile of the bore path and the location shown on the plans and specifications herein. The CONTRACTOR shall notify the ENGINEER immediately upon discovery of any deviations.

3. Mud Weights: The CONTRACTOR shall submit maximum expected mud and/or drilling fluid weights and densities for stabilization of the bore.

4. Submit maximum drilling and reaming rates anticipated for pilot bore and each reaming pass and confirm that pump capacity is adequate for these anticipated drilling rates for the drilling fluid weights and densities anticipated.

5. Pressure Test Records: The CONTRACTOR shall submit all pressure test records for both the pre-installation and post-installation tests.

6. Pilot Bore As-Built Profile: The CONTRACTOR shall submit an as-built profile of the pilot bore within 24 hours of completion of the pilot bore.

## 1.07 REFERENCES, CODES AND STANDARDS

# PART 2 PRODUCTS

## 2.01 PIPE

A. As described in Paragraph 1.1.A. The CONTRACTOR shall provide and install product pipe in accordance with Section 02600 – Fusible PVC Pressure Pipe or Section 02725 – High-Density Polyethylene (HDPE) Pipe.

## 2.02 WATER

A. The CONTRACTOR shall secure suitable source of water, and shall be responsible for transporting, storing, and disposing of any water required.

## 2.03 DRILLING FLUIDS

A. The CONTRACTOR shall provide Material Safety Data Sheets (MSDS) for all drilling fluids used or on site. The CONTRACTOR shall select mixture proportions to ensure bore stability, reduce drag on the pipe, and completely fill the annular space between the bore and the pipe to control settlement. Management and disposal of drilling fluids shall be the CONTRACTOR'S responsibility. Drilling fluids shall not be disposed of on-site or discharged to sanitary or storm sewers, or the canal.

## 2.04 DRILL PIPE

A. The CONTRACTOR shall provide high quality drill pipes that the CONTRACTOR has inspected and determined are adequate for the project requirements. Bent, cracked, or fatigued drill pipes shall not be used. Threads must be in good condition. The lengths of each drill pipe should be measured and recorded.

# PART 3 EXECUTION

## 3.01 GENERAL

A. The CONTRACTOR shall provide adequate control of surface water and drilling fluids drainage and runoff, and provide silt fences, hay bales, and wattles to prevent surface water or drilling fluids from entering the canal.

B. The CONTRACTOR shall not initiate directional drilling until all submittals are received, reviewed, and accepted by the ENGINEER.

C. The CONTRACTOR shall not initiate directional drilling until all required permits are obtained.

## 3.02 PROTECTION OF UNDERGROUND UTILITIES

A. The CONTRACTOR shall undertake the following steps prior to commencing drilling operations:

1. Visually confirm and stake all existing lines, cables, or other underground facilities including exposing any crossing utilities and utilities within ten (10) feet laterally of the designed drilled path.

2. Control drilling practices to prevent damage to existing utilities.

B. The CONTRACTOR shall be responsible for all losses and repairs occasioned by damage to underground utilities resulting from drilling operations.

## 3.03 WORK STAGING AREA

A. Work Staging: The CONTRACTOR shall limit his staging and work operations to the areas shown on the plans, or as otherwise accepted in writing by the ENGINEER, for storage of equipment and materials, parking, and actual pipe layout, drilling, and other work.

B. Construction Impacts: The CONTRACTOR shall maintain the work area in a manner that shall minimize adverse impacts on other public use activities. The CONTRACTOR shall

proceed with work in a safe, orderly manner, while maintaining the work site free of debris and unnecessary equipment and materials.

C. Control of Drilling Fluids: The CONTRACTOR shall follow all requirements of the Frac-Out Contingency Plan and control operational pressures, drilling mud weights, drilling speeds, and any other operational factors required to avoid hydrofracture fluid losses to formations, and control drilling fluid spillage. This includes any spillages or returns at entry and exit locations or at any intermediate point. All inadvertent returns or spills shall be promptly cleaned up. Due to the limited staging area, spoils shall not be stored on site. The CONTRACTOR shall maintain on site mobile spoil removal equipment during all drilling, pre-reaming, reaming, and pullback operations and shall be capable of quickly removing spoils. The CONTRACTOR shall immediately notify ENGINEER of any inadvertent returns or spills and immediately clean up the return or spill.

D. Combustible Materials: Combustible materials (fuel, oil, lubricants, etc.) shall be stored off-site or in a well-ventilated storage facility removed from the immediate vicinity of the drilling area by at least twenty (20) feet, and away from the adjacent water body by at least 20 feet. They shall also be provided with continuous spill containment.

E. Temporary Lighting: The CONTRACTOR shall procure and maintain all temporary lighting needed for CONTRACTOR'S operations, safety, testing, and inspection. Temporary lighting shall be removed after completion of construction.

F. Barricades, Warning Signs, and Lights: The CONTRACTOR shall, in accordance with approved Traffic and Safety Plans, erect appropriate barriers, warning lights, and signs, painted with approved colors, warnings, and graphics to ensure adequate warning to personnel and the public.

G. Site Security: The CONTRACTOR shall install an enclosure fence around the work area. The enclosure fence shall include a lockable gate and should be adequate to prevent entry of unauthorized persons.

H. Removal of Temporary Facilities: At the completion of construction, the CONTRACTOR shall remove all temporary facilities installed by the CONTRACTOR. Unused soil, aggregate, and other materials shall be removed and disposed of at approved sites. Any damage to streets, lawns, common areas, and sidewalks shall be restored to original or better conditions. All disturbed areas shall be re-vegetated.

## 3.04 MOBILIZATION

A. The CONTRACTOR shall mobilize all equipment, materials, and personnel necessary to construct the 12-inch nominal pipeline using the HDD process at the locations shown in the drawings.

1. Entry Area: The CONTRACTOR shall set up temporary workspace within the areas delineated in the plans and specifications. Appropriate precautions and best available technology (BAT) measures shall be employed by the CONTRACTOR to prevent erosion, surface drainage, and spillage of drilling fluids or other materials that could adversely impact the environmental quality of the site. To contain drilling fluids and cuttings and minimize infiltration of fluids, the CONTRACTOR shall maintain on-site appropriate equipment and materials to quickly contain and remove spills or frac-outs. Silt fences, hay wattles, hay bales and other BATs shall be used to line the work area to minimize erosion and contain any spillages or runoff. Shovels, brooms, buckets, and barrels shall be kept on-site to facilitate containment and cleanup. CONTRACTOR shall arrange for a vacuum truck or trailer unit to be available on standby and capable of responding to any spill incident within one (1) hour of the spill event's location.

2. Exit Area: The exit area shall have a drilling fluid pit for containing drilling fluids and cuttings. Silt fences, hay bales, wattles or other BATs shall be used to line the exit area to minimize erosion and runoff.

3. Pipe Layout Area: Layout area shall be free of stones, wood, debris and obstructions. Pipe rollers shall be provided by the CONTRACTOR to facilitate pipe pullback.

## 3.05 HORIZONTAL DIRECTIONAL DRILLING

A. Equipment: The CONTRACTOR shall provide all equipment, materials, and personnel necessary for completing the installation as shown on the plans and specified herein. The equipment and materials shall include but are not limited to:

1. Directional drilling rig with all ancillary equipment, including drill pipe, drilling fluid, cutting tools, reaming bits, swivels, expanders, motors, pumps, hoses, mixing equipment, drilling fluid processing equipment (cuttings separation equipment), downhole survey equipment, energized surface grid fluid pressure and flow rate monitoring equipment, spare parts, pipe handling equipment, crane, backhoe, roller, side boom tractors, control cabin, control equipment, and office equipment.

2. Drilling fluids, water, fuel, lubricant, polymers, or other additives.

3. Any other expendable or reusable materials, supplies, and equipment needed for the installation.

B. Drill Rig Capacity: The capacity of the directional drilling system used by the CONTRACTOR shall be adequate to install the specified pipeline. The system should have thrust, pullback, and torque capacities at least double, i.e., 100% greater, than the required

values of thrust, pullback, and torque calculated and submitted by the CONTRACTOR as necessary for the installation.

C. Pump Capacity: The pump used by the CONTRACTOR shall be adequate to supply the required flow rate and pressures at the anticipated drilling fluid viscosity at all times. Drilling speeds shall not exceed pump capacity.

D. Bore Tracking and Monitoring: At all times during the pilot bore the CONTRACTOR shall provide and maintain bore tracking and fluid monitoring system that is capable of accurately locating the position of the drill head in the x, y, and z axes and capable of monitoring fluid properties. The CONTRACTOR shall provide and maintain equipment that is capable of monitoring and recording drilling fluid pressures and drilling fluid flow rates. The CONTRACTOR shall record these data at least once per drill pipe length or every ten (10) feet or thirty (30) minutes, whichever is more frequent. These data shall be submitted to the ENGINEER by noon of the following day to which the data pertain.

1. Downhole and Surface Grid Tracking System: CONTRACTOR shall monitor and record x, y, and z coordinates relative to an established surface survey bench mark, from downhole survey data using downhole wireline system. Energized surface grid, or equivalent, shall be installed and used on both the north and south sides of the canal to augment the downhole wireline tracking system. The surface grid shall be laid out from water's edge to the southern edge of the rail tracks on the north side of the canal. The grid shall be installed from water's edge to exit point on the south side of the canal. The grids shall be surveyed to establish horizontal and vertical position to 0.1 feet accuracy. The data shall be continuously monitored and recorded at least once per drill pipe length or at ten (10) feet or thirty (30) minute intervals during drilling, whichever is most frequent.

2. Deviations between the recorded and design bore path shall be calculated and reported on the daily log. If the deviations exceed tolerances specified elsewhere, such occurrences shall be reported immediately to the ENGINEER. The CONTRACTOR shall undertake all necessary measures to correct deviations and return to design line and grade.

3. Drilling Fluid Pressures and Flow Rates: Drilling fluid pressures and flow rates shall be continuously monitored and recorded by the CONTRACTOR. The pressures shall be monitored at the pump. These measurements shall be made during pilot bore drilling, reaming, and pullback operations. Maximum allowable drilling speeds will be calculated for pilot boring and each reaming pass and shall not be exceeded for pilot boring or reaming passes.

4. Drilling Fluid Viscosity and Density (Mud Weight): The CONTRACTOR shall measure and record drilling fluid viscosity and density at least three (3) times per shift with at least two (2) hours between readings, using calibrated Marsh funnel

and mud balance. These measurements shall be included in daily logs submitted to the ENGINEER. The CONTRACTOR shall document modifications to the drilling fluids, by noting the types and quantities of drilling fluid additives and the dates and times when introduced. The reason for the addition of drilling fluid additives or other modifications shall be documented and reported.

E. Location of Entry and Exit Points: The CONTRACTOR shall employ licensed, experienced surveyors to locate the entry and exit points, and to establish horizontal and vertical datum for the bore and the pipe layout and fabrication areas.

F. Entry and Exit Angles: Drill entrance and exit angles shall be as shown on the Drawings, unless otherwise approved in writing by the ENGINEER.

G. Pilot Bore: The pilot bore shall follow the design path of the bore shown on the drawings.

1. Horizontal and Vertical Tolerances: Horizontal and vertical deviations shall be less than plus or minus one (1) foot from the design path centerline. The CONTRACTOR shall continuously monitor horizontal and vertical position and record the position at least once per drill pipe length, or at ten (10) feet or thirty (30) minute intervals, whichever is most frequent.

2. Radius of Curvature: The radius of curvature shall not be less than that shown on the drawings. The radius of curvature shall be calculated over the distance of three (3) drill pipe sections.

3. Entry and Exit Tolerances: The location of the entry shall be within a 3-foot circular area centered on the entry point coordinates shown in the drawings and verified by the CONTRACTOR‘S survey. The exit point shall be within a 6-foot wide by 10-foot long rectangle centered over the exit point coordinates shown on the plans and verified by the CONTRACTOR’S survey. The CONTRACTOR shall be solely responsible for all work necessary to correct excessive deviations from line and grade, including re-drilling, redesigning connections, and acquiring additional easement, at no additional cost to the OWNER and without schedule extension.

H. Pre-reaming and Reaming: The pilot bore shall be pre-reamed and reamed using equipment and methods submitted by the CONTRACTOR. The CONTRACTOR shall completely ream the bore to the final diameter selected by the CONTRACTOR.

I. Pre-Installation Pressure Test: The CONTRACTOR shall perform water pressure tests in accordance with Section 02600 – Fusible PVC Pressure Pipe or Section 02725 –High-Density Polyethylene (HDPE) Pipe prior to pipe pullback.

J. Pipe Pullback:

1. The pipe shall be installed by pulling it into the reamed bore path in a continuous operation, behind a final reaming tool selected by the CONTRACTOR.

2. The pipe shall be isolated from excessive torsional and axial stresses by a swivel device with a pre-established breakaway tensile capacity that is lower than the allowable tensile strength of the pipe.

3. The product pipe shall be inserted "wet." The pipe shall be filled with water as it enters the bore to reduce pullback loads and to ensure that adequate internal pressure is maintained at all points to counter balance collapse pressures.

4. The CONTRACTOR shall monitor and inspect pipe rollers and method for suspending pipe at entry during the pullback operation to avoid damage to the pipe.

5. The CONTRACTOR shall cease operations if the pipe is damaged and shall remove the pipe from the bore and repair the pipe using the manufacturer's recommended procedure or replace the damaged pipe before resuming installation.

6. Damage to the pipe resulting from installation is the responsibility of the CONTRACTOR, including costs for replacement and labor and materials. To confirm the integrity of the pipe upon completion of insertion and pull back, the CONTRACTOR shall perform the following test on the completed pipeline:

    a. A sphere or pig which is 3-5% smaller in diameter than the inside diameter of the pipe, and is capable of allowing water to pass through it, complete with a pulling cable on either side of sphere or pig shall be pulled through the entire length of the pipeline. If the pig or sphere cannot pass through the pipe, it shall be considered collapsed and damaged.

K. Post-Installation Pressure Test: The CONTRACTOR shall conduct a hydrostatic pressure and leakage testing of the installed pipeline. Final test shall be in accordance with Section 01656 – Pressure Pipe Testing and Disinfection. The CONTRACTOR will repair any defects discovered during this test, and repeat until the pipe passes the test.

L. Obstructions: The CONTRACTOR shall notify the ENGINEER immediately in the event that any obstruction is encountered that prevents further advancement of the drill pipe, or pullback of the pre-reamer, reamer, and/or pipe. The CONTRACTOR shall make all diligent and reasonable efforts to advance past the object by drilling slowly through the object, pulling back, and drilling along a new bore path that avoids the object, or excavating and exposing and removing the object, and all other reasonable attempts to continue the bore. The CONTRACTOR shall notify the ENGINEER of proposed measures to attempt to advance past the object, prior to initiating the attempt. If the CONTRACTOR attempts to pullback and re-drill, the CONTRACTOR shall adhere to

line and grade tolerances established in this specification section, unless the ENGINEER approves variance, in writing, prior to the CONTRACTOR'S attempt to re-drill. The CONTRACTOR and ENGINEER shall investigate the cause and together determine an appropriate response. Appropriate response may include revisions to equipment or methods, retraction and re-drilling of a portion of the bore, or abandonment of the hole. If abandonment is deemed necessary, the CONTRACTOR shall recover, to the extent practically possible, any drill pipe, product pipe, and tools in the bore, and properly abandon the bore, unless otherwise directed in writing by the ENGINEER. If the bore is abandoned, the CONTRACTOR shall pressure-grout the abandoned bore with a lean cement-sand grout mixture, or other approved materials. If the bore is abandoned, the CONTRACTOR shall be allowed to begin a second attempt to install the pipeline at an alternate location subject to approval, in writing, by the ENGINEER. The CONTRACTOR shall take all reasonable actions to complete the installation with minimal delays. The extra costs and payments associated with encountering a confirmed obstruction shall be negotiated between the OWNER and CONTRACTOR, based on reasonable time and materials. For purposes of this contract, an obstruction is defined as any hard object lying completely or partially within the design pathway of the bore and pipeline that prevents further advancement of the drill pipe, pre-reamer, reamer, and/or pipe, after all reasonable CONTRACTOR attempts to advance past the object or re-drill around the object have failed.

M. Site Restoration and Demobilization: The CONTRACTOR shall remove all equipment, materials, drilling fluids, muck, waste, and debris from the site and restore site to its original condition upon completion of the installation. Restoration and demobilization shall be completed by the CONTRACTOR within seven (7) days of the completion of the pipeline installation.

N. Settlement Monitoring: The CONTRACTOR shall monitor for settlement or heave before and during drilling operations as specified in Section 02445 – Geotechnical Instrumentation and Monitoring.

**END OF SECTION**

**TECHNICAL SPECIFICATIONS**
**DIVISION 2: SITE WORK**
**02445: GEOTECHNICAL INSTRUMENTATION AND MONITORING**

## PART 1 GENERAL

### 1.01 SUMMARY

A. The Work specified in this Section includes furnishing, installing, and monitoring instrumentation to monitor ground movements around and above the HDD and jack and bore alignments.

### 1.02 REFERENCES

A. Related Work Specified Elsewhere

1. Section 01300 – Contractor Submittals
2. Section 01050 – Field Engineering
3. Section 02340 – Boring and Jacking
4. Section 02413 – Horizontal Directional Drilling

### 1.03 CONTRACTOR SUBMITTALS

A. Qualifications: Submit personnel and supplier qualifications in accordance with the requirements herein.

B. Submit the following, at least one (1) month before scheduled installation of the surface control points:

1. Proposed schedule for installing the surface control points.
2. Description of methods for establishing surface control points
3. If CONTRACTOR proposes to install any instruments at locations other than those shown on the Drawings, submit drawings with alternate locations of proposed monitoring points shown in plan and profile.

C. Reports and Records:

1. Provide reports of monitoring surface control point data to the ENGINEER in accordance with the requirements of Article 3.02 herein.
2. Following installation of the surface control points, submit drawings showing the installed location, the instrument identification number, the instrument type, the installation date and time. Include details of installed instruments, accessories, and protective measures including all dimensions and materials used.

## 1.04 DEFINITIONS

A. Surface Control Points: Control points established as a reference for measuring elevation of the ground surface or points below the ground surface using optical survey methods.

## 1.05 QUALITY ASSURANCE

A. Personnel Qualifications for Instrument Installation:

1. Employ qualified technicians with a minimum of 5 years' experience in the installation of geotechnical instrumentation similar to that specified herein.

B. Surveyor Qualifications: Surveying for monitoring surface control points shall be performed by a land surveyor licensed in the State of California with previous experience surveying for the detection of structural or surface deformations.

## 1.06 TOLERANCES

A. Install surface control points within 1 foot of the horizontal location shown on the Drawings, and described herein. All other surface control points not shown on the Drawings but found necessary for installation by the ENGINEER shall be installed by the CONTRACTOR as directed by the ENGINEER.

B. Survey equipment shall be accurate to measure to the nearest 0.01 ft.

C. Movements of control points of 1/8-inch vertically shall be reported immediately to the ENGINEER. Work shall stop and progression assessed between the ENGINEER and CONTRACTOR when vertical movement reaches ¼-inch.

# PART 2 PRODUCTS

## 2.01 MATERIALS

A. General: All instrumentation materials shall remain the property of the ENGINEER following completion of the Work.

B. Surface Control Points: Surface control points shall be established by an inscribed marking or approved surveyor's nail driven flush with the surface in asphalt or concrete paved areas. In landscaped areas, surface control points shall be established by driving a 2 inch by 2 inch timber stake flush with the ground. Each control point shall have a tag or marking indicating the tunnel station and offset from centerline.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. The CONTRACTOR shall furnish, and install instrumentation, and maintain it during construction.

B. Surface control point arrays shall be installed at the locations indicated on the plans. Additionally, the CONTRACTOR shall install other instrumentation as necessary to control operations, monitor ground conditions, and ground response to achieve specified project requirements and to prevent damage to existing structures and facilities.

C. Instruments shall be installed in accordance with the approved installation tolerances as required in Article 1.06 herein.

D. Provide the ENGINEER with access to and assistance required in obtaining monitoring data.

### 3.02 MONITORING

A. Surface control points shall be monitored by the CONTRACTOR.

1. For HDD alignment, each point shall be surveyed before drilling begins to establish a baseline, daily when drilling and reaming operation is within 50 feet of the point, and weekly after pipe is installed. Final surveys shall be performed two weeks after the pipe installation is complete, including contact grouting.

2. For jack and bore alignment, each point shall be surveyed before pipe jacking begins to establish a baseline, Surface settlement points should be checked hourly when heading is within 25 feet of the ground surface, otherwise daily. . Final surveys shall be performed two weeks after the pipe installation is complete, including contact grouting.

B. Provide data from surveys of surface control points to the ENGINEER within 24 hours.

### 3.03 PROTECTION, MAINTENANCE, AND REPAIR

A. Protect the surface control points from damage. Damaged installations shall be replaced or repaired prior to continuing HDD or jack and bore operations, unless permitted otherwise by the ENGINEER.

### 3.04 DISPOSITION OF INSTRUMENTS

A. Remove all surface control points and restore the pavement, landscape, or ground surface to the original condition during the cleanup, or as required by the ENGINEER.

**END OF SECTION**

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## PART 1 – GENERAL

1.1 SUMMARY

A. The CONTRACTOR shall provide asphalt concrete pavement structural section as indicated on the Drawings, above the pavement subgrade in accordance with the Contract Documents.

B. Reworking of pavement subgrade, when directed by the Engineer.

1.2 RELATED SECTIONS

A. Section 01300 – Submittals

1.3 REFERENCES

A. Standards listed below apply to this section. Where the applicable year of adoption or revision is not listed below, the latest edition applies.

B. State of California, Department of Transportation's "Standard Specifications" Latest version (CSS).

C. State of California Department of Transportation, "Manual of Test".

1. Test 304 – Method of Preparation of Bituminous Mixtures for Testing.

2. Test 367 – Method for Recommending Optimum Bitumen Content.

D. American Society for Testing and Materials (ASTM):

1. D 244 – Emulsified Asphalts.

2. D 402 – Distillation of Cut-Back Asphaltic (Bituminous) Products.

3. D 1188 – Bulk Specific Gravity of and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens.

4. D 2950 – Density of Bituminous Concrete in Place by Nuclear Method.

1.4 SUBMITTALS

A. Submit the following in accordance with Section 01300:

1. Certificates of compliance with specified standards for natural materials and manufactured items.

2. For manufactured items, the manufacturer's technical data of the product of physical properties.

3. Asphalt concrete mix design including California Test 367 results indicating optimum bitumen content, void content and maximum density. (Do not schedule paving Work until submittal has been reviewed).

4. Samples as requested by Engineer.

1.5 DEFINITIONS

A. Pavement Subgrade: The material in excavation or embankments underlying the lowest layer of subbase, base, pavement surfacing or other specified layer which is to be placed. The surface upon which embankment is to be placed is sometimes called "subgrade" in other sections, not to be confused with pavement subgrade.

B. Structural Section: The planned traffic support layers of specified materials, normally consisting of base and pavement placed over the pavement subgrade. The structural section is also commonly called the pavement structural section.

C. Surface Course: The top layer of AC pavement. The top layer of AC pavement is sometimes called the "wearing course".

1.6 QUALITY CONTROL

A. Comply with all requirements of the Air Pollution Control District, including, but not limited to:

1. Use no rapid-curing liquid asphalt or rapid setting emulsified asphalt on this project.

2. Use no medium-curing liquid asphalt on this project unless specifically authorized by the local District. Present proof of authorization.

3. Use no slow-curing liquid asphalt on this project which contains more than 0.5% by volume of petroleum solvents which evaporate at less than 260 degrees C (500 degrees F) as determined by ASTM D402.

4. Use no emulsified asphalt on this project containing petroleum solvents in excess of 3% by volume which evaporate at less than 260 degrees C (500 degrees F) as determined by ASTM D244.

5. Medium-curing liquid asphalt may be used when the National Weather Service forecasts that atmospheric temperature for the 24-hour period following application will not exceed 50 degrees F. Maintain records

proving occurrence of this condition, and verify that local jurisdiction approves this exception.

6. Certain jurisdictions may allow use of the above prohibited products under certain conditions. Prior to use, submit proof of such allowance.

1.7 SITE CONDITIONS

A. Do not place asphalt concrete unless atmospheric temperature is at least 50 degrees Fahrenheit and rising.

## PART 2 – PRODUCTS

2.1 MATERIALS

A. General: Materials specified below, to be included in the work, are detailed on the Drawings or are indicated in these specifications.

B. Aggregates:

1. Asphalt Concrete (AC): Type A, 1/2-inch maximum size, medium grading, CSS Section 39.

2. Asphalt Concrete (AC): Type B, 1/2-inch maximum size, medium grading, CSS Section 39.

3. Aggregate Base (AB): Class 2, 3/4-inch size, CSS Section 26. Virgin rock only.

| Sieve Sizes | Percentage Passing 3/4" Maximum | |
|---|---|---|
| | **Operating Range** | **Contract Compliance** |
| 2" | — | — |
| 11/2" | — | — |
| 1" | 100 | 100 |
| 3/4" | 90-100 | 87-100 |
| No. 4 | 35-60 | 30-65 |
| No. 30 | 10-30 | 5-35 |
| No. 200 | 2-9 | 0-12 |

**QUALITY REQUIREMENTS**

| Test | Operating Range | Contract Compliance |
|---|---|---|
| Resistance (R-value) | — | 78 Min. |
| Sand Equivalent | 25 Min. | 22 Min. |
| Durability Index | — | 35 Min. |

4. Asphalt Binder: Steam-refined paving asphalt, CSS Section 92 Grade AR-4000.

5. Prime Coat: Liquid asphalt, Grade SC-70, CSS Section 93.

6. Paint Binder or Tack Coat: Type SS1h or SS1 asphaltic emulsion, CSS Section 94, subject to limitations of paragraph 1.06.

C. Prime Coat:

1. The rolled surface of the base material shall be primed with liquid asphalt prime coat, Grade SC-70, applied at a uniform rate of 0.25 gallons per square yard. Application shall conform to the requirements of Section 39, Caltrans Standard Specifications, State of California, Division of Highway.

D. Tack Coat or Binder:

1. A tack coat or paint binder shall be SS-1 asphalt emulsion in conformance with Section 39 of Caltrans Standard Specifications.

E. Fine Asphalt Concrete Patch Paving:

1. Fine asphalt concrete for patch paving shall be Type B, 3/8" maximum size. The asphalt binder shall be paving asphalt Grade AR-4000 in conformance with Section 92 of the Caltrans Standard Specification.

2.2 MIXES

A. Asphalt Concrete:

1. CSS Section 39, Type A asphalt concrete

2. CSS Section 39, Type B asphalt concrete.

3. CONTRACTOR shall determine the optimum amount of asphalt binder in accordance with the mix design prepared in accordance with California Test 367.

B. Rubberized Asphalt Concrete (RAC) Hot Mix

1. Gap graded hot mix (RAC-G). RAC-G lift thickness is limited to a minimum of 30 mm by component aggregate size, and maximum 60 mm. Match existing thickness.

C. Do not change sources from those used in mix designs without prior written approval by ENGINEER.

## PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine areas to receive asphalt concrete paving and verify the following:

1. That abutting improvements have been set at proper elevations.

2. That gradients and elevations of pavement subgrade are correct.

3. That the condition of the pavement subgrade has been approved by the ENGINEER.

4. Absence of wet receiving surfaces and other conditions that adversely affect execution of this Work.

B. Do not start Work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. If after initial preparation, the pavement subgrade is allowed to stand or is used by construction equipment, or is otherwise damaged, repair in accordance with CSS 26-1.03 at no additional cost to the Owner.

B. Protect existing Work from damage. Protect concrete Work from staining with asphalt materials. Shield from overspray.

C. Existing Asphalt Paving to receive the new wearing course of asphalt paving shall be thoroughly cleaned of all dirt, water and oil to the satisfaction of the ENGINEER. Cracks 1/8 inch wide or greater shall be cleaned and filled with bituminous material or by a method approved by the ENGINEER. Large cracks, faults or potholes shall be repaired as specified above or shown on the plans.

3.3 AGGREGATE BASE

A. Spread and compact in accordance with CSS Section 26, to thickness, lines and grades noted, with a maximum deviation of plus 0.0 and minus 0.05 feet from plan grade. Refer to Section 02200 for compaction test methods.

B. Do not incorporate into the completed section any base material used for construction traffic.

C. Water the compacted base in accordance with CSS Section 17.

3.4 BASE PRIME COAT

A. After base has been approved by ENGINEER, place asphalt concrete paving on new aggregate base while base is still tight and damp, without prime coat.

B. If base has been allowed to dry before placing asphalt concrete, apply prime coat in amount of 0.25 gallons per square yard of surface area to base in accordance with CSS Section 39, at no additional cost to the CITY. Allow at least 24 hours for prime coat to set; remove any puddles; and spread sand over damp spots before placing asphalt concrete.

3.5 PAINT BINDER

A. Prior to placing asphalt concrete surfacing, apply a coat of asphaltic emulsion paint binder to all vertical contact surfaces in accordance with CSS Section 39 at an approximate rate of 0.10 gallons per square yard of surface covered.

3.6 ASPHALT CONCRETE

A. After prime coats have been approved by ENGINEER, spread and compact asphalt concrete paving to compacted thickness shown on Drawings in accordance with CSS Section 39, including all requirements for mix temperatures, and thickness of layers.

B. Compact to a density at least 95 percent of that obtained with the California Kneading Compactor, California Test 304.

C. Provide surface which is dense, smooth, tight, free from pores, loose material or segregation, within tolerances specified, and free of bird baths.

D. Finished surface shall be to more than 0.02 feet below the bottom of a 12-foot straightedge laid on the surface in any direction.

E. Place asphalt concrete so that finished surface will be 0-inch to 1/8-inch, above edge of adjacent concrete gutters designed to collect water runoff, or 0-inch to 1/8-inch below edge of adjacent concrete designed to deposit runoff onto paved surface.

F. Carefully roll with proper heat at edges alongside curbs, walks and driveways to match balance of rolled Work. Hand tamping will be permitted only where inaccessible to heavy equipment.

G. Finish rolling before paving temperature has dropped to 150 degrees F.

3.7 FIELD QUALITY CONTROL

A. Inspection and testing shall be performed by CONTRACTOR under provisions of Section 01400.

B. CONTRACTOR shall retain service of qualified Testing Laboratory to:

1. Inspect and test base and paving, including but not limited to:

a. Compaction and thickness of base according to CSS Section 26.

b. Compaction of asphalt concrete tested with nuclear gauge in accordance with ASTM D2950. Nuclear density gauge determination will be correlated with density of compacted specimens determined according to ASTM D1188.

2. Check thickness of surfacing by coring.

C. CONTRACTOR shall:

1. Measure and record temperature of asphalt concrete just prior to paving.

2. Flood all paved surfaces with water to verify positive drainage.

3. Repair areas cored for testing.

4. As directed by ENGINEER, remove and replace or repair all paving not meeting Contract Document requirements.

D. After the completion of the inspections and tests performed, the results shall be delivered to ENGINEER within 5 working days.

3.8 PROTECTION

A. Permit no surface traffic until surface has cooled sufficiently to resist damage.

3.9 STRUCTURES

A. Adjust existing and new manholes, meter boxes, catch basins, cleanouts, etc. to match the new grade.

****END OF SECTION****

**TECHNICAL SPECIFICATIONS**
**DIVISION 2: SITE WORK**
**02490: PRECAST CONCRETE VAULTS**

## PART 1 GENERAL

### 1.01 THE REQUIREMENT

A. The CONTRACTOR shall provide precast concrete manholes and vaults, complete and in place, in accordance with the Contract Documents.

### 1.02 SPECIFICATIONS, CODES AND STANDARDS

A. Commercial Standards

| | |
|---|---|
| ASTM A48 | Gray Iron Castings |
| ASTM C 150 | Portland Cement |
| ASTM C443 | Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets |

### 1.03 CONTRACTOR SUBMITTALS

A. General: Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. Shop Drawings

1. Show dimensions, locations, lifting inserts, reinforcement, and joints.

2. Structural design calculations for vaults, signed by a registered engineer.

C. Manufacturer's Certification for Vaults: Written certification that the vault complies with the requirements of this Section.

### 1.04 QUALITY ASSURANCE

A. Inspection: After installation, the CONTRACTOR shall demonstrate that vaults have been properly installed, level, with tight joints, at the correct elevations and orientations, and that the backfilling has been carried out in accordance with the Contract Documents.

## PART 2 PRODUCTS

### 2.01 VAULTS

A. The CONTRACTOR shall provide precast vaults designed for the indicated applications and of the sizes indicated.

B. The minimum structural member thickness for vaults shall be 5-inches. Cement shall be Type V portland cement as specified in ASTM C 150. The minimum 28-day concrete

compressive strength shall be 4,000 psi. All reinforcing steel shall be embedded in the concrete with a minimum clear cover as recommended by ACI 318.

C. Design Loading: All vaults shall be designed for H-20 traffic loading. Lateral loads on vaults in all areas shall be calculated from:

| | | | |
|---|---|---|---|
| | L | = | 90 h, plus surcharge of 240 psf in areas of vehicular traffic |
| Where | L | = | loading in psf |
| | h | = | depth of fill in feet |

D. Where joints are designed in pre-cast concrete vaults, such joints shall be interlocking to secure proper alignment between members and prevent migration of soil through the joint. Structural sections at joints shall be sized sufficiently to reinforce the section against localized distress during transportation and handling and against excess contact bearing pressures through the joint.

E. Where openings for access to the vault are required, the full clear space opening indicated shall be provided, without obstructions from brackets or supports. For large openings where brackets or supports are designed to protrude into the opening for support of required covers, such brackets or supports shall be designed to be easily removed and replaced with a minimum of effort and without cutting or welding.

F. Covers for access openings shall be provided. Frames for covers shall be fabricated from steel, galvanized after fabrication, and shall be integrally cast into the vault concrete sections. All covers shall be tight fitting to prevent the entrance of dirt and debris. Where edge seams are permitted, no gaps greater than 1/16-inch between edges will be accepted. All covers, except round, heavy-weight, cast iron manhole covers, shall have securing mechanisms to hold the covers firmly in place against the effects of repetitious live loads such as pedestrian or vehicle traffic.

G. Where penetration of the pre-cast concrete vault are required for piping, conduit, or ducts, such penetrations shall be accommodated through pre-cast openings or thin-wall knock-out sections. All openings for penetrations shall be smooth and free of surface irregularities and without exposed steel reinforcing. Vaults need not be designed to resist thrust from piping passing through the vault.

H. Warning Signs

1. The entrance to every vault shall be fitted with a permanently affixed (using wedge anchors or powder activated fasteners), plastic warning sign (1-inch high red letters on white background) stating "CAUTION, VENTILATE BEFORE ENTERING." located 4 inches below the top of the vault. Each sign shall be in accordance with Section 10425 - Signs.

2. Sign Manufacturer, or Equal

   a. W.H. Brady Company;

   b. Seton Nameplate Corporation.

## PART 3 EXECUTION

### 3.01 GENERAL

A. Pre-cast concrete sections shall be transported and handled with care in accordance with the manufacturer's written recommendations. Where lifting devices are provided in pre-cast sections, such lifting devices shall be used as intended. (Also, see Paragraph 2.1.1). Where no lifting devices are provided, the CONTRACTOR shall follow the manufacturer's recommendations for lifting procedures to provide proper support during lifting.

B. Buried pre-cast concrete vaults shall be assembled and placed in excavations on properly compacted crushed rock foundations as indicated. Pre-cast concrete vaults shall be set to grade and oriented to provide the required pipe connections and dimensions and clearances from pipes and other structures.

C. Prior to backfilling, all cracks and voids in pre-cast concrete vaults shall be filled with non-shrink grout or polyurethane sealant, or both. Around pipe and conduit penetrations, openings shall be sealed with polyurethane sealant. With the authorization of the ENGINEER, grout or a closed-cell flexible insulation may be used as filler material prior to placing a final bed of polyurethane sealant.

**END OF SECTION**

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**TECHNICAL SPECIFICATIONS**
**DIVISION 2: SITE WORK**
**02565: DUCTILE IRON PIPE**

## PART 1 GENERAL

### 1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide AWWA approved-lined and coated ductile iron pipe and appurtenances complete in place, inaccordance with the Contract Documents.

### 1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

| | |
|---|---|
| ASTM A536 | Standard Specification for Ductile Iron Castings |
| AWWA C104 | Cement-Mortar Lining for Ductile-Iron Pipe and Fittings |
| AWWA C105 | Polyethylene Encasement for Ductile Iron Pipe Systems |
| AWWA C110 | Ductile Iron and Grey Iron Fittings |
| AWWA C111 | Rubber-Gasketed Joints for Ductile-Iron Pressure Pipe and Fittings |
| AWWA C115 | Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges |
| AWWA C116 | Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings |
| AWWA C150 | Thickness Design of Ductile-Iron Pipe |
| AWWA C151 | Ductile Iron Pipe, Centrifugally Cast |
| AWWA C153 | Ductile-Iron Compact Fittings |
| AWWA C600 | Installation of Ductile-Iron Mains and Their Appurtenances |

B. Other Standards: CAW Standard Specifications

### 1.3 CONTRACTOR SUBMITTALS

A. Furnish Shop Drawings of pipe, fittings and appurtenances in accordance with the Special Provisions, the requirements of the referenced standards and the following supplemental requirements as applicable:

1. Certified dimensional drawings of all fittings and appurtenances

2. For all pipes, provide line layout and marking diagrams which indicate the specific number of each fitting and the location and the direction of each fitting in the completed line. In addition, the line layouts shall include: The pipe station and invert elevation at all changes in grade or horizontal alignment; all elements of curves and bends, both in horizontal and vertical alignment; and the limits of each reach of restrained joints, or of concrete encasement.

B. **Certifications:** The CONTRACTOR shall furnish a certified affidavit of compliance for all pipe and other products or materials furnished under this Section and as specified in the referenced standards and the following supplemental requirements:

1. Physical and chemicalproperties

2. Hydrostatic test reports

C. The CONTRACTOR shall be responsible for performing and paying for sampling and testing as necessary for the certifications.

D. Provide witnessed testing of joint bonding performance.

E. Provide design of cathodic protection system in accordance with Section 13110 – Cathodic Protection. Provide and install the approved cathodic protection system. Alternately, ductile iron pipe can be supplied with special zinc coating applied at the factory by the pipe manufacturer suitable for high corrosivity conditions.

## 1.4 QUALITY ASSURANCE

A. **Tests:** Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.

B. The CONTRACTOR shall perform said material tests at no additional cost to the OWNER. The ENGINEER shall have the right to witness all testing conducted by the CONTRACTOR; provided, that the CONTRACTOR's schedule is not delayed for the convenience of the ENGINEER.

C. In addition to those tests specifically required, the ENGINEER may request additional samples of any material including lining and coating samples for testing by the OWNER. The additional samples shall be furnished as a part of the WORK.

D. **Inspection:** Pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of the referenced standards, as supplemented by the requirements herein. The CONTRACTOR shall notify the ENGINEER in writing of the manufacturing starting date not less than 14 calendar days prior to the start of any phase of the pipe manufacture.

E. During the manufacture of the pipe, the ENGINEER shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.

## PART 2 PRODUCTS

### 2.1 PIPE GENERAL

A. Lined and coated ductile iron pipe shall conform to the latest AWWA standards C151 and C110, subject to the supplemental requirements in this Section. The pipe diameter and pressure class shall be as shown on the Contract Documents.

B. **Markings:** The CONTRACTOR shall legibly mark materials in accordance with the laying schedule and marking diagram. Each fitting shall be marked at each end with top field centerline.

C. **Handling and Storage:** The pipe shall be handled as a minimum at the 1/3 points by use of wide slings, padded cradles, or other devices designed and constructed to prevent damage to the pipe coating/exterior. The use of chains, hooks, or other equipment that might injure the pipe coating/exterior will not be permitted. Stockpiled pipe shall be supported on padded skids, sand orearth berms free of rock exceeding 3 inches in diameter, sand bags, or suitable means so that the coating will not be damaged. The pipe shall not be rolled and shall be secured to prevent accidental rolling

D. **Laying Lengths:** Nominal pipe laying lengths shall be 20 ft.

E. **Finish:** The pipe shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing, and roughness.

F. **Bonding and Electrical Conductivity:** Where a corrosion protection system is being designed and installed, all pipe joints shall be bonded for electrical conductivity. The CONTRACTOR shall furnish and install all materials required for joint bonding. Joint bonds shall be exothermically welded to the pipe barrel.

### 2.2 SPECIALS AND FITTINGS

A. Fittings for ductile iron pipe shall conform to the requirements of AWWA C110 or AWWA C153. Push-on joint fittings shall be designed for a water

working pressure of 350 psi. Restrained push-on joints fittings shall be designed for a water working pressure of 350 psi for sizes 4" through 24" and 250 psi for sizes 30" through 36".

## 2.3 DESIGN OF PIPE

A. The pipe shall be designed, manufactured, tested, inspected, and marked according to AWWA C150 and C 151 except where modified by this Section.

B. **Pipe Dimensions:** The pipe shall be of the diameter and class indicated.

C. **Fitting Dimensions:** The fittings shall be of the diameter and class indicated.

D. **Joint Design:** Ductile iron pipe and fittings shall be furnished with mechanical joints, push-on joints, flanged joints, or restrained joints as required.

1. Mechanical and push-on joints shall conform to AWWA C111. Bolts for mechanical joint glands shall be high strength, low alloy steel bolts only. Bolt manufacturers certification of compliance must accompany each shipment. NSS Cor-Ten T-Bolts or approved equal.

2. Restrained joints shall be **"Flex-Ring"** restrained joint by **American Ductile Iron Pipe** or **"TR FLEX"** restrained joint by **U.S. Pipe** or **McWane Ductile**.

3. Joint restraining devices that impart point loads and/or wedging action on the pipe wall as a means of joint restraint shall not be allowed unless there are no other options for joint restraint available. Undersuch circumstances, the CONTRACTOR may propose such devices provided the following conditions are met and the request is made as a substitution:

   a. A formal request for substitution is submitted stating the location(s) where the devices are intended to be used and a statement from the device manufacturer and the pipe manufacturer that the proposed device is appropriate for the intended installation and rated at least for the class of the pipe being supplied.

   b. A statement from the pipe manufacturer is provided accepting the use of the retaining devices and indicating that the use of such devices will in no way affect the warranty of the pipe and/or the performance of thepipe.

   c. The manufacturer of the device and the pipe manufacturer jointly provide instruction on the proper installation of the device to the personnel installing the units and provide certification to the

OWNER that the installers are adequately trained in the installation of the units and that all warranties are in full affect for the project.

d. The devices shall be **Megalug Model 1100** as manufactured by **EBAA Iron** or equal. For bell-and-spigot ends with rubber gaskets, the clearance between the bells and spigots shall be such that when combined with the gasket grooveconfiguration and the gasket itself, will provide watertight joints under all operating conditions when properly installed. The CONTRACTOR shall require the pipe manufacturer to submit details complete with significant dimensions and tolerances and also to submit performance data indicating that the proposed joint has performed satisfactorily under similar conditions. In the absence of a history of field performance, the results of a test program shall be submitted.

e. Pipe gaskets shall be NBR for all pipe installed north of the seismic fitting on the north side of the Monte Road Bridge. Gaskets shall be SBR at all other locations.

## 2.4 EXTERIOR PROTECTION OF PIPE

A. **Exterior Coating of Exposed Piping:** The exterior surfaces of pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of rust-inhibitive primer, epoxy paint and finish, conforming to the requirements of Section 09900- Paints and Coatings.

B. **Exterior Coating of Buried Piping:** The exterior of the pipe shall have an asphaltic coating.

## 2.5 SERVICE HARDWARE AND APPURTENANCES

A. **Tapping Sleeves**: Mueller H-304MJ stainless steel tapping sleeve or equal.

B. **Service Saddles:** ¾" to 2" outlet size shall be JCM 438 stainless steel threaded outlet tapping sleeve or equal.

C. **Corporation Stops:** Ford F 1000 or equal.

D. **Shell Cutter:** Mueller Co, Pipeline Products, or approved equal for ductile iron pipe. Shell cutters shall be tungsten carbide tipped, designed for an easy fit through valves, and shall have large slots for debris removal. "Drill-bit" type cutters shall not be used.

## PART 3 EXECUTION

## 3.1 INSTALLATION OF PIPE

A. The CONTRACTOR shall inspect each pipe and fitting prior to installation to insure that there are no damaged portions of the pipe. Pipe damaged prior to Substantial Completion shall be repaired or replaced by the CONTRACTOR.

B. Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the WORK.

C. **Pipe Laying:** The pipe shall be installed in accordance with AWWA C600.

D. Pipe shall be laid directly on the bedding material. No blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.

E. Each section of pipe shall be laid in the order and position shown on the laying schedule. Each section shall be laid to the set line and grade, within approximately one inch plus or minus.

F. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the ENGINEER may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed 75 percent of the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount that will be detrimental to the strength and water tightness of the finished joint.

G. Except for short runs that may be permitted by the ENGINEER, pipes shall be laid uphill on grades exceeding 10 percent. Pipe that is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement. Bends shall be properly installed as indicated.

H. **Cold Weather Protection:** No pipe shall be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation before backfilling occurs.

I. **Pipe and Specials Protection:** The openings of all pipe and specials shall be

protected with suitable bulkheads to prevent unauthorized access by persons, animals, water or any undesirable substance. At all times, means shall be provided to prevent the pipe from floating.

J. **Pipe Cleanup:** As pipe laying progresses, the CONTRACTOR shall keep the pipe interior free of all debris. The CONTRACTOR shall completely clean the interior of the pipe of all sand, dirt, mortar splatter, and any other debris following completion of pipe laying and shall perform any necessary interior repairs prior to testing and disinfecting the completed pipeline.

## 3.2 RUBBER GASKETED JOINTS

A. **Rubber Gasketed Joints:** Immediately before jointing pipe, the bell end of the pipe shall be thoroughly cleaned, and a clean rubber gasket shall be placed in the bell groove. The spigot end of the pipe and the inside surface of the gasket shall be carefully cleaned and lubricated. The lubricant shall be suitable for lubricating the parts of the joint for assembly and be a compound listed as in compliance with NSF Standard 61. The lubricant shall be nontoxic, shall notsupport the growth of bacteria, and shall have no deleterious effects on thegasket material. The spigot end of the pipe section shall then be inserted into the bell of the previously laid joint and telescoped into its proper position. Tilting of the pipe to insert the spigot into the bell will not be permitted.

## 3.3 INSTALLATION OF PIPE APPURTENANCES

A. Installation of service saddles and water service lines require drilling or tapping equipment approved by the saddle manufacturer.

B. Installation of tapping sleeves will also require tapping valves. The drilling or tapping equipment shall be approved for use with tapping sleeve and valve manufacturer.

C. Installation of Valves: Valves shall be handled in a manner to prevent any injury or damage to any part of the valve. Joints shall be thoroughly cleaned and prepared prior to installation. The CONTRACTOR shall adjust all stempacking and operate each valve prior to installation to insure proper operation.

D. Valves shall be installed so that the valve stems are plumb and in the location indicated.

## 3.4 CORROSION CONTROL

A. Polyethylene encasement shall be provided for all pipe and fittings.

B. Joint Bonding: Except where otherwise indicated, all buried pipe joints shall be bonded. The pipe shall be cleaned to bare bright metal at the point where the bond is installed. And the bonding cable attached with an exothermic weld.

## 3.5 FIELD TESTING AND DISINFECTION

A. Field testing and disinfection and water mains shall conform to the requirements of Section 01656 - Pressure Pipeline Testing and Disinfection.

**END OF SECTION**

**TECHNICAL SPECIFICATIONS**
**DIVISION 2: SITE WORK**
**02570: STEEL PIPE, MORTAR LINED AND MORTAR COATED (AWWA C200, MODIFIED)**

## PART 1 GENERAL

### 1.01 THE REQUIREMENT

A. The CONTRACTOR shall provide mortar-lined steel pipe coated as specified herein, complete, in accordance with the Contract Documents.

### 1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards: The following standards are listed for convenience only. All specified standards, whether listed or not, shall apply to the Work.

| | |
|---|---|
| ANSI/ASTM A 20 | General Requirements for Steel Plates for Pressure Vessels |
| ASTM E 165 | Practice for Liquid Penetrant Examination |
| ASTM A 193 | Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications |
| ASTM A 307 | Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength |
| ASTM A 370 | Test Methods and Definitions for Mechanical Testing of Steel Products |
| ASTM A 516 | Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service |
| ASTM A 572 | Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel |
| ASTM A 673 | Standard Specification for Sampling Procedure for Impact Testing of Structural Steel |
| ASTM A 1011 | Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |
| ASTM A 1018 | Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |

| | |
|---|---|
| ASTM A 1064 | Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete |
| ANSI/AWWA C200 | Steel Water Pipe 6 In and Larger |
| ANSI/AWWA C205 | Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In and Larger - Shop Applied |
| ANSI/AWWA C206 | Field Welding of Steel Water Pipe |
| ANSI/AWWA C207 | Steel Pipe Flanges for Waterworks Service 4 in to 144 in |
| ANSI/AWWA C208 | Dimensions for Fabricated Steel Water Pipe Fittings |
| ANSI/AWWA C209 | Cold Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines |
| ANSI/AWWA C210 | Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines |
| ANSI/AWWA C214 | Tape Coating Systems for the Exterior of the Steel Water Pipelines |
| ANSI/AWWA C215 | Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines |
| ANSI/AWWA C216 | Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines |
| ANSI/AWWA C218 | Coating the Exterior of Above Ground Steel Water Pipelines and Fittings |
| ANSI/AWWA C222 | Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings |
| ANSI/AWWA C602 | Cement-Mortar Lining of Water Pipelines 4-In (100 mm) and Larger - In Place |
| ANSI/AWWA C604 | Installation of Steel Water Pipe – 4 In. (100 mm) or Larger |
| ANSI/ASTM A 36 | Carbon Structural Steel |
| ANSI/ASTM A 283 | Low and Intermediate Tensile Strength Carbon Steel Plates |

| | |
|---|---|
| ASTM A 570 | Steel Sheet and Strip, Carbon, Hot-Rolled Structural Quality |
| ASTM A 572 | High-Strength Low-Alloy Columbium-Vanadium Structural Steel |
| ASTM C 31 | Standard Practice for Making and Curing Concrete Test Specimens in the Field |
| ASTM C 33 | Standard Specification for Concrete Aggregates |
| ASTM C 39 | Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens |
| ASTM C 150 | Portland Cement |
| ASTM C 497 | Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile |
| ASTM E 165 | Liquid Penetrant Examination for General Industry |
| ASTM E 340 | Standard Test Method of Macroetching Metals and Alloys |
| ANSI/AWS D1.1 | Structural Welding Code – Steel |
| ANSI/AWS A3.0 | Standard Welding terms and Definitions |
| ANSI/ AWS QC1 | Standard for AWS Certification of Welding Inspectors |
| API Standard 1104 | Welding Pipelines and Related Structures |
| AWWA M-11 | Steel Water Pipe - A Guide for Design and Installation |
| ASME | Boiler and Pressure Vessel Code |
| NSF 61 | Drinking Water System Components – Health Effects |
| SPFA | Quality Certification Program for Steel Pipe and Accessory Manufacturers |

## 1.03 CONTRACTOR SUBMITTALS

A. Shop Drawings: Submit shop drawings of pipe and fittings in accordance with the requirements in Section 01300 - CONTRACTOR Submittals, and the following supplemental requirements as applicable.

1. Fabrication Information

a. Pipe/fitting wall construction details which indicate the type and thickness of cylinder; the position, type, size, and area of reinforcement; manufacturing tolerances; maximum angular joint deflection limitations; and all other pertinent information required for the manufacture and installation of the product.

b. Welded joint details shall be submitted for all joint types, including beveled ends for alignment conformance and deep bell or butt strap joints required for control of temperature stresses.

c. Rubber gasket joint design and details complete with dimensions, tolerances, and performance or test data.

d. Pipe Fabricator's Credentials: Submit the credentials of the pipe manufacturer/fabricator. Credentials shall include reference names, telephone numbers, and descriptions of projects for pipe conforming to AWWA C200 that is of similar diameter, length, and wall thickness to the pipe in this project. Project description shall include length, diameter, wall thickness, steel metallurgy, location of facility where pipe was manufactured/fabricated, and names of key plant personnel responsible for the manufacturing process. Submit names and qualifications of current plant personnel to be responsible for manufacture of the pipe in this project. To demonstrate ability to meet the schedule requirements of this project, submit project descriptions and manufacturing/fabrication schedules for other currently contracted pipe projects at the Fabricator's plant. The manufacturing / fabrication schedule for the pipe in this project shall be identified on schedule submittals.

e. Manufacturer's Written Quality Assurance/Control Program.

2. Materials: Material lists and steel reinforcement schedules which include and describe all materials to be utilized. Metallurgical test reports for steel proposed for use on the project. Submit chemical and physical test reports from each heat of steel that indicate the steel conforms to the Project Specifications.

3. Line Layout Information

a. Line layout and marking diagrams compatible with the requirements of AWWA Manual 11 (M-11) and which indicate the specific number of each pipe and fitting and the location of each pipe and the direction of each fitting in the completed line. In addition, the line layouts shall include: the pipe station and

centerline elevation at all changes in grade or horizontal alignment; the station and centerline elevation to which the bell end of each pipe will be laid; all elements of curves and bends, both in horizontal and vertical alignment. The location of all metered pipe sections, beveled ends for alignment conformance, and deep bell or butt strap joints for temperature stress control shall be clearly indicated on the diagrams.

b. Dimensional drawings of all valves, fittings, and appurtenances as specified in Section 15000 – Piping, General.

c. Drawings showing the location and details of bulkheads for hydrostatic testing of the pipeline, and details for removal of test bulkheads and repair of the lining.

d. Details and locations of closures for length adjustment, temporary access manways, vents, and weld lead pass holes as indicated and as required for construction convenience.

4. Provide each pipe, fitting, or appurtenance with a clear, permanent, waterproof, marked identification on the spigot end of the pipe. Markings shall include the following:

a. Identify each pipe, special, and fitting by the piece number shown on the pipeline layout schedule corresponding to position along the pipeline.

b. Size and design class of pipe as indicated on the pipeline layout schedule

c. Date of manufacture

d. Manufacturer’s trademark or name

e. Bends: field top mark, long side of bend, deflection angle

f. Beveled pipe: field top mark, long side of bevel, bevel degree

g. Special notations and tagging of special items for location on pipeline

5. Welding Information

a. Information regarding location, type, size, and extent of all welds with reference called out for Welding Procedure Specifications (WPS) numbers shall be shown on the shop

drawings. The shop drawings shall distinguish between shop and field welds. Shop drawings shall indicate by welding symbols or sketches the details of the welded joints, and the preparation of parent metal required to make them.

b. Written welding procedures for shop and field welds, including Welding Procedure Specifications (WPS's) and Procedure Qualification Records (PQR's).

c. Written nondestructive testing procedure specifications, and nondestructive testing personnel qualifications for shop and field welds.

d. Current welder performance qualifications (WPQ's) shall be submitted for each welder used prior to its performing any Work either in the shop or field. Qualification testing shall be as specified in Article 1.4 – Quality Assurance, Paragraph F, in this Section.

e. Submit the credentials of the CONTRACTOR's certified welding inspectors (CWI's) and quality control specialist for review prior to starting any welding in the shop or field. The credentials shall include, but not be limited to, American Welding Society QC-1 Certification.

f. Submit all nondestructive testing (NDT) data for each shop-welded and field-welded joint. This data shall include all testing on each weld joint, including re-examination of repaired welds, using radiographic, magnetic particle, dye penetrant examination, ultrasonic, or air test examination methods specified. Test data shall be reviewed and signed by the welding inspector(s).

g. Submit a welder log for field and shop welding. Log shall list all welders to be used for the Work and the types of welds each welder is qualified to perform.

h. Submit a welding map showing the sequence of welds for all field welds.

i. Submit a written weld repair procedure for each type of shop and field weld proposed for use on the Project.

j. Submit a written rod control procedure for shop and field operations demonstrating how the CONTRACTOR intends to maintain rods in good condition throughout the Work. The rod

control procedure shall also demonstrate how the CONTRACTOR intends to ensure that the proper rods are used for each weld.

6. Handling and Support Information: Detail drawings indicating the type, number and other pertinent details of the slings, strutting and other methods proposed for pipe support and handling during manufacturing, transport, and installation. Calculations supporting the handling and support system design shall be submitted. Drawings and calculations shall be sealed by a registered professional engineer.

7. Control of Temperature Stresses

   a. Submit proposed sequencing of events to control temperature stresses in the pipe wall during installation prior to starting of any field welding.

   b. Submit the proposed sequencing of events or special techniques to minimize distortion of the steel as may result from shop welding procedures.

   c. Submit plan for monitoring pipeline temperatures.

8. Field Lining

   a. Submit field lining CONTRACTOR's credentials.

   b. Submit a description of lining equipment and personnel to be used.

   c. Submit written procedures for pipe surface preparation, lining application, and curing.

   d. Submit cement mortar mix design.

B. Certifications: Furnish a certified affidavit of compliance for all pipe and other products, materials, or related work provided under this Section, as specified in ANSI/AWWA C200, C205, C602, and C206, respectively, and the following supplemental requirements:

1. Compliance with the additional requirements included in these Contract Documents.

2. Physical and chemical properties of all steel.

3. Hydrostatic test reports.

4. Results of production weld tests.

5. Sand, cement, and mortar tests.

6. Rubber gasket tests.

7. All materials are NSF approved for use with potable water.

8. Pipe temperature complies with Specifications prior to pouring pipe zone material, during and between periods of CLSM placement, and prior to and during welding temperature control joints (including supporting data).

9. All welds were performed in conformance with these documents.

C. All expenses incurred in making samples or collecting data for certification of tests shall be borne by the CONTRACTOR at no increased cost to the Owner.

D. Provide design of cathodic protection system in accordance with Section 13110 – Cathodic Protection.

## 1.04 QUALITY ASSURANCE

A. Inspection: All pipe, linings, welds, coatings, and related work shall be subject to inspection at the place of manufacture and/or the place the Work is performed in accordance with the provisions of ANSI/AWWA C200, C205, C206, C602, C209, C214, C215, and C222 as applicable, as supplemented by the requirements herein. Notify the Engineer in writing not less than 14 calendar days prior to the start of any phase of the pipe manufacture, welding, lining, coating, testing, or field operations.

B. Tests: Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of ANSI/AWWA C200, C205, C206, and C602, as applicable.

1. After the joint configuration is completed and prior to lining with cement-mortar, if applicable, each length of pipe of each diameter and pressure class shall be shop-tested and certified to a pressure of at least 75 percent of the minimum yield strength of the pipe steel. Test pressure shall be maintained for a sufficient time to observe the weld seams. There shall be no leaks. Any leaks shall be repaired and the pipe retested.

2. Production weld tests as required in ANSI/AWWA C200, except weld tests shall be conducted on each 5,000 feet of production welds at a

minimum, and at least one set of tests per operator per work shift shall be performed.

C. Perform said material tests at no additional cost to the Owner. The Engineer shall have the right to witness all testing conducted by the CONTRACTOR; provided, that the CONTRACTOR's schedule is not delayed for the convenience of the Engineer.

D. In addition to those tests specifically required, the Engineer may request additional samples of any material including mixed concrete and lining and coating samples for testing by the Owner. The additional samples shall be furnished at no additional cost to the Owner.

E. Welding Procedure Specifications: All welding procedures used to fabricate and install pipe shall be in accordance with the ASME Boiler and Pressure Vessel Code (BPVC) for shop welds and ANSI/AWS D1.1 for field welds. Written welding procedures shall be required for all welds, both shop and field. Welds qualified per the ASME BPVC shall include Supplementary Essential Variables for notch-tough welding. All provisions of ANSI/AWS D1.1 pertaining to notch-tough welding shall apply.

F. Welder Performance Qualifications: All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified by the CONTRACTOR under the provisions of ASME BPVC for shop welds and ANSI/AWS D1.1 for field welds. Furnish all material and bear the expense of qualifying welders.

G. Shop Nondestructive Testing: Nondestructive testing shall be performed for various weld categories as specified below. Testing shall include submitting written documentation of procedures per Section V, and acceptance criteria shall be in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code.

1. Butt Joint Welds: Spot radiographically examine pipe in accordance with Paragraph UW-52 of the ASME Boiler and Pressure Vessel Code Section VIII, Division 1. If, in the opinion of the Engineer, the butt joint welds cannot readily be radiographed, they shall be 100 percent ultrasonically examined.

2. Fillet Welds: 100 percent examine all fillet welds using the magnetic particle inspection method.

3. Groove Welds: 100 percent ultrasonically examine all groove welds that cannot be readily radiographically spot examined.

4. All Welds: Certified welding inspector shall 100 percent visually examine all welds as a minimum.

5. In addition to weld tests hereinbefore specified, doubler pads shall be air tested as stated in AWWA C206.

6. Refer to Section 01656 – Pressure Pipeline Testing and Disinfection for field nondestructive testing.

H. Onsite Observation: The pipe fabricator shall provide an experienced staff member to train the CONTRACTOR's installation crews regarding pipe handling, jointing, and backfilling. Training shall be provided for a minimum of two weeks at the beginning of the project, and as needed during construction. The staff member's duties shall include, but not be limited to, the following:

1. Observe the installation and welding of the pipe and fittings.

2. Report any concerns to the Engineer's onsite observer.

3. Answer questions and provide assistance to the Engineer and the CONTRACTOR.

I. Certified Welding Inspector (CWI): Furnish the services of a certified welding inspector(s) for all shop and field welding as specified in AWWA C200 and C206. The certified welding inspector(s) shall 100 percent visually inspect all welds, verify proper procedures are being followed using qualified welders, supervise CONTRACTOR's non- destructive testing, and witness Engineer's non-destructive testing. The welding inspector(s) shall submit written certification that all welds were performed in conformance with these documents. All shop weld tests shall be reviewed and signed by the inspector(s).

J. Pipe Manufacturer/Fabricator: The manufacturer or fabricator of the pipe shall be experienced in fabricating pipe of similar diameters and wall thicknesses required for this Work and shall have the manufacturing capability to meet the schedule requirements of this project. Experience shall include successful fabrication to AWWA C200 standards of 36-inch and larger pipe with wall thicknesses 0.300 - inch or larger within the 4-year period preceding the bid date. This experience requirement shall apply to the fabrication plant facility and responsible personnel, not to the firm which owns the facility or employs the personnel.

## PART 2 PRODUCTS

### 2.01 GENERAL

A. Unless otherwise indicated, steel pipe, linings and coatings shall conform to ANSI/AWWA C200, C205, C602, C209, C214, C215, C216, and C222, as applicable, subject to the following supplemental requirements. The pipe shall be of the diameter and wall thickness shown, shall be furnished complete with welded or gasket joints, as indicated in the Contract Documents. For pipe larger than 24 inches in diameter, the inside diameter after lining shall not be less than the nominal diameter indicated unless otherwise shown. Pipe 24 inches in diameter and smaller may be provided in standard outside diameters.

B. Markings: Legibly mark all pipes and specials in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings shall be marked at each end with top field centerline. The word "top" shall be painted or marked on the outside top spigot of each pipe section.

C. Handling and Storage: The pipe shall be handled by use of wide slings, padded cradles, or other devices, designed and constructed to prevent damage to the pipe coating/exterior. The use of chains, hooks, or other equipment which might injure the pipe coating/exterior will not be permitted. Stockpiled pipe shall be suitably supported and shall be secured to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials. Stockpiled pipe shall be supported on sand or earth berms free of rock exceeding 3 inches in diameter. The ends of all pipe shall be securely bulkheaded or otherwise sealed during transport to the jobsite. All pipe handling equipment and methods shall be acceptable to the Engineer.

D. Pay the cost of replacement or repair of pipe which is damaged at no increased cost to the Owner.

E. Strutting: Adequate strutting (stulling) shall be provided on all specials, fittings, and straight pipe so as to avoid damage or distortion to the pipe and fittings during handling, storage, hauling, and installation. The following requirements shall apply:

1. The strutting shall be placed as soon as practicable after the pipe is fabricated or the mortar lining has been applied and shall remain in place while the pipe is loaded, transported, unloaded, installed and backfilled at the jobsite.

2. The strutting materials, size and spacing shall be the responsibility of the CONTRACTOR and shall be adequate to prevent deflection and support the earth backfill plus any greater loads which may be imposed by the backfilling and compaction equipment. One strut shall be placed vertical oriented with the top of pipe. One set of struts shall be set 2 feet from each end of each pipe section and at a maximum interval of 15 feet in-between

3. Any pipe damaged during handling, hauling, storage, or installation due to improper strutting shall be repaired or replaced.

F. Laying Lengths: Maximum pipe laying lengths shall not be limited unless specifically required by the Drawings. CONTRACTOR shall select lengths to accommodate the CONTRACTOR's operation.

G. Lining: The pipe lining shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness.

H. Cathodic Protection System: Provide cathodic protection appurtenances, including insulating flanges and DC blockers as shown in the Drawings. Maintain electrical continuity except where isolation is specifically indicated in the drawings.

I. Closures and Correction Pieces: Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing indicated. The locations of correction pieces and closure assemblies shall be shown on the pipe layout diagrams and shall be subject to the Engineer's review. Any change in location or number of said items shall be approved by the Engineer.

J. Shop-Welded Surfaces: All weld seams on pipe surfaces that will have a flexible tape or polyolefin coating in accordance with Section 09900 – Paints and Coatings shall be ground such that the maximum weld bead height will not exceed 1/32 inch. All ground weld seams shall be smooth and free of all burrs. Do not grind into, or gouge, the adjacent pipe wall material.

## 2.02 MATERIALS

A. Cement: Cement for mortar shall conform to the requirements of ANSI/AWWA C205; provided, that cement for mortar coating shall be Type V, and mortar lining shall be Type II or V, per ASTM C 150. Fly ash or pozzolan shall not be used as a cement replacement.

B. Steel: Provide steel coils for spiral welded steel pipe or steel plate for straight seam welded steel pipe per AWWA C200 and as follows:

1. Yield Strength: 40,000 psi minimum. Measured yield strength shall not exceed 85% of measured tensile strength.

2. Minimum Tensile Strength: 60,000 psi

3. Coils: Steel coils shall be made from the continuous cast process or continuous cast slabs, fully killed, fine-grain practice conforming to the physical and chemical characteristics of ASTM A1018/A1018M, SS Grade 40 Type 2. For sheet steel, the maximum allowable thickness variation shall be 0.010 inch under or over the nominal thickness.

4. Plate: Steel plate shall be fully killed, conform to ASTM A20, and be manufactured to fine-grain practice conforming to the physical and chemical characteristics of ASTM A572/A572M, Grade 50. For plate steel, the maximum allowable thickness variation shall be 0.010 inch under or over the nominal thickness.

C. Pipe shall be manufactured as fabricated pipe per AWWA C200 as modified herein.

ASTM pipe manufacturing standards referenced in AWWA C200 shall not be used. Pipe sections shall be fabricated by either of the following methods:

1. Pipe sections may be spirally welded or fabricated from short cylindrical courses joined circumferentially by complete penetration butt joint welds with not more than two longitudinal seams per course. Longitudinal seams shall be staggered on both sides of the pipe.

2. Pipe sections may be rolled or pressed from no more than three sheets the full length of the pipe and welded with no more than three longitudinal seams. Patching inserts, overlays, or pounding out of dents will not be permitted. Repair of notches or laminations on second ends will not be permitted. Damaged ends shall be removed as a cylinder and the section end properly prepared. Distorted or flattened lengths shall be rejected. A buckled section shall be replaced as a cylinder.

D. Charpy Tests

1. General. Steel used in production manufacturing of pipe and specials shall be tested for notch toughness using Charpy V-Notch tests per ASTM A 370. The test acceptance shall be 25 foot-pounds at a test temperature of 30 degrees F.

2. Charpy V-Notch tests shall be conducted on all steel used in fabricating pipe and reinforcement materials 0.5-inch or greater in thickness. Test outside diameter wrap of two coils minimum per heat lot.

3. The Owner may elect to increase the Charpy testing to include more steel than indicated above at a negotiated price.

## 2.03 SPECIALS AND FITTINGS

A. Unless otherwise required, all specials and fittings shall be in accordance with Section 02572 - Steel Pipe Fabricated Specials and shall conform to the dimensions of ANSI/AWWA C208.

## 2.04 DESIGN OF PIPE

A. General: The pipe shall be steel pipe, mortar-lined and flexible or mortar-coated as shown on the Drawings, with field welded joints or gasket as indicated. The pipe shall consist of a steel cylinder, lined with Portland cement-mortar as indicated, with an exterior coating as indicated in Section 2.06 - Exterior Coating of Pipe. Field lining will only be allowed where specifically indicated on the Drawings.

B. The pipe shall be manufactured, tested, inspected, and marked according to applicable requirements previously stated and except as hereinafter modified, shall conform to ANSI/AWWA C200.

C. Pipe Dimensions: The pipe shall be of the diameter and wall thickness shown on the Drawings. The minimum steel cylinder thickness for each pipe size shall be as indicated.

D. Specials Dimensions: The specials shall be of the diameter and wall thickness indicated on the Drawings.

E. Joint Design: Unless otherwise shown, the standard field joint for steel pipe shall be a double-welded (fully circumferential) lap joint. Mechanically coupled or flanged joints shall be required where indicated on the Drawings. Butt-strap joints shall be used only where required for closures or where indicated. The joints furnished shall have the same or higher pressure rating as the abutting pipe. Provide air test tapped holes for each double welded lap joint.

F. Lap joints prepared for field welding shall be in accordance with ANSI/AWWA C200. The method used to form, shape and size bell ends shall be such that the physical properties of the steel are not substantially altered. Unless otherwise approved by the Engineer, bell ends shall be formed

by an expanding press or by the pipe being moved axially over a die in such a manner as to stretch the steel plate beyond its elastic limit to form a truly round bell of suitable diameter and shape. The ends shall not be rolled. Faying surfaces of the bell and spigot shall be essentially parallel, but in no case shall the bell slope vary more than 2 degrees from the longitudinal axis of the pipe.

G. Moderate deflections and long radius curves may be made by means of beveled joint rings, by pulling standard joints, by using short lengths of pipe, or a combination of these methods; provided that pulled joints shall not be used in combination with bevels and maximum joint deflections are not exceeded. The maximum total allowable angle for beveled joints shall be 5 degrees per pipe joint. Bevels shall be provided on the bell ends. Mitering of the spigot ends will not be permitted. The maximum allowable angle for pulled joints shall be 75 percent of the manufacturer's recommendations or the angle which results from a ¾-inch pull out from normal joint closure, whichever is less. In no case shall pulled joints result in a gap between the bell and spigot at the weld location that exceeds 1/8 inch. All horizontal deflections or fabricated angles shall fall on the alignment, as shown.

H. All vertical deflections shall fall on the alignment within laying tolerance as described in Section 3.1.

I. Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe as indicated or as otherwise acceptable to the Engineer. Holdback areas shall be coated as hereinafter specified.

J. Temperature Control Lap Joint: A special longer bell end (temperature control lap joint) shall be provided at a maximum spacing of 400 feet to account for movement of the installed pipe due to temperature changes. The pipe manufacturer shall determine the length required for the longer bell as defined by the CONTRACTOR's pipe laying procedures

K. Joint Shop Coating: All holdback areas for welded joints, all butt straps, and all bell and spigot joint rings for rubber-gasketed joints shall be thoroughly cleaned and given a shop coat of rust-inhibitive primer. The surface preparation and primer shall be compatible with the intended finish coating as specified in Section 09900 – Paints and Coatings, as applicable.

L. Shop Fit Test

1. To ensure that joints may be fully assembled and that excessive annular space between spigots and bells does not exist, and that the pipe meets the requirements of AWWA C200, the pipe fabricator shall perform a shop fit test on a minimum of five joints. The joints to be tested shall be selected by the Engineer based on pipe measurements.

2. The shop fit test shall join the pipe ends in the shop with the proposed adjacent pipe end.

3. Record the actual annular space, with the data to include as a minimum:

   a. Maximum space at any point.

   b. Minimum space at any point.

   c. Space at 90-degree intervals--top, bottom, and spring line on both sides.

4. The pipe ends shall be match marked after shop assembly.

## 2.05 CEMENT-MORTAR LINING

A. Cement-Mortar Lining for Shop Application: Where indicated on the Drawings, interior surfaces of all steel pipe, fittings, and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C205. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be of a type that has been used successfully for similar work and shall be approved by the Engineer. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at the delivery site, or after installation, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications at no additional cost to the Owner.

B. The minimum lining thickness shall be as follows, with a tolerance of plus 1/8-inch or minus 1/16-inch:

| Nominal Pipe Diameter (in) | Lining Thickness (in) |
|---|---|
| 4 – 10 | ¼ |
| 11 – 23 | 5/16 |
| 24 – 36 | 3/8 |
| Over 36 | 1/2 |

C. The pipe shall be left bare where field joints occur as indicated. Ends of the linings shall be left square and uniform. Feathered or uneven edges will not be permitted. and shall be replaced to the full thickness required. Defective linings

shall be cut back to a square shoulder in order to avoid feather edged joints. Temperature and shrinkage cracks in the mortar less than 1/16 inch wide need not be repaired. Pipe, specials, or fittings with cracks wider than 1/16 inch shall be rejected or repaired per C205 at the discretion of the Engineer.

D. Defective linings, as determined by the Engineer, shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder in order to avoid feather edged joints. Temperature and shrinkage cracks in the mortar less than 1/16 inch wide need not be repaired. Pipe, specials, or fittings with cracks wider than 1/16 inch shall be rejected or repaired per C205 at the discretion of the Engineer.

E. The progress of the application of mortar lining shall be regulated in order that all hand work, including the repair of defective areas is cured in accordance with the provisions of ANSI/AWWA C205. Cement-mortar for patching shall be the same materials as the mortar for shop or machine lining, except that a finer grading of sand and mortar richer in cement shall be used when field inspection indicates that such mix will improve the finished lining of the pipe.

F. Cement-Mortar Lining: Unless otherwise indicated, all steel pipe shall be mortar-lined. The materials and design of in-place cement-mortar lining shall be in accordance with ANSI/AWWA C602 and the following supplementary requirements:

1. Pozzolanic material shall not be used in the mortar mix.

2. Admixtures shall contain no calcium chloride.

3. The minimum lining thickness shall be as indicated for shop-applied cement- mortar lining and finished inside diameter after lining shall be as indicated.

4. Temperature and shrinkage cracks in the mortar less than 1/16 inch wide need not be repaired. Pipe, specials, or fittings with mortar cracks wider than 1/16 inch shall be rejected or repaired at the discretion of the Engineer.

5. Field applied mortar lining shall meet the requirements of this Subparagraph F.

G. Protection of Pipe Lining/Interior: For all pipe and fittings with plant-applied cement- mortar linings, provide a polyethylene or other suitable bulkhead on the ends of the pipe and on all special openings to prevent drying out of the lining. All bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

## 2.06 EXTERIOR COATING OF PIPE

A. Cement Mortar Coating – Buried Pipe

1. All pipe for buried service, including permanent bumped heads, shall be coated with a 3/4-inch minimum thickness of reinforced cement-mortar coating. Unless otherwise indicated, exterior surfaces of pipe or fittings passing through structure walls shall be cement-mortar coated from the center of the wall or from the wall flange to the end of the underground portion of pipe or fitting.

2. Materials for mortar shall conform to the requirements of AWWA C205. Cement shall be ASTM C 150, Type II or Type V. Admixtures shall contain no calcium chloride. Fly ash or pozzolan shall not be used as a cement replacement.

3. Cement mortar coating cracks shall be classified and repaired in conformance with AWWA C205.

B. Epoxy Coating – Exposed Pipe

1. Exposed pipe includes above ground pipe and pipe in vaults.

2. Exposed pipe shall be coated with a minimum of 16 mils of epoxy coating per AWWA C210.

## 2.07 PIPE APPURTENANCES

A. Pipe appurtenances shall be in accordance with the requirements of Section 15000 - Piping, General.

## 2.08 PIPELINE MARKING TAPE

A. Metallic Tape: Tape shall be minimum 5.5 mils thick aluminum foil imprinted on one side, encased in high visibility inert polyethylene jacket. Tape shall be 12 inches wide. Imprinted lettering shall be 1 inch tall, permanent black, and shall read California American Water - WATER LINE BURIED BELOW. Joining clips shall be manufacturer's standard tin or nickel coated. Tape shall be as manufactured by Reef Industries (Terra "D"), Allen (Detectatape), or equal.

B. Plastic Tape: Tape shall be minimum 4-mil thick polyethylene which is impervious to alkalis acids, and chemicals and solvents which are likely in the soil. Tape shall be 12 inches wide and lettering shall be 1-inch tall permanent black on a blue background. Lettering shall read: "California

American Water - WATER LINE BURIED BELOW." Tape shall be manufactured by Reef Industries (Terra Tape), Allen (Markline), or equal.

## 2.09 MARKERS

A. Provide pipeline markers at the locations indicated. Markers in open areas shall be High Visibility Tri-View Utility Marking Posts as manufactured by Rhino Marking and Protection Systems (www.rhinomarkers.com). Coordinate color and lettering with Owner prior to installation. Markers shall be provided at bends or changes in direction and valves.

# PART 3 EXECUTION

## 3.01 INSTALLATION OF PIPE

A. Handling and Storage: All pipe, fittings, and specials shall be carefully handled and protected against damage to lining and coating/interior and exterior surfaces, impact shocks, and free fall. All pipe handling equipment shall be acceptable to the Engineer. Pipe shall not be placed directly on rough ground but shall be supported in a manner which will protect the pipe against injury whenever stored at the trench site or elsewhere. Pipe shall be handled and stored at the trench site in accordance with the requirements stated below. No pipe shall be installed when the lining or coating/interior or exterior surfaces show cracks or other damage that may be harmful as determined by the Engineer. Such damaged lining and coating/interior and exterior surfaces, shall be repaired to the satisfaction of the Engineer, or a new undamaged pipe shall be furnished.

B. All pipe damaged prior to Substantial Completion shall be repaired or replaced by the CONTRACTOR at no additional cost to the Owner.

C. Inspect each pipe and fitting to insure that there are no damaged portions of the pipe. Remove or smooth out any burrs, gouges, weld splatter or other small defects prior to laying the pipe.

D. Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance, which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the Work.

E. Lifting points shall be no closer than the 1/3 and 2/3 points along the length of the Section. CONTRACTOR shall be responsible for selecting lifting points that when used, do not result in damage to the pipe.

F. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Excavation shall be made as needed outside the normal

trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.

G. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the Engineer may change the alignment and/or the grades. Such change shall be made by the deflection of joints, short lengths of pipe, by the use of beveled joint rings, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed 75 percent of the maximum deflection recommended by the pipe manufacturer or the amount that results in more than a 1/8-inch gap at the weld location, whichever is less. No joint shall be misfit any amount which will be detrimental to the strength and water tightness of the finished joint.

H. Except for short runs which may be permitted by the Engineer, pipes shall be laid uphill on grades exceeding 10 percent. Pipe which is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement. All bends shall be properly installed as shown.

I. Pipe struts shall be left in place until backfilling operations have been completed for pipe 42 inches in diameter and larger. Struts in pipe smaller than 42 inches may be removed immediately after laying, provided, that the deflection of the pipe during and after backfilling does not exceed that specified. After the backfill has been placed to a minimum of 3-feet, the struts shall be removed by the CONTRACTOR and shall remain the property of the CONTRACTOR. Struts shall not be removed with a torch or any other method that may damage the pipe lining or coating. The parent pipe material shall not be nicked, gouged, or damaged during strut removal. All repairs of gouges or nicks in the parent material shall be made using 3/32-inch maximum diameter E-6010 welding electrodes with a maximum heat input of 5.6 kj per inch. Tack welds, stull metal, weld splatter, slag, and burrs that remain attached to the parent metal surface after cutting shall be ground to within 1/32 inch of the parent metal. Grinding shall not penetrate the parent metal. The CONTRACTOR shall notify the Engineer prior to grinding. Following grinding, all pipe surfaces at the tack weld shall be visually inspected for defects. All defects deeper than 1/16 inch shall be repaired by welding in accordance with ANSI/AWSD.1.1 and AWWA/ANSI C206. All inspection work shall be performed by a certified welding inspector.

J. For pipe backfilled with CLSM, the pipe shall be laid directly on moist sandbags or other suitable supports approved by the Engineer in preparation for CLSM pipe zone material. Sandbags shall be placed to provide at least 6 inches of CLSM below the bottom of the pipe. Sandbags shall be spaced at a maximum interval of 8 feet and one set shall be placed within 3 feet on both sides of each joint. The CONTRACTOR shall provide additional sandbags as

needed to support the pipe on line and grade. For pipe bedded in granular material, no blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.

K. At all times, means shall be provided to prevent the pipe from floating. Take all necessary precautions to prevent the pipe from floating due to water entering the trench or from backfilling with CLSM. The CONTRACTOR shall assume full responsibility for any damage due to this cause and shall at its own expense restore and replace the pipe to its specified condition and grade if it is displaced due to floating. Maintain the inside of the pipe free from foreign materials and in a clean and sanitary condition until its acceptance by the Owner.

L. Bulkheads

1. Prior to shipment of pipe with cement mortar lining the lining shall be wetted then a suitable bulkhead shall be attached to each end of the pipe section. This bulkhead shall remain in place and in good condition through transit to the Project.

2. During construction the openings of all pipe and specials where the pipe and specials have been cement-mortar lined in the shop shall be protected with suitable bulkheads to maintain a moist atmosphere and to prevent unauthorized access by persons, animals, water or any undesirable substance. The bulkheads shall be so designed to prevent drying out of the interior of the pipe. Introduce water into the pipe as needed to keep the mortar moist where moisture has been lost due to damaged bulkheads.

M. Pipe Cleanup: As pipe laying progresses, keep the pipe interior free of all debris. Completely clean the interior of the pipe of all sand, dirt, mortar splatter and any other debris following completion of pipe laying and any necessary interior repairs prior to testing and disinfecting the completed pipeline.

N. Installation Tolerances: Each section of pipe shall be laid in the order and position shown on the laying diagram and the following requirements:

1. Each section of pipe having a nominal diameter less than 48 inches shall be laid to line and grade, within plus or minus 2 inches horizontal deviation and plus or minus 1 inch vertical deviation.

2. Each section of pipe having nominal diameter 48 inches and larger shall be laid to line and grade, within plus or minus 5 percent of diameter horizontal deviation and plus or minus 2.5 percent of diameter vertical deviation.

3. In addition to the horizontal and vertical tolerances above, lay the pipe so that no high or low points other than those on the laying diagram are introduced.

4. Pipe deflection, after backfill but prior to installation of field-applied cement mortar lining, if applied, shall not exceed 2.25 percent for flexible coated pipe and 1.5 percent for cement mortar coated pipe. Deflection shall be measured by the difference in vertical inside diameter in the installed pipe and the manufactured pipe.

5. Pipe not conforming to these criteria or which otherwise impact the ability to complete the Work shall be removed and reinstalled in full conformance with the Contract Documents at no additional cost to the Owner.

6. For each section of pipe, record the invert elevation at the lower end and incorporate the data on the Record Drawings.

O. Protection of Pipe: At locations where the CONTRACTOR proposes to cross the installed pipeline with heavy equipment, precautions as approved by the Engineer shall be taken to protect the pipe from damage. Acceptable precautions include: backfilling the pipe trench as necessary to protect the pipe, concrete encasing the pipe, and placing steel plating over the pipe. Any damage to the pipe caused by the CONTRACTOR's operation or his equipment shall be repaired at no additional cost to the Owner.

## 3.02 WELDED JOINTS

A. Welding Procedures, Welding Qualifications, and Testing

1. Field welding procedures, welders, welding operators, and tackers shall be qualified in accordance with AWS D1.1 and as defined in Section 3 of ANSI/AWWA C206 or ANSI/AWWA C200, as applicable. All qualifications shall be in accordance with all-position pipe tests as defined in Section 5 of AWS D1.1.

2. For field welding, the welder qualification testing shall be performed at the site. Previous qualifications will not be accepted. The CONTRACTOR shall obtain the services of an independent testing laboratory to perform the welder qualification onsite. Copies of all test

data and certifications shall be provided to the Engineer. All costs for welder qualification testing shall be at no increased cost to the Owner.

3. Upon completion of each field-welded joint, the welding operator shall mark his regularly assigned identification number and the last two numbers of the year in which the Work was completed, or the CONTRACTOR may have a records system that traces a welder's work completion to a specific joint. Steel stamping directly on piping will not be permitted unless "low stress" die stamps, such as interrupted dot or round nose types, are used.

4. All single welded lap joints will be inspected by the CONTRCTOR in the presence of the Engineer using magnetic particle or dye penetration methods. Field butt welds will be inspected by the CONTRCTOR in accordance with the requirements of API 1104 by the radiographic method and the acceptance criteria of API 1104. Magnetic particle testing is not required for seal welds.

5. All double welded lap joints and butt strap joints shall be air tested by the COTNRACTOR in the presence of the Engineer in accordance with Section 01656 – Pressure Pipe Testing and Disinfection, Testing and Disinfection. Repairs and retesting shall be required if any loss of pressure occurs.

6. The CONTRACTOR shall inform the Engineer before completed weld joints are to be backfilled so that the joint may be inspected. The CONTRACTOR shall assume all costs of exposing backfilled joints for inspection when backfilling preceded the inspection.

7. Personnel performing visual inspection of welds shall be qualified and currently certified as Certified Welding Inspectors (CWI) in accordance with AWS QC1, Standard for Qualification and Certification of Welding Inspectors. Personnel performing nondestructive tests shall be qualified and certified to the requirements of SNT-TC-1A.

    a. The Engineer may also order nondestructive testing by an independent testing laboratory in addition to any testing specified herein. Except as otherwise specified herein, all costs for the independent testing laboratory to inspect and test field welds will be paid for by the Owner. If the weld is defective, the inspection costs shall be paid for by the CONTRACTOR. Defective welds shall be repaired and retested at the CONTRACTOR's expense.

b. Test reports of all laboratory tests shall be submitted as provided in the quality control section.

B. Where exterior welds are performed, adequate space shall be provided for welding and inspection of the joints.

C. Lap Welded Joints: During installation of welded steel pipe in either straight alignment or on curves, the pipe shall be laid so that at any point around the circumference of the joint there is a minimum lap as shown on the Drawings.

D. Butt Straps: Where used or required, shall be as shown on the Drawings.

E. After the pipe and pipe joint are properly positioned in the trench, weld and provide external joint protection for all joints except the special temperature control lap joint hereinafter specified. The length of pipe between special temperature control joints shall be backfilled to at least one foot above the top of the pipe as hereinafter specified. The special temperature control joints shall be welded after the pipe is backfilled to at least one foot above the top of the pipe for the full distance between the temperature control joints upstream and downstream. Joint protection shall be provided for special temperature control joints after completion of the joint welds and tests as specified. Care shall be exercised during the initial backfilling to prevent movement of the pipe and to prevent any backfill material from being deposited on the special temperature control joint.

F. Control of Temperature Stresses

1. Control temperature stresses in accordance with AWWA C206, the approved temperature stress control submittal, and these Specifications. Provide special temperature control lap joints at intervals of 400 feet or less, unless otherwise approved by the Engineer.

2. To control temperature stresses, the unbackfilled special temperature control joint areas of all pipe shall be shaded from the direct rays of the sun by the use of properly supported awnings, umbrellas, tarpaulins, or other suitable materials until the pipe is backfilled at least 1 foot over the top of the pipe. The "temperature control joint area" is defined as the entire length of pipe left exposed near a control joint after placing the pipe backfill between it and the other control joints in each direction. The term "special temperature control joint area" is defined as the entire length of pipe left exposed near a control joint after placing the backfill between it and the other control joints in each direction. Shading materials at the joint area shall not rest directly on the pipe but shall be supported to allow air circulation around the pipe. Shading of the pipe joints

need not be performed when the ambient air temperature is below 45 degrees F.

3. At intervals not exceeding 400 feet along welded reaches of the pipeline, at the first regular lap-welded field joints outside concrete encasements and structures, and where shown, the pipe shall be supplied with a special temperature control lap joint and laid with an initial lap of not less than 3 inches greater than the typical lap joint. Where temperature control lap joints occur in a traveled roadway or other inconvenient location, the location of the joint may be adjusted, as acceptable to the Engineer.

4. Provide and install thermocouple temperature gauges to monitor the temperature of the steel pipe wall on the inside top of the pipe as it lays in the trench. All pipe temperature requirements specified herein shall be measured at the top inside of the steel cylinder. Specific temperature requirements for the pipeline steel cylinder shall be met prior to installation of the controlled low strength material (CLSM), during and after placement of CLSM, and during welding of the special temperature control joints. If atmospheric conditions do not allow the conditions to be met, supplemental cooling shall be required by the CONTRACTOR. The following outlines the specific temperature control requirements.

    a. Prior to and during placement of the CLSM, the pipeline steel temperature shall be at or below 90 degrees F. The specified temperature shall be maintained for at least three hours after the placement of CLSM. The specified temperature shall be maintained until the line is fully backfilled. Provide supplemental cooling as required.

    b. Placement of CLSM shall proceed in the direction of pipe laying from one special temperature control joint to the next. During placement of CLSM, the lead end of the pipe section (toward the next special temperature control joint) shall be left unbackfilled or otherwise unrestrained such that the end of the pipe is free to move in response to expansion or contraction due to temperature changes. CLSM shall not be placed in a direction which would result in CLSM placement proceeding in a direction toward previously or simultaneously placed CLSM without the written permission of the Engineer. The direction of CLSM placement will not be limited for placement at the short unbackfilled section immediately adjacent to the special temperature control joints.

c. During periods between CLSM placement operations, any section of pipeline that is backfilled with CLSM shall be shaded from the direct rays of the sun by the use of properly supported awnings, umbrellas, tarpaulins, or other suitable materials until the pipe is backfilled at least 1 foot over the top of the pipe. The temperature of the partially backfilled pipe shall not be allowed to exceed 110 degrees Fahrenheit at any time. Provide supplemental cooling as required. Shading materials shall not rest directly on the pipe but shall be supported to allow air circulation around the pipe. Shading of the partially backfilled pipe need not be performed when the CONTRACTOR can demonstrate to the satisfaction of the Engineer, using thermocouple data, that shading is not necessary to the CONTRACTOR to meet the specified temperature requirement.

d. Prior to welding the special temperature control joints, the pipeline extending 400 feet each direction from the joint shall be maintained at or below 85 degrees F. Additionally, the pipeline extending 400 feet each direction from the joint shall be backfilled with CLSM to at least one foot over the top of the pipe. At the specified temperature, the special during the coolest interval of suitable length within a 24-hour day. Use the thermocouple temperature data to demonstrate to the Engineer the coolest interval of the day.

e. After welding any temperature control joint, the pipe temperature for 150 feet in each direction from the control joint shall be maintained below 110 degrees F for a minimum of 24 hours after the temperature control joint area has been backfilled to at least 1 foot over the top of the pipe. This requirement is in addition to the shading and CLSM placement temperature requirements indicated herein.

G. Prior to the beginning of pouring CLSM or beginning the welding procedure, any tack welds or joint stops used to position the pipe during laying shall be removed. Any annular space between the faying surfaces of the bell and spigot shall be equally distributed around the circumference of the joint by shimming, jacking, or other suitable means. The weld shall then be made in accordance with ANSI/AWWA C206. Where more than one pass is required, all dirt, slag, and flux shall be removed before the succeeding bead is applied.

H. Testing of Joints: The pipeline joints shall be tested as specified herein and in Section 01656 – Pressure Pipeline Testing and Disinfection.

I. Following tests of the joint, the exterior joint spaces shall be coated in accordance with these Specifications after which backfilling may be completed.

J. Joints: The pipe ends shall be cut straight on joints where butt straps are used for realignment, adjustment, or deflection, and fillet welds shall be made as indicated.

K. Repair of Welds: All welds that are defective shall be repaired by the CONTRACTOR to meet the requirements of this Section at no additional cost to the Owner. Defects in welds or defective welds shall be removed, and that section of the joint shall then be rewelded. Only sufficient removal of defective material that is necessary to correct the defect is required. After the repair is made, the joint shall be checked by repeating the original test procedure. Welds deficient in size shall be repaired by adding weld metal.

## 3.03 JOINT COATING AND LINING

A. General: The interior and exterior joint recesses shall be thoroughly wiped clean and all water, loose scale, dirt and other foreign material shall be removed from the inside surface of the pipe.

B. After the backfill has been completed to final grade, the interior joint recess of shop-lined pipe shall be filled with grout, tightly packed into the joint recess and troweled flush with the interior surface. All excess shall be removed. At no point shall there be an indentation or projection of the grout exceeding 1/16 inch. With pipe smaller than 24 inches in diameter, before the spigot is inserted into the bell, the bell shall be daubed with grout containing one part cement to two parts sand. The spigot end then shall be forced to the bottom of the bell and excess mortar on the inside of the joint shall be swabbed out.

C. Lining of Field Joints

1. Protect the exposed interior steel joint surfaces by pointing with cement mortar in accordance with AWWA C205.

2. Cement mortar for joint lining shall consist of one part cement Type II per ASTM C150 to two parts sand and sufficient water for dry-pack consistency.

D. Coating of Field Joints

1. Fabric Grout Bands: The grout bands shall be polypropylene fabric strips, such as “Typar” (Dupont), non-woven, with steel strapping of sufficient strength to hold the fresh mortar and resist rodding of the mortar.

a. The fabric backing shall be cut and sewn into 9-inch wide strips for rubber gasket joints with slots for the steel strapping on the outer edges.

b. The grout band shall be centered over the joint space with approximately equal widths extending over each pipe end and securely attached to the pipe with the steel straps. After filling the exterior joint space with grout, the flaps shall be closed and overlapped in a manner that fully encloses the grout. The grout band shall remain in position on the pipe joint.

2. After the pipe has been laid and after sufficient backfill has been placed between the joints to hold the pipe securely in place, the outside annular space between pipe sections shall be completely filled with grout formed by the use of the polypropylene fabric bands.

3. Grout for the joint coating shall be one part cement Type II per ASTM C150 to two parts sand and sufficient water for a thick cream consistency.

## 3.04 CEMENT-MORTAR LINING, FIELD-APPLIED

A. Unless otherwise indicated, the CONTRACTOR shall construct the cement-mortar lining in- place after the pipeline is backfilled to approximate finished grade. The application of in- place cement-mortar lining shall be in accordance with ANSI/AWWA C602.

1. The lining machine shall be of a type that has been used successfully for a similar size of pipe. Perform all Work in a thorough and workmanlike manner by trained personnel, under the supervision of experienced personnel skilled in machine application of cement-mortar lining to pipelines of size comparable to this Work.

2. Curing of the in-place cement-mortar lining shall be in accordance with ANSI/AWWA C602, except the CONTRACTOR shall be responsible for curing and maintaining the lining until final acceptance by the Owner. Provide a system to maintain a suitably moist environment within the pipe to properly cure and maintain the lining. Provide additional protective devices as required to ensure that the airtight covers, which maintain a moist condition in the pipeline, are not damaged.

3. Defective areas encompassing the full diameter of the pipe shall be replaced by machine wherever the length measured along the pipe centerline is greater than 5 feet; otherwise defective areas may be replaced by hand.

## 3.05 INSTALLATION OF PIPE APPURTENANCES

A. Protection of Appurtenances: Where the joining pipe is concrete or coated with cement mortar, buried appurtenances shall be coated with a minimum thickness of one inch of cement mortar having one part cement to not more than two parts plaster sand. Following coating with cement mortar, the appurtenances shall be coated with a protective overcoat in accordance with the paragraph entitled "Protective Coating."

B. Installation of Valves: All valves shall be handled in a manner to prevent any injury or damage to any part of the valve. All joints shall be thoroughly cleaned and prepared prior to installation. Adjust all stem packing and operate each valve prior to installation to insure proper operation. Valves (body and seat) shall not be subjected to test pressures greater than manufacturer's recommendation. In some cases this may require an increase in the valve pressure class.

C. All buried valves shall be coated and protected in accordance with Section 09900 – Paints and Coatings.

D. All valves shall be installed so that the valve stems are plumb and in the location indicated.

E. Installation of Flanged Joints: Before the joint is assembled, the flange faces shall be thoroughly cleaned of all foreign material with a power wire brush. The gasket shall be centered and the connecting flanges drawn up watertight without unnecessarily stressing the flanges. All bolts shall be tightened in a progressive diametrically opposite sequence and torqued with a suitable, approved and calibrated torque wrench. All clamping torque shall be applied to the nuts only.

F. All buried flanges shall be coated and protected in accordance with Section 09900 – Paints and Coatings.

G. Flexible Coupled Joints: When installing flexible couplings, care shall be taken that the connecting pipe ends, couplings and gaskets are clean and free of all dirt and foreign matter with special attention being given to the contact surfaces of the pipe, gaskets and couplings. The couplings shall be assembled and installed in conformity with the recommendation and instruction of the coupling manufacturer.

H. Wrenches used in bolting couplings shall be of a type and size recommended by the coupling manufacturer. Coupling bolts shall be tightened so as to secure a uniform annular space between the follower rings and the body of the pipe with all bolts tightened approximately the same amount. Diametrically opposite bolts shall be tightened progressively and evenly. Final tightening shall be done with a

suitable, approved and calibrated torque wrench set for the torque recommended by the coupling manufacturer. All clamping torque shall be applied to the nut only.

I. Upon completion of the coupled joint, the coupling and bare metal of the pipe shall be cleaned, primed and protected in accordance with the requirements of Section 09900 – Paints and Coatings.

## 3.06 CORROSION CONTROL

A. Cathodic Protection: Corrosion mitigation and testing materials shall be provided where indicated.

## 3.07 MARKING TAPE INSTALLATION

A. Continuously install plastic marking tape in three locations along the pipe at the depth and locations shown on the Drawings.

## 3.08 PIPELINE TESTING AND DISINFECTION

A. The steel pipe shall be hydrostatically tested as specified in Section 01656 – Pressure Pipeline Testing and Disinfection, Testing and Disinfection.

**END OF SECTION**

**TECHNICAL SPECIFICATIONS**
**DIVISION 2: SITE WORK**
**02597: POLY VINYL CHLORIDE PRESSURE PIPE, RUBBER JOINTS (AWWA C900 AND C905, MODIFIED)**

## PART 1 GENERAL

### 1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide polyvinyl chloride (PVC) pressure pipe, complete in place, in accordance with the Contract Documents.

### 1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

| | |
|---|---|
| ANSI/AWWA C104/A21.5 | Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water |
| ANSI/AWWA C110/A21.10 | Ductile-Iron and Gray-Iron Fittings 3-in Through 48-in for Water and Other Liquids |
| ANSI/AWWA C111/A21.11 | Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings |
| ANSI/AWWA C116/A21.16 | Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings |
| ANSI/AWWA C600 | Installation of Ductile-Iron Water Mains and Appurtenances |
| ANSI/AWWA C900 | Polyvinyl Chloride (PVC) Pressure Pipe 4-in Through 12-in for Water Mains and Distribution |
| ANSI/AWWA C905 | Polyvinyl Chloride (PVC) Pressure Pipe 14-in Through 48-in for Water Mains and Distribution |
| ASTM D 2584 | Test Method for Ignition Loss of Cured Reinforced Resins |
| PPI Technical Report TR ¾ | Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials |
| AWWA Manual M23 | PVC Pipe - Design and Installation |

### 1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals.

B. Shop Drawings: Drawings of pipe, fittings, and appurtenances. Design calculations to demonstrate compliance of pipe and fittings with this Section. Manufacturer's literature for metallic locating tape.

C. Certifications: A certified affidavit of compliance for pipe and other products or materials under this Section and the following supplemental requirements:

1. Hydrostatic proof test reports.

2. Sustained pressure test reports.

3. Burst strength test reports.

D. The CONTRACTOR shall be responsible for performing and paying for sampling and testing as necessary for the certifications.

## 1.4 QUALITY ASSURANCE

A. **Inspection:** Pipe shall be subject to inspection at the place of manufacture. The CONTRACTOR shall notify the ENGINEER in writing of the manufacturing starting date not less than 14 calendar days prior to the start of any phase of the pipe manufacture.

B. During manufacture of the pipe, the ENGINEER shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.

C. **Tests:** Materials used in manufacture of the pipe shall be tested in accordance with the requirements of this Section and the referenced standards, as applicable.

D. The CONTRACTOR shall perform said material tests. The ENGINEER shall have the right to witness testing; provided that the CONTRACTOR'S schedule is not delayed for the convenience of the ENGINEER.

E. In addition to those tests specifically required, the ENGINEER may requestadditional samples of any material for testing by the OWNER. The additional samplesshall be furnished as a part of the WORK.

F. The pipe manufacturer shall have the following experience:

1. Three (3) successful installations of potable water pipe size between 10” and 24” diameter over the prior 2 years, with two of these being minimum one mile continuous installation.

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## PART 2 PRODUCTS

### 2.1 GENERAL

A. PVC pressure pipe (4-inch through 12-inch) shall conform to the applicable requirements of ANSI/AWWA C900 and PVC pressure pipe (14-inch through 48-inch) shall conform to the applicable requirements of ANSI/AWWA C905 subject to additional requirements herein.

### 2.2 PIPE DESIGN CRITERIA

A. General: PVC pressure pipe shall be designed in accordance with the requirements of AWWA Manual M23 PVC Pipe – Design and Installation, as applicable, and the supplemental requirements in this Section. Pressure class shall be as shown in the pipe design schedule below.

B. Pipe Wall Thickness for Internal Pressure: The pipe shall be designed with a minimum thickness (t) or dimension ratio (DR) of 14.

C. Determination of External Loads: Dead (earth) loads shall be computed using the following equation for trench conditions:

$$W_d = C_d w B_d^2$$

Where: $W_d$ = Earth load in pounds per linear foot
$C_d$ = Calculation coefficient
$w = 130$ lb/ft$^3$
$B_d$ = Trench width at top of pipe, feet

D. Truck live loads shall be determined using the method recommended by AASHTO in "Standard Specifications for Highway Bridges." For depths of cover less than 10 feet HS-20 live loads shall be added to the earth loads to determine the total load. For depths of cover 3 feet or less, HS-20 live load plus impact shall be included.

E. **Deflection Control:** The deflection of the pipe after installation shall not exceed 0.05 times the inside diameter. If the calculated deflection exceeds 0.05 times the outside diameter the pipe class shall be increased or the quality of the pipe zone backfill shall be improved to achieve a higher modulus of soil reaction, E'. For purposes of calculation, values of E' shall be 1,000 psi with depth of cover of 3 to 4 feet; 1,500 psi with depth of cover between 5 and 10 feet and 1,500 psi + 100 psi x (Depth of cover below 10 feet).

## 2.3 PIPE

A. The pipe shall be of the diameter and pressure class indicated, shall be furnished complete with rubber gaskets, and all specials and fittings shall be provided as required in the Contract Documents. The dimensions and pressure classes for Dimension Ratios for large PVC pressure pipe with Cast-Iron Pipe Equivalent O.D.'s shall conform to the requirements of AWWA C900 or C905.

B. **Additives and Fillers:** Unless otherwise allowed in alternate qualification procedures of PPI-TR3, compounds which have a Hydrostatic Design Basis (HOB) of 4000 psiat 73.4 degrees F and for water shall not contain additives and fillers that exceed the recommended values in Table 1, Part Y of PPI-TR3 (e.g., allowable content range for calcium carbonate is 0.0-5.0 parts per hundred of resin). If requested by the ENGINEER, the additive and filler content shall be determined using the pyrolysis method as specified in ASTM D 2584.

C. **Joints:** Joints for the buried PVC pipe shall be either an integral bell manufactured on the pipe or a separate coupling both employing a rubber ring joint. The bell and coupling shall be the same thickness as of the pipe barrel, or greater thickness. The sealing ring groove in the coupling shall be of the same design as the groove in cast iron fittings and valves available from local water works supply distributors.

D. **Joint Restraint:** Provide restrained joints at all pipeline angle points and deflections and as shown. Joint restraints shall be as follows:

1. Fully restrain all bell joints using JCM Sur-Grip Model 620 Fitting Restrainer, EBBA Iron Series 1500 or approved equal.

2. Fully restrain all mechanical joints using JCM Model 610 Sur-Grip Fitting Restrainer, EBBA Iron Series 2000 PV or approved equal.

E. **Joint Deflection:** Deflection at the joint shall not exceed 1.5 degrees or the maximum deflection recommended by the manufacturer. No deflection of the joint shall be allowed for joints that are over-belled or not belled to the stop mark.

## 2.4 PIPE DESIGN SCHEDULE

| Pressure Class | Nominal Diameter (in) | Maximum Sustained Pressure, Pw (psi) | Cover Range (feet) | Trench Condition Outside Diam+(ft) | Minimum Compaction (percent) |
|---|---|---|---|---|---|
| 305 | 4 - 12 | 175 | 3 - 10 | 0D+2 | 90 |
| 235 | 14 - 30 | 175 | 3 - 12 | 0D+2 | 90 |
| 200 | 36 | 175 | 3 - 21 | 0D+2 | 90 |
| 125 | 42-48 | 70 | 3 - 15 | 0D+2 | 90 |

## 2.5 FITTINGS

A. Fittings shall be ductile iron and shall conform to the requirements of AWWA C110, Class 350 for pressure class 200 and higher pipe. PVC pipe fittings shall be mechanical joint conforming to AWWA C111, flanged joints conforming to AWWA C115, or restrained joints as required.

B. All fittings shall be lined and coated in compliance with the latest AWWAstandards and NSF 61.

C. Each fitting shall be clearly labeled to identify its size and pressure class.

# PART 3 EXECUTION

## 3.1 GENERAL

A. Laying, jointing, testing for defects and for leakage shall be performed in the presence of the ENGINEER, and shall be subject to approval before acceptance. Material found to have defects will be rejected and the CONTRACTOR shall promptlyremove such defective materials from the Site.

B. Installation shall conform to the requirements of AWWA M23, instructions furnished by the pipe manufacturer, and to the supplementary requirements herein. Wherever the provisions of this Section and the aforementioned requirements are inconflict, the more stringent provision shall apply.

## 3.2 HANDLING AND STORAGE

A. **Handling:** Pipe, fittings and accessories shall be carefully inspected before and after installation and those found defective shall be rejected. Pipe and fittings shall be

free from fins and burrs. Before being placed in position, pipe, fittings, and accessories shall be cleaned, and shall be maintained in a clean condition. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings or any other material be dropped or dumped into trenches.

B. **Storage:** Pipe should be stored, if possible, at the Site in unit packages provided by the manufacturer. Caution should be exercised to avoid compression damage or deformation to bell ends of the pipe. Pipe should be stored in such a way as to prevent sagging or bending and be protected from exposure to direct sunlight by covering with an opaque material while permitting adequate air circulation above and around the pipe. Gaskets should be stored in a cool, dark place out of the direct rays of thesun, preferably in original cartons.

## 3.3 TRENCHING AND BACKFILL

A. Trench excavation and backfill shall conform to the requirements of Section 02200 - Earthwork.

## 3.4 INSTALLATION

A. Bell-and-spigot pipe shall be laid with the bell end pointing in the direction of laying. Pipe shall be graded in straight lines, taking care to avoid the formation of any dips or low points. Pipe shall not be laid when the conditions of trench or weather are unsuitable. At the end of each day's work, open ends of pipe shall be closed temporarily with wood blocks or bulkheads.

B. Pipe shall be supported at its proper elevation and grade, care being taken to secure firm and uniform support. Wood support blocking will not be permitted. The full length of each section of pipe and fittings shall rest solidly on the pipe bed, with recessed excavation to accommodate bells, joints, and couplings. Anchors and supports shall be provided where indicated and where necessary for fastening work into place. Fittings shall be independently supported.

C. Short lengths of pipe shall be used in and out of each rigid joint or rigid structure. Piping that does not allow sufficient space for proper installation of jointing material shall be replaced by one of proper dimensions. Blocking or wedging between bells and spigots will not be permitted.

D. Joints shall be installed according to manufacturer's recommendations. Trenches shall be kept free of water until joints have been properly made. The maximum combined deflection at any coupling shall be in accordance with the manufacturer's recommendations.

E. Pipe shall be cut by means of saws, power driven abrasive wheels, or pipe cutters, which will produce a square cut. No wedge-type roller cutters will be permitted. After cutting, the end of the pipe shall be beveled using a beveling tool, portable type sander, or abrasive disc.

## 3.5 INSTALLATION OF COPPER WIRE

A. Polyvinyl chloride pipelines shall be provided with No. 10 AWG bare copper wire laid along the top of the pipe and held in place with ties or hitches of the same kind of wire spaced not more than 13-feet apart.

## 3.6 SERVICE CONNECTIONS

A. **Service Connections:** Direct tapping will not be permitted. Double strap bronze service saddle shall be used for all service connections. Service saddles shall have abearing area of sufficient width along the axis of the pipe, so that the pipe will not be distorted when the saddle is made tight. An internal shell cutter shall be used todrill through the corporation stop to minimize PVC shavings, retain the coupon, andreduce stress. Single fluted shell cutters or twist drills are not acceptable. Lubricate thecutting and tapping edges of the tool with cutting lubricant. Make the cuts slowly anduse the follower very lightly - do not force cutter through pipe wall. Shell cutter shallhave sufficient throat depth to handle the heavy wall PVC pipe. Maximum outlet size permitted with service saddle is 2-inches. Service saddle shall be Ford S90 or equal.

B. Tapping sleeves and valves shall be used for all outlet sizes greater than 2-inches in diameter. Tapping sleeves shall be assembled and installed in accordance with the manufacturer's recommendations. Tapping sleeves shall be Mueller H-615 or equal.

## 3.7 CONNECTIONS TO EXISTING WATERLINES

A. The CONTRACTOR shall locate all underground improvements and install the pipelines to the depths indicated. Where the new work is to be connected to existing pipelines, the CONTRACTOR shall make its arrangements with the serving utility well in advance of the connections, to allow adequate time for dewatering of the existing line, if necessary, and shall expedite the work to minimize water outages to the users. Where sections of existing distribution mains are taken permanently out of service and abandoned in place, the cut ends shall be plugged solid with concrete to a depth of not less than one pipe diameter.

## 3.8 MARKING TAPE INSTALLATION

A. In accordance with CAW standards, all installations of mains and services shall have green-coated #10 GA standard copper wire for locating. At 2 feet above the top of the pipe, continuously install metallic plastic warning tape marked “Caution Water Line Below”. .

## 3.9 FIELD TESTING AND DISINFECTION

A. Field testing and disinfection and water mains shall conform to the requirements of Section 01656 - Pressure Pipeline Testing and Disinfection.

**END OF SECTION**

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**TECHNICAL SPECIFICATIONS**
**DIVISION 2: SITE WORK**
**02600: FUSIBLE PVC PRESSURE PIPE**

## PART 1 –GENERAL

### 1.1 THE REQUIREMENT

A. CONTRACTOR shall provide fusible polyvinylchloride pipe conforming to all standards and procedures, and meeting all testing and material properties as described in this specification for installation by direct bury and horizontal directional drilling (HDD).

B. CONTRACTOR shall be responsible for all installation processes and procedures associated with the installation direct bury in accordance with this specification.

C. Pipe Description

1. Pipe Supplier shall furnish fusible polyvinylchloride pipe conforming to all standards and procedures, and meeting all testing and material properties as described in this specification.
2. Pipe diameter, dimensions and pressure rating shall be as shown on the Contract Drawings.
3. The pipe installed on this project will be used to convey potable water.

### 1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. REFERENCES:

1. This section contains references to the following documents. They are a part of this section as specified and modified. In the event of a conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of design.

B. Commercial Standards

| | |
|---|---|
| ANSI/AWWA C110/A21.10 | American National Standard for Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids |
| ANSI/AWWA C111/A21.11 | American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings |
| ANSI/AWWA C153/A21.53 | AWWA Standard for Ductile-Iron Compact Fittings for Water Service |

| | |
|---|---|
| AWWA C605 | Standard for Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water |
| AWWA C651 | Standard for Disinfecting Water Mains |
| AWWA C900 | Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 12 in. (100mm Through 300mm), for Water Distribution |
| AWWA C905 | Standard for Polyvinyl Chloride (PVC Pressure Pipe and Fabricated Fittings, 14 in. through 48 in. (350mm Through 1200mm), for Water Distribution and Transmission (Prior to 2017, AWWA C905 was the standard for PVC pipe and fabricated fittings larger than 12 in. (300 mm). "AWWA C905" marking on pipe larger than 12 in. is acceptable.) |
| AWWA C907 | Standard for Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water, Wastewater, and Reclaimed Water Service |
| AWWA M23 | AWWA Manual of Supply Practices PVC Pipe—Design and Installation, Latest Edition |
| ASTM D1784 | Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds |
| ASTM D2152 | Test Method for Degree of Fusion of Extruded Poly(Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion |
| ASTM F477 | Elastomeric Seals (Gaskets) for Joining Plastic Pipe |
| ASTM F1057 | Standard Practice for Estimating the Quality of Extruded Poly (Vinyl Chloride) (PVC) Pipe by the Heat Reversion Technique |
| UNI-PUB-08 | Tapping Guide for PVC Pressure Pipe |
| NSF-14 | Plastics Piping System Components and Related Materials |
| NSF/ANSI-61-G | Drinking Water System Components--Health Effects |
| PPI TR-2 | PVC Range Composition Listing of Qualified Ingredients |

## 1.3 QUALITY ASSURANCE

A. Manufacturer Requirements

1. All piping shall be made from PVC compound conforming to cell classification 12454 per ASTM D1784.

B. Fusion Technician Requirements

1. Fusion Technician shall be fully qualified by the pipe supplier to install fusible polyvinylchloride pipe of the type(s) and size(s) being used. Qualification shall be current as of the actual date of fusion performance on the project.

C. Pipe Manufacturer and Fusion Process

1. Fusible polyvinylchloride pipe shall be used as manufactured under the trade names Fusible C-900®, Fusible C-905®, and FPVC®, for Underground Solutions, Inc., Poway, CA. Fusion process shall be as patented by Underground Solutions, Inc., Poway, CA, Patent No. 6,982,051.

D. Warranty

1. The pipe shall be warranted for one year per the pipe supplier's standard terms.
2. In addition to the standard pipe warranty, the fusion services shall be warranted for one year per the fusion service provider's standard terms.

E. Pre-construction Submittals ~~Shop Drawings~~

1. The following product data is required from the pipe supplier and/or fusion provider:
   a) Pipe Size
   b) Dimensionality
   c) Pressure Class per applicable standard
   d) Color
   e) Recommended Minimum Bending Radius
   f) Recommended Maximum Safe Pull Force
   g) Fusion technician qualification indicating conformance with this specification
2. The following work plan and information is required from the CONTRACTOR and/or horizontal directional drilling CONTRACTOR. This work plan and information shall also be supplied to the pipe supplier upon request:
   a) Work plan shall include for each HDD installation any excavation locations and dimensions, interfering utilities, bore dimensions and locations including bend radii used, and traffic control schematics.
   b) A project safety and contingency plan which shall include but shall not be limited to drilling fluid containment and cleanup procedures, equipment and plan for compromised utility installations including electrical and power lines, water, wastewater and any other subsurface utility in the area.

c) An HDD schedule identifying daily work hours and working dates for each installation.

F. Post-Construction Submittals

1. The following recorded data is required from the CONTRACTOR and/or fusion provider to the owner or pipe supplier upon request:

a) Approved datalogger device reports

b) Fusion joint documentation containing the following information:

1) Pipe Size and Thickness

2) Machine Size (Make and model number)

3) Fusion Technician Identification

4) Job Identification

5) Fusion Joint Number

6) Fusion, Heating, Cool Down, and Drag Pressure Settings

7) Heat Plate Temperature

8) Time Stamp

9) Heating and Cool Down Time of Fusion

10) Ambient Temperature and Weather Conditions

c) As-recorded Information for HDD

1) The as-recorded plan and profile will reflect the actual installed alignment, and reflect the horizontal offset from the baseline and depth of cover.

2) All fittings, valves, or other appurtenances will also be referenced and shown.

3) A daily project log, along with tracking log sheets, should they be used, shall be provided. Tracking log sheet data, should it be employed, shall include all that apply, including inclination, depth, azimuth, and hydraulic pull-back and rotational force measured.

## PART 2 – PRODUCTS

### 2.1 FUSIBLE POLYVINYLCHLORIDE PRESSURE PIPE FOR POTABLE WATER

A. Fusible polyvinylchloride pipe shall conform to AWWA C900, AWWA C905, ASTM D2241 or ASTM D1785 for standard dimensions, as applicable. Testing

shall be in accordance with the referenced AWWA standards for all pipe types.

B. Fusible polyvinylchloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.

C. Fusible polyvinylchloride pipe shall be manufactured in a standard 40' nominal length, or custom lengths as specified.

D. Fusible polyvinylchloride pipe shall be blue in color for potable water use.

E. Pipe shall be marked as follows:

1. Nominal pipe size
2. PVC
3. Dimension Ratio, Standard Dimension Ratio, or Schedule
4. AWWA pressure class, or standard pressure rating for non-AWWA pipe, as applicable
5. AWWA standard designation number, or pipe type for non-AWWA pipe, as applicable
6. ~~NSF-61 mark verifying suitability for potable water service~~ NSF-61-G (designating suitability for potable water service, including the lead-free requirements of the Safe Drinking Water Act) on all potable water pipe.
7. Extrusion production-record code
8. Trademark or trade name
9. Cell Classification 12454 and/or PVC material code 1120 may also be included

F. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

## 2.2 FUSION JOINTS

A. Unless otherwise specified, fusible polyvinylchloride pipe lengths shall be assembled in the field with butt-fused joints. CONTRACTOR shall follow the pipe supplier's written guidelines for this procedure. All fusion joints shall be completed as described in this specification.

## 2.3 CONNECTIONS AND FITTINGS FOR PRESSURE APPLICATIONS

A. Connections shall be defined in conjunction with the coupling of project piping, as well as the tie-ins to other piping systems.

1. Ductile Iron Mechanical and Flanged Fittings

Acceptable fittings for use with fusible polyvinylchloride pipe shall include

standard ductile iron fittings conforming to AWWA/ANSI C110/A21.10, or AWWA/ANSI C153/A21.53 and AWWA/ANSI C111/A21.11.

a) Connections to fusible polyvinylchloride pipe may be made using a restrained or non-restrained retainer gland product for PVC pipe, as well as for MJ or flanged fittings.

b) Bends, tees and other ductile iron fittings shall be restrained with the use of thrust blocking or other means as indicated in the construction documents.

c) Ductile iron fittings and glands must be installed per the manufacturer's guidelines.

d) Ductile Iron fittings shall be lined and coated in accordance with the latest AWWA standards C104 and be NSF 61 compliant.

2. PVC Gasketed, Push-On Fittings

Acceptable fittings for use with fusible polyvinylchloride pipe shall include standard PVC pressure fittings conforming to AWWA C900 or AWWA C905~~7~~.

a) Acceptable fittings for use joining fusible polyvinylchloride pipe other sections of fusible polyvinylchloride pipe or other sections of PVC pipe shall include gasketed PVC, push-on type couplings and fittings, including bends, tees, and couplings as shown in the drawings.

b) Bends, tees and other PVC fittings shall be restrained with the use of thrust blocking or other restraint products as indicated in the construction documents.

c) PVC gasketed, push-on fittings and mechanical restraints, if used, must be installed per the manufacturer's guidelines.

3. Fusible Polyvinyl Chloride Sweeps or Bends

a) Fusible polyvinyl chloride sweeps or bends shall conform to the same sizing convention, diameter, dimensional tolerances and pressure class of the pipe being joined using the sweep or bend.

b) Fusible polyvinyl chloride sweeps or bends shall be manufactured from the same fusible polyvinyl chloride pipe being used for the installation, and shall have at least 2 feet of straight section on either end of the sweep or bend to allow for fusion of the sweep to the pipe installation. There shall be no gasketed connections utilized with a fusible polyvinyl chloride sweep.

c) Standard fusible polyvinyl chloride sweep or bend angles shall not be greater than 22.5 degrees, and shall be used in nominal diameters ranging from 4 inch through 16 inch.

4. Sleeve-Type Couplings

   a) Sleeve-type mechanical couplings shall be manufactured for use with PVC pressure pipe, and may be restrained or unrestrained as indicated in the construction documents.

   b) Sleeve-type couplings shall be rated at the same or greater pressure carrying capacity as the pipe itself.

5. Expansion and Flexible Couplings

   a) Expansion-type mechanical couplings shall be manufactured for use with PVC pipe, and may be restrained or unrestrained as indicated in the construction documents.

   b) Expansion-type mechanical couplings shall be rated at the same or greater pressure carrying capacity as the pipe itself.

6. Connection Hardware

   a) Bolts and nuts for buried service shall be made of non-corrosive, high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21.11, regardless of any other protective coating.

## 2.4 PIPE ROLLERS

A. Pipe rollers, if required, shall be of sufficient size to fully support the weight of the pipe during handling and installation operations.

B. A sufficient quantity of rollers and spacing, per the pipe supplier's guidelines shall be used to assure adequate support and limit excessive sagging of the product pipe.

## 2.5 BEDDING AND BACKFILL

A. Bedding shall be as indicated in the construction documents and per AWWA M23.

B. Backfill shall be as indicated in the construction documents. Backfill material shall be free of rocks and debris, vegetative matter, and any other deleterious materials.

## PART 3 –EXECUTION

### 3.1 DELIVERY

A. All pipes shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Any pipe damaged in shipment shall be replaced as directed by the OWNER or ENGINEER.

B. Each pipe shipment should be inspected prior to unloading to see if the load has shifted or otherwise been damaged. Notify owner or engineer immediately if more than immaterial damage is found. Each pipe shipment should be checked for quantity and proper pipe size, color, and type.

C. Pipe should be loaded, off-loaded, and otherwise handled in accordance with AWWA M23, and all of the pipe supplier's guidelines shall be followed.

D. Off-loading devices such as chains, wire rope, chokers, or other pipe handling implements that may scratch, nick, cut, or gouge the pipe are strictly prohibited.

E. During removal and handling, be sure that the pipe does not strike anything. Significant impact could cause damage, particularly during cold weather.

F. If appropriate unloading equipment is not available, pipe may be unloaded by removing individual pieces. Care should be taken to insure that pipe is not dropped or damaged. Pipe should be carefully lowered, not dropped, from trucks.

### 3.2 HANDLING AND STORAGE

A. Any length of pipe showing a crack or which has received a blow that may have caused an incident fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work. Damaged areas, or possible areas of damage may be removed by cutting out and removing the suspected incident fracture area. Limits of the acceptable length of pipe shall be determined by the OWNER or ENGINEER.

B. Any scratch or gouge greater than 10% of the wall thickness will be considered significant and can be rejected unless determined acceptable by the OWNER or ENGINEER.

C. Pipe lengths should be stored and placed on level ground. Pipe should be stored at the job site in the unit packaging provided by the manufacturer. Caution should be exercised to avoid compression, damage, or deformation to the ends of the pipe. The interior of the pipe, as well as all end surfaces, should be kept free from dirt and foreign matter.

D. Pipe shall be handled and supported with the use of woven fiber pipe slings or approved equal. Care shall be exercised when handling the pipe to not cut, gouge, scratch or otherwise abrade the piping in any way.

E. If pipe is to be stored for periods of 1 year or longer, the pipe should be shaded or

otherwise shielded from direct sunlight. Covering of the pipe which allows for temperature build-up is strictly prohibited. Pipe should be covered with an opaque material while permitting adequate air circulation above and around the pipe as required preventing excess heat accumulation.

F. Pipe shall be stored and stacked per the pipe supplier's guidelines.

## 3.3 FUSION PROCESS

A. General

1. Fusible polyvinylchloride pipe will be handled in a safe and non-destructive manner before, during, and after the fusion process and in accordance with this specification and pipe supplier's guidelines.
2. Fusible polyvinylchloride pipe will be fused by qualified fusion technicians, as documented by the pipe supplier.
3. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine.
4. Only appropriately sized and outfitted fusion machines that have been approved by the pipe supplier shall be used for the fusion process. Fusion machines must incorporate the following elements:
    1) **Heat Plate** - Heat plates shall be in good condition with no deep gouges or scratches. Plates shall be clean and free of any debris or contamination. Heater controls shall function properly; cord and plug shall be in good condition. The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier's guidelines.
    2) **Carriage** – Carriage shall travel smoothly with no binding at less than 50 psi. Jaws shall be in good condition with proper inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.
    3) **General Machine** - Overview of machine body shall yield no obvious defects, missing parts, or potential safety issues during fusion.
    4) **Data Logging Device** – An approved data logging device with the current version of the pipe supplier's recommended and compatible software shall be used. Datalogging device operations and maintenance manual shall be with the unit at all times. If fusing for extended periods of time, an independent 110V power source shall be available to extend battery life.
5. Other equipment specifically required for the fusion process shall include the following:

1) Pipe rollers shall be used for support of pipe to either side of the machine

2) A weather protection canopy that allows full machine motion of the heat plate, fusion assembly and carriage shall be provided for fusion in inclement, extreme temperatures, and /or windy weather, per the pipe supplier's recommendations. When the pipe temperature is below 40°F, the pipe supplier's cold weather operating procedures shall be followed.

3) An infrared (IR) pyrometer for checking pipe and heat plate temperatures.

4) Fusion machine operations and maintenance manual shall be kept with the fusion machine at all times.

5) Facing blades specifically designed for cutting fusible polyvinylchloride pipe shall be used.

B. Joint Recording

Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine. The fusion data logging and joint report shall be generated by software developed specifically for the butt-fusion of fusible polyvinyl chloride pipe. The software shall register and/or record the parameters required by the pipe supplier and these specifications. Data not logged by the data logger shall be logged manually and be included in the Fusion Technician's joint report.

## 3.4 INSTALLATION

A. Fusion and Layout

1. Whenever possible, pipe lengths shall be fused in their entirety and staged prior to installation in the trench. Fused pipe lengths shall be determined by CONTRACTOR preference, pipe supplier's guideline and site constraints.
2. The allowable length and width of open trench or excavation shall adhere to all applicable jurisdictional standards and the construction documents.

B. Excavation and Trenching

1. Excavation and trenching shall comply with the construction documents and all applicable jurisdictional standards. Trenching and excavation shall be completed to proper lines and grades prior to pipe installation.
2. Unsuitable trench bottom material, dewatering and excavation shoring and bracing shall be dealt with per the construction documents and all applicable jurisdictional standards.
3. Trenching and excavation shall be prepared and bedded per the construction

documents and all applicable jurisdictional standards prior to pipe installation.

C. Pipe Installation

1. Fused lengths of pipe shall be installed by lowering into the trench or excavation, using approved strapping per the construction documents and the pipe supplier's guidelines. The lowering operation, once initiated shall proceed until the entire length of the fused section of pipe is installed.
2. Coordination of lifting equipment shall ensure that the fused pipe does not exceed the bending and buckling limitations of the pipe, per the pipe supplier's guidelines.
   a) Equipment shall be utilized and staged per the pipe supplier's guidelines.
   b) Under no circumstances will the pipe be "dropped" or "rolled" into the trench or excavation.
3. If the length of the fused pipe is longer than what the available equipment can lower into the trench or excavation at one time, equipment shall be staged so that lowering shall begin at one end of the installation, and proceed along the trench or excavation, so that the entire fused length is installed without exceeding the minimum bend radius of the fused pipe.
   Pipe may also be installed by pulling it into the end of the trench via a sloped section that is constructed so as not to exceed the minimum bending radius of the pipe. Pipe may be pulled by the use of a pull head and winch or piece of equipment as recommended by the pipe supplier.
4. Fused pipe shall be bedded and backfilled per the construction documents and all applicable standards. Initial lengths of installed fused polyvinylchloride pipe shall be bedded and backfilled before any connections are made between adjacent lengths. Initial lengths of installed fused polyvinylchloride pipe shall be allowed to come to thermal equilibrium with the temperature at burial depth, by waiting at least 24 hours after installation prior to making connections such as service lines and laterals.

D. Fusible Polyvinylchloride Pipe Care

1. The fusible polyvinylchloride pipe shall be handled with care to minimize the possibility of it being cut, kinked, gouged, or otherwise damaged. The use of cables or hooks on the pipe directly will not be permitted.
2. Sections of the fusible polyvinylchloride pipe damaged, cut, or gouged shall be repaired by cutting out the section of damaged pipe and then rejoining per the construction documents and the pipe supplier's guidelines.

## 3.5 CONNECTIONS TO EXISTING PIPING SYSTEMS

A. Approximate locations for existing piping systems are shown in the construction documents. Prior to making connections into existing piping systems,

CONTRACTOR shall:

1. Field verify location, size, piping material, and piping system of the existing pipe.
2. Obtain all required fittings, which may include saddles, sleeve type couplings, flanges, tees, or others as shown in the construction documents.
3. Have installed all temporary pumps and/or pipes in accordance with established connection plans.

B. Unless otherwise approved, new piping systems shall be completely assembled and successfully tested prior to making connections into existing pipe systems.

## 3.6 PIPE SYSTEM CONNECTIONS

A. Pipe connections shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines and as indicated in the construction documents. Pipe connections to structures shall be installed per applicable standards and regulations, as well as per the connection manufacturer's guidelines.

B. <u>If possible, pipe installed via HDD shall be filled with water prior to making any connections to the existing system or other portions of the project.</u>

## 3.7 TAPPING PIPE

A. Tapping shall be performed using standard tapping saddles designed for use on PVC piping in accordance with AWWA C605. Tapping shall be performed only with use of tap saddles or sleeves. No direct tapping will be permitted. Tapping shall be performed in accordance with the applicable sections for Saddle Tapping per Uni-Pub-8.

B. All connections requiring a larger diameter than that recommended by the pipe supplier, shall be made with a pipe connection as specified and indicated on the drawings.

C. Equipment used for tapping shall be made specifically for tapping PVC pipe:

1. Tapping bits shall be slotted "shell" style cutters, specifically made for PVC pipe. 'Hole saws' made for cutting wood, steel, ductile iron, or other materials are strictly prohibited.
2. Manually or electrically powered drilling machines may be used.

D. Taps may be performed while the pipeline is filled with water and under pressure ('wet' tap,) or when the pipeline is not filled with water and not under pressure ('dry' tap).

## 3.8 TESTING

A. Testing shall comply with all applicable jurisdictional building codes, statutes, standards, regulations, and laws.

B. Hydrostatic and leakage testing for piping systems that contain mechanical jointing as well as fused PVC jointing shall comply with AWWA C605.

C. Hydrostatic and leakage testing procedures shall follow requirements of Section 01656 – Pressure Pipe Testing and Disinfection.

D. In preparation for pressure testing the following parameters must be followed:

1) All air must be vented from the pipeline prior to pressurization. This may be accomplished with the use of the air relief valves or corporation stop valves, vent piping in the testing hardware or end caps, or any other method which adequately allows air to escape the pipeline at all high points. Venting may also be accomplished by 'flushing' the pipeline in accordance with the parameters and procedures as described in AWWA C605.

2) The pipeline must be fully restrained prior to pressurization. This includes complete installation of all mechanical restraints per the restraint manufacturer's guidelines, whether permanent or temporary to the final installation. This also includes the installation and curing of all required thrust blocking. All appurtenances included in the pressure test, including valves, blow-offs, and air-relief valves shall be checked for proper installation and restraint prior to beginning the test.

3) Temporary pipeline alignments that are being tested, such as those that are partially installed in their permanent location shall be configured to provide for the removal of trapped air in the pipeline.

## 3.9 PARTIAL TESTING

1. Segments of the pipe may be tested separately in accordance with standard testing procedure, as approved by the owner and engineer. Testing of each HDD installation prior to connection to the system or other piping is preferred.

## 3.10 DISINFECTION FOR POTABLE WATER PIPING

A. Chlorine granules shall not be used or present near the pipe ends while the pipe sections are being joined. After installation, the pipeline, having passed all required testing, shall be disinfected prior to being put into service. Unless otherwise directed by the owner or engineer, the pipeline will be disinfected per AWWA C651.

B. Disinfection procedures shall follow requirements of Section 01656 – Pressure

Pipe Testing and Disinfection.

-END OF SECTION-

**TECHNICAL SPECIFICATIONS**
**DIVISION 2: SITE WORK**
**02830: CHAIN LINK FENCING**

## PART 1 GENERAL

### 1.01 SUMMARY

A. Provide all material, labor, equipment and service necessary for the furnishing and installation of chain link fencing and gates, as shown on the Drawings and as specified herein. The work includes, but is not limited to:

1. Removal and disposal of old fence and gates.

2. Polyvinyl Chloride (PVC) coated and galvanized or aluminized chain link fencing, posts, rails, aluminum sliding gate and accessories.

3. Finish hardware.

4. Replacement of unsatisfactory materials.

### 1.02 RELATED SECTIONS

A. Section 01300 – CONTRACTOR's Submittals.

B. Section 01400 – Quality Control.

C. Section 02052 – Site Preparation, Clearing, Grubbing and Stripping.

D. Section 03300 – Cast-In-Place Concrete.

### 1.03 QUALITY CONTROL

A. CONTRACTOR shall perform all quality control including inspection and testing specified in this section. See specification 01400 – Quality Control for detail.

B. Provide chain link fence complete units controlled by a single source including: necessary erection accessories, fittings, and fastenings. The single source installer shall have not less than 5 years of successful experience in installation of chain link fences similar to those required for this project.

C. Fence shall be erected by skilled craftsperson or tradesperson in accordance with the best practice of the trade and taking into account the recommendation of the fence Manufacturer's Institute.

## 1.04 SUBMITTALS

A. Product Data: Submit the following to the OWNER Representative for acceptance:

1. Submit manufacturer's technical data, and installation instructions for metal fencing, fabric, posts, rails, and accessories.

B. Materials: Submit a two foot square sample evergreen color polyvinyl chloride coating over galvanized coating with a 1-inch mesh fencing fabric to the OWNER Representative for approval.

C. Shop Drawings: Submit shop drawings indicating thicknesses, dimensions, fastenings, hinges, and post anchoring method to OWNER Representative for review and approval. Provide separate drawings for each of the following:

1. Post layout and fence material.

2. Post anchoring system.

3. Fence layout, include the connection system of the fabric to the top and bottom rail

4. Gates, including all hardware and appurtenances

## 1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. All material shall be delivered and unloaded at job site on pallets and bound in such a manner that no damage occurs to the product during hauling, handling, unloading, or storing at the job site.

# PART 2 PRODUCTS

## 2.01 FENCE FABRIC

A. Chain Link Fence Fabric for perimeter security fences shall be Polyvinyl Chloride (PVC)-Coated ASTM F668 Class 2b over zinc-coated steel wire with minimum coating weight of 2.0 ounces of zinc per square foot of coated surface. Fabric shall be fabricated of 9-gauge wire woven in 1-inch mesh. Fence height shall be 7 feet with top and bottom rails and one foot of barbed wire at top of fence, 8 feet overall height including barbed wire.

B. Fence fabric shall conform to the following: PVC-coat fabric color shall be evergreen complying with ASTM F 934. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage.

## 2.02 GATES

A. All gates shall conform to the ASTM F 900 standards per detail. Gate frames shall conform to strength and coating requirements of ASTM F 1083 for Group IA, steel pipe, with external coating Type A, nominal pipe size shall be (NPS) 1.9 inch and coated with PVC per 2.01B. Gate post diameters shall be as shown on the drawings.

B. Aluminum sliding gate frame material to be in accordance with ASTM F 1184 Type II Class 2. Grade shall be structural aluminum: 6063-T52 unless otherwise specified. Color shall match with fabric.

C. Gate fabric shall be PVC-coat fabric color shall be evergreen complying with ASTM F 934. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage.

D. Gate leaves more than 8 feet wide shall have either intermediate members and diagonal truss rods or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Gate fabric shall be attached to the gate frame by the method approved by the manufacturer. Welding is prohibited.

E. Latches, hinges, stops, keepers, rollers, post caps, and other hardware items shall be furnished as required for the operation of the gate and painted evergreen to match fence (2 coats). Latches shall be commercial grade and arranged for padlocking so that the padlock will be accessible from both sides of the gate – except at double gates that require accessibility from the inside part of gate ONLY. Latch holes for the padlocks on vehicle gates shall be of sufficient diameter to accommodate OWNER's padlocks.

## 2.03 POSTS

A. Metal Posts for Chain Link Fence: All metal posts for chain link fence shall conform to standard ASTM F 1083, zinc-coated. Group IA, with external coating Type A steel pipe. Group IC steel pipe, zinc-coated with external coating Type A or Type B, shall meet the strength and coating requirements of ASTM F 1043. Sizes shall be as shown on the drawings. Line posts and terminal (corner, gate, and pull) posts selected shall be of the same designation throughout the fence. Gatepost shall be for the gate type specified subject to the limitation specified in ASTM F 900. All posts shall be capped and shall PVC coating per 2.01B.

## 2.04 BRACES AND RAILS

A. ASTM F 1083, zinc-coated, Group IA, steel pipe, size NPS 1-1/4. Group IC steel pipe, zinc-coated, shall meet the strength and coating requirements of ASTM F 1043 and shall have PVC coating per 2.01B.

## 2.05 ACCESSORIES

A. All posts shall be capped to prevent rainwater from filling the posts and shall have PVC coating per 2.01B.

B. Miscellaneous hardware coatings shall conform to ASTM A 153/A 153M unless modified.

C. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment.

## 2.06 CONCRETE

A. ASTM C 94, using 3/4-inch maximum size aggregate, and having minimum compressive strength of 4,000 psi at 28 days. Grout shall consist of one part Portland Cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

# PART 3 EXECUTION

## 3.01 INSTALLATION

A. Fence shall be installed to the lines and grades indicated. The area on either side of the fence line shall be cleared per drawings. Line posts shall be spaced equidistant at intervals not exceeding 10 feet. Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts as practical; however, runs between terminal posts shall not exceed 200 feet for security fences. Any damage to galvanized surfaces shall be repaired with paint containing zinc dust in accordance with ASTM A 780.

B. All fence and gate bolts shall be mounted so that they cannot be easily removed from the unsecured side of the fence or gate.

C. All fence and gates shall be installed so that the fence or gate cannot be easily climbed from the unsecured side of the fence/gate due to improperly mounted fence rails, fence hardware, or gate hardware.

D. The gap at the bottom of the fence should be as small as possible to prevent prying. The fence bottom rail should be a maximum of 3 inches from the

concrete/asphalt. The fence fabric SHALL extend below the bottom rail so that the maximum gap between the fabric and the concrete/asphalt is 2 inch.

## 3.02 EXCAVATION

A. Postholes shall be cleared of loose material. Waste material shall be spread as directed by the OWNER Representative. The ground surface irregularities along the fence line shall be eliminated to the extent necessary to maintain a minimum clearance between the bottom rail and finish grade, asphalt, or concrete curb. For over excavated area, fill area with concrete or asphalt with strength similar to the concrete post.

## 3.03 POST INSTALLATION

A. Post installation and footing as indicated on Drawings.

1. Concrete and grout shall be thoroughly consolidated around each post, shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for 72 hours prior to attachment of any item to the posts.

2. Line posts may be mechanically driven, for temporary fence construction only, if rock is not encountered. Driven posts shall be set to a minimum depth of 3 feet and shall be protected with drive caps when being set.

3. Fence post rigidity shall be tested by applying a 50 pound force on the post, perpendicular to the fabric, at 5 feet above ground; post movement measured at the point where the force is applied shall be less than or equal to 3/4 inch from the relaxed position; every tenth post shall be tested for rigidity; when a post fails this test, further tests on the next four posts on either side of the failed post shall be made; all failed posts shall be removed, replaced, and retested at the CONTRACTOR's expense.

## 3.04 RAILS

A. Top and bottom rails shall be installed as indicated on Drawings.

B. Field verify all horizontal and vertical angles and custom fabricate brackets as needed. Submit to OWNER Representative for review.

## 3.05 CHAIN LINK FABRIC

A. Chain link fabric shall be installed on the side of the post indicated on the Contract drawings. Fabric shall be attached to terminal posts as indicated on drawings. The fabric shall be installed and pulled taut to provide a smooth and

uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height.

B. After installation is complete, CONTRACTOR shall provide testing equipment, and the fabric shall be tested by applying a 30 pound pull at the center of the panel shall cause fabric deflection of not more than 2-1/2 inches when pulling fabric from the post side of the fence; every second fence panel shall meet this requirement; all failed panels shall be resecured and retested at the CONTRACTOR's expense. In areas where posts are directly driven; failure to achieve necessary tension required shall result in the posts being set in concrete.

## 3.06 BARBED WIRE SUPPORTING ARMS, BARBED WIRE AND STEEL-TAPE CONCERTINA

A. General Requirements

1. Barbed wire supporting arms and barbed wire shall be installed as indicated and as recommended by the manufacturer. Supporting arms shall be anchored with 3/8-inches diameter plain pin rivets or, at the CONTRACTOR’s option, with studs driven by low-velocity explosive-actuated tools for steel, wrought iron, ductile iron, or malleable iron. Studs driven by an explosive-actuated tool shall not be used with gray iron or other material that can be fractured. A minimum of 2 studs per support arm shall be used. Barbed wire shall be pulled taut and attached to the arms with clips or other means that will prevent easy removal. Steel-tape concertina shall be installed as indicated and recommended by the manufacturer.

## 3.07 GATE INSTALLATION

A. Gates shall be installed at the locations shown. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be installed as required. Hinge pins, and hardware shall be welded or otherwise secured to prevent removal. Gates shall be constructed in such a manner as to prevent the ability of a person from climbing over the secured site of an unopened gate.

## 3.08 GROUNDING

A. Pedestrian gates at fences shall be grounded as shown on the Drawings. See Electrical Drawings.

## 3.09 CLEANING AND TOUCH UP

A. Cleaning and Touch up: Posts and rails and accessories shall be cleaned and touched up of missing coatings and debris with vinyl coated PVC product.

**END OF SECTION**

**TECHNICAL SPECIFICATION**
**DIVISION 2: SITE WORK**
**SECTION 02890: TRAFFIC SIGNS AND MARKERS**

## PART 1 GENERAL

### 1.01 SUMMARY

A. This specification section includes the following items of work:

1. Furnishing and installing markers, marker posts and signs.

### 1.02 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. When a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition available on the date of Notice Inviting Bids shall be used.

B. American Society for Testing and Materials (ASTM):

1. ASTM C150: Specifications for Portland Cement.

### 1.03 CONTRACTOR SUBMITTALS

A. Submit in accordance with Section 01300, "Submittals" at least 60 days in advance of the relevant work commencing or materials being ordered, unless noted otherwise.

B. Submit shop drawings of markers, signs, posts, and connecting hardware.

## PART 2 PRODUCTS

### 2.01 MATERIALS

A. Posts for the metal markers and signs shall be of standard galvanized steel pipe in the diameter shown on the Drawings.

B. Traffic Loops: Follow the requirements of each local community.

C. Signs and markers shall be manufactured of porcelain enamel or baked enamel on 18 gauge steel. The signs and markers shall have black letters on white background. The dimensions shall be as shown on the Drawings.

1. Markers will display the pipeline station of the gate or appurtenance.

## PART 3 EXECUTION

### 3.01 GENERAL

A. Provide metal markers showing pipeline station at the following locations on the appurtenance:

1. Main Line Valves.
2. New and any currently unmarked Air Release/Air Vacuum Valves vaults.
3. New and any currently unmarked Water Blow-Offs vaults.
4. New and any currently unmarked Vehicular and Personnel Gates

B. Signs (metal markers on posts) will be required at the following locations:

1. Where access road crosses pipeline.
2. Both sides of drainage crossings.

C. The CONTRACTOR shall install markers and signs at pipeline appurtenances and road crossings and along the alignment as indicated herein and on the Drawings. The CONTRACTOR shall furnish bolts and hardware as required to install the signs on the posts.

D. The exact location of the markers and signs will be determined by the OWNER Representative.

**END OF SECTION**

# PART 1 GENERAL

## 1.01 SCOPE

A. CONTRACTOR shall apply seeding, complete and in place, in accordance with the Contract Documents.

B. Seeding materials, installation, and maintenance methods shall be compatible with Central California coastal conditions and fully comply with applicable permit requirements, if any.

C. With the exception of farm land, all disturbed, non-paved areas of the project shall be seeded according to this specification. The seed mix shall be appropriate for the existing environmental conditions within each distinct portion of the project area. Work shall include, but is not limited to, all labor, tools, materials, equipment, and incidentals required to complete activities shown on the Drawings, described in these specifications, and as directed by the Engineer. No deviations from the plans or these specifications shall be allowed without written approval from the Engineer. CONTRACTOR shall plan for appropriate crew sizes supplied with necessary equipment to complete the required work for seeding, as described in this Section.

## 1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

1. Cal-IPC. 2006. California Invasive Plant Inventory. Cal –IPC Publication, Berkeley, CA.

2. AGRICULTURAL MARKETING SERVICE (AMS):AMS-01 (Amended through: Aug 1988) Federal Seed Act Regulations (Part 201-202)

3. COMMERCIAL ITEM DESCRIPTIONS (CID) CID A-A-1909 (Basic) Fertilizer

4. FEDERAL SPECIFICATIONS (FS) FS O-F-241 (Rev D) Fertilizers, Mixed, Commercial

5. California Agricultural Code.

6. FS O-F-241D Fertilizer, Mixed, Commercial.

7. ANSI/ASTM D 422 Method for Particle-Size Analysis of Soils.

## 1.03 DEFINITIONS

A. SEEDING PERIOD: The Seeding Period refers to the time required to complete required pre-seeding weed management, site and soil preparation, and seeding as indicated on the Drawings and described in these Specifications. Written, signed, and dated "Seeding Period Acceptance" issued by the ENGINEER upon satisfactory completion of the two-part Seeding Period Inspection shall constitute the beginning of the Seeding Establishment Period.

B. SEEDING PERIOD ACCEPTANCE: Seeding Period Acceptance is the milestone when all work associated with the Seeding Period is completed to the OWNER's satisfaction upon completion of the Seeding Period Inspection.

C. SEEDING ESTABLISHMENT PERIOD: The Seeding Period work performed shall be followed by a one-year establishment period immediately following Seeding Acceptance by the OWNER of each of the seeded portions of the project. The CONTRACTOR shall be responsible for the maintenance of the entire Project Area as defined by the Drawings as Limit of Work and these Specifications during the Seeding Establishment Period. Specific maintenance actions required will be based on seasonality, weather and soil conditions, terrestrial populations and distribution of invasive weeds, seeded plants condition, and percent cover. Seeding establishment maintenance actions include: supplemental irrigation, appropriate site weeding, reseeding of herbaceous cover in under-performing areas, trash removal, and any other actions necessary to successfully establish the area to meet the performance standards prescribed herein. The CONTRACTOR shall be responsible for the work as required by the Specifications and the Drawings, until the OWNER gives Final Project Acceptance of the project in writing.

D. FINAL SEEDING ACCEPTANCE: The conclusion of the Seeding Establishment Period shall be based upon satisfactory completion of the Seeding Establishment Period and required performance standards prescribed herein.

E. HEALTHY PLANTS: Healthy plants shall be those that are of good form, free of disease and insect infestation, are robust, and exhibit vigorous growth. Plants must not be heat or water stressed.

F. NATIVE GRASSLAND: For the purposes of this Contract, native grassland is defined as established native grasses and forbs comprised of the seeded species contained in the Drawings and Specifications.

G. SEEDBED PREPARATION: Activities required to prepare an area for seeding. Seedbed preparation activities vary by treatment area, as described in Part 3, Execution of this Section, and can include clearing debris, weed management, discing, leveling, and irrigation system removal.

H. SUITABLE SEEDBED: A suitable seedbed is defined as a vegetation- and thatch-free soil surface that has been cultivated and prepared to provide a uniform surface as determined by ENGINEER.

I. NATIVE GRASS SEED MIX: Native grass seed mix is a seed mix prescribed on the Drawings and in these Specifications, and shall be applied according to the prescribed application rates of pounds per acre of Pure Live Seed (PLS) at the locations shown on the plans.

## 1.04 QUALIFICATIONS

A. All work shall be done by an experienced Landscaping Contractor familiar with native herbaceous vegetation seeding and horticulture, industry methods and standards for seeding. The Contractor shall employ modern equipment and state of the art methods and techniques. The Contractor shall have a minimum of 3 years of applicable on-the-job experience with native herbaceous plant seeding and weed control and shall possess a C-27 California Landscaping Contractor License

## 1.05 SUBMITTALS

A. Furnish submittals in accordance with Section 01300-Contractor Submittals for approval.

B. Materials List: A list of all materials to be used in the seeding operations together with the source of those materials. The list shall include mulches, soil amendments, and seed mixtures. Manufacturer's literature showing physical characteristics, applications, and installation equipment shall be included.

C. Schedules: CONTRACTOR shall provide the following schedules within 15 calendar days of the Award of Contract, and before any work is started.

1. Delivery schedule: CONTRACTOR shall provide a seeding delivery schedule describing planned activities, their location, start dates, and durations.

2. Establishment Period Work Schedule: Written calendar schedule for the beginning of seeding establishment period, planned establishment activities, such as weeding, irrigation, seeding, dead vegetation removal (their start dates, frequencies, durations, and number of personnel performing them), and end of seeding establishment period. When there is more than one establishment period, the boundaries of the different seeding areas covered for each period shall be described. The schedule shall address all aspects of weed management (i.e., monitoring, assessment, eradication, and control) for the OWNER’s approval. The schedule shall include weed eradication methods descriptions, mowing

events, discing and reseeding, and a description of the types of equipment. The plan shall propose a sequence of mowing and eradication methods tailored to specific weed populations, and shall include a written Pest Control Advisor (PCA) recommendation.

3. Herbicide Treatment Plan and Schedule, giving proposed sequence of pesticide treatment work, before work is started. The pesticide trade name, chemical composition, formulation, concentration, application rate of active ingredients and methods of application for all materials furnished, and the name and state license number of the state-certified applicator shall be included. No herbicides shall be used prior to ENGINEER approval and before all Integrative Pest Management methods of invasive plant control are exhausted.

D. Equipment: A list of seeding and mulching equipment to be used during seeding, descriptive data, and calibration tests.

E. Reports

1. Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described. Reports for the following materials shall be included.

   a. Topsoil: For pH, plant macro- and micronutrient chemical analysis, organic material contents, and particle size.

   b. Fertilizer or Compost: For chemical analysis and composition percent.

   c. Seed: For mixture, percent pure live seed, minimum percent germination and hard seed, maximum percent weed content, date tested and state certification. The OWNER may at any time request, test, and analyze seeding materials to ensure their conformance to these Specifications. The Contractor shall furnish, at no additional cost, certified seed mix labels from the supplier affixed to sealed seed mix bags for the OWNER’s approval prior to seeding. Seeding materials not meeting the OWNER’s approval shall be immediately removed from the project site at the Contractor's expense. The Contractor shall incur any additional expenses required because of materials not meeting the requirements of these Specifications.

   d. Straw Mulch: Harvest date, source location, species, and weed content

e. Percolation Test: For each distinct seeding area, and for each different part of the same seeding area if soil conditions vary.

F. **Certificates:** Certificates of compliance that materials meet the indicated requirements prior to the delivery of materials.

G. Records:

1. Plant Establishment Period Monthly Activities Reports

2. Final Seeding Acceptance Report

3. Maintenance Instructions Report

4. As-built drawings indicating which seed mixes were installed, when and in what areas.

## 1.06 INSPECTIONS

A. It is the CONTRACTOR's responsibility to notify the ENGINEER at least 10 working days prior to each anticipated inspection. The ENGINEER may at any time inspect work without notification. The following are key inspection events:

1. Pre-Installation Conference: Conduct conference at Project site in the presence of the ENGINEER.

2. Seeding Areas Layout Acceptance Inspection.

3. Seeding Application Inspection: Seeding shall not start and shall not be accepted without this inspection. The CONTRACTOR shall provide supplier and collector names and addresses upon award of contract. Seed suppliers and collectors are subject to inspection of methods, materials, and processing. Seed shall be inspected upon arrival at the job site on the day of seeding by the ENGINEER for conformity to species, quantity and quality. Seed shall be delivered to project site in sealed bags with seed suppliers or testing laboratory tags attached. The CONTRACTOR shall provide ENGINEER with receipts of the seed purchased and delivered to the site. Receipts shall provide name of company from which the seed was purchased, seed species, seed place of origin, composition, quantity, germination rate, and pure-live-seed (P.L.S.) percentage. Other seeding materials shall be inspected for compliance with specified requirements. Unacceptable materials shall be removed from the job site and replaced by the CONTRACTOR. Immediately prior to commencement of seeding operations, the CONTRACTOR shall adjust and calibrate equipment as per manufacturer's specifications and field test in the presence of the ENGINEER. Seeding operation shall be inspected during equipment

calibration, material loading, and seed application. CONTRACTOR shall not start calibration, seeding material loading or seeding in any area before the ENGINEER's presence at the project site.

4. Seeding Period Inspection: This inspection shall be performed by the ENGINEER in two parts. First, a preliminary punch list inspection of the seeded areas will be performed. This inspection will be followed by the final verification inspection upon CONTRACTOR notice of punch list items completion. During the preliminary inspection, unsatisfactory conditions and deficiencies will be listed in a punch list. The following items will be reviewed: conformance of the seeding aerial extent with Drawings, quantity and type of species seeded, clean-up requirements, and the acceptability of the seeding operation. During the verification re-inspection, the ENGINEER will evaluate completion of the punch list items to ensure they have been corrected. A "Seeding Period Acceptance" will be issued after all seeding requirements have been satisfactorily completed and approved by the ENGINEER. If the ENGINEER is required to perform additional punch list items verification inspections because any of the punch list items are not complete during the first verification inspection, the CONTRACTOR shall be responsible for any expenses associated with the additional inspection. Partial acceptance of any area or any item will not be issued. Written, signed and dated "Seeding Period Acceptance" issued by the ENGINEER shall constitute the beginning of the Establishment Period.

5. Final Seeding Inspection: This inspection shall be performed by the ENGINEER in two parts at the end of the Seeding Establishment Period. First, a preliminary punch list inspection of the seeded areas will be performed. This inspection will be followed by the final verification inspection upon CONTRACTOR notice of punch list items completion. During the preliminary inspection, unsatisfactory conditions and deficiencies will be listed in a punch list. The following items will be reviewed: vegetation cover, native grass cover, and broadleaf invasive exotic plant cover compliance with performance criteria in Table 1 of this specification, conformance of the aerial extent of seeding with Drawings, quantity and type of species seeded, clean-up requirements, and the acceptability of the seeding operation. During the verification re-inspection, the ENGINEER will evaluate completion of the punch list items to ensure they have been corrected. A "Final Seeding Acceptance" will be issued after all seeding requirements have been satisfactorily completed and approved by the ENGINEER. If the ENGINEER is required to perform additional punch list items verification inspections because any of the punch list items are not complete during the first verification inspection, the CONTRACTOR shall be responsible for any expenses associated with the additional inspection. Partial acceptance of

any area or any item will not be issued. Written, signed and dated "Final Seeding Acceptance" issued by the ENGINEER shall constitute the satisfactory completion of the seeding work.

## 1.07 SHIPMENT, DELIVERY, STORAGE AND HANDLING

A. Shipment: Preparation for shipment shall be done in a manner that will not cause damage to seed or any other seeding material.

B. Delivery: Seeds, fiber, mulch, and any other seeding material shall be protected from weather and contamination during delivery.

C. Storage: Seeding material shall be stored in areas approved by the ENGINEER. Seed shall be stored in cool, dry locations away from contaminants. Chemicals of any kind shall not be stored with other landscape materials and shall be stored in a spillage-contained area. Mulch shall be kept covered from rain.

D. Handling: Except for bulk deliveries, material shall not be dropped or dumped from vehicles.

## 1.08 TIMES AND CONDITIONS

A. Seeding Conditions: Seeding shall be performed only during periods when beneficial results can be obtained. When excessive moisture, winds or other unsatisfactory conditions prevail, the work shall be stopped as directed by the ENGINEER. When special conditions warrant a variance to the seeding operations, a proposed seeding time shall be submitted in writing to, and approved by, the ENGINER. The CONTRACTOR shall be prepared to seed at the earliest time when all conditions (weather, moisture, temperature) are acceptable.

B. Seeding Restrictions: Coordinate carefully seeding periods with seeding establishment period activities to provide required care from the first date of seeding completion.

C. Weather Limitations: Proceed with seeding only when existing and forecasted weather conditions permit seeding to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions. Seeding shall not commence on days when the official weather report predicts 95°F or higher temperature during any time of the day.

D. The CONTRACTOR shall closely review the Integrative Pest Management Ordinance and methodology and consult with an Integrative Pest Management Specialist before any weed, pest or disease corrective action is undertaken.

## PART 2 PRODUCTS

### 2.01 TOPSOIL

A. Topsoil shall be the existing soil stripped to the depth indicated and stockpiled at a location directed by the ENGINEER in accordance with Section 02200-Earthwork.

B. Additional topsoil, if needed, shall comply with the following:

1. Topsoil shall be of loam texture suitable for plant growth. Topsoil shall be subject to ENGINEER inspection and approval at the source of supply and upon delivery.

2. Topsoil shall be obtained from naturally drained areas and shall be fertile, friable loam suitable for plant growth. Topsoil shall be subject to inspection and approval at the source of supply and upon delivery.

3. Topsoil shall be of uniform quality, free from subsoil, stiff or lumpy clay, hard clods, hardpan, rocks, disintegrated debris, plants, roots, seeds, and any other materials that would be toxic or harmful to seeded plant growth. Topsoil shall contain no noxious weeds or noxious weed seeds.

4. Topsoil shall contain at least 6 percent organic matter as determined by loss of weight after ignition of dried (moisture-free) samples in accordance with current methods of the Association of Official Agricultural Chemists.

5. The acidity range of the topsoil shall be (pH 5.5 to pH 7.5). The salinity level shall be less than 3 millimhos/cm.

6. Clay, as determined by the Bouyoucous hydrometer or by the decantation method, shall not exceed 60 percent of the topsoil material.

C. Soil Test

1. Topsoil history: A 3-year history of the herbicide(s) used and crops grown on the topsoil shall be provided by the CONTRACTOR. The history shall also be provided to the laboratory performing the soil test.]

2. Topsoil tests: The topsoil shall be tested for pH, particle size, salt levels, chemical analysis, and plant macro- and micronutrient analysis, by an independent testing company or agency which uses State of California recommended procedures. The soil samples for the soil tests shall be of a quantity and locations so an accurate soil test representative of the soil(s) can be performed. The independent testing company or agency shall

outline the soil testing procedures. The ENGINEER will have the right to be present at the time the samples are taken.

3. Topsoil recommendation: The independent test company performing soil test shall establish the quantities and type of soil amendments and fertilizer (initial and maintenance) that the CONTRACTOR shall add to topsoil. The CONTRACTOR shall obtain approval of topsoil and soil amendments and their amounts by the ENGINEER prior to the beginning of work.

## 2.02 FERTILIZER AND OTHER SOIL AMENDMENTS

A. Fertilizer shall be furnished in bags or other standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon. Fertilizer containers shall not exceed 50 pounds each.

B. Chemical fertilizers shall be a mixed commercial fertilizer conforming to FS 0-F-241D, Type I, with percentages of nitrogen, phosphoric acid, and potash at [5-10-5 or 6-10-4). The combined N-P-K content shall be the following percentages of total weight: [5] percent nitrogen, [10] percent phosphoric acid and [5] percent potash. Fertilizers shall be uniform in composition, dry, and free flowing.

C. Animal fertilizer shall be well-rotted cattle manure, free from sawdust, shaving or refuse of any kind, and shall contain no more than 25 percent straw or litter by volume. Limestone shall be ground to such fineness that 100 percent will pass a No. 200 sieve.

D. Lime shall be dolomitic limestone containing not less than 85 percent of total carbonates. Limestone shall be ground to such fineness that 100 percent will pass No. 200 sieve.

E. Agricultural gypsum shall be approved standard brand agricultural calcium sulfate (CaS04) as applied to soils and shall contain 19 percent combined sulfur and a minimum of 90 percent of calcium sulfate, finely ground with 90 percent passing through No. 50 (0.30-mm) sieve.

F. Iron Sulfate shall be granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

G. Sulfur shall be granular, biodegradable, containing a minimum of 90 percent sulfur, and with a minimum of 99 percent passing through No. 6 (3.35-mm) sieve and a maximum of 10 percent passing through No. 40 (0.425-mm) sieve

## 2.03 MULCH

A. Wood Cellulose Fiber: Wood cellulose fiber shall be commercially available and produced from virgin wood fiber. Fiber shall be of such character that fiber will

disperse into uniform slurry when mixed with water. The water content of the fiber before mixing into the slurry shall not exceed 15 percent of the dry weight of the fiber. The moisture content of the fiber shall be clearly marked on the package.

1. Ash Content: Fiber shall not contain more than 7 percent ash as determined by the Technical Association of the Pulp and Paper Industry (TAPPI) Standard T 413, and shall be nontoxic to plant or animal life and shall not contain any growth or germination-inhibiting factors.

2. Water-holding Capability: Fiber shall have a water-holding capability by weight of not less than 1,200 percent. Water-holding capability of the fiber shall be marked on the package.

3. Composition: 9 to 15 percent moisture based on air-dry weight basis, and pH range from 4.5 to 6.0.

4. Coloring: Fiber shall be colored to contrast the area on which the fiber is to be applied to aid visual monitoring during application. The material used for color shall be nontoxic to plant and animal life and biodegradable.

5. Paper Fiber. Paper fiber mulch is not allowed.

B. Straw: Straw mulch shall consist of native hay or stalks of native grasses. It shall be applied at a rate of 3 tons per acre.

1. Straw shall be furnished in air-dry condition and with a consistency for placing with commercial mulch-blowing equipment. Substitutions shall be requested in writing and must be approved by ENGINEER. Rice straw is not allowed in wetland or mesic areas.

## 2.04 SEED MIXTURES

A. General: Seed shall conform with applicable County, State of California, and Federal regulations. Seed shall be mixed by the seed supplier. The CONTRACTOR shall furnish the seed supplier's guaranteed germination of each variety listed in the seed mixture. Seed shall not be delivered to the Site until samples have been approved by the ENGINEER. Approval of samples, however, shall not affect the right of the ENGINEER to reject seed upon or after delivery. Seed which has become wet, moldy, or otherwise damaged prior to use will not be accepted.

A. Seed Source: Seed will be sourced from Monterey County or areas with the same environmental conditions within 100 miles of the Project Site. The seed collector is responsible for maintaining records of source populations and amounts collected per collection site.

B. Seed Classification: State-certified seed of the latest season's or previous season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis, including percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with AMS-01 and applicable state seed laws. AOSCA / CCIA certifications for seeds are encouraged.

B. Packaging: Seed shall be delivered in strong, clearly marked containers or bags not exceeding 50 pounds each.

C. Seed Quality: Weed seed shall not exceed five percent by weight of the total of each seed mix. Wet, moldy, insect-infested, or otherwise damaged seed shall be rejected and removed from project site. Open containers or bags of seed or improperly tagged containers or bags will be rejected and removed from project site.

D. Sampling: For all seeds or containers, it is the option of the OWNER to take random samples for each species, and require the CONTRACTOR to provide analysis of samples at no extra cost to the OWNER.

E. Seed Mixing: If additional seed mixing is necessary, it shall be performed by the CONTRACTOR, in ENGINEER.

F. Substitutions: Substitutions will not be allowed without written request and approval from the ENGINEER.

C. The CONTRACTOR is hereby warned that these seed mixtures are composed of native grass,rass-like species, as well as forbs and some lead time will be necessary to locate a distributor or seed collector and to have the seed mix dried, mixed and prepared (cleaned and pre-treated) for seeding.

| **SEED MIXES** | | | |
|---|---|---|---|
| **Common Names** | **By Weight (lbs)** | **Proportion Purity (percent)** | **Germination (percent)** |
| **Type 1: Upland Non-Irrigated Landscaped or Urban Areas (Disturbed Habitat) Seed Mix Application rate of 38 lbs/acre** | | | |
| California barley (*Hordeum brachyantherum* ssp. *californicum*) | 15.00 | | |
| California brome (*Bromum carinatus*) | 10.00 | | |
| Zorro annual fescue (*Festuca [Vulpia] myuros var.* | 5.00 | | |

| | | | |
|---|---|---|---|
| *hirsute 'Zorro'*) | | | |
| Idaho fescue (*Festuca idahoensis*) | 5.00 | | |
| Spanish clover (*Acmispon americanus* var. *a.* [Lotus purshianus]) | 1.00 | | |
| tree clover (*Trifolium ciliolatum*) | 2.00 | | |
| **Type 2: Streambank Areas (Riparian Habitat) Seed Mix Application rate of 40 lbs/acre** | | | |
| meadow barley 'salt-tolerant' (*Hordeum brachyantherum* ssp. *b.*) | 15.00 | | |
| blue wildrye (*Elymus glaucus*) | 10.00 | | |
| Molate fescue (*Festuca rubra* (Molate)) | 5.00 | | |
| creeping wildrye (*Leymus triticoides*) | 5.00 | | |
| coastal tufted hairgrass (*Deschampsia cespitosa* ssp. *holciformis*) | 3.00 | | |
| spreading rush (*Juncus patens*) | 0.25 | | |
| mugwort (*Artemisia douglasiana*) | 0.25 | | |
| deerbed sedge (*Carex praegracilis*) | 0.50 | | |
| Umbrella sedge (*Cyperus eragrostis*) | 1.00 | | |
| **Type 3: Sandy Coastal Salt Spray Areas (Coastal Strand) Seed Mix Application rate of 35 lbs/acre** | | | |
| American dune grass (*Elymus mollis* ssp. *mollis*) | 15.00 | | |
| salt grass (*Distichlis spicata*) | 15.00 | | |
| silver dune lupine (*Lupinus chamissonis*) | 2.00 | | |
| Lizzard tail (*Eriophyllum staechadifolium*) | 0.25 | | |
| sandhill sage (*Artemisia pycnocephalla*) | 0.50 | | |
| Beach strawberry (*Fragaria chiloensis*) | 0.25 | | |

| | | | |
|---|---|---|---|
| Silver beachweed (*Ambrosia chamissonis*) | 0.50 | | |
| Beach saltbush (*Atriplex leucophylla*) | 1.00 | | |
| Red sand verbena (*Abronia maritima*) | 0.50 | | |
| **Type 4: Well Developed Mesic (Not Sand) Soil Areas (Coastal Terrace Prairie) Seed Mix Application rate of 45 lbs/acre** | | | |
| California oatgrass (*Danthonia californica*) | 10.00 | | |
| Idaho fescue (*Festuca idahoensis*) | 10.00 | | |
| coastal tufted hairgrass (*Deschampsia cespitosa* ssp. *holciformis*) | 10.00 | | |
| purple needlegrass (*Stipa pulchra*) | 10.00 | | |
| brown-headed rush (*Juncus phaeocephalus*) | 2.00 | | |
| California buttercup (*Ranunculus californicus*) | 0.25 | | |
| Blue-eyed grass (*Sisyrinchium bellum*) | 0.25 | | |
| tomcat clover (inoculated) (*Trifolium willdenovii*) | 2.50 | | |

## 2.05 PESTICIDE

A. Use of pesticides is prohibited without express written approval from ENGINEER, and upon exhausting all Integrative Pest Management methods to control invasive plant populations.

B. Pesticide shall be insecticide, herbicide, fungicide, nematocide, rodenticide, and miticide. Pesticide material shall be labeled for use and applied only as registered by EPA and approved.

C. Herbicide shall contain maximum 54 percent glyphosate as an active ingredient. The herbicide shall not contain a surfactant. The herbicide shall allow seeding/sodding to take place 3 days after application of the herbicide.

## 2.06 TACKIFIER

A. The tackifier shall be non-toxic to plant and animal life, non-corrosive, non-crystalline, and non-staining to concrete or painted surfaces. The tackifier shall be biodegradable.

### 2.07 WATER

A. Water shall be the responsibility of the CONTRACTOR, unless otherwise noted. Water shall not contain elements toxic to plant life.

## PART 3 EXECUTION

### 3.01 SOIL PREPARATION

A. The seeding shall not begin until the CONTRACTOR has repaired all areas of settlement, erosion, rutting, etc. and the soils have been placed, compacted, and contoured to finish grade. The ENGINEER shall be notified of areas which prevent the seeding work from being executed.

B. After removal of waste materials in the planting areas, such as weeds, roots, rocks 6- inches and larger, construction materials, etc., the seeding subgrade shall be scarified and pulverized to a depth of not less than 6 inches and all surface irregularities removed.

C. Areas requiring grading by the CONTRACTOR including adjacent transition areas shall be uniformly level or sloping between finish elevations to within 0.1-ft above or below required finish elevations.

D. Any unusual subsoil condition that will require special treatment shall be reported to the ENGINEER.

E. Topsoil: Topsoil shall be distributed uniformly and spread evenly to a thickness of 4 inches on subgrade for seeded areas. Subgrade shall be ripped or disked to a depth of 8-12 inches. Topsoil shall be spread so that seeding can proceed with little additional soil preparation or tillage. Topsoil shall not be placed when the subgrade is excessively wet, extremely dry, excessively compacted or in a condition detrimental to the proposed planting or grading.

F. Fertilizer: Fertilizer shall be applied at the rate recommended by the soil testing laboratory and approved by ENGINEER. Fertilizer shall be incorporated into the soil to a minimum depth of 4 inches and may be incorporated as part of the tillage or hydroseeding operation.

G. Tillage

1. Preparation. Seeded areas shall be filled as needed or have surplus soil removed to attain the finished grade. Drainage patterns shall be maintained as indicated on Drawings. Seeded areas compacted by construction operations shall be completely pulverized by tillage.

2. Seeded Areas Debris. Seeded areas shall have debris and stones larger than 6 inch in any dimension removed from the surface.

3. Protection. Finished graded areas shall be protected from damage by vehicular or pedestrian traffic and erosion.

4. Finish Grading. Finished grade shall be 1 inch below the adjoining grade of any surfaced area. New surfaces shall be blended to existing. Make minor adjustments of finish grades as directed by the ENGINEER.

H. No seeding shall be done when wind velocity exceeds 4 mph, within 4 hours; after rain, or if the surface has been compacted without first loosening the ground.

## 3.02 APPLICATION OF PESTICIDE MATERIAL

A. When pesticide becomes necessary to remove a disease or pest upon exhausting all integrative pest management methods and upon ENGINEER's written approval, a state-certified applicator shall apply required pesticide in accordance with State EPA label restrictions and recommendations. Hydraulic equipment for the liquid application of pesticides shall consist of a leak-proof tank, positive agitation methods, controlled application pressure, and metering gauges. A pesticide treatment plan shall be furnished to the ENGINEER as indicated above.

## 3.03 BROADCAST SEEDING

A. Broadcast seeding shall be performed where indicated or as directed in the field by the ENGINEER.

B. The soil shall be prepared per soil preparation instructions. The ENGINEER will inspect and approve the soil preparation prior to commencing with seeding and fertilizing. The CONTRACTOR shall prepare only enough ground that can be planted within 24 hours thereafter.

C. Fertilizer shall be evenly applied to the prepared ground at a rate of 350 pounds per acre. Fertilizing shall be completed prior to seeding.

D. Sow seed at the application rates indicated above. Equal quantities of seed shall be sown in two directions at right angles to each other to produce an even distribution of seed over the entire area.

E. The seed shall then be covered with a fine layer of soil to a depth not greater than 1/4- inch.

F. Critical areas within 12 feet of streams or other water bodies shall be mechanically or hand raked to cover seed prior to mulching or installation of

erosion control fabric. ENGINEER may designate in the field other areas that require raking.

G. Flat, seeded areas shall be evenly covered with a weed-free straw mulch at the rate of [2,000] pounds per acre. Areas with slopes steeper than 4 horizontal to 1 vertical shall be covered with the indicated erosion control matting.

H. Broadcast seeding method shall be utilized between October 15 and November 15 or between February 1 and March 1.

I. Mechanical application (hydroseeding) is acceptable. The CONTRACTOR shall notify the ENGINEER of proposed method, mulch, and type of equipment to be used and shall receive approval before beginning this operation.

## 3.04 HYDROSEEDING

A. **General:** Areas labeled seed shall be hydroseeded or drill seeded if flat and larger than 1/2 acre.

B. **Equipment:** Mixing shall be performed in a tank. The tank shall have a built-in continuous agitation and circulation system, of sufficient operating capacity to produce a homogenous slurry of mulch, stabilizer, seed, fertilizer and water in the designated unit proportions for a minimum coverage of one-half acre. The tank shall have a discharge system which will permit attachment of at least 500 feet of hose extensions, a change of elevation of 150 feet in height from tank to discharge nozzle, and still retain enough pressure to apply the slurry to the areas at a continuous and uniform rate.

C. **Proportions:** Proportions per acre shall be as follows:

1. Mulch, 2,500 pounds
2. Seed, proportioned to mixture of seed as specified herein
3. Stabilizer, 120 pounds
4. Fertilizer, 350 pounds
5. Water, 3,000 gallons

D. Application

1. With agitation system operating at part speed, water shall be added to the tank and good recirculation shall be established. Materials shall be added in such a manner that they are uniformly blended into the mixture.

2. When the tank is 1/3 filled with water, add the following materials in the sequence listed:

| Sequence | Material |
|---|---|
| 1 | Stabilizer, 1/2 acre requirement |
| 2 | Three 50-pounds bales mulch |
| 3 | Seed, 1/2 acre requirement |
| 4 | Fertilizer, 1/2 acre requirement |

a. Agitate mixture at full speed when the tank is half filled with water.

b. Add remainder of mulch requirement before tank is 3/4 full.

c. Slurry distribution shall begin immediately. Application of slurry shall be done only when rain is not anticipated for at least three days after slurry application.

d. The entire tank of each batch of slurry shall be emptied and the slurry evenly applied to areas to be hydroseeded within a 2-hour period following the mixing of each slurry batch. Slurry batches not applied during this time will be rejected.

## 3.05 DRILL SEEDING

A. Flat areas larger than 1/2 acre in size that are designated for seeding in the Contract Documents shall be seeded by drilling.

B. **Seeding:** Seed shall be uniformly drilled to an average depth of 1/4 to 1/2 inch at the rate specified using equipment having drills not more than 6-1/2 inches apart. Row markers shall be used with the drill seeder. Drill seeding shall take place 3 days after application of herbicide.

C. **Rolling:** Immediately after seeding, the entire area shall be firmed with a roller not exceeding 90 pounds for each foot of roller width. Areas seeded with drills equipped with rollers shall not be rolled.

D. **Water:** Watering shall be started within 4 days after completing the seeded area. Water shall be applied at a rate sufficient to ensure moist soil conditions to a minimum depth of 2 inches. Run-off and puddling shall be prevented.

## 3.06 SEEDING ESTABLISHMENT PERIOD

A. General: The CONTRACTOR shall be responsible for protecting, watering, fertilizing, weeding, and maintaining seeded areas until Final Seeding Acceptance.

B. At time of Final Seeding Acceptance, seeded areas shall be completely established with no bare spots. The target percent cover for seeding in seeded areas as shown on the Drawings shall meet the performance standards in Table 1 below. If the performance is less than the standards indicated in Table 1, remedial actions shall be taken, in conformance to the Drawings and these Specifications, as required to achieve the identified performance standards. If the performance standards are not met at the time of Final Project Acceptance, the project will not be accepted until the identified remedial actions are implemented by the CONTRACTOR, at the CONTRACTOR's expense, and as directed by the OWNER. Remedial actions could include additional weed control, or additional soil preparation and replanting or reseeding, followed by another one-year Seeding Establishment Period as determined by the ENGINEER. All remedial actions shall be conducted in strict coordination with, and upon the approval of, the OWNER. OWNER shall provide CONTRACTOR with the performance assessment methodology. CONTRACTOR shall conduct surveys at a time that allows data to be analyzed and corrective actions to be taken at the appropriate time of year (i.e., Fall/Winter). CONTRACTOR shall submit results to OWNER in the form of Final Acceptance Report described in Article 3.6, Project Area Establishment Reports, in this Section.

**Table 1.**
**Performance Standard for Seeded Areas**

| Seeded Vegetation Type | Absolute Cover[2] |
|---|---|
| All native and nonnative vegetation | greater than or equal to 90% |
| Native grasses | greater than or equal to 50% |
| Nonnative broadleaf weeds[3] | less than 10% |

[1] Performance standard applies to cover surveyed during Year 3 of the Maintenance Period.
[2] Cover surveys shall adhere to the City's Native Standards (Protocol).
[3] Cal IPC invasive broadleaf plants with High and Moderate rating.

C. Upon completion of seeding, the entire seeded area shall be soaked to saturation by a fine spray. The soil in the seeding areas shall be kept constantly moist during the first three weeks after seeding and during dry weather or whenever necessary for proper establishment. Care shall be taken to avoid excessive washing or puddling on the surface and any such damage caused thereby shall be repaired by the CONTRACTOR.

D. Protection: The CONTRACTOR shall provide adequate protection to all newly seeded/sodded areas including the installation of approved temporary fences to prevent trespassing and damage, as well as erosion control, until the end of the one-year correction period.

E. The CONTRACTOR shall replace any materials or equipment it has damaged or which has been damaged by its employees or subcontractors.

F. Partial utilization of the project shall not relieve the CONTRACTOR of any of the requirements of this Section

G. Maintenance shall include, in addition to the foregoing, cleaning, edging, the repair of erosion, and other maintenance work. Sidewalks and other paved areas shall be kept clean while planting and maintenance are in progress.

## 3.07 CLEANUP

A. Upon completion of all seeding operations, the portion of the Site used for a work or storage area by the CONTRACTOR shall be cleaned of all debris, superfluous materials, equipment, and garbage.

B. Walks, pavement, and any other hardscape structures shall be swept or washed clean upon completion of the WORK of this Section.

**END OF SECTION**

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**TECHNICAL SPECIFICATIONS**
**DIVISION 3: CONCRETE**
**SECTION 03100: CONCRETE FORMWORK**

## PART 1 - GENERAL

1.01 SUMMARY

A. This specification section includes the following items of work:

1. Concrete formwork, including all accessories, shoring and form support required to place concrete in accordance with the Drawings.

1.02 RELATED SECTIONS

A. Section 01300 – CONTRACTORs Submittals.

B. Section 01400 – Quality Control.

C. Section 02052 – Site Preparation, Clearing, Grubbing and Stripping.

D. Section 03300 – Cast-In-Place Concrete.

1.03 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition available on the date of the Notice Inviting Bids shall be used.

B. American Concrete Institute (ACI):

1. ACI 301: Specifications for Structural Concrete for Buildings.
2. ACI 347: Recommended Practice for Concrete Formwork.

1.04 SUBMITTALS

A. Submit in accordance with Section 01300, CONTRACTOR Submittals at least 60 days in advance of the relevant work commencing or materials being ordered, unless noted otherwise.

B. Submit formwork calculations as prepared by a civil or structural engineer registered in the State of California. The design and engineering of formwork as well as its construction shall be the complete responsibility of the CONTRACTOR. OWNER Representative's review of forms and/or drawings in no way relieves the CONTRACTOR of his/her responsibility for adequately designing, constructing, and maintaining the forms so that they will function properly.

C. Submit all manufacturer's product data and application procedures for the form coating materials, form coatings, form ties, and other accessories.

D. Shop Drawings:

1. Submit formwork Shop Drawings prepared by or under the supervision of a qualified Professional Engineer detailing fabrication, assembly and support.
2. Form Ties Tapered Through Bolts: Submit proposed method of sealing form tie hole; coordinate with any details shown on Drawings.

E. Quality Control Submittals: Statements of qualification for formwork and shoring designer. For reused formwork provide:

1. Record Documents of previous reuse.
2. Operation and Maintenance records of past use.
3. Warranty.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Formwork, falsework, and shoring designs prepared by a civil or structural Engineer experienced in design of this type of work and registered in the State of California.

B. Maintain one copy of ACI 347 and ACI 301 on site.

C. Conform to requirements of the Division of Industrial Safety, State of California, and all other codes and regulations.

1.06 TOLERANCES

A. Tolerances for construction of formwork shall be as necessary to provide completed concrete structures within the tolerances specified in ACI 301 and ACI 347, as applicable, and Section 03300, "Cast-In-Place Concrete." Provide positive means of adjustment to maintain tolerances before and during concrete placement.

**PART 2 - PRODUCTS**

2.01 MATERIALS

A. Form materials accessories shall meet the recommendations and requirements of ACI 347.

B. Form materials shall be made of wood or an approved equal. Wood sheathing shall meet the following minimum specifications:

1. APA grade-stamped "B-B plyform, Class 1, Exterior" Douglas fir plywood; each piece grade marked.
2. Minimum 3/4 inch thick.
3. Clean, smooth, uniform in size and free of raised grain, torn surfaces, worn edges, patches or other defects.
4. No mill oiling permitted.

C. Use of form materials other than wood must be approved by the OWNER Representative.

D. Forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete, and shall have sufficient rigidity to maintain specified tolerances. Nails, spikes, lag bolts, through bolts, and anchorages shall be sized as required to prevent movement of formwork during placing and setting of concrete.

E. Seal porous form materials to prevent absorption of water from the concrete.

F. Use of aluminum form materials in contact with concrete is prohibited.

G. Use of form release agents is prohibited on surfaces where crystal forming waterproofing is to be applied.

H. Form coating: Non-staining and non-toxic after 30 days; VOC compliant. Form coatings containing mineral oils or petroleum solvents such as paraffin or other non-drying materials will not be permitted.

2.02 FORMWORK ACCESSORIES

A. Form ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent deflection, and to prevent spalling of concrete surfaces upon their removal.

1. Unless otherwise shown, provide ties so that portion remaining within concrete, after removal of exterior parts, is at least 1-1/2 inch from the outer concrete surface.
2. Unless otherwise shown, provide form ties that will leave a hole not larger than 1 inch diameter in the concrete surface.
3. Ties shall be of sufficient strength to prevent the spreading of the forms during concrete placement.
4. The use of wire ties will not be permitted.

B. Form sealers and gaskets, tape and other miscellaneous materials: At the CONTRACTOR's option to produce specified finishes and tolerances.

C. All other materials, not specifically described, but required for proper completion of concrete formwork, may be as selected by the CONTRACTOR but are subject to approval of the OWNER Representative.

## PART 3 - EXECUTION

3.01 INSPECTION

A. The OWNER Representative will inspect the substrate, ground or other support and the conditions under which concrete formwork is to be performed; the OWNER Representative will notify the CONTRACTOR of unsatisfactory conditions and require the CONTRACTOR to correct all deficiencies.

B. Do not proceed with the work until unsatisfactory conditions have been corrected.

C. Concrete shall not be deposited in the forms until all work connected with the forms has been completed, all material required to be embedded has been placed, and the OWNER Representative has inspected the formwork and related materials. This work shall include the removal of all dirt, chips sawdust, water and other foreign material from the forms.

D. The approval by the OWNER Representative shall not absolve the CONTRACTOR for design or erection deficiencies.

3.02 FORMWORK DESIGN REQUIREMENTS

A. Design and construction of all forms and form supports shall be performed by the CONTRACTOR and their safety and adequacy shall be solely the responsibility of the CONTRACTOR.

B. Design, support, brace and maintain formwork to safely support vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. Carry vertical and lateral loads to ground by formwork system and in-place structure construction that has attained adequate strength.

C. Design forms and falsework to include assumed values of live load, dead load, weight of moving equipment operated on form work, temporary construction material, foundation pressures, stresses, lateral stability, and other factors pertinent to safety of structure during construction.

D. Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.

E. Provide formwork sufficiently tight to minimize leakage during concrete placement. Solidly butt joints and provide backup material at joints, as required, to minimize leakage and fins.

F. Provide temporary openings in wall forms, column forms, and at other locations necessary for inspection and cleanout.

G. Forms for Exposed Concrete:

1. Drill forms to suit ties used, and to prevent leakage of concrete material around tie holes. Do not splinter forms by driving ties through improperly prepared holes.
2. Provide sharp, clean corners, without visible edges of offsets, at intersecting planes. Back joints with extra studs or girts to maintain true, square intersections.
3. Use extra studs, wales and bracing, to prevent bowing of forms between studs, and to avoid bowed appearance in concrete
4. Assemble forms to be readily removed without damage to exposed concrete surfaces.
5. Form molding shapes, recesses, and projections, with smooth-finish materials, and install with sealed joints to prevent displacement.
6. Make plywood panel patterns regular and symmetrical, joints plumb and level, and horizontal joints continuous. Control reuse of forms for exposed surfaces to provide surface of uniform color and texture without sharp demarcation between adjacent surfaces.
7. Form ties for exposed concrete surfaces shall be arranged symmetrically and shall be aligned both vertically and horizontally (do not stagger).

H. Corner Treatment:

1. Form unexposed corners either square or chamfered.
2. Provide 3/4 inch chamfers for all exposed joints, edges, and external corners except as otherwise indicated. Form chamfers accurately and surface to produce uniformly straight lines and tight edge joints. Extend terminal edges to required limit and miter chamfer at changes in direction.

I. Joints: Furnish and install construction and contraction joints as shown on the Drawings, or as proposed by the CONTRACTOR and concurred by the OWNER Representative.

J. Provisions for Other Trades:

1. Provide blockouts and sleeves to accommodate work of other trades, including mechanical and electrical work, even though not shown on the Drawings.
2. Accurately place and securely support items to be built into forms.

K. For tremie placed concrete, design forms to facilitate tremie placement and prevent water pockets.

3.03 FORM CONSTRUCTION

A. Construct forms complying with ACI 301, to the sizes, lines, and dimensions shown, and as required to obtain accurate alignment, location and grades. Level and plumb work in finished structures.

B. Provide temporary openings where interior area of formwork is inaccessible for cleanout, inspection before concrete placement, or placement of concrete mortar. Locate temporary openings in an inconspicuous location, and consistent with project requirements.

C. At the CONTRACTOR's option, as concurred by the OWNER Representative, form sides of footings in lieu of placing concrete directly against excavated surfaces.

D. Where placement of concrete against an excavated surface is shown, the excavated surface shall be sound and shall not extend inside the concrete lines indicated.

E. Provide shores and struts, with positive means of adjustment, capable of taking up formwork settlement during concrete placing operations. Provide trussed supports when adequate foundations for shores and struts cannot be secured.

F. Support form facing materials by structural members spaced sufficiently close, and of sufficient stiffness to limit deflection. Fit forms for continuous surfaces to accurate alignment, free from irregularities, and within allowable tolerances.

G. Edge sealing: Edge seal plywood forming materials with an effective water-excluding coating. Seal cutouts, holes and field cuts.

H. Secure all embedded items before concreting. Use templates for equipment anchor bolts and other embedded items. Fill voids with readily removable material to prevent entry of concrete.

3.04 FORMWORK MAINTENANCE

A. Provide positive means of adjustment. Inspect and adjust formwork before and during concrete placement to achieve the specified tolerances.

B. Thoroughly clean forms prior to reuse.

C. Where form coatings and form release agents are used, verify compatibility with the form materials.

3.05 INSTALLATION OF EMBEDDED ITEMS

A. Provide formed openings, where required, for pipes, conduits, sleeves, and other work embedded in, and passing through, concrete members.

B. Locate and set in place items that will be cast directly into concrete.

C. Coordinate the work of other technical sections in locating and forming openings, slots and recesses, and in locating sleeves, anchor bolts and other inserts.

3.06 FORMWORK REMOVAL

A. General:

1. Do not remove forms, shores, and bracing until concrete has gained sufficient strength to carry its own weight and the construction and design loads imposed. Verify strength of concrete by test results.
2. Remove formwork progressively, and in accordance with code requirements, so that no shock loads or unbalanced loads are imposed on the structure.
3. Reshore structural members as required. Remove load supporting forms only when concrete has attained the required 28 day compressive strength.
4. Remove forms in a manner which will not damage concrete.

B. Limit construction loads at all times to those which can be carried safely by the developed strength of the structure at time of loading, and by formwork and shoring in-place at time of loading.

3.07 REUSE OF FORMS

A. Clean and repair surfaces of forms to be reused in the work. Damaged form facing materials will not be acceptable.

B. Patched forms for textured, coated, or smooth architectural surfaces will not be acceptable.

C. Reuse of form facings more than four times will not be permitted.

3.08 SPECIAL TECHNIQUES

A. Circular Structures:

1. Forms conform to the circular shape of structure.
2. Straight panels may be substituted for circular forms provided panels to not exceed 2 feet in width and angular deflection is no greater than 3-1/2 degrees per joint.

END OF SECTION

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**TECHNICAL SPECIFICATION**
**DIVISION 3: CONCRETE**
**SECTION 03200: CONCRETE REINFORCEMENT**

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## PART 1 GENERAL

### 1.01 SUMMARY

A. This specification section includes the following items of work:

1. All reinforcement and accessories required to place reinforcement in accordance with the Drawings.

### 1.02 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition available on the date of Notice Inviting Bids shall be used.

B. American Concrete Institute (ACI):

1. ACI 301: Specifications for Structural Concrete for Buildings.

2. ACI 318: Building Code Requirements for Reinforced Concrete.

3. ACI SP-66: Detailing Manual, (including ACI 315 and ACI 315R).

C. American Public Works Association, Southern California Chapter (APWA):

1. Standard Specifications for Public Works Construction (SSPWC).

D. American Society for Testing and Materials (ASTM):

1. ASTM A185: Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

2. ASTM A497: Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.

3. ASTM A615: Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

E. Concrete Reinforcing Steel Institute (CRSI):

1. MSP-2-01, Manual of Standard Practice for Reinforced Concrete Construction.

2. Manual of Standard Practice.

3. Placing Reinforcing Bars.

F. Wire Reinforcement Institute (WRI):

1. Manual of Standard Practice, Welded Wire Fabric.

G. California Code of Regulations (CCR):

1. Title 8, Construction Safety Order.

## 1.03 SUBMITTALS

A. Submit in accordance with Section 01300, CONTRACTOR Submittals at least 60 days in advance of the relevant work commencing or materials being ordered, unless noted otherwise.

B. Provide shop drawings in accordance with the requirements of CRSI Manual of Standard Practice (MSP-2-01) and the ACI Detailing Manual SP-66, ACI 315. Bar lists and drawings for the fabrication and placing of reinforcement shall have sufficient plans, elevations, and sections to adequately detail and label all reinforcement. The bar lists and drawings shall also include a reference to the structure in which the reinforcement will be installed and to the Drawings showing the reinforcement. In addition, provide the following specific information:

1. Fabrication and bending lists.

2. Fabrication and placing drawings.

3. Lab test reports/mill certificates showing stress-strain curves, yield strength, ultimate strengths, and chemical properties.

4. Shop drawings showing location of lap splices where required by the Drawings or where the CONTRACTOR specifically requests consideration for use.

5. All embedments.

## 1.04 DELIVERY, STORAGE, AND HANDLING

A. The CONTRACTOR shall deliver steel with suitable hauling and handling equipment. Steel shall be stored to prevent bending, damage, contact with the ground, and kept free of moisture, dirt, oil or other injurious contaminants. The unloading, storing, and handling of bars on the job shall be in accordance with the requirements of CRSI publication "Placing Reinforcing Bars."

B. Only bars delivered in bundles from the mill and tagged with valid identification Certificates are acceptable for use. All steel which cannot be properly identified will be rejected, and shall be immediately removed from the job site.

## PART 2 PRODUCTS

### 2.01 MATERIALS

A. Deformed billet-steel bars shall be in accordance with the requirements of ASTM A615, Grade 60.

B. Smooth bars: ASTM A615, Grade 60.

C. Mechanical Couplers:

1. Type: Tension-Compression

2. Strength: Develop 125% of the reinforcing yield strength in tension and compression.

3. Reinforcing Coupler shall be Dayton Superior D-250 Bar Lock L-Series Coupler (ICC ER-5064) or approved equal.

D. Welded Wire Fabric: ASTM A185 or A497

E. Tie Wire: 16-gauge minimum.

F. Dowel Sleeves: Shall be of the dimensions as shown in the Drawings and shall fit the dowel bar snugly. One end of the sleeve shall be closed so that concrete cannot enter. The sleeve shall be indented or have suitable flange at least 1-inch from the closed end to provide a limiting stop for the sleeve when being placed on the dowel bar and to insure subsequent free movement of the dowel in the sleeve. The sleeve shall be of such rigid design that the closed end will not collapse during construction.

G. Grease for dowels in dowel sleeves shall be food grade and conform to requirements of NSF 60.

### 2.02 ACCESSORIES

A. Tie wire shall be soft-annealed wire where tie wire is bent to be not closer than one-inch from surface after tying.

B. Supports for deformed reinforcing bars and welded wire fabric shall be cement-mortar cubes wherever the finished concrete surface is continuously in contact with

water. Cubes shall be of the same strength and density as the concrete in the section being placed.

C. Metal supports, where used, shall have stainless steel tips as supplied by Burke Concrete Accessories, Inc.; Superior Concrete Accessories, Inc.; or equal. Supports shall conform to CSRI Class 2, Type B so that no non-stainless steel wire of the bar support lies closer than 0.75 inch to the form surface.

D. Supports made with plastic material or with plastic tips shall not be used.

E. Aluminum or stainless steel supports or accessories shall not be used.

## 2.03 FABRICATION

A. The CONTRACTOR shall cut and bend all reinforcement in accordance with reviewed fabrication details. Fabricate bars of indicated size and accurately form to shapes and lengths indicated and required. Fabricate by methods not injurious to materials. Reject bars with kinks or bends not scheduled. All bars shall be bent cold.

B. Fabrication shall conform to CRSI Manual Chapters 6 and 7, including tolerances.

C. Splice, development and embedment lengths: Furnish bars with lap lengths equivalent to ACI 318, Class B splices for the specified concrete strength, bar size and location, unless noted otherwise.

D. Welded splices are not permitted.

E. Dowels:

1. Provide deformed reinforcing steel bar dowels as shown on the Drawings.

2. Provide same dowel size and spacing as the reinforcing to which they are spliced, unless noted otherwise.

# PART 3 EXECUTION

## 3.01 GENERAL

A. The CONTRACTOR shall fabricate and place reinforcement in structures in accordance with reviewed complete bending diagrams, placing lists, and placing diagrams prepared in accordance with the requirements as specified herein.

B. Details of reinforcement for fabrication and erection shall be in accordance with the requirements of these specifications and to those applicable provisions not in conflict with the requirements specified herein of CRSI MSP-2-01.

C. All reinforcement and welded wire fabric shall be furnished, fabricated, and installed by the CONTRACTOR. The CONTRACTOR shall also furnish all the wires, metal supports, clips, and other appurtenances necessary to fulfill the requirements of the specifications.

D. The CONTRACTOR shall notify the OWNER Representative when reinforcing is ready for inspection and allow sufficient time for this inspection prior to casting concrete.

E. The Contract Drawings will be used for inspection of reinforcing.

## 3.02 PREPARATION

A. Surface Preparation:

1. Clean metal reinforcement of loose mill scale, oil, earth, and other contaminants that might reduce the bond between steel and concrete.

## 3.03 ERECTION AND INSTALLATION

A. General: Reinforcing steel placement shall be in accordance with the requirements of ACI 301 and SP-66, and the ends of bars shall be covered to protect workers from impalement in accordance with Cal/OSHA, CCR, Title 8, Construction Safety Orders.

B. Straightening and Re-bending:

1. The CONTRACTOR shall not straighten or re-bend metal reinforcement.

2. Bundle or space bars, instead of bending, where construction access through reinforcing is necessary.

3. Where construction access through reinforcing is necessary, details shall be submitted and OWNER Representative's review shall be obtained prior to placing.

C. Spacing and Positioning:

1. The CONTRACTOR's performance shall be in accordance with requirements of the current edition of the SSPWC, reviewed placing drawings, Design Drawings, and the specifications.

2. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

3. Reinforcement shall be placed not closer than two inches to formed surfaces of concrete in contact with water, ground, or air, or three inches to the surfaces of concrete placed against the ground, unless otherwise shown on the Drawings.

4. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

5. Reinforcement shall be placed not closer than three inches to any embedded piping or sleeves passing through walls or slabs, unless otherwise shown on Drawings.

6. Bars additional to those shown on the Drawings or ordered, which may be found necessary or desirable by the CONTRACTOR for the purpose of securing reinforcement in position, shall be furnished and installed by the CONTRACTOR.

D. Surface condition of reinforcement: Before placing concrete, clean reinforcement of loose rust and other substances that would impair bond with concrete. Remove rust by vigorous rubbing with burlap cloth or wire brushing.

E. Reinforcement shall at all times be protected from moisture until concrete is placed around it. Ends of bars left projecting from the concrete for any considerable time shall be painted with a heavy coat of neat cement grout. Take special care to prevent any disturbance of reinforcement in concrete that has already been placed.

F. The CONTRACTOR shall place reinforcing steel in accordance with the following location tolerances:

**Table 03200-1**

| | **Condition** | **Tolerance** |
|---|---|---|
| Variation from protective covering | With 2" or less cover | 1/4" |
| | With 3" cover | 1/2" |
| Variation from indicated spacing | | 1/2" |

G. Splicing:

1. Bars shall be spliced only at points shown on the approved bending lists and Drawings or where approved by the OWNER Representative.

H. Wherever bars are spliced, they shall be lapped to meet the requirements for a Class B tension lapped splice in accordance with ACI 318, unless otherwise shown on the Drawings. For bars of different sizes, the lap length shall be that given for the smaller size bar or shall be equal to the required embedment for the larger size bar, whichever is greater. Bars in lapped splices shall be in contact and shall be tied in a manner which maintains bar spacing shown on the Drawings.

I. The CONTRACTOR's performance shall be in accordance with the requirements of CRSI Placing Reinforcing Bars and to the details and notes on the Drawings.

J. The CONTRACTOR shall place an equivalent area of steel around the pipe or opening and extend on each side sufficiently to develop bond in each bar. Bar extension length on each side of opening shall be as shown on the Drawings. Where welded wire fabric is used, extra reinforcement shall be provided using fabric or deformed bars.

## 3.04 PLACING WELDED WIRE FABRIC

A. The CONTRACTOR shall extend fabric to within two inches of the edges of the slab, and lap splices at least two courses of the fabric and a minimum of eight inches. Laps and splices shall be securely tied at ends and at least every 24 inches with 16-gauge black annealed steel wire. Welded wire fabric shall be placed on cement-mortar cubes at the proper distance above the bottom of the slab and supported rigidly. The CONTRACTOR's performance shall be in accordance with the requirements of the WRI Manual of Standard Practice, Welded Wire Fabric, regarding placement, bends, laps, and other requirements. Fabric that has been rolled shall not be used; flat sheets only shall be used.

## 3.05 FIELD BENDING

A. Field bending of reinforcing steel bars is not permitted when re-bending will later be required to straighten bars.

## 3.06 FIELD QUALITY CONTROL

A. Inspection:

1. The OWNER Representative will inspect and approve sub-grade or existing concrete before the installation of reinforcement.

2. The OWNER Representative will inspect all reinforcing installations. The CONTRACTOR shall provide 48 hours' notice for inspection of reinforcing bar installation before concrete placement. If installation is not approved, CONTRACTOR shall make corrections and give 24 hours' notice for the

OWNER Representative's re-inspection. Do not schedule concrete placement without inspection approval

3. Verify placement tolerances are not exceeded.

**END OF SECTION**

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**TECHNICAL SPECIFICATION**
**DIVISION 3: CONCRETE**
**SECTION 03300: CAST-IN-PLACE CONCRETE**

## PART 1 GENERAL

### 1.01 SUMMARY

A. This specification section includes but is not limited to requirements for the following items of work:

1. All cast-in-place structures.
2. Pipe encasement, pipe bedding, and culvert headwalls.
3. Pipe support footings.
4. Concrete slabs.

B. Furnish all labor, materials, tools, equipment and other services necessary for supplying, placing, and consolidating concrete for structures required for the Contract work.

C. Provide concrete mix design, concrete placement and patching, grouting, sealants and methods of crack repair.

D. Provide methods of concrete finishing and curing.

### 1.02 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition available on the date of Notice Inviting Bids shall be used.

B. American Concrete Institute (ACI):

1. ACI 117: Specifications for Tolerances for Concrete Construction and Materials and Commentary.
2. ACI 301: Specifications For Structural Concrete.
3. ACI 304: Measuring, Mixing, Transporting and Placing Concrete.
4. ACI 305R: Hot Weather Concreting.
5. ACI 306R-88: Cold Weather Concreting.
6. ACI 308: Standard Specification for Curing Concrete.

7. ACI 309: Guide for Consolidation of Concrete.

8. ACI 318: Building Code Requirements for Reinforced Concrete and Commentary.

C. American Public Works Association, Southern California Chapter (APWA):

1. Standard Specifications for Public Works Construction (SSPWC).

D. American Society for Testing and Materials (ASTM):

1. ASTM C31: Standard Practice for Making and Curing Concrete Test Specimens in the Field.

2. ASTM C33: Standard Specification for Concrete Aggregates.

3. ASTM C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

4. ASTM C94: Standard Specification for Ready-Mixed Concrete.

5. ASTM C117: Standard Test Method for Materials Finer than 75μm (No. 200) Sieve in Mineral Aggregates by Washing.

6. ASTM C131: Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

7. ASTM C136: Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

8. ASTM C143: Standard Test Method for Slump of Hydraulic Cement Concrete.

9. ASTM C150: Standard Specification for Portland Cement.

10. ASTM C171: Standard Specification For Sheet Materials For Curing Concrete.

11. ASTM C172: Practice for Sampling Freshly Mixed Concrete.

12. ASTM C260: Standard Specification for Air-Entraining Admixtures for Concrete.

13. ASTM C289: Test Method for Potential Reactivity of Aggregates (Chemical Method).

14. ASTM C295: Standard Guide for Petrographic Examination of Aggregates for Concrete.

15. ASTM C309: Standard Specification For Liquid Membrane-Forming Compounds For Curing Concrete.

16. ASTM C494: Standard Specification for Chemical Admixtures for Concrete.

17. ASTM C595: Specification for Blended Hydraulic Cement.

18. ASTM C618: Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

19. ASTM C856: Standard Practice for Petrographic Examination of Hardened Concrete.

20. ASTM C1077: Practice for Laboratories Testing Concrete and Concrete Aggregates for use in Construction and Criteria for Laboratory Evaluation.

21. ASTM C1240: Standard Specification For Silica Fume Used in Cementitious Mixtures.

22. ASTM C1260: Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Mortar-Bar Method).

23. ASTM D994: Standard Specification For Preformed Expansion Joint Filler For Concrete (Bituminous Type).

24. ASTM D1751: Standard Specification For Preformed Expansion Joint Filler For Concrete Paving and Structural Construction (Non-extruding and Resilient B.

25. ASTM D1752: Standard Specification For Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers For Concrete Pavement and Structural Construction.

26. ASTM D3406: Specification of Joint Sealant Hot Applied Elastomeric Type for Portland Cement Concrete Pavements.

27. ASTM D2419: Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

E. State of California, Department of Transportation (CALTRANS):

1. California Department of Transportation (Caltrans): Test Method No. 109, Method for Testing of Weighing and Measuring Devices.

2. California Department of Transportation (Caltrans): Test Method No. 217, Method of Testing for Sand Equivalent.

3. Test Method No. 515, Method of Testing for Relative Mortar Strength of Portland Cement Concrete Sand.

F. U.S. Army Corps of Engineers (USACE) Handbook for Concrete and Cement:

1. CRD-C 61-89A: Test Method for Determining the Resistance of Freshly Mixed Concrete to Washing Out in Water.

2. CRD-C-119: Method of Test For Flat and Elongated Particles in Coarse Aggregate.

3. CRD-C-120: Method of Test For Flat and Elongated Particles in Fine Aggregate.

4. CRD-C-572: Method of Test For Polyvinyl Chloride Waterstop.

5. EM 1110-2-2000: Engineering and Design - Standard Practice for Concrete for Civil Works Structures Proponent.

G. American Association of State Highway Transportation Officials (AASHTO):

1. AASHTO M182: Burlap Cloth Made From Jute of Kenaf.

H. International Building Code (IBC) 2006

## 1.03 SUBMITTALS

A. Submit in accordance with Section 01300, CONTRACTOR Submittals at least 60 days in advance of the relevant work commencing or materials being ordered, unless noted otherwise.

B. Submittals shall include the following:

1. Source of fine and coarse aggregate including test results from an approved testing laboratory for all tests required by this section. Once approved, the source of fine or coarse aggregate shall not be changed without written approval of the Owner Representative.

2. Mix designs for each strength and type of concrete proposed for use. Each mix design shall show clearly where each mix will be used in the work and shall show all ingredients of the mix and shall include:

a. Type, brand, source and amounts of cement, silica fume, fly ash, pozzolans, admixtures or other additives. Include mill test reports for cement proposed for use on the project.

b. Source and amounts of water and aggregates.

c. Sieve analysis of coarse and fine aggregates.

d. Representative samples of materials for materials testing and mix proportion testing.

e. Combined grading of each mix design.

f. Specific gravity of all materials.

g. Results of all required tests shall be submitted with the proposed mix design. Refer to Article 1.04 for Quality Assurance requirements.

3. Concrete admixture material specifications, instructions for use and material safety data sheets.

4. Bond preventer material specifications, instructions for use and material safety data sheets.

C. CONTRACTOR shall submit complete details of their proposed concrete supply source to allow the Owner Representative to evaluate the acceptability of the plant. The submittal shall include, but not be limited to the following:

1. Name of supplier.

2. Plant location.

3. Plant volume or output quantity.

4. Capacity and number of transit equipment.

5. Estimated travel time from plant to work site.

6. Evidence of National Ready Mixed Concrete Association plant certification or equivalent industry recognized plant certification as approved by the Owner Representative.

7. Details of the offsite plant's batching and mixing facilities.

8. Details of the means and methods for stockpiling and handling coarse and fine aggregates.

9. Details of sorting, mixing and dispensing of chemical admixtures.

10. Proposed procedures for mixing and transporting the concrete to the point of placement.

11. Provisions for meeting hot weather concreting requirements.

D. Certificates of compliance for each load of cement offered for use as detailed in Article 1.04, Quality Assurance.

E. A delivery ticket with all the information stated in Section 13 of ASTM C94, excepting actual scale weights of materials, shall be furnished to the Owner Representative with each batch of concrete before unloading at the site.

1. Provide a print out of the actual scale weights for all loads batched.

F. Submit placement drawings showing locations of construction joints and control joints; lift sequence; locations of all embedded items, waterstops and block-outs; and estimated volume of concrete to be placed in each lift for the concrete structures as shown on the Drawings.

G. Submit detailed procedures for the production, transportation, placement, protection, curing, and temperature monitoring of concrete during cold weather in accordance with ACI 306R. In the submittal, include procedures to be implemented upon abrupt changes in weather conditions or equipment failures. Do not begin cold weather concreting until these procedures have been reviewed and accepted.

H. Submit the plans and data listed below prior to commencing shaft work. All drawings and calculations submitted to satisfy requirements listed below shall be prepared and stamped by a Civil or Structural Engineer registered in the State of California.

1. CONTRACTOR's method statement for constructing the concrete linings, including transporting, placing and consolidating concrete, sequence of placement, and method of curing.

2. CONTRACTOR's method statement for forming the concrete liner, including spacing and details of transverse construction joints, provisions to prevent uplift and lateral movement of forms, and coordination with reinforcement placement, and placement of embedded parts.

3. Structural design calculations and drawings for any formwork system prepared by an engineer registered in the State of California.

I. Samples: Submit any item of product data not fully assembled by a single Manufacturer.

J. Tremie Concrete: Submit CONTRACTOR's qualifications showing a minimum of 5 years experience with 3 similar projects in successful tremie concrete placement.

## 1.04 QUALITY ASSURANCE

A. CONTRACTOR Qualifications: 10 years of experience constructing similar concrete structures.

B. Construction Standard: Applicable requirements of the IBC, ACI 301, and recommendations of ACI 318.

C. Concrete Products and Materials Tests: Certified by independent commercial testing laboratories. Submit certification on cementitious products and aggregates performed within the past 6 months.

D. Concrete Mix Designs: By an independent commercial testing laboratory, complying with ASTM C1077

E. Concrete Mix Test Results:

1. Submit result statistics of satisfactory mix designs from prior projects.

2. Submit test results of trial batches prepared for this Contract.

F. Field Inspection:

1. The CONTRACTOR shall advise the Owner Representative of his readiness to proceed at least 72 hours prior to each concrete placement. No placement shall be made without the inspection and acceptance of the Owner Representative.

2. When forms are removed, void, stone pockets, and other defects shall not be remedied until the Owner Representative has inspected them and given his direction.

G. Plant Inspection:

1. The Owner Representative will have access to and has the right to inspect and approve facilities of suppliers, manufacturers, SUBCONTRACTORs, and CONTRACTORs providing products. Batch plants shall have current weigh-scale certification in accordance with the requirements of Caltrans Test Method No. 109.

2. Batch plant equipment shall be either semi-automatic or fully automatic, meeting the requirements of ACI 304.

3. Concrete truck mixers shall be in accordance with the requirements of ASTM C94.

H. The CONTRACTOR shall furnish the Owner Representative with each batch of concrete, before unloading at the site, a delivery ticket with all the information stated in Section 13 of ASTM C94.

I. Certificates of Compliance: Acceptability of the following materials will be based upon documentation furnished by the manufacturer identifying each batch of material and certifying compliance with the requirements specified:

1. Portland cement.

2. Admixtures and curing materials.

3. Aggregates.

4. Fly ash, silica fume, and pozzolans.

J. Concrete Tests, as Placed: Performed by Testing Laboratory:

1. Test frequency: Each mix type placed, each day placed.

2. Concrete Sample: ASTM C172. Provide all material required.

3. Compressive strength: A set of four standard 6-inch x 12-inch concrete cylinders will be cast for each 100 cubic yards or fraction thereof.

   a. Making, storing and initial cure of cylinders: ASTM C31.

   b. Testing laboratory: Provided by the Owner

   c. Final cure and tests of cylinders: ASTM C39. Testing laboratory will transport cylinders from site, cure, test and provide report. Test two cylinders at age of 7-days, and two at 28-days.

4. Slump: Test will be performed on each 50 cubic yards or fraction thereof. Test each sample used for strength tests.

   a. Test: ASTM C143.

   b. Results outside the limits indicate possible cause for rejection of concrete as indicated and directed by the Owner Representative.

K. Tremie Concrete: The CONTRACTOR or SUBCONTRACTOR supplying and placing tremie concrete shall be capable of developing a mix design, and batching, mixing, handling and placing tremie concrete; and shall have a record of experience and quality of work using tremie concrete that is satisfactory to the Owner Representative.

## 1.05 TOLERANCES

A. Tolerances on formed surfaces shall be as specified below:

1. Variation from the plumb: 1/4 inch per 10 feet.

2. Variation from the level or grades shown on the Drawings: 1/4 inch per 10 feet; 1/2 inch per 20 feet or more.

3. Variation of linear building lines from established position in plan: ¼-inch per 10 feet; 1/2 inch per 20 feet or more.

4. Variation in thickness: minus 1/4 inch; plus 1/2 inch.

5. Variation in the sizes and locations of sleeves, floor openings and wall openings, and in the thickness' of slabs and walls: minus 1/4 inch; plus 1/2 inch.

B. Unformed Surfaces:

1. As specified in ACI 117 and ACI 301 for the applicable surface finish.

C. Evaluation and acceptance of concrete and concrete structures will be in accordance with ACI 301.

## 1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery, storage, and handling shall be in accordance with the following specific requirements:

1. Cement:

a. Bins or silos shall be tight, moisture proof and provide for free movement to discharge opening. Where storage is provided for different types of cement or cementitious materials, different materials shall be isolated to prevent intermingling or contamination.

b. Storage bins for bulk cement shall be so constructed that there will be no dead storage and they will be of sufficient capacity to maintain an adequate supply at all times.

c. Sack cement or cementitious materials shall be stored in a weather-tight warehouse and cement shall not be stacked more than seven sacks high.

d. Upon deliver at the site, store immediately in a dry, weather-tight, properly ventilated structure/container, with adequate provisions for prevention of moisture absorption and overheating of the cement.

2. Aggregates:

    a. Procedures shall be implemented for unloading, stockpiling and intra-plant handling of aggregates, such as to prevent harmful segregation, breakage, and inclusion of foreign material. Stockpiles shall be located to prevent contamination and arranged to assure that each aggregate as removed from its stockpile is distinct and not intermingled with others. Separate storage bins or compartments for each size and type of aggregate shall be properly constructed and charged to prevent mixing of different sizes or types.

    b. Dry sand shall be moistened before handling, when necessary, to prevent segregation.

    c. For hot weather concreting, the following provisions for aggregate storage and handling, in accordance with the requirements of ACI 305R or other means submitted by the CONTRACTOR and approved by the Owner Representative, shall be implemented individually or in combination to produce concrete within the specified temperature range:

    d. Aggregates in storage and conveyors for aggregates shall be shaded;

    e. Water spray or misting of coarse aggregate stockpiles for evaporative cooling effect. Adequate drainage shall be provided beneath the stockpiles;

    f. Immersion of coarse aggregates in chilled water and/or processing fine aggregates in chilled water in its final classification;

    g. Cooling the coarse aggregate while on the belt conveyor enroute to the batch bins by spraying with chilled water;

    h. Chilling batch water by heat pump technology, liquid nitrogen injection or other such means as approved by the Owner Representative; and

    i. Use of ice as batch water provided adequate and reliable means for weighing crushing (uncrushed block ice shall not be allowed), and transporting the ice to the mixer are provided.

3. Water:

    a. Water shall be in adequate supply, with pressures sufficiently constant or regulated to prevent interference with accuracy of measurement.

4. The CONTRACTOR shall provide facilities for obtaining samples of cement, pozzolan, aggregates, and concrete for their own quality control program and for

use by the Owner Representative. The facilities shall be provided at the batching plant.

## PART 2 PRODUCTS

### 2.01 GENERAL

A. Obtain materials from an established and experienced manufacturer or supplier. Provide new materials of ingredients guaranteed to perform the service required.

### 2.02 MATERIALS

A. Cement:

1. All Portland cement shall be in accordance with the requirements of ASTM C150 for low alkali cement. Type II cement shall be used unless otherwise specified or permitted by the Owner Representative. All cement shall be procured from the same mill. The color shall not significantly alter the typical grey concrete color.

2. Pozzolan shall conform to the requirements of ASTM C618, Class N.

3. Blended Cement shall conform to ASTM C595, Type 1P(MS)

4. Fly ash shall be used only when approved by the Owner Representative. Fly ash and its use shall be in accordance with the requirements of SSPWC, Section 201 1.2.5, Class F fly ash, including the optional requirement for reactivity with cement alkalis, unless otherwise specified. Additional requirements are:

    a. Loss on ignition shall not exceed 4.0 percent.

    b. Available alkalis shall not exceed 1.5 percent.

    c. Sulfur Trioxide ($SO_3$) shall not exceed 3 percent

    d. Moisture content shall not exceed 1 percent.

B. Concrete Aggregates:

1. Aggregate Source:

    a. Fine and coarse aggregate shall be obtained only from sources approved by the Owner Representative. The CONTRACTOR shall notify the Owner Representative in writing not less than 30 days prior to use, naming the source of fine and coarse aggregate. Once such notification is given, the source of fine or coarse aggregate shall not be changed without prior written approval of the Owner Representative. Approval of sources shall

not be construed as constituting approval of all materials taken from said sources, and the CONTRACTOR shall be responsible for the specified quality of all such materials used in the work.

b. Aggregate shall not originate from sources susceptible to producing reactive or degenerative rock products.

2. General: ASTM C33:

a. Provide free from organic materials, waste products, clay balls, shale, and mica and thoroughly washed before use.

b. Provide aggregates that do not deleteriously react with the alkalies in the cement.

c. Grading: Submit results of sieve analysis. The grading shall conform to ASTM C33 Standard Specification for Concrete Aggregates, in Table 2.

d. Reactivity:

1) ASTM C289. Submit graphical data showing compliance.

2) Samples of coarse and fine aggregates shall be tested for alkali-silica reactivity in accordance with ASTM C289. A certification shall be submitted to the engineer for review under Article 1.03 of this Section. A petrographic examination of the course and fine aggregates according to ASTM C295 shall be performed to determine the presence of potentially alkali-silica reactive and alkali-carbonate reactive constituents of the aggregates. Fine and coarse aggregate containing more than the following quantities of constituents shall be considered potentially reactive:

a) Optically strained, microfractured, or microcrystalline quartz exceeding 5.0% (a common constituent of granite and granite gneiss)

b) Chert or chalcedony exceeding 3.0%

c) Tridymite or cristobalite exceeding 1.0%

d) Opal exceeding 0.5%

e) Natural volcanic glass in volcanic rocks exceeding 3.0%

3) ASTM C1260 and ASTM C295 are to be performed by a certified and approved testing laboratory retained by the CONTRACTOR as per Section 01400, "Quality Control" in these Specifications.

4) Aggregates evaluated by ASTM C1260 that exhibit mortar bar expansion at 14 days greater than 0.10%, shall be considered potentially reactive.

5) Aggregates that have shown evidence of reactivity in service shall be considered potentially reactive. Determination of reactivity in structures must include:

a) Petrographic analysis of cores by ASTM C856

b) Visual examination of cracking and expansion of elements of the structure.

c) Evaluation of available data, including construction records

6) Aggregates determined to be potentially reactive with alkalis shall not be used.

3. Coarse aggregates:

a. When tested in accordance with the requirements of ASTM C131, shall be rejected when the loss exceeds 45 percent by weight at 500 revolutions.

b. The CONTRACTOR shall submit to the Owner Representative certified test results from a certified (Caltrans, ACI or National Institute of Certification of Engineering Technologies, NICET) testing laboratory indicating compliance with the test requirements in ASTM C1260 and other requirements of these specifications.

c. The quantity of flat and elongated particles larger than the No. 4 sieve, as determined by USACE CRD C 119, and smaller than the No. 4 sieve, as determined by USACE CRD-C-120, shall not exceed 30 percent in any size group.

d. Coarse aggregate shall be gravel, crushed rock, or a combination thereof, and shall be composed of strong, hard, clean, durable uncoated rock, free from alkali. Coarse aggregate shall be washed free of organic or other deleterious matter.

e. Deleterious substances: Submit compliance with ASTM C33, Table 3 as follows:

1) Clay lumps and friable particles: Not more than 5 percent

2) Abrasion: ASTM C131: Not more than 45 percent

3) Soundness: ASTM C88: Not more than 10 percent.

4) Cleanness: CALTRANS Test 227. For three tests, not less than 70, with an average greater than 75.

f. Coarse aggregate shall be washed and, if necessary, shall be uniformly moistened just before batching. Coarse aggregate shall be stored in separate batching bins and batched as required in accordance with the combined grading requirements.

g. In no case shall the greatest dimension of any aggregate particle exceed 75 percent of the least dimension between reinforcing bars or between reinforcing bars and forms in the area where it is placed. No concrete using aggregates larger than primary size No. 2, as specified in SSPWWC, Section 200 shall be batched or delivered to the work site until the mix design has been submitted to and approved by the Owner Representative.

h. Maximum sizes of coarse aggregate for concrete classes shall be in accordance with Table 3300-1:

**Table 3300-1**

| Concrete Class Designation | Maximum Size |
|---|---|
| 4000A | 3/4 inch |
| 4000B | 1-1/2 inches |
| 3000A | 3/4 inch |
| 3000B | 1-1/2 inches |
| 2000A | 3/4 inch |
| 2000B | 1-1/2 inches |

4. Fine Aggregates:

   a. Fine aggregate (sand) for concrete shall consist of natural or manufactured sand, or a blend of the two fine aggregates, and shall in all cases be washed. The CONTRACTOR shall do all sorting, crushing, screening, blending, washing, and other operations necessary to make the available material in accordance with said requirements. In case the finer particles from the crushed coarse aggregate are to be mixed with the sand from natural deposits, the two products shall be uniformly blended before washing or screening to ensure a combined product of constant composition.

   b. Fine aggregate shall be of such quality as to develop relative mortar strength of not less than 90 percent when tested in accordance with the requirements of Caltrans Test Method No. 515.

   c. Deleterious substances: Submit compliance with ASTM C33, Table 1 and as follows:

      1) Organic impurities: ASTM C87. Not less than 95% relative strength.

      2) Sand equivalent: ASTM D2419 or CALTRANS Test 217. For three tests not less than 70, with an average greater than 75.

   d. Fine aggregate varying in any respect from the foregoing requirements shall not be used in the work.

   e. Washed or saturated sand shall be allowed to drain for at least 24 hours to uniform water content before batching.

   f. Dry sand shall be moistened before handling to prevent segregation.

C. Bond preventer shall be a non-staining type, which will provide positive bond prevention. Proposed material will be approved by the Owner Representative.

D. All materials required for protection of the concrete shall be available at the project site before cold weather concreting.

E. Concrete for slabs and other flatwork exposed to cycles of freezing and thawing in a wet condition during the construction period shall be air entrained as specified in ACI 301 even though the concrete may not be exposed to freezing in service.

## 2.03 WATER

A. The water for curing and washing aggregate, and the ice and water for mixing concrete shall be potable, clean, and free from objectionable quantities of organic matter, alkali, salts, oil and other impurities which, in the opinion of the Owner Representative, might reduce the strength, durability, or otherwise adversely affect the quality of the concrete.

B. Water and ice shall not contain more than 1000 parts per million of chlorides as Cl nor more than 1,300 parts per million of sulfates as $SO_4$. In no case shall the water or ice contain an amount of impurities that will cause a change in the setting time of portland cement of neither more than 25 percent nor a reduction in the compressive strength of mortar at 14 days of more than five percent when compared to the results obtained with distilled water.

C. Water for curing shall not contain any impurities in a sufficient amount to cause discoloration of the concrete or mortar, or produce etching of the surface.

D. The sources of water and ice shall be approved by the Owner Representative prior to use and any change in water or ice supply shall be tested by the CONTRACTOR and approved by the Owner Representative prior to use.

E. The Owner Representative may require tests of the water should there be a question of the quality. The CONTRACTOR shall bear the costs for such tests.

## 2.04 ADMIXTURES

A. Air-entraining admixture shall be in accordance with the requirements of ASTM C260.

B. Water-reducing admixtures for concrete shall be in accordance with the requirements of ASTM C494, Type A or D. In addition, all water-reducing admixtures shall be in accordance with the requirements of the following:

1. The admixture shall be a polymer type, a specially manufactured derivative of a hydroxylated carboxylic acid or a lignosulfonate base.

2. The admixture shall contain no calcium chloride.

3. The admixture shall contain no air-entraining agent.

4. High range water reducers shall be sulfonated polymer in accordance with the requirements of ASTM C494, Type F or G second or third generation type. High range water reducing agents added at the batch plant shall be formulated to provide the extended slump retention necessary to place the concrete prior to experiencing loss of slump.

5. Accelerating admixture shall comply with ASTM C494, Type C or E.

C. No Admixture containing any chloride ions is acceptable

D. Add admixtures to concrete mix ingredients in liquid form by a special dispensing unit, approved by the manufacturer of the admixture as suitable for accurately dispensing the admixture. Install an alarm or indicator which will immediately inform the batch plant operator if the dispensing unit malfunctions. Dispense admixtures uniformly into the mixing water as it is added to the concrete batch. Confirm that the strength of the concrete containing the admixture, at the age of 48 hours and longer, be not less than that of similar concrete without the admixture.

E. Tremie concrete shall contain an anti-washout admixture: Master Builder's PS-802 or Sika SC-100, or approved equal.

## 2.05 DESIGN OF CONCRETE MIX

A. General:

1. Employ an independent commercial testing laboratory complying with ASTM C1077 and favorably reviewed by the Owner Representative to design all concrete mixes and carry out all necessary testing.

2. If the testing laboratory has satisfactory mix designs available from prior projects, submit test record statistics to demonstrate compliance with the requirements of this Section.

3. If new mix designs are required, prepare a range of trial batches for each design and submit the mixes that demonstrate satisfactory test results

4. Allow for the variability of concrete strength from test to test by increasing the required average compressive strength over the specified strength as specified in 2006 IBC Section 1905.3 & 1905.6.

5. Design the mixes far enough ahead of concrete placement to allow completion of trial batch testing and submittal of the test results and mix design to the Owner Representative for review.

6. The CONTRACTOR shall take sole responsibility for selection of laboratory, submittal of materials to laboratory in time for all tests, and overall timing of all aspects of testing program, including submittals.

7. Prepare mix designs for concrete placement by the batch process and/or by pumping, as required, and state the process on the design submittal

8. Design the mixes to take into account hot or cold weather conditions and the time required to transport the concrete from the mixer to the site and to place within the

forms. If accelerating or retarding admixtures will be required for only a proportion of the concrete placements, submit test results that include the full range of options.

9. Do not exceed the water-cementitious material ratios. Vary the water-reducing admixtures to accomplish an increase in slump or workability time.

10. Proportion cementitious materials, aggregates, and water by weight.

11. Check periodically the weight of moisture contained within the stockpiled aggregates. Compensate for this water when proportioning the concrete mix and adjust when change occurs.

12. Do not use chlorides in any concrete mix.

B. The CONTRACTOR shall use an approved water-reducing admixture in all concrete except as approved by the Owner Representative for specific locations.

1. A water-reducing admixture shall be added to the mix in the proportion recommended by current available printed data indicating the basic amounts required to achieve optimum water reduction. Variations in the proportions of the admixture used shall be made whenever, in the opinion of the Owner Representative, such variations are necessary to maintain uniform requirements under variable temperature conditions. The water-reducing admixture, in suitable dilute form, shall be added to the batch with the mixing water.

2. When approved by the Owner Representative, a high range water- reducing admixture may be used to increase the slump above the working limit specified in this section.

C. The materials for concrete will be proportioned to produce a concrete capable of being deposited so as to obtain maximum density. Where deposited in forms, the concrete shall have maximum smoothness of surface, and have an ultimate compressive strength, at the age of 28 days, as designated by the concrete Class number. Water-cement ratio is determined by weight of water and portland cement or portland cement plus fly ash.

D. Additional cement will be permitted to obtain a high-early-strength concrete, but the total quantity of cement shall not exceed 700 pounds per cubic yard of concrete, unless otherwise specified or approved by the Owner Representative. Use of high early strength cement is also acceptable with approval of the Owner Representative.

E. The nominal maximum size of coarse aggregate for any part of the work shall be the largest of the specified sizes whose use is practicable from the standpoint of satisfactory placement of concrete and consolidation of the concrete by vibration.

F. Accelerators containing chlorides shall not be used. Non-chloride accelerators and high-range water reducers may only be used where approved by the Owner Representative.

G. The Owner Representative may rescind the approval for use of any admixture, which demonstrates incompatibility with the materials being used on the work. Any admixture so rejected shall be replaced with an admixture that demonstrates compatibility.

H. A starter mix shall be used as the first batch of concrete deposited on hardened concrete in wall forms. The starter mix shall be placed to a depth of two inches over the area of hardened concrete. Starter mix shall be an over sanded mix with one-inch maximum size aggregates, an additional sack of cement (94 pounds) per cubic yard, and a five-inch slump. The total coarse aggregate shall equal 50 percent of the amount of coarse aggregate in the succeeding continuous mix.

I. Durability:

1. Air content: Provide concrete mixes with air content based on aggregate size as follows:

| **Table 03300-2** | |
|---|---|
| **Nominal maximum size of coarse aggregate, inches** | **Total air content, % by volume** |
| 3/8-inch or 3/4 inch | 6 |
| 1-1/2 inches | 4.5 |
| 3 inches | 3 |

2. Water-cement ratio: For concrete that will be exposed to water when the structure is completed, water-cement ratio shall not exceed 0.48±0.3%.

J. Locations of use: Provide concrete mixes of the following classes for use at the indicated locations; where a specific concrete class is noted on the Drawings and is in conflict with this table, the note on the Drawings will govern:

| **Table 03300-3** | | |
|---|---|---|
| **Location** | **Class** | **Slump** |
| Backfill Concrete | 2000B | 4” |
| Concrete for Pipe Bedding | 2000A | 4” |
| Tremie concrete | 3000A | 10” |

| | | |
|---|---|---|
| All other structures | 4000A or B | See 3.06.E.2 |

K. Use the larger size aggregate unless section dimensions and clear spacing between reinforcing bars, in accordance with ACI 318 requirements, require a smaller size.

L. Mix Test Requirements:

1. Compression: ASTM C192 for cylinder preparation. ASTM C39 for cylinder tests. Perform three tests after 7 days and three more after 28 days curing.

2. Slump: Conform to ASTM C143.

3. Air Content: Conform to ASTM C231.

4. After favorable review of the mix design, no variations of the constituents are permitted during the project without prior submittal and favorable review.

5. Tremie mix shall conform to CRD-D 61-89A.

## 2.06 ACCESSORY MATERIALS

A. Curing materials:

1. Cure by fog spray, or by one of the following methods after discontinuance of the fog spray:

B. Liquid Curing Compound: A water-based membrane-forming resin suitable for exterior and interior use as a curing and hardening compound on freshly placed concrete.

1. Provide an emulsion of synthetic resinous solids dispersed in water containing no waxes, paraffin or oils. Provide the fugitive type that will oxidize and disintegrate completely within 60 days when exposed to sunlight in exterior applications or that can be removed by washing with dilute muriatic acid or TSP in interior applications.

2. Water retention materials: ASTM C309, Type 1 and Type 2. The solid dissolved in vehicle shall be Class B, when tested in accordance with ASTM C156.

3. Use ASTM 309, Type 2, white pigmented material for exterior applications and use Type 1, clear or translucent material for interior applications.

4. Comply with the applicable local air quality district.

5. Exterior surfaces: Aqua Resin Cure by Burke; 1100-Clear by W.R. Meadows; or equal.

6. Interior surfaces: Spartan-Cote by Burke; Vocomp 20 by W.R. Meadows; or equal.

C. Sheet Materials: ASTM C 171. Waterproof paper, plastic sheeting or white burlap-polyethylene sheet.

1. Plastic sheeting: fungus-resistant, minimum 4 mil thick, clear and free of defects, having ASTM E96 perm rating of not more than 0.5.

2. Water proof paper: Two layers of non-staining kraft paper laminated with latex adhesive and reinforced with glass in both directions. Seal joints with 2-inch-wide tape with water resistant adhesive.

D. Wet Blankets: Clean cotton mats (burlap is unacceptable). Provide material free from any substance which will have a deleterious effect on the concrete. Use a thickness sufficient to retain moisture between programmed applications of water.

E. Color admixture: For underground electrical duct bank red concrete, Conrad Sovig Permatint Integral Pigment No. 1503; or equal. Mix in accordance with manufacturer's instructions for color requirement.

## 2.07 EPOXY MORTAR FOR REPAIR OF CONCRETE

A. Epoxy mortar: Non-shrink type cement mortar specifically manufactured for repairing cracked, spalled and worn concrete; Euclid Chemical Co. Epoxy #456 LV Mortar; Sika Chemical Corp., Sikadur Hi-Mod Mortar; Five Star Structural Concrete; or equal.

## 2.08 READY-MIX CONCRETE

A. Supply concrete for the project using truck mixers and a ready-mix plant certified by the National Ready-Mix Concrete Association. Submit certification to the Owner Representative before placing concrete.

B. Alternatively, qualify the supplier according to ASTM C94 Sections 8 through 11, inclusive.

## 2.09 SOURCE QUALITY CONTROL

A. Forms: Verify that components pre-assembled offsite are satisfactory for the purpose. Verify that designs, products and samples have been submitted for product review.

B. Concrete:

1. Verify that ready-mix batch plant delivery tickets contain all product information necessary for acceptance of the concrete delivered to site.

2. Verify that the mixing and trucking equipment have adequate capacity to deliver the concrete batches to site on time, thoroughly mixed and discharged without segregation.

## PART 3 EXECUTION

### 3.01 GENERAL

A. All cast-in-place concrete used in the work shall be ready-mixed concrete produced at a single offsite batching plant. All aspects of the batching, mixing, and transportation (equipment and procedures) are subject to approval by the Owner Representative.

B. Concrete formwork shall be in accordance with the requirements of Section 03100, "Concrete Formwork."

### 3.02 PROPORTIONING CONCRETE MATERIALS

A. Place no concrete prior to favorable review of submittals for reinforcing steel, materials specified in this Section and the mix design proposed. Unfavorable results of actual pours may require a redesign of mixes.

B. Make no substitutions to the constituents tested in the design of concrete mixes without favorable review of the revised mix and the new test results.

### 3.03 SEQUENCE OF PLACING CONCRETE

A. The CONTRACTOR shall alternate placement of slab, wall, or roof areas, to allow for strength gain and volume change (shrinkage) to take place. The CONTRACTOR shall prepare a schedule for the sequence of placing concrete and obtain the approval of the Owner Representative. All concrete joints shall be in accordance with the requirements of Section 03100, "Concrete Formwork," and this section. Construction joints for controlling shrinkage shall be provided in floor slabs and intake towers. Construction joints shall be located as shown on the Drawings, or as approved by the Owner Representative. Intermediate slabs and wall sections shall not be placed until seven days after the adjoining slabs and walls have been placed. Corner sections of the walls shall not be placed until the contiguous wall sections have cured at least 14 days. Unless otherwise shown or approved, joints in slabs shall continue into related walls unless structural requirements dictate otherwise.

B. When not otherwise shown or specified, concrete slabs shall be constructed in segments not larger than 30 feet by 30 feet. The long dimension of the slab panel shall not exceed 1.5 times the short dimension unless otherwise approved by the Owner Representative. Walls shall be constructed in segments no longer than 30 feet.

C. At the CONTRACTOR's option, a slip form may be used to place the concrete. The CONTRACTOR shall submit all information required to clearly show his proposed overall placement plan, methods and procedures, and equipment which will be used to accomplish the intent of these specifications for the Owner Representative's review and approval.

## 3.04 BATCHING AND MIXING OF MATERIALS

A. General:

1. Concrete shall conform to ASTM C94 and to these specifications, except, when a conflict exists between ASTM C94 and these specifications, these specifications shall govern.

2. Concrete shall be discharged at the job within 1-1/2 hours after the water has been added to the cement and aggregates, and prior to stiffening or initial set.

3. Do not add mixing water during hauling. Add water after delivery only when agreed by the Owner Representative. Should water be added, revolve the mixing drum not less than 30 revolutions at mixing speed after adding and before commencing discharge.

4. Truck mixers shall be equipped with approved revolution counters by which the number of revolutions of the drum or blades may readily be verified. Counters shall be continuously registering types, each mounted in a position permitting its inspection from alongside the truck. The truck water tank system shall be equipped with gauges, which will permit accurate determination of the tank contents.

5. When mixing in a truck mixer, each batch of concrete shall be mixed for not less than 80 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of the equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. Total number of revolutions shall not exceed 300. All materials, including mixing water, with the exception of high range water reducers specified herein, shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.

6. The Owner Representative may increase the mixing time when the discharging and mixing operations fail to produce a delivered batch in which variations of consistency, mix, or grading are within limits specified.

7. Deliver each load at the job site accompanied by a ticket showing mix design number, volume of concrete, the weight of cement in pounds and the total weight of each ingredient in pounds. Also show the time at which the materials were

batched and the reading of the revolution counter at the time the truck mixer was charged.

8. No re-tempering of partially hardened material is permitted. Do not use partially hardened concrete in the work.

B. Batching in adverse weather:

1. Cold Weather: Based on ACI 306R, when the air atmospheric temperature is below 55ºF, or is likely to fall below 55ºF during the 24-hour period after placing, heat the materials before mixing, so that the temperature of the mix when deposited shall be between 60ºF and 70ºF. Do not heat the mixing water over 140ºF. Remove lumps of frozen material and ice from the aggregate before they are placed in the mixer.

2. Hot Weather: Based on ACI 305R, when the air temperatures are above 90ºF, reduce the temperature of the concrete mix by using ice as part of mixing water, and protecting aggregates and cement from direct rays of the sun. Do not place concrete when the air temperature exceeds 80ºF.

3. If the provisions given in 1. and 2. above are not possible or practical, postpone the batching until favorable weather conditions.

## 3.05 TRANSPORTATION

A. Transporting Ready-Mixed Concrete to Site:

1. The methods and equipment used for transporting concrete to the site of work and the time that elapses during transportation shall be such as will not cause segregation of coarse aggregate or slump loss in excess of one inch in the concrete as it is delivered into the work. Any concrete that is transported an appreciable distance after mixing shall be agitated in transit, or remixed. Transit mixing and long distance transportation of mixed concrete will not be permitted in any case where control of measurement of cement, aggregates, water, concrete temperature, or any other operation affecting the quality of concrete fails to comply with the requirements set forth elsewhere. Concrete shall be placed before stiffening or initial set has occurred.

2. Truck mixers and their operation must be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before use of the unit will be permitted.

3. Only the use of agitating equipment for transporting ready-mixed concrete will be permitted. The quality and quantity of materials used in ready-mixed concrete shall be subject to continuous inspection at the batching plant by the Owner Representative.

B. Pumping of Concrete:

1. General:

a. The type and operation of any concrete pump or of any pneumatic or other type of placing equipment used on the work shall be subject to the approval of the Owner Representative. The equipment used in placing the concrete and the method of its operation shall be such as will permit introduction of the concrete into the forms without high velocity. Only experienced operators shall operate placing equipment.

b. If the pumped concrete does not produce concrete conforming to these specifications, the CONTRACTOR shall discontinue the pumping operation and proceed with the placing of concrete using other methods approved by the Owner Representative.

2. Pumping Equipment:

a. The minimum diameter of the hose (conduit) shall be four inches, unless otherwise approved by the Owner Representative.

b. Pumping equipment and hoses (conduits) that are not functioning properly shall be replaced.

c. Aluminum conduits for conveying the concrete shall not be used.

## 3.06 PLACING CONCRETE

A. Inspection:

1. Unless specifically waived by the Owner Representative, all formwork shall be inspected and approved prior to placing of concrete. The CONTRACTOR shall notify the Owner Representative at least 24 hours in advance of all inspections for concrete placements. Prior to such notification all work shall be complete and ready for inspection on that portion of the work for which concrete is to be placed. Any defective or incomplete work discovered by the Owner Representative shall be corrected in a timely fashion to allow for re-inspection and further corrective action if necessary.

2. Remove hardened concrete and foreign materials from the inner surface of the mixing and conveying equipment. Remove all debris from the space to be occupied by the concrete.

3. Provide satisfactory redundancy in the delivery system so that work can continue in the event of a breakdown.

4. The order of placing concrete and the number, type, position, and design of construction joints shall be approved by Owner Representative. In formed concrete, a transverse construction joint with a roughened face shall be provided at the end of any continuous placement.

5. Concrete shall be placed as soon as possible after leaving the mixer without segregation or loss of ingredients.

6. Concrete shall not be dropped through reinforcement or into any deep form, whether reinforcement is present or not, so as to cause segregation, nor shall concrete be placed in any form in such a manner as to leave an accumulation of mortar on the form surfaces above the placed concrete. Hoppers and, if necessary, vertical ducts of canvas, rubber, or metal (non-aluminum) shall be used in the forms, or other means shall be employed so that the concrete is deposited, as nearly as practicable, directly in its final position. The concrete shall not be caused to flow such that the lateral movement permits or causes segregation. Clusters of coarse aggregate separated from the concrete mass shall be scattered before the concrete is vibrated. In no case shall the free fall of concrete exceed four feet below the ends of ducts, chutes, or buggies; nor shall the horizontal movement of concrete in the forms exceed five feet.

7. Do not use aluminum materials in pumping lines, transfer hoppers or chutes linger than 12 feet. Provide conveyor belts instead of chutes when the distance is longer than 50 feet. Use a storage hopper at the start of the line.

8. For pumped concrete, provide a hose with an angle-change to create a back-pressure at the outlet.

9. Provide illumination if necessary inside the forms so that the placed concrete will be visible from the deck at the top of the formwork.

10. Provide thermometer for measuring concrete temperature when weather conditions are predicted to go beyond the range of $50^{o}$F to $80^{o}$F.

11. Precautions shall be taken to prevent overloading floors, beams, and other members, and the CONTRACTOR shall comply with the Owner Representative's instructions respecting the loads, which may be imposed on such members during construction.

12. All concrete shall be placed in continuous, approximately horizontal layers, the depths of which generally shall not exceed 20 inches. The Owner Representative will require lesser depths where necessary to ensure each new layer being placed while the previous layer is still soft and such that the two layers can be made monolithic by penetration of the vibrators. Concrete placement shall begin at the lowest point in each section of concrete to be placed.

13. All horizontal construction joints, which will be exposed to view, shall be made straight and level. Vertical construction joints shall be plumb.

B. Embedded Items:

1. Before any concrete is placed, reinforcement, anchor bolts, reglets, edge angles, trench angles, sleeves, drains, piping, pipe supports, mounts, electrical conduit, and any other materials and equipment shall be accurately and properly placed in accordance with approved Shop Drawings, or as directed by the Owner Representative. They shall be secured against displacement with templates or other approved methods during placement of the concrete. Incorrectly located items to be embedded shall be reset as directed by the Owner Representative. Embedded items shall be kept clear of the reinforcement.

2. Hot-dip galvanize all ferrous metal sleeves, inserts, anchors, and other embedded ferrous items unless shown otherwise. Set anchor bolts for equipment in templates, carefully plumbed and checked for location and elevation with an instrument, and held in position rigidly by double nutting to the template to prevent displacement while concrete is being poured.

3. Move reinforcement bars as necessary to avoid interference with other reinforcing steel, conduits, or embedded items, but not so as to impair design strengths of the member. If bars are moved more than two bar diameters, submit the resulting arrangement of bars for review.

4. Concrete placed around waterstops shall be thoroughly and systematically vibrated to avoid air entrapment and provide positive contact between the waterstop and concrete. Prior to completion of the concrete placement, the exposed portion of the waterstop shall be swept and cleaned of all foreign objects to ensure positive contact between the waterstop and concrete.

C. Surface Preparation:

1. Immediately before placing concrete, all surfaces of foundations upon or against which the concrete is to be placed shall be free from standing water, mud, and debris. Rock surfaces shall be washed free of all loose material with air-water jets and/or vacuuming. Rock, and all other surfaces upon or against which concrete is

to be placed shall, in addition to the foregoing requirements, shall be clean and free from oil; objectionable coatings; and loose, detached, or unsound fragments.

2. Earth surfaces, after being trimmed and compacted in accordance with the requirements of these specifications, shall be thoroughly moistened, but not muddied, by sprinkling prior to the placing of any concrete upon them and shall be kept moist by frequent sprinkling as required up to the time of placing concrete thereon.

3. All vertical surfaces of concrete members shall be formed unless placement of concrete against the ground is shown on the Drawings or is explicitly authorized in writing by the Owner Representative. The dimensions of concrete members shown on the Drawings shall apply to formed surfaces except where otherwise indicated. Where concrete is permitted to be placed against trimmed ground in lieu of forms the trimmed ground line shall be a minimum of 1 inch in excess of the design lines shown on the Drawings. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to required lines and will stand securely without caving or sloughing until concrete has been placed.

4. All surfaces of forms and embedded items that have been encrusted with dried mortar or grout from concrete previously placed shall be cleaned of all such mortar or grout before the surrounding or adjacent concrete is placed.

5. Concrete surfaces upon or against which new concrete is to be placed and to which new concrete is to adhere, or where the placement of concrete has been stopped or interrupted such that, in the opinion of the Owner Representative, the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surfaces of construction joints shall be clean and rough prior to covering with fresh concrete or mortar. Cleaning shall consist of the removal of all laitance, loose or defective concrete and foreign matter. The surfaces of the joints shall be sufficiently rough to assure satisfactory bond with the new concrete. All pools of water shall be removed from the surfaces of construction joints before the new concrete is placed.

6. Where the placing of concrete is to be interrupted long enough for the concrete to take its final set, the working face shall be given a shape by the use of forms or other means that will secure proper union with subsequent work.

7. Where new concrete is to be placed against concrete in existing structures or against new concrete that is more than 30 days old or against concrete that has been permitted to dry out, the surfaces shall be roughened and cleaned as specified herein, and in addition thereto, the surfaces shall be kept thoroughly wet during the 24 hour period immediately prior to the placement of the new concrete. This wetting shall be accomplished by continuous sprinkling or by covering exposed

surfaces with burlap, or by packing holes full of burlap and keeping the burlap wet. All existing projecting steel bars to be embedded in new concrete shall be cleaned.

8. Before new concrete is placed on old concrete, the bonding surface of the old concrete shall be roughened to enhance the joining of old-to-new concrete. The surface shall be roughened to create a profile of approximately 1/4 inch using abrasive blasting or high-pressure water blasting techniques.

9. Bond-preventer compound to be applied to the surfaces of concrete at joints to prevent bonding, as shown on the Drawings, shall be applied in accordance with the manufacturer's printed instructions, except that the compound shall be applied by brush. Care shall be taken to keep the compound off the surfaces of the grooves in which sealant is to be placed. Bond preventer shall be used only where permitted by the Owner Representative.

10. No concrete shall be placed until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes or other means and carried out of the forms, clear of the work. No concrete shall be deposited under water nor shall the CONTRACTOR, without explicit permission, allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Tremie concrete is an exception to this requirement.

11. Placing of concrete will not be permitted to begin during any rainfall. If rain should fall during or subsequent to placement, the concrete shall be completely protected until curing is complete.

12. When concrete slabs or other unformed concrete are placed under warm, dry, dusty or windy conditions, the CONTRACTOR shall protect the concrete surfaces from rapidly drying by providing windbreaks, shading, fogging with properly designed nozzles, or any combination of these methods. Proper dust control shall be provided in the surrounding areas during such placement. If, in the opinion of the OWNER Representative, these conditions are not satisfactorily met, concrete shall not be placed.

13. No concrete shall be placed until all formwork, installation of parts to be embedded, and preparation of surfaces involved in the placing have been approved by the OWNER Representative.

14. Remove all snow, ice, and frost from the surfaces, including reinforcement, against which the concrete is to be placed. Before beginning concrete placement, thaw the subgrade to the depth at which the subgrade is not frozen. Do not place concrete around massive embedments unless such embedments are at a temperature above freezing.

D. Temperature:

1. The temperature of concrete as placed shall not be more than 75 degrees F. Hot weather concreting shall comply with ACI 305R. When the temperature of the materials or the probability of increases in ambient air temperature indicates a temperature of concrete, as placed, above 75 degrees F, the CONTRACTOR shall employ effective means to maintain the temperature of concrete within the specified limits, such as pre-cooling aggregates and mixing water, using ice as part of the mixing water, shading of aggregates, or placing at a time of day when the ingredients will not produce concrete above 75 degrees F. Any wetting of aggregates for cooling shall be performed sufficiently in advance of delivery into the batching plant bins and in such manner that the batched material will have a uniform and stable water content.

2. The CONTRACTOR shall submit to the OWNER Representative its method of obtaining and maintaining the required concrete temperature.

3. Placement Temperature: The minimum temperature of concrete immediately after placement shall be as specified in Column 2 of Table 3300-4. The temperature of concrete as placed shall not exceed the values shown in Column 2 of Table 3300-4 by more than 20 degrees F.

**Table 3300-4**

| Least Dimension of Section (in) | Minimum temperature of concrete as placed and maintained during the protection period ($^{o}$F) | Maximum gradual decrease in surface temperature during any 24 hour after end of protection ($^{o}$F) |
|---|---|---|
| Less than 12 | 55 | 50 |
| 12 to less than 36 | 50 | 40 |
| 36 to 72 | 45 | 30 |
| Greater than 72 | 40 | 20 |

4. Protection temperature: Unless otherwise specified, the minimum temperature of concrete during the protection period shall be as shown in Column 2 of Table 3300-4. Temperatures specified to be maintained during the protection period shall be those measured at the concrete surface, whether the surface is in contact with formwork, insulation, or air. Measure the temperature with a surface temperature measuring device having an accuracy of ±2oF. Measure the temperature of

concrete in each placement at regular time intervals not less than twice per 24 hour period.

5. Termination of protection: The maximum decrease in temperature measured at the surface of the concrete in a 24-hour period shall not exceed the values shown in Column 3 of Table 3300-4. Do not exceed these limits until the surface temperature of the concrete is within 20 degrees F of the ambient or surrounding temperatures. When the surface temperature of the concrete is within 20 degrees F of the ambient or surrounding temperature, all protection may be removed.

E. Consistency:

1. The quantity of water entering into a batch of concrete shall be just sufficient, with a normal mixing period, to produce a concrete which, can be worked properly into place without segregation and which can be compacted to give the specified density, impermeability, and smoothness of surface. The quantity of water shall be changed as necessary with variations in the nature or water content of the aggregate, to uniformly produce the desired consistency.

2. Except as indicated in Article 2.05. J, the slump of the concrete immediately prior to placing shall be in accordance with the limits in the table below, measured in inches.

   a. The slump, as indicated herein, shall be measured in accordance with the methods prescribed in ASTM C143.

   b. The "Working Limit" is the maximum slump permissible for estimating the quantity of mixing water to be used in the concrete. The specified slump will be the minimum slump that will enable placing and consolidating concrete as specified and will be less than the "Working Limit." The "Inadvertency Margin" is the allowable deviation from the "Working Limit" for such occasional batches of concrete as may inadvertently exceed the "Working Limit." Batches of concrete with slumps above the working limit will be rejected if the frequency of their occurrence exceeds 50 percent of the slumps measured. Concrete with a slump exceeding the "Rejection Limit" shall not be used for the work. Concrete that has been rejected for failure to meet slump limits shall not be salvaged for use in the work. Increased mixing time, addition of dry materials, or similar modifications of a rejected batch for the purpose of conforming to slump limits will not be permitted.

| Type of Concrete | Working Limit | Inadvertency Margin | Rejection Limit |
|---|---|---|---|
| Top of walls and horizontal or | 2 | 1 | 3 |

| | | | |
|---|---|---|---|
| nearly horizontal slabs | | | |
| Structure walls 12 inches thick or less | 4 | 1 | 5 |
| Structure walls greater than 12 inches thick | 3 | 2 | 5 |

3. The re-tempering of concrete or mortar will not be permitted. Any concrete or mortar, which has stiffened so that proper placement and consolidation cannot be assured, shall be wasted.

F. Placing:

1. Transfer the concrete to the place of final deposit as rapidly as practical by methods which can prevent the separation or loss of ingredients. Under no circumstances shall partially hardened concrete be deposited. Deposit concrete in the forms as close to its final position as practical to avoid re-handling. Maintain, until the completion of the pour, a plastic concrete surface, approximately horizontal.

2. Deposit concrete without segregation of the aggregate and without displacement of the reinforcement.

3. Deposit concrete continuously or in layers 12 to 20 inches in depth so that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously as originally planned, locate construction joints during the placement.

4. Use every means to secure a dense, impervious, homogeneous concrete, free from voids or pockets. If honeycomb, air, or rock pockets occur, repair the structure to the complete satisfaction of the Engineer, and modify the placing method or mix design, to prevent recurrence of deficient concrete. Provide such repairs and modifications at no additional cost. Extensive honeycomb or pockets may be cause for rejection of the work.

G. Time Limit: Place all concrete in its final position in slab or forms within 1-1/2 hours of batching.

H. Structural concrete placement in vertical forms shall be started with a starter mix. This mix shall be placed two inches deep on the construction joint. A mortar layer shall not be used. This starter mix shall be omitted in open work in which the regular mix can be readily placed on the construction joint without loss of mortar and shall be thoroughly vibrated.

I. The CONTRACTOR shall protect all concrete against damage from inclement weather, excessive heat, overstress, lack of moisture, or any other cause until final acceptance by the OWNER Representative. Special care shall be taken to prevent the drying out of concrete during the curing period and to avoid roughening or otherwise damaging the surfaces.

J. Tremie Concrete Placement:

1. The CONTRACTOR will be required to maintain a record of theoretical concrete quantity versus placement depth during the tremie operation, and to carefully monitor the top of concrete elevation versus the depth of tremie embedment while pulling the tremie out. The CONTRACTOR shall also verify concrete placement up to the intended level to fully encapsulate the reinforcing cage.

2. At the start of tremie concrete placement, a “go-devil” such as a vermiculite plug should be used to separate the concrete and standing water in the forms or pile casings.

3. Tremie shall be placed through a water-tight tube fitted with a valve or other device so that at no time does concrete in the tube come in contact with water when it is being filled.

4. The means of supporting the tremie is such as to permit free movement of the discharge end and to permit its being lowered rapidly when necessary to choke off or retard the flow of concrete.

5. Water shall not be permitted to enter the tremie tube.

6. The discharge end of the tremie tube is completely submerged in concrete at all times and the tremie tube is always filled to a height to overcome the head of water.

## 3.07 CONSOLIDATION

A. The CONTRACTOR shall consolidate all concrete, including lean concrete and sand/cement slurry, with internal vibrators having a frequency of a least 7,000 vibrations per minute, with amplitude adequate to consolidate the concrete in the section being placed. At least one standby vibrator in operable condition shall be at the placement site prior to placing the concrete. Consolidation equipment and methods shall be in accordance with the requirements of ACI 309. The forms shall contain sufficient windows or be limited in height to allow visual observation of the concrete and the vibrator operator shall be required to see the concrete being consolidated to ensure good quality workmanship.

B. Concrete shall be consolidated by vibration to the maximum practicable density so that it is free from pockets of coarse aggregate and entrapped air and closes snugly against all surfaces of forms and embedded materials. In consolidating each layer of concrete, the vibrator shall be operated at regular and frequent intervals and in as nearly a vertical position as practicable.

C. The vibrating head shall be allowed to penetrate deeply and revibrate concrete in the underlying layers. The vibrator shall then be withdrawn at a slow rate, which will allow the escape of entrapped air to the surface of the lift. The top layer of each placement shall be revibrated systematically at the latest time the concrete can be made plastic by means of vibration. Layers of concrete shall not be placed until the layers previously placed have been vibrated thoroughly as specified. Care shall be exercised to avoid contact of the vibrating head with the surfaces of the forms. Consolidation of concrete shall be by electric or pneumatic drive vibrators of sufficient power and capacity to consolidate the concrete effectively and quickly.

D. Vibration of the formwork will not be permitted.

E. When required by the OWNER Representative, the top two feet of walls shall be revibrated approximately one hour after placement of concrete, while a running vibrator will still sink under its own weight into the concrete and liquefy it momentarily.

F. The number of vibrators employed shall be sufficient to consolidate the incoming concrete within 15 minutes after it is deposited in the forms.

G. When required, supplement by hand spading and tamping. Consolidate slabs 6-inches or less in depth by hand tampers, spreading and settling with a heavy leveling straightedge.

H. Furnish sufficient vibrators to complete the compaction as specified without causing delay in the depositing of concrete. Provide at least one spare unit for each structure when concrete is being placed and at least one vibrator for each 25 cubic yards per hour of concrete placement.

I. Vibrate by direct action in the concrete for approximately 10 seconds at approximately 12-inch intervals, not against forms or reinforcements. Do not move concrete horizontally by vibration. Work the concrete around the reinforcement, and around embedded fixtures and into the corners of the forms. Penetrate 6 to 12 inches into previously poured layers as new layers are poured, provided the running vibrator penetrates by its own weight. To secure even and dense surfaces, free from aggregate pockets, honeycomb, or air pockets, supplement vibration when required by forking or spading by hand or hammering the forms lightly opposite the freshly deposited concrete. Revibrate the final layer. Stop vibrating when concrete is thoroughly compacted and has ceased to decrease in volume and give off air bubbles.

J. When placing concrete with 8-inch or more slump, reduce the time of vibration to 5 seconds and follow the admixture manufacturer's recommendations for technique.

## 3.08 REPAIR OF DEFECTIVE CONCRETE

A. As soon as forms are removed, all exposed surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground down in a satisfactory manner so as to secure a smooth, uniform, and continuous surface.

B. Plastering or coating of surfaces to be smoothed will not be permitted.

C. No repairs shall be made until after inspection by the OWNER Representative.

D. Any concrete found to be damaged; or which may have been originally defective; or which becomes defective at any time prior to the final acceptance of the completed work; or which varies from the established line or grade; or which, for any other reason, is not in accordance with the specifications, shall immediately be satisfactorily repaired, or removed and replaced with acceptable concrete.

E. Only water cure will be permitted on areas requiring treatment of surface defects until such treatment has been satisfactorily completed.

F. Concrete containing voids, holes, honeycombing, or similar depression defects shall be completely removed and replaced; provided, that where required or approved by the OWNER Representative, defects shall be repaired with pneumatically applied mortar.

G. Surface and near-surface air voids resulting from improperly performed vibration shall be treated as defective concrete and shall be filled with dry-packed mortar or removed and repaired when deemed appropriate in the OWNER Representative's opinion.

H. In no case will patching of honeycombed concrete be permitted.

I. All repairs and replacements herein specified shall be promptly executed by the CONTRACTOR.

J. It is the intent of these specifications that repairs are made, if possible, while the base concrete is still uncured (green).

K. Minor Defects:

1. Clean thoroughly, including removal of any curing compound. Cut out to solid concrete but to a depth of not less than 1 inch. Prepare the edges of the cut slightly more than perpendicular to the surface of the concrete, so as to form a key.

2. Repair with cement mortar. Use minimum water, consistent with the requirements of handling and placing. Thoroughly compact the material into place and screed off to leave the patch flush with the surrounding surface.

3. Keep the surface damp for at least 48 hours.

4. Featheredges will not be permitted.

5. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of all laitance or soft material, and not less than 1/32 inch depth of the surface film from all hard portions, by means of an efficient sandblast.

6. After cutting or sandblasting, the surfaces shall be wetted sufficiently in advance of concrete placement so that, while the repair material is being applied, the surfaces under repair will remain moist, but not so wet as to overcome the adhesion upon which a good bond depends.

7. The material used for repair purposes shall consist of a mixture of one sack (94 pounds) of cement to three cubic feet of sand.

8. On exposed work where required by the OWNER Representative, the cement shall contain such a proportion of an approved white Portland cement as is required to make the color of the patch match the color of the surrounding concrete.

L. Holes left by the removal of tie rods or fasteners from the ends of the tie rods shall be properly reamed with suitable toothed reamers before being filled with dry-packed mortar.

1. After being reamed as specified, holes left by tie-rod cones or tie-rods and other imperfections having a depth greater than their least surface dimension shall be repaired in an approved manner with dry-packed mortar.

M. Major Defects:

1. Large areas involving voids or rock pockets extending through the section may be cause for rejection of the work.

2. For the major defects, the CONTRACTOR shall submit the fix method to the OWNER Representative for review and approval.

3. If acceptable repairs can be made without adversely affecting the structural integrity of the work, cut out the section and either dry pack, or reform or re-pour to match the adjacent concrete. Do not cut the reinforcing but cut keyways into the adjacent sound concrete to securely fasten the patch to the original work. Prepare

edges of the damaged area with a minimum of 1 inch cut perpendicular to the concrete surface.

4. Coat all surfaces with epoxy bonding compound immediately prior to patching. Place the concrete patch before the epoxy has set. Follow the epoxy bonding manufacturer's recommendations.

5. Provide a patch with strength and modulus of elasticity compatible with the parent concrete. Cure in accordance with this specification.

N. All repairs shall be built up and shaped in such a manner that the completed work shall be in accordance with the requirements for concrete finishes for formed surfaces, using approved methods which will not disturb the bond or cause sagging or horizontal fractures.

O. Surfaces shall match the finish of the surrounding concrete and shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.

P. All repairs shall be sound and free from shrinkage cracks and drummy areas after the fillings have been cured and have dried at least 30 days.

Q. Repairs requiring pressure injection shall be epoxy resin as follows, or equal:

1. Select Products, GP-2000.

2. Sika Corporation, Sika Dur 35 Hi-Mod Epoxy.

## 3.09 CONCRETE FINISHES

A. Finishing of concrete surfaces shall be performed only by skilled workers. Concrete surfaces will be tested by the OWNER Representative to determine that surface irregularities are within the specified limits.

B. All finished formed surfaces shall conform accurately to the shape, alignment, grades, and sections shown on the Drawings.

C. Increase the humidity of the air directly above the concrete surface, prior to and during finishing operations by adding a fine fog mist of water to the air with mist nozzles when atmospheric conditions (temperature, humidity, and wind) are such that rapid evaporation of mixing water from the concrete is likely to occur.

D. Complete all patching and finishing within 10 days after stripping forms.

E. The surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind and shall present a finished, smooth, continuous, hard surface.

F. Precautions shall be taken to ensure that all interior concrete surfaces, which will come in contact with flowing water, have the smooth and even texture produced by the proper use of the forms and the most current means of concrete placement as defined by ACI 304.

G. Concrete surfaces which will not be in contact with flowing water shall likewise be finished in a good and workmanlike manner and shall be free from unsightly or injurious defects, but will not require the same care specified for the surfaces which will come in contact with flowing water.

H. External corners shall be rounded or beveled, where required, by the use of molding strips or with suitable molding or finishing tools.

I. Where grooves are shown on the Drawings they shall be formed by molding strips or other suitable means.

J. Unformed Surfaces:

1. Floor and flat roof surfaces where drains are provided shall be finished with slope to the drains. Also, concrete walkways and the concrete roofs of all structures shall be sloped to drain, except as otherwise shown on the Drawings. The direction of the slopes and amount of crown shall be as shown on the Drawings, but if not shown, then at a slope of not less than 1/8 inch per foot.

2. The following practices will not be permitted on slab or floor finishes:

   a. The dusting on of dry cement or sand to absorb excess moisture.

   b. Excessive troweling or manipulation, which brings water or a large amount of fines to the surface.

   c. Use of the floor during construction in any manner that leads to marring or staining the finish.

   d. Addition of water to the surface during the finishing operation.

3. The variation from established elevations for slab or floor surfaces shall not exceed 1/8 inch, and there shall be no offsets or visible waviness in the finished surface.

K. Steel Trowel Finish:

1. A steel trowel finish shall be provided on all unformed concrete surfaces unless otherwise specified.

2. In placing the concrete to receive a steel trowel finish, the mix shall be adjusted to prevent water gain on the surface. The concrete shall be brought up evenly to

slightly above finished grade and thoroughly compacted by vibrating, tamping, and rolling or other approved means.

3. The top shall be struck off to accurately established grade strips or grade blocks and the surface floated to bring just enough mortar to the surface for troweling. The surface shall be tested with a straightedge and a template to detect high and low spots which, if found to exceed 1/8 inch in ten feet, shall be eliminated.

4. As soon as any moisture sheen has disappeared from the floated surface and the concrete has hardened sufficiently to prevent drawing moisture and fine materials to the surface, the surface shall be steel troweled to produce a smooth, hard, uniform finish.

5. A final steel troweling shall be given after the concrete is so hard that no mortar accumulates on the trowel when it is manipulated to give heavy pressure to compact and harden the surface.

6. Machine finishing producing equally satisfactory results may be substituted for the finishing process herein prescribed subject to approval by the OWNER Representative.

7. Excessive undulations and local irregularities in shape, although of smooth appearance, will not be permitted.

8. The use of a special mortar-finishing coat will not be permitted, but the desired surface shall be obtained by thoroughly working the normal concrete mix. No water will be added to the surface during finishing.

L. Wood Float Finish:

1. A wood float finish shall be provided on the following unformed concrete surfaces:

   a. Concrete roof slabs.

   b. Unformed surfaces of miscellaneous concrete structures not subject to foot traffic, in contact with flowing water, or exposed to view.

2. Wood float finished surfaces shall be in accordance with the requirements of steel trowel finish except that wood floating shall be substituted for steel troweling.

M. Broomed Finish:

1. Applies to all exposed uniformed surfaces those will experience foot traffic.

2. Complete the work required under “Preliminary Steps for Other Finishes.”

3. Apply a second steel troweling after the concrete has set sufficiently so mortar does not adhere to the edge of the trowel and sufficient pressure can be applied to further consolidate the surface.

4. Apply broom finishing in direction parallel to the slope.

N. Detail work: Applies to all concrete flatwork and to exposed top edges of all formed concrete.

1. Edging Slabs: Tool a 3/8-inch radius on all exposed edges of slabs, curbs and other exposed horizontal edges unless a formed chamfered edge is called for. Repeat tooling with each floating or troweling operation

2. Apply a trowel finish to the top of the formed walls.

## 3.10 CONCRETE TOLERANCES

A. Tolerance limitations for all structures shall be in accordance with Article 1.05 except that for all elements of the structure the tolerances permitted in the several categories shall not be combined to allow a total combined tolerance greater than that allowable under a single category. :

B. Where tolerances closer than those given above are necessary to accommodate the installation of all items or equipment, they shall be limited to values compatible with the installation requirements.

C. Failure of concrete to meet specified tolerances will be grounds for rejection of concrete work.

## 3.11 CURING AND PROTECTION

A. General: Maintain concrete above 50ºF and below 90ºF in a moist condition and without external loadings for 14 days after placement. After the specified initial moist cure, provide further moist curing, impervious-sheeting curing, or application of liquefied membrane-forming compound, as noted.

B. Application of Pre-Cure Finishing Aid:

1. Concrete flatwork subject to rapid evaporation due to hot weather, drying winds, and sunlight may be protected with a pre-cure finishing aid. The finishing aid shall form a monomolecular film on the surface of fresh, plastic concrete to retard evaporation.

2. Immediately following screeding, pre-cure finishing aid shall be sprayed over the entire surface of fresh, plastic concrete flatwork at a rate of not less than 200 square feet per gallon, in accordance with the manufacturer's recommendations.

The spray equipment shall have sufficient capacity to continuously spray finishing aid at approximately 40 psi with a suitable nozzle as recommended by the manufacturer.

3. The sprayable solution shall be prepared as recommended by the manufacturer.

4. Under severe drying conditions, additional applications of finishing aid may be required following each floating or troweling, except the last finishing operation

C. Foundations and Slabs:

1. Initial moist cure: Provide a 36-hour uniform spray treatment immediately following final troweling and before the surface can dry out, but after bleeding has stopped. Use clean water and special fog spray nozzles of type and number required to keep entire surface moist. Keep all traffic off the floor surfaces.

2. Continued cure: After 36 hours, continue fog curing, or before the surface dries out, continue curing by one of the following methods for the balance of 14 days.

   a. Place waterproof curing paper smoothly upon the moist concrete surface with all joints and edges lapped a minimum of 4 inches and continuously sealed with tape. Do not use paper that will leave an impression on the finish. Repair, replace and reseal torn or scuffed sheets.

   b. Install polyethylene plastic sheeting and maintain in the same manner as curing paper.

   c. Apply liquid membrane curing compound, if favorably reviewed for this purpose. Apply while slab is still damp from the fog spray.

      1) Agitate compound thoroughly by mechanical means during use and apply uniformly in a two coat continuous operation by appropriate power-spraying equipment. Apply the two coats at right angles. Apply between 150 and 200 square feet per gallon of undiluted compound, total coverage. Form a uniform, continuous, coherent film that will not check, crack, or peel and free from pinholes or other imperfections. Apply an additional coat immediately to areas where the film is defective.

      2) Keep alternate specified covering readily available for use in the event conditions occur which prevent correct application of the compound at the proper time.

      3) Respray surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied (when slab reaches a

moist condition and there is no standing water) with two additional coats of curing compound by the foregoing method and coverage.

4) Allow foot traffic only after 36 hours of cure time and only when slab is protected with paper or sheeting.

5) Allow building material storage only after 14 days of cure time and only on plywood sheets and wood sleepers that spread the load and protect the finish.

D. Walls:

1. When forms are in place, keep concrete damp by spraying the outside and top of the forms with water.

2. When forms are in place, but loosened, keep concrete damp by streaming water down inside the forms.

3. When forms are removed, continue curing by one of the following methods for the balance of the 14 days.

   a. Provide continuous perforated hose sprays at the top of wall covering the entire wall, both sides, with water.

   b. Place water-retaining blankets continuously over the wall surfaces and hose periodically with water, 24 hours a day.

   c. Apply liquid membrane curing compound, if favorably reviewed for this purpose. Follow the procedures for slabs contained in paragraph above.

E. Other Surfaces:

1. Provide a curing program equivalent to either slab or wall system, as appropriate.

2. Include construction joint surfaces when applying curing compound.

3. Cover, or protect joint openings, exposed reinforcing, surfaces to be painted and other areas when curing compound may enter and interfere with a special finish.

4. Remove curing compound sprayed on reinforcing or construction joints by sandblasting after curing is completed, or before placing the next pour. If the cones of tie holes are sprayed with curing compound, lightly ream prior to patching.

F. Prevent concrete from drying during the required curing period. If water curing is used, terminate use at least 24-hours before any anticipated exposure of the concrete to freezing temperatures.

G. Combustion heaters: Vent flue gases from combustion heating units to the outside of the enclosure.

H. Overheating and drying: Place and direct heaters and ducts to avoid areas of overheating or drying of the concrete surface.

I. Hot Weather Requirements: Provide additional cooling to concrete when temperatures rise to more than 20ºF above the values shown in column 2 of Table 03300-4, or low humidity, wind and temperature combine to cause high surface evaporation, over 0.2 lb/sq. ft./hour:

1. Provide additional water if curing by fog spray or ponding or saturated blankets.

2. Provide shade to surfaces exposed to direct sunlight.

3. Apply an evaporation retarder during the finishing operation, following the manufacturer's recommendation.

4. Maximum air temperature: During the protection period, do not expose the concrete surface to air having a temperature more than 20oF above the values shown in Column 2 of Table 03300-4, unless otherwise specified. The protection period may be reduced to 2 days if use of one or more of the following to alter the concrete mixture is accepted:

   a. Type III Portland cement meeting the requirements of ASTM C 150.

   b. A strength-accelerating admixture meeting the requirements of ASTM C 494.

   c. 100 lb/yd$^3$ of additional cement.

J. Cold Weather Requirements: Provide adequate equipment for heating the placed concrete during freezing or near freezing weather:

1. Whenever the surrounding air temperature is below 40ºF, or may fall below 40ºF within the 24-hour period after pouring of concrete, maintain all freshly poured concrete at not less than 50ºF for 5 days.

2. Keep the housing, covering, or other protection in place and intact at least 24 hours after the artificial heating is discontinued.

3. Do not use manure, salt, calcium chloride, or other chemicals on the concrete to prevent freezing.

K. During periods not defined as cold weather, but when freezing temperatures may occur, protect concrete surfaces against freezing for the first 24-hours after placing.

L. Protection for structural safety: If the concrete strength is required for structural safety, extend the protection period to ensure the necessary strength development. The strength required for formwork removal, for reshoring, or for continued construction shall be not less than 500 psi concrete compressive strength.

M. Protection deficiency: If the temperature requirements during the specified protection period are not met but the concrete was prevented from freezing, continue protection until twice the deficiency of protection in degree-hours is made up. Deficient degree-hours may be determined by multiplying the average deficiency in temperature by the number of hours the temperature was below the values shown in Column 2 of Table 03300-4.

## 3.12 FIELD TESTING

A. The OWNER Representative will make all quality assurance (QA) tests. The CONTRACTOR shall cooperate in the making of such tests by furnishing necessary labor to assist the OWNER Representative in obtaining, handling, protecting, and curing samples at the work site.

B. The CONTRACTOR shall be responsible for all quality control (QC) tests to determine compliance with these specifications. The CONTRACTOR shall perform quality control tests of concrete at test locations designated by the OWNER Representative to demonstrate compliance with this specification section and Section 01400, “Inspection of the Work and Quality Control.”

C. The determination of compressive strength in pounds per square inch will be made by testing 6 inch by 12-inch cylinders fabricated and cured in accordance with the requirements of ASTM C31 and tested in accordance with the requirements of ASTM C39. The OWNER Representative will make tests and analyses of the aggregate and of the resulting concrete at frequent intervals, and the mixes used shall be changed whenever such change is necessary or desirable in order to secure the required workability, density, impermeability, surface finish, and strength.

D. Before concrete production is started, the CONTRACTOR shall provide acceptable facilities for obtaining samples of cement, aggregates, and concrete as required. These facilities shall be provided at the batching and mixing plant. Samples of aggregate and samples of concrete shall be furnished as requested by the OWNER Representative.

E. Frequency of testing is presented in Table 03300-5:

**Table 03300-5**

| Test | Test Type | Frequency |
|---|---|---|
| Aggregate Testing | QC | One sample of each size aggregate per 8-hour shift. In the first month of production, several samples per shift until |

| Table 03300-5 | | |
|---|---|---|
| **Test** | **Test Type** | **Frequency** |
| | | production control has reached uniformity |
| Aggregate Testing | QA | One sample of each size aggregate per every third shift after the first month of production |
| Aggregate Grading Correlation Tests | QC | Before start of concrete placement and twice a week thereafter while concrete is being placed. |
| Aggregate Grading Correlation Tests | QA | Before construction and every 60 days while concrete production continues |
| Aggregate Quality | QC | Initial testing and once a week while concrete is being placed. |
| Aggregate Quality | QA | Once every two months while concrete is being placed. |
| Free Moisture on Aggregates | QC & QA | Once per week while concrete is being placed |
| Slump & Air | QC | Twice per shift for each concrete mixture being placed |
| Slump & Air | QA | When cylinders for compressive strength are fabricated |
| Concrete Temperature | QC | Twice per shift when concrete is being placed |
| Compressive Strength | QC | All other concrete: Once per Shift - 4 cylinders, 1 for information age and 2 for design age as specified by USACE EM 1110-2-2000, Chapter 9 |
| Compressive Strength | QA | One cylinder for every ten cylinders tested by the CONTRACTOR |

## 3.13 FIELD QUALITY CONTROL

A. Concrete Placement:

1. Verify that forms and reinforcement are accurately placed and secured in position. Confirm that both forms and reinforcement have been inspected and approved with all requested corrections, re-inspected and approved.

2. Verify that tie wire ends have been bent back away from the forms.

3. Verify that all sleeves, castings, pipes, conduits, bolts, anchors, and any other items required, are accurately and securely placed within or on the forms.

4. Verify waterstop is correctly in place and that splices are watertight.

5. Verify adequate vibrators used are available.

6. Verify construction and expansion joint faces have been prepared for the next concrete placement.

7. Check that the mix design is compatible with the method of placement of the concrete, by pump or by batch.

8. For wall placements, verify that the modified concrete mix required at construction joints is to be delivered.

9. Verify the concrete delivered to site is satisfactory, including checks on the batch tickets, quality assurance tests and direct observation of the batches.

B. Concrete Curing:

1. Verify procedures and equipment are available for controlling concrete temperature during hot and cold weather conditions.

2. Verify actual time of application of evaporation retardant, fog spray and curing materials for each placement.

## 3.14 CLEANUP

A. The CONTRACTOR may be required, at any time prior to final acceptance of the work, to clean all permanently exposed surfaces of concrete.

B. Upon completion of all work performed under this Section, remove from the site all excess materials, storage facilities and temporary facilities. Smooth and clean all debris in the areas where used for or occupied during concrete construction operations. The site condition shall be cleaned and acceptable to the OWNER Representative.

**END OF SECTION**

## PART 1 - GENERAL

### 1.01 SUMMARY

A. The Work specified in this Section includes the requirements for furnishing and installing precast concrete units as shown on the Drawings. Work includes the fabrication, delivery, and installation of units complete in place. Work also includes all erection and miscellaneous hardware required to connect units to adjacent construction. Precast concrete vaults may be constructed as an alternative to cast-in-place vaults only at the locations shown on the Plans. Where a precast vault alternative is not indicated, the Contractor shall construct the vault using cast-in-place methods.

B. Related Sections:

1. Section 01300 – Submittals
2. Section 01400 – Quality Control
3. Section 02052 - Site Preparation, Clearing, Grubbing, and Stripping.
4. Section 02160 - Excavation Support Systems.
5. Section 02200 - Earthwork.
6. Section 02231 - Aggregate Base and Subbase.
7. Section 03100 - Concrete Formwork.
8. Section 03200 - Concrete Reinforcement.
9. Section 03300 - Cast-in-Place Concrete.

### 1.02 REFERENCES

A. American Concrete Institute (ACI):

1. ACI 504R-90, Guide to Joint Sealants for Concrete Structures.

B. American Society for Testing and Materials (ASTM):

1. ASTM C150, Specification for Portland Cement.
2. ASTM C387, Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.

3. ASTM C487, Specification for Precast Reinforced Concrete Manhole Sections.

4. ASTM C857, Specification for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.

5. ASTM C858, Specification for Underground and Precast Concrete Utility Structures.

1.03 SUBMITTALS

A. General: Make submittals in accordance with Section 01300.

B. Product Data:

1. Manufacturer's catalog data on precast concrete items. Show materials of construction by ASTM reference and grade.

2. Manufacturer's laboratory test reports as required.

C. Shop Drawings:

1. Detailed drawings showing complete information for fabrication including, but not limited to:

a. Member dimensions and cross sections; location, size, and type of reinforcement, including additional reinforcement and lifting devices for handling and erection.

b. Welded connections indicated by AWS standard symbols.

c. Details of connections, joints, accessories, and openings or inserts.

d. Location and details of anchorage devices.

e. Structural design calculations and analysis.

D. Working Drawings and Methods Statements:

1. Erection procedures, sequence of erection, and required handling equipment.

2. Layout dimensions and identification of each precast unit corresponding to the sequence and procedure of installation.

3. Details of field connections, joints, accessories, and openings or inserts.

4. Details for watertight joints.

E. Quality Control:

1. Certifications:

a. Manufacturer's certification that vault design and manufacture comply with the referenced ASTM specifications (e.g., ASTM C857 and C858). Vault design calculation shall be signed by a California Registered Civil or Structural Engineer.

1.04 QUALITY ASSURANCE

A. Acceptance Criteria:

1. The manufacturer shall demonstrate the capability to make and provide the specified quality products by attestation of the Prestressed Concrete Institute under the Plant Certification Program.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Store each unit in a manner that will prevent cracking, distortion, warping, straining, and other physical damage and in a manner to keep marking visible.

B. Lift and support each unit only at designated lifting points and supporting points as shown on the Shop Drawings.

**PART 2 - PRODUCTS**

2.01 MATERIALS

A. Precast Concrete Vaults:

1. Precast concrete vaults shall comply with ASTM C858, except as modified herein.

2. Precast construction shall be of the rigid type and behave monolithically. Do not use panel-type vaults. Design loads shall be in accordance with ASTM C857. Traffic loads shall be designation A-16 per Table 1 with a 20 percent increase due to impact. Soil lateral loads shall be as determined by ASTM C857 or loadings specified in the project soils report, whichever is greater. Alternate design by the ultimate strength method shall include a load factor of 1.7 for lateral earth and 1.4 for hydrostatic pressures. Minimum wall thickness shall be 8 inches. Two layers of reinforcing steel shall be required in wall and roof sections.

3. Necessary provisions shall be made in the design to accommodate additional stresses or loads which may be imposed during factory precasting, transporting, or erecting.

4. In the event of conflict between or among standards, the more stringent shall govern.

5. Each member or element shall be marked to indicate location in the structure, top surface, and date of fabrication.

6. Precast concrete vaults shall be designed not to float during a flood event.

B. Precast Concrete Risers:

1. Precast concrete grade rings and cones shall comply with ASTM C478, except that the minimum wall thickness shall be six inches. Provide interlocking keyways on rings and cones. Provide grade ring with cast-in-place inserts for the access hatch or manhole frame and cover. Provide watertight joints.

C. Concrete:

1. Concrete for the manhole base shall be Class A per Section 03300.

D. Sealants and Grout:

1. Plastic sealing compound shall be SIKADUR 1A, or equal. Mortar shall comply with ASTM C387, Type S, or use grout complying with Section 03300.

E. Metalwork:

1. Ladders, access hatches, manhole frames and covers shall conform to Section 05500, Miscellaneous Metal Work .

## PART 3 - EXECUTION

3.01 PREPARATION

A. Perform excavation, backfill and compaction in accordance with Section 02200. Compact each lift of structural backfill all around vault before placing next lift.

B. Form and place cast-in-place concrete base in one monolithic pour.

3.02 INSTALLATION

A. Set each precast concrete vault unit plumb.

B. Install access hatches and manhole frames and covers per manufacturer's recommendations. Install the access hatches and manhole frames and covers to the finished elevations shown on the Plans, or as follows:

1. In paved areas the top of cover shall be 0.05 feet above the paving surface.

2. In shoulder areas the top of cover shall be 0.1 feet above the existing surface where the cover is located outside of the traveled way.

C. Fill joints between precast sections with joint compound/sealant per manufacturer's recommendation to produce a watertight joint. Dry pack interior of all joints with non-shrink grout to provide a smooth finish.

D. Apply crystalline waterproofing to the exterior surfaces of all buried structures after installation and before backfilling per Section 09900.

3.03 FIELD QUALITY CONTROL

E. Quality control shall be performed under the provisions of Section 01400.

F. Products: Submit verification that the installed products are authentic (delivery receipts, bill of lading, etc.).

G. Execution: Submit verification that the work was installed correctly (inspection records, as-built drawings, etc.).

1. Provide survey coordinates for all buried products.

2. Provide photographs for all buried products.

**END OF SECTION**

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## PART 1 - GENERAL

1.01 DESCRIPTION:

Furnish all labor, materials, equipment, and incidentals required, and install grout complete as shown on the Drawings and as indicated and in compliance with Contract Documents.

1.02 SUMMARY

A. Section Includes:

1. Material for grouting reinforcing bars, anchor bolts into existing or newly placed concrete.

2. Material for grouting under bearing plates for columns or beams.

3. Materials for grouting under equipment.

4. Materials for grouting under and around steel tanks.

5. Materials for miscellaneous grouting including but not limited to railing posts, equipment guides, bollards, precast concrete joints and supports etc.

1.03 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):

1. M182: Burlap Cloth made from Jute or Kenaf

B. American Petroleum Institute (API):

1. RP 686: Recommended Practice for Machinery Installation and Installation Design

C. ASTM International (ASTM):

1. C33: Standard Specification for Concrete Aggregates

2. C150: Standard Specification for Portland Cement

3. C531: Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts, and Monolithic Surfacings

4. C827: Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixes

5. C1107: Standard Specification for Packaged Dry, Hydraulic, Cement Grout (Non-shrink)

6. D695: Standard Test Method for Compressive Properties of Rigid Plastics

D. U.S. Army Corps of Engineers Standard (CRD):

1. C621: Corps of Engineers Specification for Non-shrink Grout

E. National Sanitation Foundation (NSF):

1. 61: Drinking Water System Components – Health Effects

1.04 DESIGN REQUIREMENTS:

A. Design grout and related anchorage systems in accordance with the design loads specified on the contract drawings or as required by the equipment manufacturer.

B. The design and selection of the grout and grouting system shall be based on the duration and magnitude of the load and the frequency of application. The use of a grout for a specific application shall be verified by the manufacturer of the grout.

1.05 SUBMITTALS

A. Submit the following shop drawings in accordance with Section 01300.

B. Product Data:

1. Commercially manufactured non-shrink, non-metallic cementitious grout:

a. Include catalogue cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to referenced ASTM standards, and Material Safety Data Sheet.

2. Commercially manufactured non-shrink epoxy grout:

a. Include catalogue cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to referenced ASTM Standards and Material Safety Data Sheet.

3. Cement grout:

a. Include the type and brand of the cement, the gradation of the fine aggregate, product data on any proposed admixtures, and the proposed mix of the grout.

4. Concrete grout:

    a. Include data for concrete as delineated in Section 03300. This includes the mix design, constituent quantities per cubic yard, and the water/cement ratio.

5. Bonding Agent:

    a. Include catalogue cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to referenced ASTM standards, and Material Safety Data Sheet.

C. Laboratory Test Reports.

1. Submit laboratory test data as required under Section 03300 for concrete to be used as concrete grout.

D. Mill test reports for each shipment of cement, regardless of quantity, prior to incorporation into the work.

E. Manufacturer's specifications and instructions for all admixtures, curing materials, adjustable inserts and non-shrink non-metallic grout. Manufacturer’s certification of compatibility of all admixtures.

F. Provide certification that all materials used in grout or the curing and repair of concrete, meet the requirements of ANSI/NSF 61 for contact with potable water.

1.06 QUALITY ASSURANCE

A. Qualifications

1. Grout manufacturer to have a minimum of 5 years experience in the production and use of the type of grout proposed for the Work.

B. Field Testing

1. Field testing and inspection services required will be provided by the OWNER. Provide assistance in the sampling of materials and provide any ladders, platforms, etc. for access to the Work. Comply with the applicable ASTM Standards for testing.

2. The field testing of concrete grout will be as specified for concrete in Section 03300.

3. Take compression test specimens from the first placement of each type of grout to ensure compliance with these Specifications.

    a. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C109 at intervals during construction as selected by the ENGINEER. A set of three specimens will be made for testing at one, seven and 28 days.

    b. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C579, Method B. A set of three specimens will be made for testing at seven days.

1.07 RESPONSIBILITIES:

A. Assist the OWNER in obtaining specimens for testing and furnish all materials necessary for fabricating the test specimens.

B. The cost of laboratory tests on grout will be paid by the OWNER except where test results show the grout to be defective. In such case, the Contractor shall pay for the tests, removal and replacement of defective work, and re-testing all at no cost to the OWNER.

1.08 WARRANTY:

A. Warrant the materials and products specified in this Section against defective materials and workmanship with the manufacturer’s standard warranty, but for no less than one year from the date of substantial completion.

B. Warrant the work against defects for one year from the date of substantial completion.

1.09 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements in Section 01600.

B. Deliver materials to the jobsite in original, unopened packages, clearly labeled with the manufacturer's name, product identification, batch numbers, and printed instructions.

C. Store materials in accordance with the manufacturer's recommendations. Total storage time from date of manufacture to date of installation shall be limited to six months or the manufacturer's recommended storage time, whichever is less.

D. Reject material that becomes damp, lumpy or otherwise unacceptable and immediately remove from the site and replace with acceptable material at no cost to the OWNER.

E. Deliver non-shrink cement based grouts as pre-blended, prepackaged mixes requiring only the addition of water.

F. Deliver non-shrink epoxy grouts as premeasured, prepackaged, three component systems requiring only blending as directed by the manufacturer.

1.10 **SERVICES OF MANUFACTURER'S REPRESENTATIVE:**

A. The Contractor shall provide the services of a qualified manufacturer's technical representative who shall instruct the Contractor's personnel in the mixing, proper use and application of the non-shrink grout and epoxy grout.

B. The manufacturer's representative shall provide written certification that materials have been mixed and applied properly and surfaces to receive these products have been prepared properly, all in conformance with manufacturer's requirements.

C. The on-site time required for the manufacturer's representative to achieve a successful installation shall be at the expense of the Contractor.

## PART 2 - PRODUCTS

2.01 GENERAL:

A. Provide materials produced by one manufacturer or supplier in order to provide standardization of appearance.

2.02 APPLICATION:

A. Unless indicated otherwise, provide grouts as listed below:

**Table 03600-1**

| Type of Grout | Application |
|---|---|
| Cement Grout | Surface repairs |
| Non-Shrink – Class I | Storage tanks and other non-motorized equipment. |
| | Filling block-out spaces for embedded items such as railing posts, gate guide frames, etc. (Where placement time is less than 20 min.). |

| | |
|---|---|
| | Repair of holes and defects in concrete members that are not water bearing and not in contact with soil or other fill material. |
| Non-Shrink – Class II | Column base plates. |
| | Filling block-out spaces for embedded items such as railing posts, gate guide frames, etc. (where placement time exceeds 20 min.) |
| | Under precast concrete elements. |
| Non-Shrink Epoxy | Machinery subject to severe shock loads and high vibration. |
| | |
| **However, for larger projects, refer to Section 03300** | |
| Concrete Grout | Toppings and concrete/grout fill. |

2.03 MATERIALS:

A. Non-shrink Class I Grout:

1. Non-shrink Class I Grout shall have a minimum 28-day compressive strength of **5000 psi**, when mixed at a fluid consistency.

2. Non-shrink Class I grout shall meet the requirements of ASTM C1107, Grade B or C, when mixed to fluid, flowable and plastic consistencies.

4. Products:

   a. Sika Corp.; SikaGrout 212.

   b. Master Builders, Inc.; Set Grout.

   c. The Euclid Chemical Co.; Euco NS.

B. Non-shrink Class II Grout:

1. Non-shrink grout shall be a high precision, fluid, extended working time grout. The minimum 28-day compressive strength shall be **7,500 psi**, when mixed at a fluid consistency.

3. Grout shall have an extended working time of 30 minutes minimum when mixed to a fluid consistency as defined in ASTM C827 at temperature extremes of **45 to 90 degrees F** in accordance with ASTM C1107.

4. Non-shrink grouts shall meet the requirements of ASTM C1107; Grade B or C when tested using the amount of water needed to achieve fluid consistency per ASTM C939.

5. The grout when tested shall not bleed or segregate at maximum allowed water.

6. Products:

   a. Master Builders, Inc.; Masterflow 928.

   b. The Euclid Chemical Co.; Hi-Flow Grout.

   c. Sika Corp.; SikaGrout 212.

C. Cement Grout:

1. Cement grouts shall be a mixture of one part Portland cement conforming to ASTM C150 types I, II, or III and one to two parts sand conforming to ASTM C33 with sufficient water to place the grout. The water content shall be sufficient to impart workability to the grout, but not to the degree that it will allow the grout to flow.

2. Cement grout materials shall be as indicated in Section 03300 Cast-in-Place Concrete.

D. Concrete Grout:

1. Concrete grout shall conform to the requirements of Section 03300 except as specified herein. Proportion with cement, coarse and fine aggregates, water, water reducer, and air entraining agent to produce a mix having an average strength of **2,000 psi** at 28 days. Coarse aggregate size shall be **3/8-inch** maximum. Keep the W/C ratio as low as practical while still retaining sufficient workability.

2. dd synthetic reinforcing fibers as specified in Section 03200 to the concrete grout mix at the rate of **1.5 pounds**. of fibers per cubic yard of grout. Add fibers from the manufacturer's premeasured bags and according to the manufacturer's recommendations in a manner that will ensure complete dispersion of the fiber bundles as single monofilaments within the concrete grout.

E. Non-shrink epoxy-based grout:

1. Provide a pre-proportioned, three component, 100 percent solids system consisting of epoxy resin, hardener, and blended aggregate. It shall have a compressive strength of **14,000 psi** in seven days when tested in conformity with

ASTM D695 and have a maximum thermal expansion of 30 x 10-6 when tested in conformity with ASTM C531.

2. Products:

a. Ceilcote 648 CP by Master Builders, Inc.

b. Five Star Epoxy Grout by U.S. Grout Corp.

c. Sikadur 42 Grout-Pak by Sika Corp.

d. High Strength Epoxy Grout by the Euclid Chemical Co.

H. Dry Pack Grout:

1. Make dry pack (to be packed or tamped in place) at no slump consistency.

2. When mixing the batch, add only enough water to the dry materials to produce a rather stiff mixture. Additions of water may be made in small increments until the desired consistency is obtained.

I. Non-epoxy Bonding Compound:

1. Provide non-epoxy bonding compound that is re-wetable for up to two weeks.

2. Products:

a. Larsen Products Corp.; Weldcrete.

b. Sta-Dry Manufacturing Corp.; Link.

c. Euclid Chemical Co.; Euco Weld

2.04 CURING MATERIALS:

A. Curing materials for cement grout shall be as specified in Specification and as recommended by the manufacturer for prepackaged grouts.

## PART 3 - EXECUTION

3.01 GENERAL:

A. Grout shall not be placed until base concrete or masonry has attained its design strength, unless authorized otherwise by the ENGINEER.

B. Prepare surfaces for curing, and protection of cement grout in accordance with Section 03300 Cast-in-Place Concrete.

C. Shade the work sites from sunlight for at least 24 hours before and 48 hours after grouting.

D. Contact the grout manufacturer's representative for assistance on hot and cold weather grouting techniques and precautions if applicable.

3.02 PREPARATION

A. Perform excavation, backfill and compaction in accordance with Section 02200. Compact each lift of structural backfill all around vault before placing next lift.

B. Form and place cast-in-place concrete base in one monolithic pour.

3.03 INSTALLATION

A. Block out the original concrete or finish off a sufficient distance below the bottom of the machinery base to provide for the thickness of grout shown on the Contract Drawings. After the machinery has been set in position and placed at the proper elevation by steel wedges, the space between the bottom of the machinery base and the original placement of concrete shall be filled with a pourable non-shrink grout. Grout and grouting procedure shall be in accordance with API 686.

B. Clean concrete surfaces to receive grout free of ice, frost, dirt, grease, oil, curing compounds, laitance and paints, and free of all loose or unsound material or foreign matter that may affect the bond or performance of the grout.

C. Preparation: Where indicated on the drawings, anchor bolts and threaded rod anchors shall be epoxy grouted in holes drilled into hardened concrete. Diameters of holes shall be as follows:

D. The embedment depth for epoxy grouted anchor bolts and threaded rod anchors shall be at least 15 bolt or rod diameters, unless otherwise indicated on the drawings. Holes shall be prepared for grouting as recommended by the grout manufacturer. Installation: Anchor bolts and threaded rod anchors shall be clean, dry and free of grease and other foreign matter when installed. The bolts, rods and bars shall be set and positioned and the epoxy grout shall be placed and finished in accordance with the recommendations of the grout manufacturer. Care shall be taken to ensure that all spaces and cavities are filled with epoxy grout, without voids. During assembly of all threaded stainless steel components, anti-seize thread lubricant shall be liberally applied to the threaded portion not embedded in concrete.

E. Roughen concrete surfaces by chipping, sandblasting, or other mechanical means to ensure bond of the grout to the concrete. Remove loose or broken concrete. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance and firmly embedded into the parent concrete.

F. Remove all loose rust, oil or other deleterious substances from metal embedments prior to the installation of the grout.

G. Wash concrete surfaces clean and keep them moist for at least 24 hours prior to the placement of cementitious or cement grout. Saturate by covering the concrete with a plastic sheet or using either a soaker hose, flooding the surface or other method acceptable to the ENGINEER. Remove visible water from the surface upon completion of the 24-hour period prior to grouting. Use an accepted adhesive bonding agent in lieu of surface saturation when accepted by the ENGINEER for each specific location of grout installation.

H. Epoxy based grouts do not require the saturation of the concrete substrate. Surfaces in contact with epoxy grout shall be completely dry before grouting.

I. Construct grout forms or other leak proof containment. Forms shall be lined or coated with release agents recommended by the grout manufacturer.

J. Support equipment during alignment and installation of grout by shims, wedges, blocks, or other accepted means. Prevent the shims, wedges, and blocking devices from bonding to the grout by appropriate bond breaking coatings and remove them after grouting unless otherwise accepted by the ENGINEER.

3.04 FIELD QUALITY CONTROL

A. Cement Grouts and Non-shrink Cementitious Grouts:

1. Mix in accordance with manufacturer's recommendations. Do not add cement, sand, pea gravel, or admixtures without prior approval by the grout manufacturer and the ENGINEER.

2. Avoid mixing by hand. Pre-wet the mixer and empty excess water. Add premeasured amount of water for mixing, followed by the grout. Begin with the minimum amount of water recommended by the manufacturer and then add the additional water required to obtain workability. However, do not exceed the manufacturer's maximum recommended water content.

3. Place grout into the designated areas in a manner that will avoid segregation or entrapment of air. Do not vibrate grout to release air or to consolidate the material. Placement should proceed in a manner that will ensure the filling of all

spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary. Place grout rapidly and continuously to avoid cold joints. Do not place cement grouts in layers. Do not add additional water to the mix (re-temper) after initial stiffening.

4. Just before the grout reaches its final set, cut back the grout to the substrate at a 45-degree angle from the lower edge of bearing plate unless otherwise accepted by the ENGINEER.

5. Begin curing immediately after form removal, cutback, and finishing. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement or longer if recommended by the manufacturer.

B. Non-shrink Epoxy Grouts:

1. Apply bonding agent, if required, in accordance with the requirements of the grout manufacturer. Mix in accordance with the procedures recommended by the manufacturer. Do not vary the ratio of components or add solvent to change the consistency of the grout mix. Do not over mix. Mix full batches only to maintain proper proportions of resin, hardener, and aggregate. Partial mixes will be rejected and will require the suspect grout to be removed and be replaced.

2. Monitor ambient weather conditions and contact the grout manufacturer for special placement procedures to be used for temperatures below 60 degrees F or above 90 degrees F.

3. Place grout into the designated areas in a manner that will avoid trapping air. Placement methods shall ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.

4. The extension of grout horizontally beyond base plate shall be less than or equal to the grout thickness.

5. Epoxy grouts are self-curing and do not require the application of water. Maintain the formed grout within its recommended placement temperature range for at least 24 hours after placing, or longer if recommended by the manufacturer.

C. Concrete Grout:

1. Provide the underlying concrete surface with a broomed finish. Protect and keep the surface clean until placement of concrete grout.

2. Remove the debris and clean the surface of all dirt and other foreign materials.

3. Saturate the concrete surface for at least 24 hours prior to placement of the concrete grout. Remove excess water just prior to placement of the concrete grout. Place a cement slurry immediately ahead of the concrete grout so that the slurry is moist when the grout is placed. Work the slurry over the surface with a broom until it is coated with approximately **1/16- to 1/8-inch** thick cement paste.

B. Dry Pack:

1. Dry pack consistency shall be such that the grout is plastic and moldable but will not flow.

2. The use of pneumatic pressure for dry-packed grouting requires acceptance of the ENGINEER.

2.02 CLOSEOUT ACTIVITIES:

A. Provide in accordance with Section 01700.

**END OF SECTION**

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**TECHNICAL SPECIFICATION**
**DIVISION 5: METALS**
**SECTION 05051: ANCHOR BOLTS AND ADHESIVE ANCHORS**

## PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
1. Provide all labor, materials, equipment and incidentals as shown on the Drawings, specified, and required to furnish and install anchor bolts (cast-in place) and adhesive anchors.

B. Coordination:
1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before anchor bolt or adhesive anchor work.

C. This Section includes all anchor bolts (cast-in-place) and adhesive anchors required for the Work, but not specified under other Sections.

D. The types of Work using anchor bolts (cast-in-place) and adhesive anchors include, but are not limited to the following:
1. Hangers and brackets.
2. Equipment.
3. Piping.
4. Tanks.
5. Grating and floor plate.
6. Electrical, Plumbing and HVAC Work.
7. Metal, wood, and plastic fabrications.
8. Partitions and ceilings.
9. Shelf angles and masonry lintels.
10. Structural members and accessories.

1.2 QUALITY ASSURANCE

E. Reference Standards: Comply with the applicable provisions and recommendations of the following, except as shown on the Drawings or specified otherwise.
1. ASTM F 593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
2. ASTM F 594, Specification for Stainless Steel Nuts.
3. 2012 International Building Code.

1.3 SUBMITTALS

A. Samples: Representative samples of anchor bolts (cast-in-place) and adhesive anchors as may be requested by ENGINEER. Review will be for type and finish only. Compliance with all other requirements is exclusive responsibility of CONTRACTOR.

Product Data: Submit product data for manufactured items, including paint products and grout.

B. Shop Drawings: Submit for approval the following:
   1. Setting drawings and templates for location and installation of anchorage devices.
   2. Copies of manufacturer's specifications, load tables, dimension diagrams, and installation instructions for the devices.
   3. Copies of ICC, UL, or FM Reports certifying load carrying capacities and installation requirements for the anchorage devices.

## PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. When the size, length or load carrying capacity of an anchor bolt or adhesive anchor is not shown on the Drawings, provide the following:
   1. For anchor bolts (cast-in-place), provide the size, length, and capacity required to carry the design load based on the values and requirements for concrete given in the 2012 International Building Code.
   2. For adhesive anchors, provide the size, length, type, and capacity required to carry the design load based on the values and requirements given in the ICC Evaluation Report, or similar certifications by UL or FM, for the anchor to be used. Alternately, the capacity may be based on independent testing lab capacities for tension and shear strength using a minimum safety factor of four. Consideration of reduced capacity due to spacing and edge distance shall be made.

B. Determine design loads as follow:
   1. For equipment anchors, use the design load recommended by the equipment manufacturer and approved by ENGINEER.
   2. For pipe hangers and supports, use one half of the total weight of: pipe, fittings, and water contained in pipe, plus the full weight of valves and accessories located between the hanger or support in question, and the next adjacent pipe hanger or support, in both directions along the pipe.
   3. Allowances for vibration are included in the safety factor specified above.
   4. Anchor bolts (cast-in-place) and adhesive anchors shall develop ultimate shear and pull out loads of not less than the following values in 4,000 psi concrete:

| Bolt Diameter (Inches) | Min. Shear (Pounds) | Min. Pull-Out Lead (Pounds) |
|---|---|---|
| 1/2 | 5,000 | 7,600 |
| 5/8 | 8,000 | 12,000 |
| 3/4 | 11,500 | 17,000 |
| 7/8 | 15,700 | 20,400 |
| 1 | 20,500 | 28,400 |

2.2 APPLICATION

A. Where a concrete anchor is shown on the Drawings, either install an adhesive anchor or anchor bolt (cast-in-place).

B. Anchor Bolts (Cast-in-Place):
   1. Use in concrete or grout filled masonry.
   2. Where an anchor bolt is indicated, only a cast-in-place anchor bolt shall be used, unless another anchor type is accepted by the ENGINEER.
   3. Provide anchor bolts as shown on the Drawings or as required to secure structural steel to concrete or masonry.

C. Adhesive Anchors:
   1. Use in concrete or masonry.
   2. Use where subject to vibration or where buried or submerged.
   3. Use for pipe supports.
   4. Shall not be used for vertical overhead installations.

2.3 MATERIALS

A. Anchor Bolts:
   1. Unless otherwise indicated, provide stainless steel bolts complete with washers and nuts, complying with ASTM F 593 and ASTM F 594, AISI Type 316.
   2. For equipment, provide anchor bolts which meet the equipment manufacturer's requirements for size, material, strength, embedment length, and projection.
   3. Locate and accurately set the anchor bolts using templates or other devices as required.

B. Adhesive Anchors in Concrete or Grout Filled Masonry:
   1. Provide stainless steel adhesive anchors complete with washers and nuts, complying with ASTM F 593 and ASTM F 594, AISI Type 316.
   2. Anchors shall be of the size required for the concrete strength specified.
   3. Adhesive anchors shall consist of threaded rods anchored with an adhesive system into hardened concrete or grout-filled masonry. The adhesive system shall use a two-component adhesive mix. Adhesive shall be injected with a static mixing nozzle following manufacturer’s instructions. The embedment depth of the threaded rod shall provide a minimum allowable bond strength that is equal to the allowable steel tensile capacity of the threaded rod, unless noted otherwise on the Drawings.
   4. Adhesive Anchors in concrete:
      a. Product and Manufacturer: Provide one of the following:
         1) HIT-RE 500-SD Epoxy Adhesive Anchor System, by Hilti, Inc.
         2) SET-XP Epoxy Adhesive Anchor System, by Simpson Strong-Tie Company, Inc.
         3) Or equal.
   5. Adhesive Anchors in grout filled masonry:

a. Product and Manufacturer: Provide one of the following:
   1) HIT-HY 150 MAX Adhesive Anchor System, by Hilti, Inc.
   2) SET Adhesive Anchor System, by Simpson Strong-Tie Company, Inc.
   3) Or equal.

C. Powder activated fasteners and other types of bolts and fasteners not specified herein shall not be used, unless approved by ENGINEER.

D. Expansion anchors will not be allowed.

## PART 3 - EXECUTION

### 3.1 INSPECTION

A. Examine areas and conditions under which anchor bolt (cast-in-place) and adhesive anchor Work is to be installed, and notify ENGINEER, in writing, of conditions detrimental to proper and timely completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

### 3.2 INSTALLATION

A. Protect anchor bolt (cast-in-place) and adhesive anchor threads and shank from damage during installation of equipment and metal framing.

B. Adhesive Anchors in Concrete or Grout Filled Masonry:
   1. Holes shall be drilled in hardened concrete or grout to the adhesive anchor system manufacturer's recommended diameter and depth to develop the required pullout resistance but shall not be greater in diameter than 1/4-inch more than the anchor diameter nor less than 12 times the anchor diameter in depth, unless shown otherwise on the Drawings.
   2. Holes shall be drilled by methods which do not interfere with the proper bonding of the adhesive. Use rotary percussion drilling with carbide bit to avoid cutting reinforcing steel embedded in the concrete.
   3. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling. The location of holes to be drilled shall be adjusted to avoid drilling through or nicking any existing reinforcing bars. Holes in adjusted locations may be drilled only after approval by the ENGINEER.
   4. Holes shall be brushed and blown clean with clean, dry compressed air to remove all dust and loose particles. Conform to the adhesive system manufacturer's written instructions.
   5. Adhesive shall be injected into the hole through the injection system-mixing nozzle (and any necessary extension tubes) placed to the bottom of the hole. The discharge end shall be withdrawn as resin is placed but kept immersed to prevent formation of air pockets. The hole shall be filled to a depth that ensures that excess material is expelled from the hole during dowel placement.

6. Anchor rods shall be twisted during insertion into the partially filled hole so as to guarantee full wetting of the bar surface with adhesive. Anchor rods shall be inserted slowly to avoid developing air pockets.
7. Adhesive anchor manufacturer's representative shall observe and demonstrate the proper installation procedures for the adhesive anchors and adhesive material at no additional expense to OWNER. Each installer shall be certified in writing by the manufacturer to be qualified to install the adhesive anchors.

3.3 CLEANING

A. After embedding concrete is placed, remove protection and clean anchor bolts.

3.4 FIELD QUALITY CONTRAL

A. Testing of Adhesive Anchors:
   1. Employ the services of an independent testing laboratory to perform field quality testing of adhesive anchors. A minimum of 10 percent (but no less than 15 anchors) shall be chosen at random by the testing laboratory and confirmed by the ENGINEER. Unless otherwise directed by the ENGINEER, adhesive anchors shall be tensioned to 60 percent of the specified yield strength. Where adhesive anchors are located less than eight dowel diameters from the edge of concrete the ENGINEER will determine the tensile load required for the test.
   2. Provide access for the testing agency to places where Work is being produced so that required inspection and testing can be accomplished.
   3. CONTRACTOR shall be responsible for the failure of any adhesive anchor. If any anchor fails, the testing shall be increased to 20 percent (but no less than 30 anchors), and may be increased further after review by the ENGINEER.
   4. Correct improper workmanship, remove and replace, or correct as directed by the ENGINEER, all adhesive anchors found unacceptable or deficient, at no additional cost to the OWNER.
   5. Pay for all corrections and subsequent tests required to confirm the integrity of the adhesive anchors.
   6. The independent testing and inspection agency shall complete a report for each area. The report shall summarize the observations made by the Inspector and be submitted to the ENGINEER.

END OF SECTION

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**TECHNICAL SPECIFICATION**
**DIVISION 5: METALS**
**SECTION 05500: MISCELLANEOUS METALWORK**

## PART 1 - GENERAL

### 1.01 SUMMARY

A. This specification section includes the following items of work:

1. Furnishing and installing Miscellaneous Metal Work as shown on the Drawings including but not limited to:

   a. Pipe hanger components including steel plates, eye rods, clevis hangers, and related hardware

   b. Steel casings at each end of the bridge structure

   c. Bolts, nuts, washers

   d. Ladders.

   e. Handrails.

   f. Metal Grating.

   g. Stairways/Treads.

   h. Pipe supports and hangers (see also Section 15006).

   i. Walkways.

   j. Trashracks.

   k. Access hatches.

   l. Aluminum metalwork.

   m. Miscellaneous brackets and connectors.

2. All steel components furnished that is shown on the contract plans and not otherwise paid for shall be miscellaneous metal.

### 1.02 REFERENCE

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition available on the date of Notice Inviting Bids shall be used.

B. Caltrans Standard Specifications, Section 75 Miscellaneous Metal. Installation of water pipe on the Monte Road bridge must comply with section 75 of Caltrans standard specifications.

C. American Society for Testing and Materials (ASTM):

1. ASTM A6: Revision A, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
2. ASTM A36: Standard Specification for Carbon Structural Steel.
3. ASTM A53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
4. ASTM A123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
5. ASTM A153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
6. ASTM A167: Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
7. ASTM A276: Standard Specification for Stainless Steel Bars and Shapes.
8. ASTM A296: Standard Specification for Corrosion-Resistant Iron-Chromium, Iron-Chromium-Nickel, and Nickel-Base Alloy Castings for General Application.
9. ASTM A307: Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
10. ASTM A312: Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
11. ASTM A314: Standard Specification for Stainless Steel Billets and Bars for Forging.
12. ASTM A325: Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
13. ASTM A385: Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
14. ASTM A500: Revision A, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
15. ASTM A501: Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
16. ASTM A563: Standard Specification for Carbon and Alloy Steel Nuts.
17. ASTM A572: Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
18. ASTM A588: Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance.
19. ASTM A740: Standard Specification for Hardware Cloth (Woven or Welded Galvanized Steel Wire Fabric).

20. ASTM A780: Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
21. ASTM A786: Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
22. ASTM A1011: Revision B, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High- Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
23. ASTM B633: Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
24. ASTM F436: Standard Specification for Hardened Steel Washers.
25. ASTM F593: Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
26. ASTM F594: Standard Specification for Stainless Steel Nuts.
27. ASTM F738M: Standard Specification for Stainless Steel Metric Bolts, Screws, and Studs.
28. ASTM F836M: Standard Specification for Style 1 Stainless Steel Metric Nuts.

D. American Welding Society (AWS):
   1. D1.1, Structural Welding Code--Steel.
   2. D1.2, Structural Welding Code--Aluminum.
   3. D1.3, Structural Welding Code--Sheet Steel.
   4. D1.6, Structural Welding Code--Stainless Steel.

E. International Code Council (ICC):
   1. IBC, International Building Code, 2006.

F. California Occupational Safety and Health Administration (CAL/OSHA).

G. National Association of Architectural Metal Manufacturer's (NAAMM):
   1. MBG 531, Metal Bar Grating Manual.

H. American Institute of Steel Construction (AISC):
   1. AISC 303, Code of Standard Practice for Steel Buildings and Bridges for tolerances and material identification only.
   2. AISC 325, Steel Construction Manual.
   3. AISC 360, Specifications for Structural Steel Buildings

I. American National Standards Institute (ANSI):

1. ANSI B18.2.1, Square and Hex Bolts and Screws Inch Series.
2. ANSI B18.2.3.8M, Metric Hex Lag Screws.
3. ANSI B18.6.3, Machine Screws and Machine Screw Nuts.
4. ANSI B18.21.1, Lock Washers (Inch Series).
5. ANSI B18.22.1, Plain Washers-Reaffirmation and Redesignation of ASA B27.2-196
6. ANSI B18.22M, Metric Plain Washers.

J. Federal Specifications (FS):

1. FS FF-B-588, Bolt, Toggle; and Expansion Sleeve, Screw.

K. Uniform Federal Accessibility Standards (UFAS) / Americans with Disabilities Act – Accessibility Guidelines (ADAAG):

1. Part 36, Appendix A, Section 4.26, Handrails, Grab Bars, and Tub and Shower Seats

## 1.03 SUBMITTALS

**A.** Submit in accordance with Section 01300 - Contractor Submittals at least 60 days in advance of the relevant work commencing or materials being ordered, unless noted otherwise.

B. Product Data: Submit product data for manufactured items, including paint products and grout.

C. Shop Drawings: Submit shop drawings for all fabricated metal items including but not limited to ladders, safety rail, steel handrails, steel stairs, steel gratings, trashrack, access hatches, removable roof decking, and other miscellaneous metal items indicated on the Drawings.

1. Detail materials, profiles, sizes, connection attachments, reinforcing, anchorage, hardware, size and type of fasteners and accessories.

2. Include assembly drawings, framing plan (including member-member connection details), grating plan, sections, elevations and details where applicable.

3. Indicate welded connections using standard AWS welding symbols; indicate net weld lengths and proposed field welds.

4. Submit proposed location of all field welds. Approval required from OWNER Representative for all field welds.

5. Show all material types referenced to ASTM standards and show shop finish.

D. Certifications: Submit evidence of welder qualification showing date of qualification; and qualified positions and processes.

E. Quality Control Submittals:

F. Submit fabricator's quality control plan.

G. Submit Welding Procedure Specifications for all welds in accordance with the applicable AWS code.

H. Material Test Data: Provide certified laboratory test reports for all materials.

I. Design Calculations: Submit stamped design calculations for fabricated items requiring designs by a Professional Engineer registered in the State of California.

## 1.04 QUALITY ASSURANCE

**A.** To ensure proper fitting of the work, field-verify critical dimensions at the jobsite prior to preparation of shop drawings and before product fabrication begins. Field fabrication will not be permitted.

## PART 2 - PRODUCTS

## 3.01 MATERIALS

A. Basic Ferrous Metal – All steel shall be galvanized or coated as indicated unless otherwise noted.

1. Steel Pipe or Pipe Sleeves: ASTM A53, Schedule 40, black or hot dip galvanized.
2. Steel Plates, Angles, Channels, and Bars: Carbon steel, ASTM A36.
3. Steel Wide Flange Shapes: ASTM A992.
4. Hinges: Hinges provided for the grating panels shall have the design capacity to support 100 psf live load and the dead load of the grating.
5. Bird screen and insect screen: ASTM A740, hot dip galvanized after weaving; 1/8-inch size mesh screen.
6. Floor plate; checkered plate; raised pattern plate: ASTM A786, high strength low alloy carbon steel, flat back style, standard raised pattern No. 1, 4, or 5. Plate thickness as shown on the Drawings. Provide all plate in a single pattern and hot dip galvanized.
7. Pulling eyes: Smooth steel round bar, hot dip galvanized, sized and bent as shown on the Drawings.

B. Fasteners:

1. If stainless steel fasteners, bolts, washers, or nuts are specified, they shall conform to ASTM F593 or ASTM F594, alloy Group 1 or Group 2.
2. Welding stud anchors: AWS D1.1.. Size and type as shown on the Drawings.
3. Machine Screws: ANSI B18.6.3.
4. Lag Bolts: ANSI B18.2.1 (ANSI B18.2.3.8M).
5. Plain Washers: Round, carbon steel, ANSI B18.22.1 (ANSI B18.22M).
6. Lock Washers: Helical, spring type, carbon steel, ANSI B18.21.1.
7. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as required.

C. Stainless Steel: At locations identified on the Drawings.

1. Type: ASTM A276, Type 304 or 304L, unless otherwise indicated.
2. Bar Stock: For railings use ASTM A314, Type 302/304, No. 4 finish. For all other use ASTM A276.
3. Plate: ASTM A167.
4. Sheet: ASTM A167.
5. Structural Shapes: ASTM A276, Type 304 or 304L.
6. Castings: ASTM A296, iron-chromium-nickel alloy.
7. Pipe: ASTM A312.
8. Stainless Steel Diamond Floor Plate (checker plate): ASTM A276.

D. Welding materials: AWS D1.1, D1.2, D1.3 or D1.6; type required for materials being welded.

## 3.02 FABRICATED ITEMS

A. Ladders:

1. The ladders shall be fabricated of stainless steel plates, bars and angles to the dimensions shown on the Drawings.
2. Ladder rungs shall be 1 5/8 inch wide fabricated of 16-gauge stainless steel.
3. Install the ladders with stainless steel epoxy anchor bolts conforming to the requirements of the specifications for epoxy anchor bolts.
4. The safety posts shall be attached securely to ladder rungs.

B. Fall Arrest Protection System:

1. All ladders shall comply with the current CAW fall protection design requirements.

2. Ladders over 20 feet in height shall be equipped with CAL/OSHA approved harness safety equipment attachment with the following characteristics:
    a. Working load: 250 pounds.
    b. Permit user to ascend or descend hands free.
    c. Maximum possible fall length: 6 inches.
3. The main support rail shall be continuous, notched, and mounted permanently to ladder.
4. The slide or safety sleeve shall be equipped with locking mechanism for making connection between rail and safety belt.
5. All components shall be stainless steel.

C. ARV Enclosure
1. Stainless Steel ARV enclosure shall be Guard Shack Lift Off Model CGS-1 or approved Equal.

D. Handrails:
1. All rails and posts shall be ASTM A53, schedule 40.
2. Handrails shall be designed, fabricated and installed in accordance with applicable CAL/OSHA requirements, 29 CFR Part 1910, Section 1910.23.
3. Unless noted otherwise on the Drawings, the handrail height shall be 3'-6" as measured from working surface with horizontal rails spaced as shown on the Drawings. Post spacing shall not be greater than 6'-0". Posts shall be a single, unspliced length. Lower rails shall be a single unspliced length between posts. Top rails shall be continuous whenever possible, and a single, unspliced length shall, whenever possible, be attached to a minimum of three posts.
    a. Unless noted otherwise on the Drawings, any handrails with the potential for personnel to be present on levels below the handrail shall be a three rail system with a kick plate.
    b. Unless noted otherwise on the Drawings, handrails located above spaces with no personnel access shall be a four rail system without a kick plate.
4. Expansion joints shall be installed in all rails as per manufacturer's recommendations.
5. Posts, Rails and Toe Boards: Hot dip galvanized.
6. Provide bracket or plate attachments as indicated on the Drawings.
7. All fasteners except anchor bolts used to anchor the handrails shall be stainless steel. All anchor bolts shall be stainless steel.

8. Design of handrails shall comply with applicable UFAS, ADAAG, and CAL/OSHA Standards.

E. Structural Steel Framed Stairs/Treads:

1. Fabricate stairs to conform to sizes and locations shown on the Drawings.
2. Materials as specified under Paragraphs 2.02-A and B of this specification.
3. Treads in all stairs shall be welded steel bar grating. Design treads to support a uniform load of 100 lb/sq. ft., or a concentrated load of 300 pounds located to produce maximum stress condition.
4. Fabricate grating treads with corrugated angle nosing on one edge and with steel angle or steel plate carrier at each end for stringer connections.
5. Posts and railing for stairs shall be made in accordance with Paragraph 2.02.C.
6. Provide steel framing, posts, railings, clips, brackets, bearing plates and other components for the support of the stairs and as required to anchor and contain the stairs on the supporting structure.
7. Coatings:
   a. Treads: See Paragraph 2.02 E, Steel Gratings.
   b. Posts and railings for stairs: see Paragraph 2.02C, Handrails.
   c. Steel framing and other components not stainless or galvanized: paint with coating system No.3, Section 09900, “Paints and Coatings.”
   d. Surfaces that are damaged shall be repaired or replaced at no cost to the OWNER.

F. Steel Gratings:

1. Fabricate walkways and platforms to conform to sizes and locations shown on approved Shop Drawings.
2. All grating shall be hot dip galvanized welded steel bar grating fabricated from material consistent with ASTM A1011 standard.
3. Use stainless steel fasteners, inserts, and anchors. A minimum of four fasteners (maximum spacing between fasteners 5 feet) shall be utilized for attaching each grating panel, and the grating shall be removable from the grating walkway or platform surface.
4. Dimension all gratings that require openings to reflect the Drawings. Any deviation from these will be cause for rejection and re-fabrication will be at Contractor’s expense
5. Provide grating so that bearing bars or structural shapes traverse the shorter (span) direction or as identified on the Drawings.

G. Access (Roof) Hatch: Type S Roof Hatch or approved equal, sizes as indicated on the Drawings.

1. Cover Material: 14 gauge type 304 stainless steel .
2. Cover Support Frame Material: ASTM 276 type 304
3. Cover: Breakformed, hollow-metal design with 1 inch concealed fiberglass insulation, 3 inch beaded, overlapping flange, fully welded at corners, and internally reinforced for 40 psf live load.
4. Curb: 12 inches in height with integral cap flashing, 1 inch fiberboard insulation, fully welded at corners, and 3-1/2 inches mounting flange with 7/16 inch holes provided for securing frame to concrete roof deck.
5. Hatch Gasket: Extruded EPDM rubber gasket permanently adhered to cover and hatch.
6. Hinges: Heavy-duty pintle hinges with 3/8 inch type 316 stainless steel hinge pins.
7. Latch: Slam latch with interior and exterior turn handles and padlock hasps.
8. Lift Assistance: Compression spring operators enclosed in telescopic tubes. Automatic hold-open arm with grip handle release.
9. Hardware: Stainless Steel, Type 316.
10. Safety Post: Device shall be steel, hot dipped galvanized, and designed with a telescoping tubular section that locks automatically when fully extended. Unit shall be completely assembled with fasteners for securing to the ladder rungs in accordance with the manufacturer's instructions. Bilco LadderUP® Safety Post, model LU-2 or approved equal.

H. 6 inch Floor Drain: NEENAH R-4030-6‡ drain grate or approved equal.

## 3.03 FABRICATION

A. General:

1. Fabricate items of the material specified and with joints tightly fitted and secured.
2. Fit and shop assemble metal fabrications in largest practical sections for delivery to site, or as required to fit the specific locations.
3. Remove burrs from all exposed cut edges, remove spatter and grind exposed welds to match adjacent surface.
4. Supply all components required for anchoring the fabricated items as they are specified in the Construction Drawings, and of the specified material for each item. Fabricate anchorage and related components of same material and finish as metal fabrication, except where specifically noted otherwise.

B. Shop Finish:

1. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
2. Do not prime surfaces which will be in direct contact bond with concrete or where field welding is required.
3. Prepare fabricated metal to receive finishes in accordance with 09900 - Paints and Coatings.
4. Where metal fabrications are shop primed as part of the manufacturer's standard procedures, provide field painting in accordance with 09900 - Paints and Coatings.
5. All galvanizing shall be hot dip after fabrication unless indicated otherwise. Hot dip galvanize items to minimum 2.0 oz/sq ft zinc coating in accordance with ASTM A123, A153, and A385, as applicable.

## Part 3 EXECUTION

### 3.01 PREPARATION

A. Examine surfaces for defects that would impair installation.

B. Obtain OWNER Representative's approval before site-cutting, field-welding, or making non-scheduled adjustments.

C. Clean steel items to bare metal where site welding is scheduled.

D. Prepare for erection loads with temporary bracing; keeping work in alignment.

E. Supply setting templates for items required to be cast into concrete and confirm placement with a supplementary measurement at the location of installation.

### 3.02 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices, fasteners, and manufacturer's templates where necessary for securing miscellaneous metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required. Refer to manufacturer's specifications for proper installation procedures.

B. Install all items in accordance with manufacturer's published instructions and as shown on the Drawings.

C. Install items plumb and level, accurately fitted, and free from distortion or defects.

D. Perform field welding in accordance with the applicable AWS Code: AWS D1.1, AWS D1.2, AWS D1.3, or D1.6 and ASTM A6. Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and contour of welded surface matches those adjacent.

E. After installation, touch-up field welds and scratched or damaged sections as specified or as directed by the OWNER Representative.

F. Grating Installation:

1. Comply with recommendations of NAAMM Metal Bar Grating Manual for installation of gratings, including installation clearances and standard anchoring details.

2. Secure removable units to supporting members with type and size clips and fasteners recommended by grating manufacturer for type of installation conditions shown.

## 3.03 COATING

**A.** Repair paint on metal fabrications in accordance with 09900, “Paints and Coatings."

**B.** Repair damaged and uncoated areas of hot dip galvanized coating according to ASTM A780.

END OF SECTION

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**TECHNICAL SPECIFICATION**
**DIVISION 5: METALS**
**SECTION 05550: MISCELLANEOUS DRAINAGE FACILITIES**

## PART 1 - GENERAL

### 1.01 GENERAL

A. See Caltrans Standard Specifications 2015, Section 70 Miscellaneous Drainage Facilities for technical specifications.

B. Replace the 1st paragraph of section 70-1.01 with:

Section 70-1 includes general specifications for:

1. Installing miscellaneous drainage facilities for water drainage and transmission
2. Constructing casings for bridges
3. Installing water pipe on bridges

C. Add to section 70-1.01:

Installation of water pipe on bridges must comply with section 75.

END OF SECTION

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**TECHNICAL SPECIFICATIONS**
**DIVISION 9: FINISHES**
**09900: PAINTS AND COATINGS**

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PART 1 **GENERAL**

## 1.01 SUMMARY

A. This Section specifies the requirements for materials and application of painting and coating systems required throughout this project as indicated on the Drawings and the Specifications.

B. Items included in this Section:

1. Above grade pipeline segments.

C. Items not included in this Section:

1. For valves and other appurtenances, please refer to CAW Standard Drawings.

D. Related Sections:

1. Section 01300 – Contractor Submittals.

2. Section 01400 – Quality Control

3. Section 05500 – Miscellaneous Metalwork

E. Definitions:

1. The terms “paint,” “coatings,” or “finishes,” as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and other protective coatings, excepting galvanizing or anodizing; whether used as a pretreatment, primer, intermediate coat, or finish coat.

2. The term “DFT” means Dry Film Thickness, without any negative tolerance.

3. For galvanizing requirements see Section 05500 – Miscellaneous Metalwork.

## 1.02 REFERENCES

A. Reference Standards:

1. American National Standards Institute (ANSI):

a. ANSI A159.1, Surface Preparation Specifications.

2. ASTM International (ASTM):

a. ASTM D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.

b. ASTM D522, Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings.

c. ASTM D570, Standard Test Method for Water Absorption of Plastics.

d. ASTM D2240, Standard Test Method for Rubber Property-Durometer Hardness.

e. ASTM D4060, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.

f. ASTM D4541, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

g. ASTM E96, Standard Test Methods for Water Vapor Transmission of Materials.

h. ASTM G14, Standard Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test).

3. American Water Works Association (AWWA):

a. AWWA C222, Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings.

4. National Sanitation Foundation (NSF):

a. NSF-61, Drinking Water System Components - Health Effects.

5. National Association of Pipe Fabricators, Inc. (NAPF)

a. NAPF 500-03

## 1.03 SUBMITTALS

A. General: All submittals shall be made in accordance with Section 01300, Contractor Submittals.

B. Product Data:

1. Manufacturer's data sheets shall show the following information:

a. Percent solids by volume.

b. Minimum and maximum recommended DFT per coat for prime, intermediate, and finish coats.

c. Recommended surface preparation.

d. Recommended thinners.

e. Statement verifying that the specified prime coat is recommended by the manufacturer for use with the specified intermediate and finish coats.

f. Application instructions, including recommended equipment and temperature limitations.

g. Curing requirements and instructions.

h. Life expectancy/frequency and methods of recoating or repairing.

i. Material Safety Data Sheet.

## 1.04 QUALITY CONTROL

A. Manufacturer's Qualifications: Firms regularly engaged in the manufacture of paints and coatings, whose products have been in satisfactory use in similar service for not less than five years.

B. Certification, Paint and Coatings Performance: The Contractor shall provide Paint and Coatings whose performances, under specified operating conditions, are certified by the manufacturer.

C. Plan: Identify how the quality of materials and installation will be controlled (e.g. measurements, inspections, testing, etc.) in accordance with Section 01400 – Quality Control.

D. Workforce Qualifications: Submit verification that the workforce is qualified to complete the work of this Section (licenses, certifications, etc.) and that the work has been effectively supervised (manager, foreman, etc.).

## 1.05 WARRANTY

A. The Engineer may conduct an inspection one month prior to the end of the Contract Warranty period. The Contractor and a representative of the coating material manufacturer shall attend this inspection. Defective Work shall be repaired in accordance with these Specifications and to the satisfaction of the Engineer. The Engineer may, by written notice to the Contractor, reschedule the inspection to another date within the Warranty period or may cancel the inspection altogether. The

Contractor is not relieved of its responsibilities to correct defects, whether or not the inspection is conducted.

## PART 2 PRODUCTS

### 2.01 MATERIALS

A. General:

1. Suitability: The Contractor shall use suitable coating materials as recommended by the manufacturer. Materials shall comply with Volatile Organic Compound (VOC) limits applicable at the Site.

2. Material Sources: Where manufacturers and product numbers are listed, it is to show the type and quality of coatings that are required. If a named product does not comply with VOC limits in effect at the time of Bid opening, that product will not be accepted, and the Contractor shall propose a substitution product of equal quality that does comply. Coating materials shall be materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, and water and wastewater treatment plants.

3. Compatibility: In any coating system only compatible materials from a single manufacturer shall be used in the Work. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.

4. Containers: Coating materials shall be sealed in containers that plainly show the designated name, formula, or specification number; batch number, color, date of manufacture, and name of manufacture;, all of which shall be plainly legible at the time of use.

5. Colors: Colors and shades of colors of coatings shall be as indicated or selected by the Engineer. Each coat shall be of a slightly different shade to facilitate inspection of surface coverage of each coat.

6. Substitute or "Or-Equal" Products:

   a. Contractor shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or-equal" product that the material meets the indicated requirements and is equivalent or better in the following properties:

      1) Quality

2) Durability

3) Resistance to abrasion and physical damage

4) Life expectancy

5) Ability to recoat in future

6) Solids content by volume

7) DFT per coat

8) Compatibility with other coatings

9) Suitability for the intended service

10) Resistance to chemical attack

11) Temperature limitations during application and in service

12) Type and quality of recommended undercoats and topcoats

13) Ease of application

14) Ease of repairing damaged areas

15) Stability of colors

b. Protective coating materials shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. When requested, the Contractor shall provide the OWNER Representative with the names of not less than 10 successful applications of the proposed manufacturer's products that comply with these requirements.

c. If a proposed substitution requires changes in the Work, the Contractor shall bear such costs involved as part of the Work.

## 2.02 PAINTING AND COATING SYSTEMS

A. For each painting and coating system, the required surface preparation, prime coat, intermediate coat (if required), topcoat, and coating thicknesses are described below. Mil thicknesses shown are minimum DFT.

B. Provide materials for a specified painting system, including primer, intermediate, and finish coats by the same manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the paint manufacturer for the particular coating system.

C. Deliver paints to the jobsite in the original, unopened containers.

### 2.03 SYSTEM 1 - ALKYD ENAMEL

A. Applications:

1. Above grade pipe as shown on drawings, Color: to be determined by the Engineer.

B. Materials:

| | |
|---|---|
| **Primer** | manufacturer's recommendation |
| **Finish Coat Type** | high quality alkyd, medium long enamel |
| **Demonstrated suitable for** | ferrous, galvanized, and nonferrous surfaces in industrial exposure, producing high gloss surface that is resistant to mild corrosion and chemical fumes, has good color and gloss retention, good weathering, and sunlight resistance |
| **VOC Content, max** | 428 grams per liter |

1. Application and manufacturers:

| Surface Preparation | Prime Coat (DFT = 2.5-3.5 mils) | Finish Coat (DFT = 4 to 6 mils) | Total System DFT |
|---|---|---|---|
| Manufacturer's recommendation | Tnemec Omnithane Series 90-97 or approved equal | Tnemec Enduratone Series 1028 approved equal | 6.5 – 9.5 mils |

## PART 3 EXECUTION

### 3.01 PREPARATION

A. General:

1. Refer to manufacturer's recommendations for surface preparation.

2. Surface preparation shall conform with NAPF Surface Preparation Specifications as follows:

    a. Solvent Cleaning, NAPF 500-01

    b. Hand Tool Cleaning, NAPF 500-02

    c. Power Tool Cleaning, NAPF 500-03

    d. Abrasive Blast Cleaning for Ductile Iron Pipe, NAPF 500-04

    e. Abrasive Blast Cleaning for Cast Ductile Iron Fittings, NAPF 500-05

3.

## 3.02 INSTALLATION

A. Weather Conditions:

1. Do not paint in the rain, wind, snow, mist, and fog or when steel or metal surface temperatures are less than 5 degrees F above the dew point.

2. Do not apply paint when the relative humidity is above 85 percent or the temperature is above 90 degrees F.

3. Do not paint when temperature of metal to be painted is above 120 degrees F.

4. Do not apply alkyd or inorganic zinc paints if air or surface temperature is below 40 degrees F or expected to be below 40 degrees F within 24 hours.

5. Do not apply epoxy and polyurethane paints on an exterior or interior surface if air or surface temperature is below 60 degrees F or expected to drop below 60 degrees F in 24 hours.

B. Paint Mixing:

1. Prepare multiple-component coatings using all of the contents of the container for each component as packaged by the paint manufacturer. Do not use partial batches. Do not use multiple-component coatings that have been mixed beyond their pot life. Provide small quantity kits for touch-up painting and for painting other small areas. Mix only the components specified and furnished by the paint manufacturer. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

C. Shop-Applied Prime Coats:

1. After application of primer to surfaces, allow coating to cure for a minimum of two hours before handling to minimize damage.

2. When loading for shipment to the Project Site, use spacers and other protective devices to separate items to prevent damaging the shop-primed surfaces during transit and unloading. If wood spacers are used, remove wood splinters and particles from the shop-primed surfaces after separation. Use padded chains or ribbon binders to secure the loaded items and minimize damage to the shop-primed surfaces.

3. Cover shop-primed items 100 percent with protective coverings or tarpaulins to prevent deposition of road salts, fuel residue, and other contaminants in transit.

4. Handle shop-primed items with care during unloading, installation, and erection operations to minimize damage. Do not place or store shop-primed items on the ground or on top of other work unless ground or work is covered with a protective covering or tarpaulin. Place shop primed items above the ground upon platforms, skids, or other supports.

D. Field Touch-ups of Shop-Applied Prime Coats:

1. Remove oil and grease surface contaminants on metal surfaces in accordance with NAPF 500-01. Use clean rags wetted with a degreasing solution, rinse with clean water, and wipe dry.

2. Remove loose annealing oxide, loose rust, loose mold coating and other loose detrimental foreign matter in accordance with NAPF 500-02 or 500-03.

3. Blasting is allowable only with prior approval of the Engineer and shall be performed in accordance with NAPF 500-04.

4. Use repair procedures on damaged primer which protects adjacent primer.

5. Remove dust, blast particles, and other debris after cleaning of damaged and defective areas by dusting, sweeping, and vacuuming; then apply the specified touch-up coating.

6. Field touch-up surfaces that are shop primed with inorganic zinc primers with organic zinc primer to cover all scratches or abraded areas.

7. Field touch-up other surfaces that are shop primed with the same primer used in the original prime coat.

E. Application of Coatings:

1. Follow the recommendations of the coating manufacturer including the selection of spray equipment, brushes, rollers, cleaners, thinners, mixing, drying time, temperature and humidity of application, and safety precautions.

2. Stir, strain, and keep coating materials at a uniform consistency during application. Apply each coating evenly, free of brush marks, sags, runs, and other evidence of poor workmanship. Use a different shade or tint on succeeding coating applications to indicate coverage where possible. Finished surfaces shall be free from defects or blemishes.

3. Do not use thinners unless recommended by the coating manufacturer. If thinning is allowed, do not exceed the maximum allowable amount of thinner per gallon of coating material. Stir coating materials at all times when adding thinner. Do not flood the coating material surface with thinner prior to mixing. Do not reduce coating materials more than is absolutely necessary to obtain the proper application characteristics and to obtain the specified DFT.

4. Remove dust, blast particles, and other debris from blast cleaned surfaces by dusting, sweeping, and vacuuming. Allow ventilator fans to clean airborne dust to provide good visibility of working area prior to coating applications. Remove dust from coated surfaces by dusting, sweeping, and vacuuming prior to applying succeeding coats.

5. Apply coating systems to the specified minimum DFT as measured from above the peaks of the surface profile.

6. Apply primer immediately after blast cleaning and before any surface rusting occurs, or any dust, dirt, or any foreign matter has accumulated. Re-clean surfaces by blast cleaning that have surface colored or become moist prior to coating application.

7. Apply a brush coat of primer on welds, sharp edges, nuts, bolts, and irregular surfaces prior to the application of the primer and finish coat. Do the brush coat prior to and in conjunction with the spray coat application. Apply the spray coat over the brush coat.

F. Surfaces not to be Coated:

1. Do not paint the following surfaces unless otherwise noted on the Drawings or in other Specification Sections. Protect during the painting of adjacent areas:

   a. Stainless steel.

   b. Metal letters.

c. Glass.

d. Copper tubing, red brass piping, and PVC piping except where such piping occurs in rooms where the walls are painted, or required for color coding.

e. Electrical fixtures except for factory coatings.

f. Nameplates.

g. Grease fittings.

h. Brass and copper, submerged.

i. Aluminum handrail, stairs, and grating.

G. Protection of Surfaces not to be Painted:

1. Remove, mask, or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. Mask openings in motors to prevent paint and other materials from entering the motors.

H. Surfaces to be Coated:

1. Coat surfaces as described below:

a. Coat aboveground and exposed piping or piping in vaults and structures as described in the piping specifications. Color will be as selected by the Owner.

## 3.03 FIELD QUALITY CONTROL

A. Quality control will be performed under the provisions of Section 01400.

B. Products: Submit verification that the installed products are authentic (delivery receipts, bill of lading, etc.).

C. Execution: Submit verification that the work was installed correctly (inspection records, as-built drawings, etc.).

1. Provide photographs for all buried products.

D. Testing and Inspection

1. The Contractor's QC program shall be responsible for the performance of all inspections and testing.

2. The Contractor shall provide access to the Engineer or Testing Agency for additional inspection and testing.

E. Inspections by the Contractor will include:

1. Review manufacturer's recommended application procedures.

2. Continuously inspect installation for conformance with Contract Documents and manufacturer's recommendations.

3. The Contractor shall give the Engineer a minimum of 3 days advance notice of the start of any field surface preparation or coating application, and a minimum of 7 days advance notice of the start of any surface preparation activity in the shop.

4. Such Work shall be performed only in the presence of the Engineer, unless the Engineer has granted prior approval to perform such Work in its absence.

5. Inspection by the Engineer, or the waiver of inspection of any particular portion of the Work, shall not relieve the Contractor of its responsibility to perform the Work in accordance with these Specifications.

6. Scaffolding shall be erected and moved to locations where requested by the Engineer to facilitate inspection. Additional illumination shall be furnished on areas to be inspected.

7. Inspection Devices: The Contractor shall furnish inspection devices in good working condition for the detection of holidays and measurement of DFT of coatings. DFT gauges shall be made available for the Engineer's use while coating is being done, until final acceptance of such coatings. The Contractor shall furnish the services of a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of the Engineer.

F. Testing

1. Holiday Testing: The Contractor shall test for continuity all coated ferrous surfaces that will be buried, submerged in water, and surfaces coated with any of the submerged and severe service coating systems. Areas that contain discontinuities shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then be retested.

2. Coatings with thickness exceeding 20-mils total DFT: Pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E., Stearns Co. Model 14/20, or equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the required coating thickness.

3. Coatings with thickness of 20-mils or less total DFT: Tinker & Rasor Model M1 non-destructive type holiday detector, K-D Bird Dog, or equal shall be used. The unit shall operate at less than 75 volts. For thicknesses between 10- and 20-mils, a non-sudsing type wetting agent, such as Kodak Photo-Flo or equal, shall be added to the water prior to wetting the detector sponge.

4. Film Thickness Testing: On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC-PA-2, using a magnetic-type DFT gauge such as Mikrotest Model FM, Elcometer Model 111/1EZ, or equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.

G. Surface Preparation: Evaluation of blast cleaned surface preparation will be based upon comparison of the blasted surfaces with the standard samples available from NACE, using NACE standards TM-01-70 and TM-01-75.

H. Repair of Improperly Coated Surfaces

1. If the item has an improper finish color or insufficient film thickness, clean and recoat the surface with the specified paint material to obtain the specified color and coverage. Sandblast or power-sand visible areas of chipped, peeled, or abraded paint, feathering the edges. Then prime and finish coat in accordance with the specifications. Work shall be free of runs, bridges, shiners, laps, or other imperfections.

**END OF SECTION**

## PART 1 GENERAL

### 1.01 SUMMARY

A. This Section covers furnishing and installing the following types of signs under the Contract Documents:

B. The Contractor shall provide miscellaneous signs for the project as directed by the Owner or Engineer. Signs may be needed during several stages of the project, including: pre-construction, during construction, and post-construction. Permanent signs are to be provided where indicated in the Contract Documents.

C. Related Sections:

1. Section 01300 – Contractor Submittals.

2. Section 01400 – Quality Control.

3. Section 09900 – Paints and Coatings.

### 1.02 REFERENCES

A. Reference standards include but are not limited to:

1. FHWA 2004 Standard Highway Signs Book.

2. FHWA Clearview Typeface Supplement.

3. California Sign Specifications, 2006.

4. Respective Owner and county Standard Specifications through which the pipeline is installed.

### 1.03 SUBMITTALS

A. General: Submit the following in accordance with Section 01300, Contractor Submittals.

B. Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.

C. Shop Drawings: Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, reinforcement, accessories, layout, and installation details.

5. Provide message list for each sign required, including large-scale details of wording and layout of lettering.

## 1.04 QUALITY CONTROL

A. Plan: Identify how the quality of materials and installation will be controlled (e.g. measurements, inspections, testing, etc.) in accordance with Section 01400 – Quality Control.

B. Workforce Qualifications: Submit verification that the workforce is qualified to complete the work of this Section (licenses, certifications, etc.) and that the work has been effectively supervised (manager, foreman, etc.).

C. Single-Source Responsibility: For each separate type of sign required, obtain signs from one source from a single manufacturer.

## 1.05 PROJECT/SITE CONDITIONS

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

# PART 2 PRODUCTS

## 2.01 SIGN TYPES

A. As directed by the Owner or Engineer, including but not limited to:

1. Access Control: Mounted on posts or fences.

2. Facility Identification: Mounted on a structure.

3. Safety Signs: Mounted on equipment, structures, posts, or fences.

4. Roadway markers with reflectors.

## 2.02 SIGN SIZESAND ESTIMATED QUANTITIES

| | | |
|---|---|---|
| A. | Small Signs: Approximately 6” x 6” | 10 units |
| B. | Medium Signs: Approximately 12” x 12” | 50 units |
| C. | Large Signs: Approximately 36” x 36” | 25 units |
| D. | Extra Large Signs: Approximately 36” x 36” | 6 units |

E. Road Markers with reflectors 100 units

## 2.03 MATERIALS

A. Aluminum – Caltrans type traffic sign rated.

B. Vinyl Lettering.

C. Color – In general, two colors will be sufficient per sign, but colors will vary.

D. Content: Confirm with Owner Representative.

E. Attach sign with anti-theft fasteners.

# PART 3 EXECUTION

## 3.01 GENERAL

A. Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.

1. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.

## 3.02 INSTALLATION

A. Fence-Mounted: Attach to fence with stainless steel fasteners.

B. **Post-Mounted:** Attach to posts using manufacturer’s recommendation.

C. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using the methods indicated below:

1. Silicone-Adhesive Mounting: Use liquid silicone adhesive recommended by the sign manufacturer to attach sign units to irregular, porous, or vinyl-covered surfaces. Use double-sided vinyl tape where recommended by the sign manufacturer to hold the sign in place until the adhesive has fully cured.

D. Road Markers: Place in shoulder of access roads.

## 3.03 FIELD QUALITY CONTROL

A. Quality control will be performed under the provisions of Section 01400.

B. Products: Submit verification that the installed products are authentic (delivery receipts, bill of lading, etc.).

C. Execution: Submit verification that the work was installed correctly (inspection records, as-built drawings, etc.).

D. Testing and Inspection:

1. The Contractor's QC program shall be responsible for the performance of all inspections and testing.

2. The Contractor shall provide access to the Engineer or Testing Agency for inspection and testing.

E. Inspections by the Contractor will include:

1. Reviewing manufacturer's recommended application procedures.

2. Continuously inspect installation for conformance with Contract Documents and manufacturer's recommendations.

3. Finished installations shall be carefully inspected for proper anchoring.

F. Defective WORK shall be repaired.

G. At completion of the installation, clean soiled sign surfaces in accordance with the manufacturer's instructions. Protect units from damage until acceptance by the Owner Representative.

**END OF SECTION**

## PART 1 - GENERAL

### 1.01 GENERAL

A. Section 10430 includes specifications for performing work on existing structures.

B. Work performed on existing bridge structures must comply with Caltrans Standard Specifications 2015, Section 60.

END OF SECTION

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**TECHNICAL SPECIFICATION**
**DIVISION 13: SPECIAL CONSTRUCTION**
**SECTION 13110: CATHODIC PROTECTION**

## PART 1 GENERAL

### 1.01 SUMMARY

A. The Contractor shall design and install a cathodic protection system for metallic pipelines and appurtenances. Data reviewed by AECOM indicate the soils are corrosive to highly corrosive.

B. Section Includes:

1. Design and submittal requirements.

2. Material requirements including: insulating flange joints, dielectric shields, bonding cables and wires, including anodes and test stations for cathodic protection

### 1.02 REFERENCES

| | | |
|---|---|---|
| A. | NACE SP0169 | Standard Recommended Practice, Control of External Corrosion on Underground or Submerged Metallic Piping Systems |
| B. | NACE RP0286 | Standard Recommended Practice, The Electrical Isolation of Cathodically Protected Pipelines |
| C. | NFPA NEC Article 310 | Conductors for General Wiring |

### 1.03 SUBMITTALS

A. Product Data:

1. Test stations

2. Mounting posts

3. Prepackaged anodes

4. Permanent reference cells

5. Leads and cables, including color designations, and cable identifiers

6. Dielectric shields

7. Insulating flange kits

8. Underground marking tape

B. Quality Assurance/Control Submittals:

1. System currents and voltages

2. Evidence of experience required under section 1.04 Quality Assurance.

3. Design package that includes drawings and details of the cathodic protection system. The location of anodes, test stations, devices and appurtenances shall be shown on the drawings. The cathodic protection system design shall include at a minimum the design components shown in the project drawings and specifications.

4. Corrosion Survey Test Report:

   a. Contents of report:

      1) Anode current for pipeline.

      2) Detailed test procedures and results of field testing and inspection.

      3) All field test data obtained during the Work.

      4) Analysis of the data.

      5) List of deficiencies and proposed resolutions.

   b. Clearly define all parameters.

   c. Tabulate test station data. Table(s) shall include:

      1) Actual station numbers as indicated.

      2) Brief description of location.

      3) Potential readings.

      4) Nearby landmarks.

      5) GPS coordinates with 3 feet accuracy

   6) Results of quality assurance/quality control testing

   d. Place report in a 3-ring binder.

   e. Submit upon approval of cathodic protection system.

C. Installation, Operation, and Maintenance Manual

1. Test stations traffic boxes
2. Prepackaged anodes
3. Permanent reference cells
4. Leads and cables, including color designations, and cable identifiers
5. Insulating flange kits
6. Corrosion survey test report
7. Record drawings including test station locations with site description

## 1.04 QUALITY ASSURANCE

1. All Work under this Section 13110 shall be in accordance with the following:
   a. NACE RP0169
   b. NACE RP0286
   c. NFPA NEC Article 310
2. A registered professional corrosion engineer that has NACE accreditation shall be responsible for designing the cathodic protection system and preparing the Corrosion Survey Report.

## 1.05 LOCATIONS OF EQUIPMENT

1. The Contractor shall be responsible for the design of the cathodic protection system and final location and sizes of anodes, test stations, and other devices and appurtenances. Final locations shall be determined in the field and are subject to the approval by the Owner.

# PART 2 PRODUCTS

## 2.01 LEAD AND CABLES

A. All leads except shielded cable for permanent reference electrode:

1. Visually inspect all leads. If any damage to the wire or insulation is discovered, replace anode assembly.
2. Rated for 600 volts.

3. Conform to NFPA NEC Article 310

4. Stranded single conductor copper.

5. Length as required for construction installation.

6. For all leads terminating at a test station, factory-attach a cable identifier within 4 inches of end of lead at terminal board in test station.

7. Cable identifier shall meet the following requirements:

   a. Print letters and numbers 3/16-inch minimum.

   b. Wrap-around type with a high resistance to oils, solvents, and mild acids.

   c. Fully encircle cable with imprinted alphanumeric characters.

8. Lead colors, minimum sizes, and insulation type unless otherwise indicated:

   a. Test leads:

      1) Size: #10 THHN

      2) Color: White unless otherwise indicated.

   b. Anode leads:

      1) Size: #12 THHN unless otherwise indicated.

      2) Color: Black

   c. Structure leads:

      1) Size: #8 or #10 THHN

      2) Color: Black, white, green

9. Equip test leads with a steel rod for connecting to the pipeline or aqueduct.

B. Shielded cable for permanent reference electrode

1. #14 HMWPE.

C. Pipeline leads:

1. Shop-connect leads to the steel strap core with silver solder for pipeline connection.

D. Underground marking tape:

1. Polyethylene.

2. Yellow.

3. 6 inches wide.

4. Black lettering.

5. Continuous message that reads: "CAUTION - CATHODIC PROTECTION LINE BURIED BELOW."

## 2.02 MAGNESIUM ANODES

A. Anode ingots:

1. Cast with a perforated galvanized steel strap core.

2. Recess one end of anode so that one end of strap is accessible for lead wire connection.

B. Insulate connections in factory with electrical potting compound recommended by anode manufacturer to prevent intrusion of moisture.

C. Anode leads:

1. Factory installation of anode leads prior to shipment shall conform with the following requirements:

a. One continuous length without splices from the anode connection to the respective test stations.

1) If lead is damaged, replace wire and anode

b. Ship anode leads with the attached anode to Site with wire wound on a reel. Minimum core diameter of reel shall be 6 inches. Bends shall have minimum 2 1/2 inches radius.

D. No splices shall be allowed between the anode connection and the pipe or test station.

E. Prepackage anode in permeable cloth bag containing a low resistivity backfill consisting of 75 percent ground hydrated gypsum, 20 percent powdered bentonite and 5 percent anhydrous (sodium sulfate).

F. Magnesium anodes:

1. 60 pounds.

2. Composition: standard alloy Grade C as described below:

| Element | Minimum Percent | Maximum Percent |
|---|---|---|
| Aluminum | -- | 0.010 |
| Manganese | 0.5 | 1.3 |
| Copper | - | 0.02 |
| Nickel | - | 0.001 |
| Iron | - | 0.03 |
| Other | | 0.300 total or 0.05 each |
| Magnesium | Remainder | Remainder |

## 2.03 TEST STATIONS FOR PIPELINE

A. Types:

1. Type A (anode and test station)

2. Type B (insulated flange, anode, and test station on valve and pipeline)

3. Type C (blowoff assembly)

B. Manufacturers:

1. Cott, Flush Fink model

2. Tinker & Rasor

3. Or Approved Equal

C. Mounting pipe: Schedule 40 galvanized steel as indicated.

D. Terminal boards for test stations:

1. Reinforced phenolic plastic,

2. or approved equal.

3. Sized as indicated.

E. Double-nut bolts, washers, and all hardware:

1. Brass

2. Factory-install on terminal boards as indicated.

F. Nameplates: Factory-mount inside each test station on terminal board as indicated.

G. Shunts:

1. Calibrated 0.01-ohm manganin wire.

2. 5-amp capacity.

3. Accuracy: plus or minus one percent.

4. Shunt manufacturers:

a. Holloway

b. Cott

c. Or Approved Equal

H. Test station color: Orange.

**2.04 INSULATING FLANGE KIT FOR PIPELINE**

A. Each insulating flange kit shall consist of:

1. Full-faced central insulating gasket.

2. Full-length insulating sleeve for each flange bolt.

3. Two insulating washers with two steel washers for each bolt.

B. Ring-type central insulating gasket:

1. 1/8-inch thick sheet packing

2. Dielectric constant: high.

3. Mylar insulating sleeves

C. Stainless steel washers:

1. Fit well within the bolt facing on the flange

D. Insulating washers:

1. Fabric-reinforced phenolic resin

2. Shall fit within the bolt facing the flange over the outside diameter of the sleeve.

E. Complete assembly:

1. Pressure rating equal to that of the flanges between which flange kit is installed.

## 2.05 DIELECTRIC BLANKETS AND SLEEVES/WRAPS

A. Dielectric Blankets shall consist of ¼ inch thickness of one of the following materials:

1. Butyl Rubber

2. PVC

3. HDPE

4. Neoprene

5. Or approved equal

B. Sleeves or wraps shall consist of ¼ inch thickness of one of the following materials:

1. Phenolic plastic

2. Fiberglass sheet

3. Or approved equal

# PART 3 EXECUTION

## 3.01 CORROSION MONITORING SYSTEM FOR PIPELINE

A. Installation of anodes and reference cells:

1. Remove plastic or paper bags from prepackaged anodes before lowering into hole.

2. Do not suspend anodes by lead wires.

3. Install prepackaged anodes as indicated.

4. Place anode at each insulating flange joint and valve locations.

5. Do not bury anodes until Owner has inspected placement of anodes and given permission to backfill.

6. Backfill with native soil, compacted in 6-inch lifts.

7. Compact soil around anode during each lift until backfill has reached grade.

8. When compacted soil has been placed to the top of the anode, pour water into the hole to saturate anode packing and surrounding soil.

9. Anodes placed in violation of this Section 13110 will be rejected.

10. If damage occurs to the canvas bag enclosing anode and packing material, anode-to-lead connection, copper wire, or wire insulation, replace entire assembly.

11. Install anode lead wires as indicated and attach to panel board in test station.

B. Silver solder connections to pipeline:

1. Remove concrete mortar from surface of pipe over an area just sufficient to make the connection.

2. Clean surface of pipe to white metal by grinding or filing prior to soldering conductor. Resin-impregnated grinding wheels will not be allowed.

3. Remove enough insulation from conductor to solder conductor to pipe.

4. Silver solder connections to pipeline as indicated.

5. After solder has cooled, remove all slag, and test metallurgical bond for adherence to substrate.

6. Cover all exposed surfaces of copper and steel with insulating materials.

7. Before application of coating, dry all surfaces and clean free of oil, dirt, loose particles and all other foreign matter.

8. For cement mortar-lined and coated pipe, match coating over connection with exterior mortar.

9. Apply coating to all exposed metal on pipe and conductor at silver solder locations per manufacturer's recommendations.

10. Do not bury connections to structures or piping until Owner has inspected the connections and given permission to backfill. Connections made in violation of this provision will be rejected.

C. Installation of leads for pipeline:

1. Clear bottom of finished trench free from stones, roots or other materials that may injure insulation of conductors.

2. Install wires in conduit buried in the ground straight, without kinks, with a minimum cover of 24 inches.

3. Install underground marking tape above buried wire and conduits at a maximum depth of 18 inches below grade over the wire and conduit location.

4. Place anode wire identification tags on wires prior to placing wire in conduit and prior to backfilling.

5. Run each conductor length continuously, free of joints or splices, unless otherwise indicated.

6. Use care during installation to avoid punctures, cuts and similar damage to insulation. If any damage occurs to insulation, replace entire cable length.

7. Leave at least one foot of slack for each conductor at each test station housing. Slack shall be that amount of wire which, when the cover is removed and the wire extended, protrudes beyond the opening of the box or enclosure.

8. Wire bends shall not exceed bend radius stated in NEC or as specified by manufacturer.

9. Use copper or brass terminal rings sized for wire and stud to make all wire connections to terminal studs.

10. During installation, do not pull wire beyond its tensile strength as specified by manufacturer.

D. Installation of test stations:

1. Install test stations to the side of roads, if located in a road.

2. Install using applicable equipment specified for anodes and pipeline, and at dielectric insulation pipe flanges and valve connections as indicated.

3. Place post-mounted test stations as close to pipeline in graveled areas where possible and away from roads subject to vehicular traffic.

4. Place flush-mounted concrete box test stations as close to pipeline as practical, as approved by Owner, if subject to vehicular traffic.

5. Field verify final locations of the test stations with Owner.

6. Place wire identifiers on all wire prior to installation and backfill of test stations.

E. Installation of dielectric blankets:

1. Install dielectric blankets at the approximate locations as indicated.

2. Dielectric blanket shall be installed as close to the midpoint between the two lines as possible.

F. Installation of sleeves or wraps for electrical isolation between pipelines:

1. Prevent electrical contact of the pipeline to other buried metal structures.

2. Insert a 1/4-inch thick material to prevent contact between the structures.

3. Where pipeline is within 5 feet of a small foreign metal structure, install a sleeve or wrap to prevent contact between structures.

G. Joint bonds:

1. Provide bonds on:

a. All buried iron-based metallic pipe to and across all mechanical joints.

b. Any joint not welded or threaded.

c. Elsewhere to provide electrical continuity in exposed areas during construction.

2. Install to allow for at least two-inch movement in the pipe joint.

3. Attach cable/rod by soldering.

4. Provide at least two bonds.

## 3.02 TESTING

A. After entire cathodic protection system is installed, Contractor shall conduct tests to demonstrate that installation is in proper working order and in accordance with the Contract Documents. All testing shall be observed and signed off by the Engineer.

B. Contractor shall bear costs of retesting occasioned by defects and failures of equipment to meet the requirements of the Contract Documents.

C. Prior to backfilling, test silver solder connections for:

1. Adherence to pipe.

2. Electrical continuity between pipe and leads.

D. Use a 22-ounce hammer for testing adherence by striking a blow to the weld.

E. Avoid hitting leads and damaging pipe.

F. Measure and record anode current for pipeline:

1. Measure current output of anodes at each anode test station across the permanent shunts.

2. Record current and submit for review and acceptance by Owner.

G. After installation, and prior to backfilling:

1. Circulate current through pipe and valve connections.

2. Compare measured resistance to the theoretical resistance of pipe and bond cables.

3. Resistance measured shall not exceed 150 percent of the theoretical resistance.

H. Upon completion of backfilling operations, test all joint bonds for effectiveness.

I. Place insulating joints on pipelines immediately inside structures.

J. Conduct testing with insulation checker:

1. Manufacturers for insulation checker:

a. Gas Electronic, Model #601

b. Tinker & Rasor RF-IT

c. Or Approved Equal

2. Test parameters:

a. Insulating flanges must not be less than 100 percent insulation.

3. Upon completion of backfilling operations, re-test insulating flange kits for effectiveness.

4. Conduct testing by measuring half-cell potentials at either side of the flange kit, or other means, as necessary to confirm that the flange kit was not damaged by backfilling.

5. For any non-functioning insulating flange or insulating coupling, correct non-functioning part.

K. Conduct structure-to-soil potential tests on anodes prior to their connection to the pipeline to ensure that the proper anode material is provided.

1. Anode-open circuit potential shall be more negative than –1600 millivolts (mV) with respect to the anode.

L. Prior to and after leak test, test dielectric insulation fittings per NACE Standard RP0286 to ensure their proper installation. Backfilling is allowed after leak test.

M. Conduct a post-installation survey consisting of the following tests as a minimum:

1. Pipe-to-soil potentials at test stations.

2. Anode current outputs at test stations.

## 3.03 SYSTEM CHECKOUT

A. Upon completion of installation, provide testing of the complete systems.

1. The system must comply with NACE RP0169

B. In presence of Owner, conduct measurement of:

1. Potentials of metallic piping and fittings prior to and after connection of anodes

2. Current readings

C. Correct any non-functioning insulating flange and insulating coupling deficiencies and rectifier deficiencies.

D. A factory-authorized Technical Representative shall approve the final installation and start-up of the cathodic protection installation.

E. Retest prior to Final Acceptance.

**END OF SECTION**

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**TECHNICAL SPECIFICATION**
**DIVISION 13: SPECIAL CONSTRUCTION**
**13300: INSTRUMENTATION AND CONTROL GENERAL**

## PART 1 – GENERAL

### 1.1 WORK OF THIS SECTION INCLUDES:

A. The WORK of this Section includes the general specification and requirements for the instrumentation and control WORK under this and other applicable Specifications. The WORK also includes providing instrumentation and all related wiring as shown in the Contract Documents.

B. The CONTRACTOR shall provide (furnish and install), test, and place into service the operating process instrumentation, control systems, and all appurtenant work, all in accordance with the requirements of the Contract Documents. The Contractor shall procure equipment and obtain the services of a qualified Control System Supplier.

C. Systems specified as a part of Division 13 shall be furnished, manufactured, wired and tested as a complete system by a qualified Control System Supplier (CSS). The CSS shall provide all equipment, materials, instrumentation and assemblies complete. The CSS shall provide, but not necessarily be limited to, installation coordination, factory testing, configuration testing, system commissioning and final acceptance.

D. The CSS shall provide the pump electrical and control systems including the Service Entrance, pump drives, instrumentation, and Control System complete as assembled and tested system at the CSS facility.

E. The CSS shall be responsible for the detailed design, procurement, installation coordination, testing, commissioning, training, and documentation of electrical, instrumentation and control systems provided under this Contract.

F. The CSS shall be responsible for interfacing with existing American Water's Supervisory Control and Data Acquisition (SCADA) communications systems and components. The CSS shall provide all hardware, test software, installation, factory testing, commissioning and training for new system. The CSS shall coordinate all field and point testing with the local Programmable Logic Controller (PLC) programming and SCADA configuration applications to verify all I/O.

G. The CSS shall provide all PLC and Operator Interface Panel (OIP) configuration programming, operation screens, historical data logging, and coordinate the SCADA system programming as indicated in Section 13370.

H. The Contractor shall note that the equipment loop, logic, system, PLC and elementary diagrams are not manufacturer model or part number specific and are based on system supplier and vendor information to indicate a general scope of supply from the Equipment Manufacturers. The specifications address functional requirements, features and operation that may require additional options or components from the Contractor to provide for a complete and functional system.

I. The CSS shall coordinate all requirements with the equipment manufacturers suppliers at bid time to provide for a complete and operable system and shall include all costs in its bid to add additional instruments, wiring, computer inputs/outputs, controls, conduit, interlocks, electrical hardware, drawing revisions, etc., into the design based on Equipment Manufacturer's requirements and final certified prints to meet the specifications. Such changes to instrumentation and electrical work to meet the specification requirements shall be incorporated into the scope of work at no additional cost to the Owner.

J. Per specified submittal requirements the CSS shall be responsible for the generation of panel wiring diagrams equipment interconnection diagrams, network diagrams and loop drawings which depict the interconnection between instruments, control panels, field panels, electrical equipment, control equipment, motorized equipment, and packaged systems.

K. The CSS shall generate a complete analog and digital loop drawing for each measuring and/or control loop. The loop drawing shall include information as specified in the submittal requirements for loop drawing preparation.

L. All control system field tests including factory tests, loop tests, site commissioning, operational readiness testing, plant startup, and final acceptance shall be the responsibility of the Contractor. The Contractor shall be responsible for providing field and facility personnel to perform factory and field testing of all systems associated with the SCADA. The Contractor shall be responsible for providing all personnel and equipment (current drivers, jumpers, read out devices, oscilloscopes, voltage-resistance meters, etc.) required to perform the loop test simulations. All devices used shall be traceable to the National Institute of Standards and Technology (NIST).

M. The Contractor shall perform field engineering as required for mounting and supporting all field mounted components. The Contractor shall develop any additional schematic and interconnection diagrams required to interface with existing systems, PLC and instrumentation equipment, which may be required for a complete and operable instrumentation and control system.

N. The CSS shall procure, fabricate, assemble, program and configure the instrumentation and control system based on the requirements of Divisions 13, 16, and related Mechanical and Civil Divisions.

O. Instrumentation materials, process wetted parts and installations shall be designed to be compatible with the process media, area environment and classification in which it shall operate.

P. Instrument installation shall provide for unobstructed access to the instruments for calibration, diagnostics and process display. Instrumentation displays shall be protected

from direct sunlight exposure and shall be provided with sunshields as required to provide legible display viewing during daylight hours at a 24" viewing distance.

Q. The CSS shall design, procure, program, factory test, install, commission and support a PLC system that shall integrate all process controls required to provide a complete and operational system. The PLC system shall be designed in accordance with Owner standards for SCADA and PLC systems. The CSS shall coordinate the I/O grouping and arrangement with the Cal Am during the submittal process.

R. The CSS shall field verify the operation of switches and interlocking logic to operate in either the Normally Open or Normally Closed states. The Contractor shall provide interposing relays and wiring necessary to meet the operational requirements specified.

S. The CSS shall be a U.L. 508 panel shop and shall label all assemblies produced with their U.L. listing or registration number.

## 1.2 RELATED SECTIONS

A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK with respect to interfacing electrical, instrumentation and control systems packaged under the mechanical and civil specification sections.

B. Division 16 - Electrical

C. Division 13 - Special Construction

D. Division 1 – General Requirements

## 1.3 CODES

WORK of this Section shall comply with the current editions of the following codes:

A. Uniform Fire Code

B. National Electrical Code

C. California Electrical Code

D. City and County Service and Electrical Requirements

## 1.4 SPECIFICATIONS AND STANDARDS

Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

A. ISA-RP60.6: Nameplates, Labels, and Tags for Control Centers

B. ISA-RP12.6: Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations

C. ISA-S5.1: Instrument Symbols and Identification

D. ISA-S5.4: Instrument Loop Diagrams

E. ISA-S20: Specification Forms for Process Measurement and Control Instrumentation; Primary Elements and Control Valves.

## 1.5 SUBMITTALS

A. Submittals shall be supplied in accordance with section 01300, 16010 and as supplemented or modified by this specification section.

B. Control panel submittals

1. Control panel submittals shall be grouped by location, area and process. Bill of Materials and fabrication drawings shall be individually grouped by facility, area and control panel.

2. A separate technical brochure or bulletin shall be included for each instrument, and equipment item, system, and other element. The brochures shall be indexed by systems or loops. If, within a single system or loop, a single item is employed more than once, one brochure may cover all identical uses of that item in the system. Each brochure shall include a list of tag numbers to which it applies. System groups shall be separated by labeled tags.

3. Schematic and wiring diagrams for control circuits shall be submitted in two stages. Initially, schematic control diagrams shall show complete details on the circuit interrelationships of all devices within and outside each Control Panel. Subsequent to acceptance of all schematic control diagrams, by the Engineer, piping and wiring diagrams shall be submitted. The diagrams shall consist of component layout drawings to scale, showing numbered terminals on components together with the unique number of the wire to be connected to each terminal. Piping and wiring diagrams shall show terminal assignments from all primary measurement devices, such as flow meters, and to all final control devices, such as pumps, valves, chemical feeders and local control panels. Wiring diagrams shall include VFD panels, SCADA Panel, circuit and breaker number for each power feed

4. Assembly and construction drawings for each alarm annunciator, local indicating panel, process control panel and for other special enclosed assemblies for field installation. These drawings shall include dimensions, identification of all components, surface preparation and finish data, and nameplates. These drawings

also shall include enough other details, including photographs, to define exactly the style and overall appearance of the assembly.

5. Installation, mounting, and anchoring details for all components and assemblies to be field-mounted, including conduit connection or entry details.

6. Complete control panel layouts, all drawn to a 1-1/2 inch=1 foot scale showing:

   a. Physical arrangements which define and quantify the physical groupings of PLC components, handstations, recorders, indicators, pilot lights and all other instrumentation devices associated with control panel sections, auxiliary panels, subpanels and racks.

   b. All cutout locations fully dimensioned.

   c. All outside panel dimensions shall be shown.

   d. Locations of back-of-panel stiffeners.

   e. Backpanel equipment layout and terminal point locations for all panel and back-of-panel piping and wiring connections. Terminations shall be coded with identifiers for wiring and piping connections for all electric, hydraulic and pneumatic terminations.

7. Bill of Material: A complete and detailed bill of material list shall be submitted for each field mounted device or assembly as well as cabinet assemblies and subassemblies. Bills of material shall include all items within an enclosure. An incomplete submittal shall be rejected and no further evaluation performed until a complete and detailed bill of material is submitted.

8. Panel Power Calculations: Provide local calculations and back-up power capacity for all DC power supplies and Uninterruptible Power Systems (UPS). Power requirements shall state required voltages, currents, and phases.

9. Cooling and Heating: Provide heating and cooling calculations. Calculations shall include heat dissipation, and operating temperature. Heat dissipation shall be at maximum and shall be stated in BTU per hour or watts. Operating temperature shall be calculated at specified ambient temperatures or at 40 degrees C, if no other ambient temperature is specified. If ventilation fans are used, provide audible sound level for the fans.

## 1.6 FIELD INSTRUMENTATION

A. Instrumentation Summary/Schedule and Bill of Material

B. Technical brochures, bulletins and data sheets containing:

1. Fully completed ISA S20 data sheets
2. Technical Specification Data Sheets
3. Component functional descriptions
4. Locations or assembly at which component is to be installed
5. Materials of a component's parts which will be in contact with process fluids or gases

C. Instrumentation Loop Diagrams per ISA S-5.4

## 1.7 PLC CONFIGURATION

A. The CSS shall provide a SCADA I/O database referencing all PLC I/O points, internal registers accessed by the SCADA and associated PLC setpoints. The Database shall utilize the same format and structure utilized by Cal Am in an Excel Spreadsheet.

B. The CSS shall provide a PLC and OIP applications programming submittal fully documented and annotated as specified in section 13350. Submittal shall be provided in a three ring binder and electronically as a Modicon Proworx program file, or as directed by Cal Am.

C. Programming of the PLC shall utilize the same methods, procedures and format as that of existing PLC programs to maintain program uniformity.

## 1.8 SCADA CONFIGURATION

The CSS shall coordinate the SCADA programming and configuration requirements with Cal Am to insure that the system I/O, Internal Registers and communications protocols are consistent with the requirements for SCADA monitoring and control.

## 1.9 SYSTEM START-UP AND COMMISSIONING

The CSS shall provide comprehensive-testing procedures, forms and reports complete. Testing submittals shall address the testing and commissioning requirements of Divisions 13, and 16.

## 1.10 PROJECT MEETINGS

Attend meetings as specified.

## 1.11 OWNER'S MANUAL

Information included in the OWNER'S MANUAL shall comply with the requirements of specifications with the following exceptions:

A. Two copies of the OWNER'S MANUAL shall be submitted after acceptance of all submittals under Paragraph 1.5. One set will be returned to the CONTRACTOR with comments.

B. Final copies (6) of the OWNER'S MANUAL, after revision, shall be submitted to the ENGINEER 15 days prior to startup.

C. The following shall be included in the OWNER'S MANUAL:

1. Installation, connection, operating, troubleshooting, maintenance, and overhaul instructions from the manufacturer.

2. Exploded or details views of all instruments, assemblies, and accessory components.

3. Parts lists and ordering instructions.

4. Wiring diagrams.

5. A list of spare parts for 1 year operation recommended by the manufacturers of all analog equipment.

## 1.12 AS-BUILT DRAWINGS

A. As-built drawings shall be prepared in accordance with Section 01720 with the following exceptions and changes:

B. The Contractor shall keep current an approved set of complete analog and digital loop diagrams and schematic diagrams which shall include all field and panel wiring, all piping and tubing runs, all routing, all mounting details, all point-to-point diagrams with cable, wire, tube and termination numbers. These drawings shall include all instruments and all instrument elements for the complete instrument loop as provided under Divisions 13 and 16 of this Contract.

C. One set of original drawings and two copies of each as-built drawing under this Section shall be submitted to the ENGINEER after completion of field checkout but before placing the systems in service for the OWNER'S use.

D. Drawings shall also be submitted in electronic format as AutoCAD files. PDF format is not acceptable for project specific drawings unless agreed in advance by the Owner. PDF may only be used for mass produced equipment. PDF files submitted shall be from original programs files, not optically scanned paper. PDF files from optical scans shall not be accepted.

## 1.13 COORDINATION

The Contractor shall coordinate protective circuit requirements with the equipment suppliers. The CSS shall obtain from the actuator supplier the protective devices required by the manufacturer to maintain the warranty of the valve and actuator. The CSS shall install and wire, actuator- supplier furnished protective circuitry in accordance with the manufacturers requirements.

## 1.14 SERVICES OF MANUFACTURER

A. Calibration, Testing and Startup: The contractor shall provide the services of technical service representative of the manufacturer who shall visit the site and perform the following on all flow meters and chemical system analyzers.

1. Inspection, checking and calibrating the equipment.

2. Startup and field testing for proper operation.

3. Performing field adjustments to ensure that installation and operation comply with the Specifications.

B. Instruction of OWNER'S Personnel: The manufacturer's technical service representative shall instruct the OWNER'S personnel.

## 1.15 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials: Products delivered to the site for incorporation into the WORK of this Section shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.

B. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

C. Installed Equipment: Equipment installed in place for periods exceeding 24 hours prior to the field wiring and commissioning of electrical and electronic equipment shall be protected from dust and exposure to the elements.

D. Shipment: Panels shall be crated for shipment using a heavy framework and skids. Panel sections shall be cushioned to protect the finish of the instruments and panel during shipment. Instruments, which are shipped with the panel, shall have suitable shipping stops and cushioning material installed to protect instrument parts from mechanical shock damage during shipment. Each panel crate shall be provided with removable lifting lugs to facilitate handling.

## 1.16 ENVIRONMENTAL CONDITIONS

A. General: All instrumentation and control system components and associated wiring shall be suitable for use in an environment where there may be high energy AC fields, DC

control pulses, and varying ground potentials between transducers and system components. The system design shall be adequate to provide proper protection against interferences from all such possible situations.

B. Field Located Equipment: The system design shall be adequate to provide proper protection in the environment typically associated with these facilities. As a minimum, the instrumentation and control systems shall be designed and constructed for satisfactory operation and low maintenance requirements under the following environmental conditions:

1. Temperature Range: 0 through 60 degrees C (32 - 144 degrees F)

2. Thermal Shock: 0.55 degrees C per minute (1.0 degrees F per minute)

3. Relative Humidity: 20 - 95 percent (non-condensing)

C. Noise Tolerance: The instrumentation and control system components shall not exceed a noise level of 55dB(A) when monitored 3-feet away from the devices. If upon testing it is found that this limit is exceeded at the option of the ENGINEER and at no additional cost to the OWNER, devices shall be replaced in order to achieve a maximum level of 55 dB(A) or sound absorption materials shall be added in a manner acceptable to the Owner.

## 1.17 CABLE NUMBERING

A. All cables and conductors shall be permanently marked with a unique cable identifier.

B. The first characters shall denote the facility or area number.

C. The second group of characters identifies the field device being served ISA or equipment tag reference.

D. The third section is the loop or equipment number.

E. The fourth section uses one of the four suffixes in the table below. Where multiple circuits of the same type are routed to the same endpoint, the suffix will be P1, P2, as required.

F. At each device or termination point, the circuit identification number is appended with the individual wire number. For Direct Current (DC) circuits only, wire polarity is shown in parentheses as (+) or (-). Spaces are not allowed. Letters shall be in upper case.

| SUFFIX | CIRCUIT TYPE | EXAMPLE |
|---|---|---|
| (S) - Signal | 24 vdc analog (4-20 mA) | FIT2101S1+ |
| (C) – AC Control | 120 volt AC control | YIA2101C2 |

| | | |
|---|---|---|
| (D) – DC Control | 24vdc digital status or control | LSH2101D1+ |
| (P) – Power | Power (480V, 5 kV, 15 kV, etc.) | RWP2101P2 |
| (L) – Power | Power (120/240 volt) | RWP2101P2 |
| (T) - Communications | Communications | FON2101T2 |

## 1.18 GENERAL

A. All meters, all instruments, and all other components shall be of the most recent field-proven models marketed by their manufacturers at the time of submittal of the shop drawings unless otherwise indicated.

B. Outdoor instrumentation shall be suitable for operation in the ambient conditions at the equipment installation locations. Heating, cooling, and dehumidifying devices shall be incorporated with the outdoor instrumentation in order to maintain it within its rated environmental operating ranges.

C. The Contractor shall provide all power wiring for these devices.

D. Outdoor enclosures suitable for the environment shall be provided at the specified locations.

E. All instrumentation in hazardous areas shall be intrinsically safe or be approved for use in the particular hazardous classification in which it is to be installed.

F. Mercury switches and components containing liquid mercury shall not be used.

G. Analog measurements and control signals shall be electrical and shall vary in direct linear proportion to the measured variable, except as indicated. Electrical signals outside control board(s) shall be 4-20 mA DC except as noted. Signals within enclosures shall be 1-5 volts DC unless otherwise specified. Dropping resistors shall be installed at all panel side terminations in the control panels to ensure loop integrity.

H. The accuracy of each instrumentation system or loop shall be expressed as a probable maximum error; this shall be the square-root of the sum of the squares of certified "accuracies" of the designated components in each system, expressed as a percentage of the actual span or value of the measured variable. Each individual instrument shall have a minimum accuracy of ± 0.5 percent of full scale and a minimum repeatability of ± 0.25 percent of full scale unless otherwise indicated. Instruments that do not conform to or improve upon these criteria are not acceptable.

I. Each control loop shall be individually fused.

## 1.19 INSTRUMENTATION AND CONTROL PANELS

A. General:

1. Control panels shall be provided as specified in Section 13340.

2. Equipment Framework and Supports:

   a. The rear of each control panel section or Instrument wall panel shall have a steel framework for supporting conduit, tubing, wireways, switches, air piping and all instrument accessory items such as relay or terminal enclosures, transducers, pressure switches, valves and air relays. The main frame work shall be constructed of standard structural shapes. Special shapes such as "Unistrut" may be used for secondary supports. Framework must not interfere with instrument connections or access needed for maintenance or adjustments.

   b. Preparation: The front and rear face of the panel, both sides and the edges of all flanges, and the periphery of all openings shall be prepared as follows:

      1) All high spots, burrs, and rough spots shall be ground smooth.

      2) The surfaces shall be sanded or sandblasted to a smooth, clean bright finish.

      3) All traces of oil shall be removed with a solvent.

   c. Finishing:

      1) A 3-mils dry coat of Amercoat 185 or equal primer shall be applied over the entire panel surface immediately after solvent cleaning.

      2) Wet sand, dry, and then quick glaze spot putty on the front of the panel only. Dry, then wet sand again and dry.

      3) Apply a second 3-mils dry coat of alkyd enamel primer to the front of the panel.

      4) Wet sand to smooth clear finish, and then dry.

      5) At least two 3-mil dry coats of air-dry, satin finish, alkyd enamel shall be applied over the entire surface. Color to be as selected by Owner.

      6) The CONTRACTOR shall furnish two 1-pint containers of the enamel to the Owner.

## 1.20 INSTRUMENT MOUNTING

A. The Contractor shall provide field cut-outs, installation mounting racks, mounting brackets, bracing, shelving and stanchions, and shall mount all instrument and control items indicated, including any instruments indicated to be furnished by the Owner or other manufacturers.

B. The Contractor shall also mount, behind existing panels, other instrument accessory items as indicated or necessary for interfacing with existing equipment.

C. Control Panel Requirements:

1. Controls panels shall be wired and fabricated in accordance with section 13340.

2. Field modifications of existing panels shall adhere to the requirements of section 13340.

3. The Contractor shall provide all wiring, conduit, wireways, and switches required to make instruments and other panel electrical devices operational.

4. Conduit, wireways, junction boxes and fittings shall be installed for all signal and control wire. Provide in accordance with Division 16.

5. Each terminal connection shall have a plastic plate with a terminal and instrument tag number. All wiring shall be identified with stamped tubular heat shrink wire markers.

6. Unless otherwise specified, wiring methods and materials for all panels shall be in accordance with the NEC requirements.

7. Wire for 115-volt control circuits shall be No. 14 AWG stranded with Type THWN-2/THHN-2 insulation. All terminals for external wiring connections shall be suitable for No. 10 AWG wire.

8. Flexible conduit shall be utilized only for short transitions (36”) from instrument or equipment.

9. Conduit fittings shall be cast fittings.

10. Soldered or pressure crimped wire splicing in conduits is an NEC violation and shall not be acceptable.

11. For case grounding, panels shall be provided with a 1/4-inch by 1-inch copper ground buss completed with solderless connector for one No. 4 AWG bare stranded copper cable. The Contractor shall connect the copper cable to a system ground loop.

D. Instrumentation Requirements:

1. Instruments located on a single panel section that serve one process unit may be connected to a common branch power circuit. The number of branch circuits shall be such that no circuit load exceeds 10 amps. Different panel sections and instruments serving different process units shall not use common branch circuits. A 15-amp, two-pole circuit breaker shall be provided in each branch circuit.

2. When instruments not equipped with integral fuses, the contractor shall furnish and install fuses as required for the protection of individual instruments and equipment against fault currents. Fuses shall be mounted on the back of the panel, in a fuseholder, with each fuse identified by a service name tag.

3. Each potentiometer type instrument, electronic transducer, controller or analyzer shall have an individual disconnect switch. Disconnect switches shall have metal or plastic tags listing the associated instrument tag numbers. Individual plug and cord set power supply connections may be used without switches when indicated.

E. Field Signal Wiring:

1. Signal cable shall be constructed of No. 16 AWG copper signal wires with THWN insulation.

2. Control conductors shall be 14 AWG minimum routed in conduit or troughs. Control conductors shall be THWN insulation.

3. Wire color code for instrument signal wiring shall be:

   a. Positive - White (+)

   b. Signal Ground Negative - Black (-)

   c. Equipment Ground – Green

   d. Ungrounded – Red

   e. Energized by voltage found external to panel – Yellow

   f. DC circuit - Blue

   g. Control – Violet

4. Multi-conductor signal cables where indicated shall consist of No. 16 AWG copper signal wires twisted in pairs, with 300 volt insulation. A copper drain wire shall be provided for the bundle with a wrap of aluminum polyester shield. The overall bundle jacket shall be PVC. Multi-conductor cables, wireways and

conduit shall provide for 20 percent allocation of spare, unused signal wires in addition to the indicated requirements.

5. Remote I/O (RIO), Modbus Plus (MB+), and Ethernet cabling shall be provided, installed and terminated in accordance with the manufacturers cabling and termination procedures. Wiring for other systems shall follow manufacturer's requirements.

F. Color Conventions: Lens covers/LED's for indicating lights on all panels will be colored as follows:

1. Red-ON when;
    a. Motor not running (STOPPED)
    b. Valve CLOSED (not fully opened)
    c. Device not energized.
    d. Circuit breaker OPENED
2. Green-ON when;
    a. Motor running in forward direction (fast speed for multi-speed motors).
    b. Valve OPEN (not fully closed)
    c. Device energized.
    d. Circuit breaker CLOSED
3. White-ON when;
    a. Power available
    b. System in AUTOMATIC mode.
    c. Monitoring taking place.
4. Amber-ON when;
    a. Malfunction trip.
    b. Equipment locked out.
    c. Alarm condition

## 1.21 NAMEPLATES

A. Nameplates shall be provided for instruments, function titles for each group of instruments, and other components mounted on the front panel(s) as indicated. A nameplate shall be provided for each signal transducer, signal converter, signal isolator, and electronic trip mounted inside the panel(s). Nameplates shall be descriptive to define the function and system of such element. These nameplates shall be of the same material as those on the front of the panel(s). Nameplates shall be attached with two stainless steel screws per 16010-2.2-A. Nameplates shall be fabricated from black face white-center laminated engraving plastic. Where adhesive attachment is specifically allowed by the Owner, painted surfaces shall be prepared to allow permanent bonding of adhesives. Colors, lettering, styles, abbreviations and sizes shall be in conformance with ISA_RP60.6 with an intended viewing distance of 3 feet to 6 feet.

B. Equipment Interior Nameplates - Nameplate material shall be clear plastic with black machine printed lettering as produced by a KROY or similar machine; except caution, warning, and danger nameplates shall have red lettering. The size of the nameplate tape shall be no smaller than 1/2” in height with 3/8" lettering unless otherwise approved by the Engineer. Securely fasten nameplates in place on a clean surface using the adhesion of the tape. Add additional clear glue to hold the nameplate securely in place when necessary. For each device with a specific identity (relay, module, power supply, fuse, terminal block, etc.) mounted in the interior of a piece of equipment provide a nameplate with the inscription as shown in the Contract documents. Where no inscription is indicated in the Contract documents, furnish nameplates with an appropriate inscription providing the name and number of device used on the submittal drawings. Stamp the nameplates with the inscriptions as approved by the Engineer in the submittal.

## PART 2 – PRODUCTS

### 2.1 GENERAL

A. Equipment and materials shall be products of reputable, experienced manufacturers. Similar items in the project shall be the products of the same manufacturer. All equipment shall be of industrial grade, a standard of construction, shall be of sturdy design and manufacture, and shall be capable of long, reliable, trouble-free service.

B. The field equipment panels shall be fabricated to house, controllers, instrumentation and communications equipment specified elsewhere and as indicated on the contract drawings. Control panels shall be fabricated and wired in accordance with Section 13340 and applicable specification sections.

C. Instrumentation control equipment shall be UL listed.

### 2.2 FIELD INSTRUMENTATION

Provide Field Instrumentation in accordance with Section 13330, Instrumentation.

## 2.3 COMPONENTS GENERAL

A. Field Terminal Blocks: Terminal blocks shall be molded plastic with barriers and box lug terminals, and shall be rated 25 amperes at 600 volts. White marking strips, fastened securely to the molded sections shall be provided and wire numbers or circuit identifications shall be marked thereon with permanent marking fluid.

B. Indicators: Indicators shall be provided at the locations specified and shall be rated for the voltage required. Indicators shall be full-voltage Push-To-Test high brightness LED.

## 2.4 GENERAL INSTRUMENTATION AND CONTROL COMPONENTS

A. General instrumentation components shall be provided as specified in Section 13330 Instrumentation and 13340 Control Panel.

B. Signal Isolators, Converters, and Power Supplies: Signal isolators shall be provided in each measurement and control loop, wherever required, to match adjacent component impedances, provide signal amplification or splitting, or where feedback paths may be generated or to maintain loop integrity when the removal of a component of a loop is required. Signal converters shall be provided where required to resolve any signal incompatibilities. Signal power supplies shall be provided to supply sufficient power to each loop component.

C. Power supply and conversion modules shall be supplied as required to provide the required equipment operational voltage and current. Power supplies shall be sized to provide 125 percent of the maximum current requirements.

D. General Purpose Relays: General purpose relays in the Control Panels shall be plug-in type with contacts rated 10 amperes at 120 volts ac; quantity and type of contacts shall be as indicated. Each relay shall be enclosed in a clear plastic heat and shock resistant dust cover with LED status indicator. Sockets for relays shall have touch-safe screw type terminals.

E. Industrial Control Relays: Industrial control relays shall be 20 Amp rated with four-pole convertible contacts. The coil voltage shall be as required to interface with the required control logic. The ICR shall be capable of providing eight contacts with the addition of a four-pole module mounted to the deck assembly.

F. Time Delay Relays: Time delay relays shall be electronic on-delay or off-delay type with contacts rated 10 amperes at 120 volts AC. Units shall include adjustable dials with graduated scales covering the indicated time range. Timers shall be provided with status and timing LED indication.

G. Slave Relays: Slave relays shall be provided when the number or type of contacts indicated exceeds the contact capacity of the indicated relays and timers.

H. Circuit Breakers: Circuit breakers shall be single pole, 120 volt, 15 ampere (minimum) rating or as required to protect wiring and equipment. Circuit breakers shall be mounted inside the panels as shown. Trip curves and trip points shall be selected to provide a coordinated system localizing trips to the breaker closest to the fault.

## PART 3 - EXECUTION

### 3.1 GENERAL

A. The CONTRACTOR shall employ qualified installers who are skilled and experienced in the installation and connection of all elements, all instruments, all accessories, and all assemblies provided under this Contract.

B. The CONTRACTOR shall install all instruments according to the manufacturer's installation instructions and provide the following:

1. Perform field engineering as required for mounting and supporting all field mounted components.

2. Prepare any additional schematic and interconnection diagrams required for installation.

3. Assemble and interconnect instrument components disconnected for shipping purposes.

4. Remove all temporary supports, bracing, and padding inserted in instrument control panels and other equipment to prevent damage during shipping, storage, or installation

### 3.2 PROCESS TUBING AND PIPING

A. The CONTRACTOR shall provide for all chemical sample piping and chemical analysis system piping/tubing installations in accordance with Owner standards. All flow thru, tee and insertion instrumentation sensors shall be installed with hot-tap assemblies or valving systems that allow the instrument to be removed from the system without disruption of the process.

B. Adequately support and protect capillary tubing. All extra tubing shall be carefully coiled, tied, and protected at the instrument location.

C. Instrument tubing and conduit shall be installed level and parallel with, or at right angles to, the structural members of buildings and support systems. Vertical runs shall be straight and plumb and installed with adequate strain relief to prevent damage and separation of tubing and tubing support systems.

D. All tubing installations shall allow clear and unobstructed access to equipment, doorways, controls, control panels, and field devices. Tubing and conduit installations

shall allow easy removal of components or equipment. Components in tubing, but shall be separately supported by a specified wall or stanchion equipment mounting system.

E. All installations of piping, tubing, mounting hardware and equipment enclosures shall be field measured prior to fabrication and erection. Any significant discrepancies between drawings and field conditions shall be reported to the Engineer. The Owner will not be responsible for any costs to the Contractor for rework because of Contractor failure to take measurements prior to fabrication.

## 3.3 CONDUIT AND WIRE

A. It is the intent of the Contract Documents that all installation of conduit and wiring external to Control Panels is provided under the requirements of Division 16. Further, it is the general intent that all 4-20 mA signal circuits, process equipment control wiring, signal wiring to field instruments, and Control Panel input and output wiring, be provided under Division 16.

B. Wire terminations and installation integrity shall be verified and tested under Division 13.

C. The CONTRACTOR's attention is directed to the electrical and mechanical schematics and details of this project. Referral to these portions of the Contract Documents shall be required in order to understand the full intent and scope of work required.

D. Monitoring and control system configurations are diagrammatic only. Locations of equipment are approximate unless dimensioned on the drawings. The contractor shall determine exact locations and routing of wiring and cables, which shall be governed by structural conditions, physical interferences, area classifications and locations of electrical terminations on equipment.

E. All instruments shall be located and installed for ready access by the OWNER'S operation and maintenance staff. Instruments shall be installed with due regard for servicing and maintainability. The OWNER reserves the right to require minor changes in location of equipment prior to roughing without any additional cost to the OWNER.

## 3.4 FIELD SIGNAL AND CONTROL CIRCUIT WIRING

A. Wiring Installation: All wires shall be in plastic wireways except (1) field wiring, (2) wiring between mating blocks in adjacent sections, (3) wiring from components on a swing-out panel to components on the fixed structure, and (4) wiring to panel-mounted components. Wiring from components on a swing-out panel to other components on fixed panels shall be tied into bundles with nylon wire ties, and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at the terminals.

B. Wiring to control devices on the front panels shall be tied together at short intervals with nylon wire ties and secured to the inside face of the panel using adhesive mounts.

C. Wiring to rear terminals on panel-mount instruments shall be in plastic wireways secured to horizontal brackets above or below the instruments in about the same plane as the rear of the instruments.

D. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all shop drawings. These numbers shall be marked on all conductors at every terminal using white numbered wire markers which shall be permanently marked heat-shrink plastic.

## 3.5 INSTRUMENT CABLE TESTS

A. General: The following tests shall be performed on each instrumentation and control system cable. All tests shall be end-to-end tests of installed cables with the ends supported in free air, not adjacent to any grounded object. All test data shall be recorded on forms, which are available from the Engineer. Complete records of all tests shall be made and delivered to the Engineer. The Owners Representative who witnessed the testing shall sign each form.

B. Continuity tests shall be performed by measuring wire/shield loop resistance of each signal cable as the wires, taken one at a time, are shorted to the channel shield. No loop resistance measurement shall vary by more than plus or minus 2 ohms from the calculated average loop resistance value.

C. Insulation resistance tests shall be performed by using a 500 volt megometer to measure the insulation resistance between each channel wire, between each channel wire and the channel shield, between individual channel shields in a multi-channel cable, between each individual channel shield and the overall cable shield in a multi-channel cable, between each wire and ground, and between each shield and ground. Values of resistance less than 10 megohms shall be unacceptable.

## 3.6 FACTORY OPERATIONAL READINESS TEST

A. Factory Inspection:

1. Instrumentation and control panels shall be inspected for compliance with requirements at the factory prior comprehensive system factory testing and before shipment to the site. The Contractor shall notify the Owner two weeks in advance of the testing date. The Owner or a representative of the Owner will visit the factory to make the inspection.

B. The Contractor shall perform the following tests prior to arrival of the Engineer:

1. All control wiring and interlock circuits rung out to determine their operability.

2. Electrical circuits checked for continuity and where applicable, operability.

3. Nameplates checked for correct spelling and correct size of letters.

4. Other tests required to place the panel in an operating condition.

C. It shall be the responsibility of the Contractor to furnish all necessary testing devices and sufficient manpower to perform the tests required by the Engineer to determine conformance to the requirement of the Contract documents.

D. If the above tests have not been performed prior to the arrival of the Engineer, the Contractor shall reimburse the OWNER for the cost of the extra time required for the inspector's services and travel expenses

E. General: The complete control system shall be tested at the factory prior to installation of the PLC, communications and SCADA system. The Factory Operational Readiness Tests (FORT) for the entire system shall be conducted at the manufacturer's facilities as a complete and operable system including the OIP and PLC's.

F. The CSS shall provide the service of a qualified PLC technician to setup, configure and test each system to verify equipment operation prior to the FORT. The technician shall be experienced in the programming, configuration and testing of PLC systems employing the communications protocols utilized. The CONTRACTOR shall coordinate all shipping, set-up, configuration and testing tasks related to the FORT. The OWNER and Engineer shall witness the FORT.

G. Tests shall be conducted to exercise all process variables and confirm setpoint trip points, process permissives, process interlocks, alarming and control functions. The CONTRACTOR shall provide the necessary personnel to operate, test and confirm all SCADA and PLC associated functions pertaining to graphical displays, setpoint interaction, PLC control strategies, alarm monitoring and manual control of the equipment.

H. The CSS shall prepare a FORT test procedure in the form of I/O checklists, calibration sheets for analog I/O and step by step process control strategy tests that exercise all normal, emergency and alternative control modes. I/O checklist shall reference each I/O by type, tag and description with a checkbox to verify PLC operation, Communication, DCS Display, Alarm Function and Command function with a comment field for testing notes.

I. Process control test forms shall be provided for each control strategy and subdivided into individual process loops and modes of operation contained within the process control strategy. The test procedure shall be provided on a step-by-step basis addressing each process on a loop-by-loop and function-by-function basis. A signature and comments box shall be provided for each procedure.

## 3.7 INSTALLATION

A. Installation and Connection:

1. The CONTRACTOR shall install and connect all field-mounted components, equipment enclosures and assemblies under the following criteria:

   a. Process sensing lines and air signal tubing shall be installed to the installation of conduit indicated under Section 16010. Individual tubes shall be run parallel and near the surfaces from which they are supported. Supports shall be used at intervals not longer than 3 feet of tubing.

   b. Bends shall be formed with the proper tool and to uniform radii and shall be made without deforming or thinning the walls of the tubing. Plastic clips shall be used to hold individual plastic tubes parallel. Ends of tubing shall be square-cut and cleaned before insertion into fittings. Bulkhead fittings shall be provided at all panels requiring pipe or tubing entries.

   c. All flexible cables and all capillary tubing shall be provided in flexible conduits. Lengths shall be sufficient to withdraw the cables and tubing for periodic maintenance.

   d. RTD/Thermocouple lead wire shall be provided in dedicated conduit or wireway from the thermocouple to the control panel. Conduit or wireway shall be sized in accordance with the capacity of the instrument.

   e. All power and all signal wires shall be terminated with spade type lugs.

   f. All connectors shall be, as a minimum, watertight.

   g. After all installation and connections have been completed, a technical field representative of the CONTRACTOR shall check the WORK for polarity of electric power and signal connections, leaks at all process connections, and conformance with requirements. The technical field representative shall certify in writing to the ENGINEER that each loop and system meets requirements.

   h. All wire and all cable shall be connected from terminal to terminal without splices, arranged in a neat manner and securely supported in cable groups. All wiring shall be protected from sharp edges and corners.

   i. At least [30] days before installation testing begins, the CONTRACTOR shall submit to the ENGINEER a detailed description, in duplicate, of the installation tests to be conducted to demonstrate correct installation of the instrumentation and control system and the anticipated dates the testing will occur.

## 3.8 SYSTEM COMMISSIONING

A. Instrument Calibration

1. All analog and discrete instrumentation and all control system equipment shall be field calibrated and tested after installation to verify that requirements are satisfied. The CONTRACTOR shall provide all necessary labor, tools, and equipment to calibrate and test each instrument in accordance with the manufacturer's instructions. Each instrument shall be calibrated at a minimum of three points using test equipment to simulate inputs and read outputs.

2. All test equipment and all instruments used to simulate inputs and read outputs shall be suitable for the purpose intended and shall have accuracy better than the required accuracy of the instrument being calibrated. Test equipment shall have accuracies traceable to the NIST as applicable. All analog instruments shall be calibrated and tested in place without removal.

3. Test data, applicable accuracy requirements, all instrument manufacturer published performance specifications and all permissible tolerances at each point of calibration shall be entered on test forms available from the ENGINEER. These test forms shall verify compliance with all.

4. A calibration report shall be delivered to the ENGINEER for each instrument, certifying that the instrument has been calibrated in the presence of the Owners designated representative and meets contract and system requirements.

B. Point Testing

1. Analog Loop Tests: The CONTRACTOR shall be responsible for loop checking and testing all instrumentation loops with this project. The CONTRACTOR shall coordinate all loop check functions with the SCADA system, final element, PLC logic and intermediate equipment to ensure that a single total loop check is conducted. The intent of the loop checks is to confirm and document each loop's component specification conformance up to and including all field-situated devices.

2. The CONTRACTOR shall provide all control room personnel to witness and confirm loop check results at the SCADA display level.

3. The CONTRACTOR shall provide all necessary labor, tools, and equipment to field test, inspect and adjust each instrument to its indicated performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirement, or any published manufacturer performance specification for functional and operational parameters, whether or not indicated in the Contract Documents, shall be repaired or replaced, at the discretion of the ENGINEER at no additional cost to the OWNER.

4. Programmable Controllers, Operator Interface Units, and electronic function modules, shall be tested and exercised by the CONTRACTOR to demonstrate correct operation, first individually and then collectively as functional analog networks. Each hardwired analog control network shall be tested to verify proper performance within indicated accuracy tolerances. Accuracy tolerances for each analog network are defined as the root-mean-square summation of individual component accuracy tolerances. Individual component accuracy tolerances shall be as indicated by contract requirements, or by published manufacturer accuracy specifications, whenever contract accuracy tolerances are not indicated.

5. Each analog network shall be tested by applying simulated inputs to the first element(s). Simulated sensor inputs corresponding to 10 percent, 50 percent, and 90 percent of span shall be applied, and the resulting outputs read to verify compliance to network accuracy tolerance requirements. Continuously variable analog inputs shall be applied to verify the proper operation of discrete devices. Temporary settings shall be made on controllers, alarms, etc., during analog loop tests. All analog loop test data shall be recorded on test forms, which include calculated root-mean-square summation system accuracy tolerance requirements for each output.

6. When installation and loop tests have been successfully completed for all individual instruments and all separate analog control networks, a certified copy of all test forms signed by the Owner's representative as a witness, with test data entered, shall be submitted together with a clear and unequivocal statement that all instrumentation has been successfully calibrated, fully inspected, and fully tested.

C. System Pre-commissioning:

1. The CONTRACTOR shall be responsible for demonstrating the operability of all systems provided under this specification. Pre-commissioning shall commence after acceptance of all wire, all calibrating and loop tests, and all inspections have been conducted. Pre-commissioning shall demonstrate proper operation of all systems with process equipment operating over full operating ranges under actual operating conditions.

2. The CONTRACTOR shall develop and submit to the ENGINEER for approval a Pre-Commissioning Plan which describes detailed test procedures, checklists, blank forms and data to be recorded, test equipment to be used and calculated tolerance limits.

3. System pre-commissioning activities shall include the use of water to establish service conditions that simulate, to the greatest extent possible, normal final control element operating conditions in terms of applied process loads, operating ranges and environmental conditions. Final control elements, control panels, and

ancillary equipment shall be tested under start-up and steady-state operating conditions to verify that proper and stable control is achieved using motor control center and local field mounted control circuits. All hardwired and software control circuit interlocks and alarms shall be operational.

4. The control of final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits. The stable steady-state operation of final control elements running under the control of field mounted automatic analog controllers or software based controllers shall be assured by adjusting the controllers, as required, to eliminate oscillatory final control element operation. The transient stability of final control elements operating under the control of field mounted, and software based automatic analog controllers shall be verified by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter oscillations (if any) and making necessary controller adjustments, as required, to eliminate excessive oscillatory amplitudes and decay rates.

5. All electronic control stations incorporating proportional, integral or differential control circuits shall be optimally tuned, experimentally, by applying control signal disturbances and adjusting the gain, reset or rate setting(s) as required to achieve a proper response. Measured final control element variable position/speed setpoint settings shall be compared to measured final control element position/speed values at 10 percent, 50 percent and 90 percent of span and the results checked against indicated accuracy tolerances. Accuracy tolerances are defined as the root-mean-square summation of individual component accuracy tolerances.

6. Individual component accuracy tolerances shall be as indicated in the Contract Documents or as specified by published manufacturer accuracy specifications whenever not indicated.

7. The CONTRACTOR shall submit an instrumentation and control system pre-commissioning completion report which shall state that all Contract requirements have been met and which shall include a listing of all instrumentation and all control system maintenance and repair activities conducted during the pre-commissioning testing. The ENGINEER must accept the instrumentation and control system pre-commissioning testing before the 14 day operational testing may begin. Final acceptance of the control system shall coincide with final acceptance of the WORK.

D. Operational Testing

1. 14-Day Operational Testing: The CONTRACTOR shall furnish his own personnel, electrical personnel, and any instrument manufacturer's representatives

as required during the testing period to produce and maintain a fully operational system.

## 3.9 OPERATIONS AND MAINTENANCE MANUALS:

A. The CONTRACTOR shall furnish to the OWNER 6 complete sets of operation and maintenance manuals. The manuals shall include date, information drawings, etc., for the system, subsystem, and all components, and shall include names, addresses and telephone numbers of equipment suppliers, representatives and repair facilities.

B. This shall include a complete description of the recommended operating procedures, maintenance procedures, and spare/replacement parts list for equipment items with catalog data, diagrams, and drawings or cuts describing the equipment. Each set shall include full size assembly and wiring diagrams; drawings showing "as-built" conditions shall be furnished to the OWNER.

## 3.10 TRAINING

A. Instruction: The CONTRACTOR shall train the OWNER'S maintenance personnel in the maintenance, calibration and repair of all instruments provided under this contract.

B. The training shall be scheduled a minimum of 3 weeks in advance of the first session. The training shall be performed concurrent with the pre-commissioning.

C. The training shall be performed by qualified representatives of the instrument manufacturers and shall be specific to each instrument model provided. Instructors shall have at least 2 years of training experience.

D. Each training class shall be a minimum of 4 hours in duration and shall cover Operational Theory, Maintenance, Trouble Shooting/Repair, and Calibration of the instrument.

E. Proposed training material, including resumes for the proposed instructors and a detailed outline of each lesson shall be submitted to the ENGINEER at least 30 days in advance of when the lesson is to be given. The ENGINEER shall review the submitted data for suitability and provide comments that shall be incorporated into the course.

F. Within 10 days after the completion of each lesson the CONTRACTOR shall present to the ENGINEER the following:

1. A list of all OWNER personnel that attended the lesson.

## 3.11 FINAL ACCEPTANCE TEST (FAT)

A. After start up and commissioning has been completed, the System shall undergo a 30-day Final acceptance test (FAT).

B. The FAT shall not commence until all training is complete and the operations and maintenance manuals approved as-noted

C. The System must run continuously for 30 consecutive days. During this period, all System functions shall be exercised by the Owner. Any System interruption and accompanying component, subsystem, or program failure shall be logged for cause of failure, as well as time of occurrence and duration of each failure.

D. A failure shall cause termination of the 30-day acceptance test. Continuation of the FAT shall be based on the following criteria:

1. A minor (No Equipment Shutdown) malfunction or error that is identified and corrected within 4 hours of the event. The FAT shall be stopped and restarted at the time of correction.

2. An equipment shutdown or failure that is non-essential to system operation shall stop the FAT until the cause is identified and corrected. Three shutdown events shall stop the FAT and it shall be restarted from the beginning.

3. A system shutdown event that initiates a plant, process or system shutdown. Shall terminate the FAT.

4. An operational error that requires operator action, which is not normal to the operation of the system to monitor and conduct operations, shall terminate the FAT.

E. When the cause of a failure has been corrected, a new 30-day acceptance test shall be started. Each time the CONTRACTOR'S technician is required to respond to a System malfunction, he must complete a report that shall include details concerning the nature of the complaint or malfunction and the resulting repair action required and taken.

**** END OF SECTION * ***

**TECHNICAL SPECIFICATIONS**
**DIVISION 13: SPECIAL CONSTRUCTION**
**13330: FIELD INSTRUMENTATION**

## PART 1 GENERAL

### 1.01 SCOPE OF WORK

A. Provide all devices, wiring, terminal blocks, accessories, and enclosures as specified herein and as shown on Contract Drawings for the instrumentation system and associated solar power systems (applicable at two sites). The Contract Documents are intended as an outline for the work and are descriptive of the type of hardware and software configuration to be provided. Any error or omission of detail shall not relieve the CONTRACTOR from the obligations thereunder to provide and install in correct detail any and all materials necessary for a complete operational instrumentation system, at no additional cost to the OWNER.

B. The contract documents are not intended to cover every detail of materials, software, hardware, configuration, or construction. The CONTRACTOR shall furnish all tools, temporary utilities, materials, setup, parts, labor, and other incidentals necessary to fully complete the entire work, whether or not said details are particularly shown or specified, all at no additional cost to the OWNER.

### 1.02 RELATED WORK

A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK with respect to interfacing electrical and control system packaged under the mechanical and civil specification sections.

B. Installations of primary elements which require placement into or taps off of a process flow line are included under Division 15.

### 1.03 SUBMITTALS

Provide submittals and drawings as specified in Section 13300 Instrumentation and Control and Section 16010 Electrical General.

### 1.04 OPERATING INSTRUCTIONS

Provide operating instructions as specified in Section 16010.

## PART 2 PRODUCTS

### 2.01 QUALITY

A. Quality includes that specified in Section 13300 and Section 16010.

B. All equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without

manual resetting or operator interaction when power is restored. All instrumentation shall be provided with non-volatile memory to retain all programming and configuration in the event of a power interruption.

C. Signal transmission from remote or field electric and electronic devices shall be 4-20 mA, sourced by a 24 VDC loop supply from the control panel that is to receive the signal. Nonstandard transmission methods such as impulse duration, pulse rate, and voltage regulated will not be permitted except where specifically noted.

D. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission.

## 2.02 PRESSURE INDICATING TRANSMITTER

A. The pressure indicating transmitter shall be a two wire 4-20 mA linear transmitting device proportional to the applied direct pressure. Each transmitter shall have the following standard features: independent zero and span adjustments, adjustable dampening 0.0 to 36.0 seconds, integral solid state circuitry, RFI filtering and shielding, 100 to 1 turndown, elevated zero range of 100% upper limit, capability to drive 0 to 500 ohm loads at 24 VDC. The transmitter shall have accuracy +/- 0.075% of span. Minimum operating temperature range shall be -40 to 185°F.

B. Process wetted materials shall be 316 stainless steel. Process flanges and diaphragm seals shall be 316 stainless steel. Process connections shall be 1/2" NPT. The transmitter shall be setup with the proper span and a zero suppression (or elevation). The transmitter shall have instrument mounted 4-digit LCD meter with HART programming. The pressure transmitter shall be Endress Hauser PMP 71, Rosemount 3051TG, or approved equal.

C. The CONTRACTOR shall setup all programming and configuration prior to the start of field tests. The pressure transmitters shall be calibrated to the ranges listed below.

D. Pressure transmitters shall be supplied with 316 SS block and bleed valves for maintenance and calibration. Process wetted materials shall be compatible for the service application specified. Block and bleed valves shall be SMAR, Hex, Anderson Greenwood or approved equal.

E. Locate remote pressure display in the flowmeter cabinet as indicated in the plans.

F. Pressure transmitters shall be powered by telemetry panel power source.

## 2.03 PRESSURE GAUGE

A. Gauges shall have Type 316 stainless steel movement and stainless steel or phenolic case. Except as otherwise indicated, gauges shall have a 4-1/2-inch dial, ½-inch threaded

connection, a Type 316 stainless steel snubbed adapter, and a shut-off valve. Gauges shall be calibrated to read with an accuracy of ± 1 percent to 150 percent of the indicated pressure. Gauges shall be vibration and shock resistant. Gauges on liquid service should have cases filled with a suitable liquid.

B. Gauges attached to systems containing chemical solutions, corrosive fluids, sludge, sewage, or other liquids containing solids, shall be equipped with diaphragm seals, or equal protective pressure or vacuum sensing devices, and comply with the following:

1. Seals shall be fabricated with Type 316 stainless steel, with stainless steel diaphragm for pressures over 15 psi, and elastomer diaphragm for pressures of 15 psi and below with Type 316 stainless steel nuts and bolts, fill connection and valved flush port size ¼-inch N.T.P., capable of disassembly without loss of filler fluid.

C. Combined pressure gauge and switch assemblies PI/PSHH shall be provided as a complete assembly by the System Integrator for installation by the CONTRACTOR.

D. Pressure gauges shall be Wika, Ashcroft or approved equal.

## 2.04 FLOWMETER (MAGMETER)

A. The flowmeter shall consist of a flow tube flow element (FE) and a remotely mounted indicator/totalizer FQ/FIT with a 4 – 20 mA transmitter and pulse output, complete with all necessary interconnecting cables and conduits.

B. Flowmeter shall read and have bi-directional totalization.

C. Flow tube shall be ANSI 150 pound service.

D. Remote transmitter assembly shall be provided in telemetry control panel.

E. Indicator/register shall provide an analog signal output to the PLC. Register shall be provided with two displays: a continuous flow display and totalizer.

F. The FQ/FIT shall provide both a 4-20 mA analog signal output proportional to the flow rate and pulsed output programmable in gallons. The flow rate indicator and totalizer shall be remotely mounted from the flow tube element. The flowmeter shall be Sparling, Tigermag EP, with remote transmitter, or approved equal.

G. Electrode Material shall be 316 Stainless Steel.

H. Provide grounding rings.

I. Liner Material shall be polyurethane.

J. Sensor Cable: The sensor cable shall be a multi-conductor, abrasive resistant, polyurethane jacketed cable flexible to -40°F. The sensor cable shall be permanently bonded to the sensor. Cable shall be provided by the Contractor. Cable length shall be coordinated by the CONTRACTOR for connection to the remote transmitter.

K. Pressure/Temperature Limits: -40 to 266°F

L. The flow meter shall operate at pressures up to 300 psi.

M. Power Requirements: 24V DC. Power consumption shall not exceed 20 Watts.

N. The meter shall have flanged connections conforming to ANSI B16.5, Class 150. Meter size shall be as shown on the Contract Drawings.

O. The meter accuracy shall be at least 0.5% of flow rate over a 33:1 turndown at all flow rates above 1 foot-per-second (fps). Accuracy shall be verified by calibration in a flow laboratory traceable to the U.S. National Institute of Standards and Technology.

P. The exterior of the flow meter shall be factory epoxy painted.

Q. Flowmeter flow rate ranges shall be approved during submittal.

R. Locate remote display, interface, controller, batcher in the telemetry cabinet as shown in the plans.

S. Flowmeters shall be powered by telemetry cabinet power source.

## 2.05 SOLAR ELECTRIC GENERATOR SYSTEMS

A. The solar electric generator systems indicated on the Drawings shall consist of solar modules, charge controller, batteries, lockable weatherproof corrosion resistant enclosure, power inverter (if needed), all associated mounting and interconnection hardware, and all other incidentals to power the instruments and telemetry cabinets.

B. The solar photovoltaic (PV) modules shall be high performance with 20 year design life. PV modules shall be supplied with all mounting, racking and support structures, including concrete foundations. Foundation and structural calculations shall be submitted for approval by the Engineer, including seismic loading calculations.

C. PV module output shall be 120 watts minimum. Solar power system PV modules, charge controller, and batteries shall be sized by the CONTRACTOR to supply normal telemetry panel loads, with maximum 50% depth of discharge on the batteries under normal conditions, including after a period of five days of cloudy weather conditions.

D. The PV system shall supply all loads in the telemetry panel and the associated field instrumentation. Additional panel space shall be provided if needed. PV system design calculations shall be submitted for review and approval by the Engineer.

E. The solar electric generator systems shall be Sunwize, Sunpower, or an approved equal.

## PART 3 EXECUTION

### 3.01 WORKMANSHIP

A. All instrumentation work in this contract shall conform to the codes and standards specified in Section 16010 and Section 13300.

B. The CONTRACTOR shall employ personnel who are skilled and experienced in the installation and connection of all elements, equipment, devices, instruments, accessories, and assemblies. All installation labor shall be performed by qualified personnel who have had experience on similar projects. Provide first class workmanship for all installations.

C. Ensure that all equipment and materials fit properly in their installations.

D. Perform any required work to correct improper installations at no additional expense to the OWNER.

E. The OWNER reserves the right to halt any work that is found to be substandard or being installed by unqualified personnel.

F. Rejected equipment or equipment without approved submittals shall be immediately removed from the delivery or job site by the CONTRACTOR.

### 3.02 INSTALLATION

A. Contract Drawings are intended to show the basic functional requirements of the instrumentation system and do not relieve the CONTRACTOR from the responsibility to provide a complete and functioning system.

B. All wires shall be identified with machine printed labels. Plastic wire gutters shall be used for routing of wire bundles. Wiring shall be neat and laced with plastic tie wraps.

C. Install and supply all products necessary, at no additional cost to the OWNER, to provide an operational system. This shall include the following:

1. Provide relays, signal converters, isolators, boosters, power conditioners, circuit cards, and other miscellaneous devices as required for the proper interface.

2. Provide analog loop isolators where required to eliminate "ground loops."

3. The instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions and located as shown on the Drawings or as approved by the Engineer. When manufacturer's installation literature specifies a particular location or orientation in a process line due to measurement accuracy considerations, the installation shall be in conformance with the manufacturer's instructions.

4. Engineering scales and charts for all instruments shall be provided that match the range of instruments that monitor the process. All displays and scales shall read in engineering units.

D. Instrument installation methods.

1. Install instruments at the location shown on the Plans or approved by the OWNER. Instruments shall be NEMA rated enclosures for the installed location.

2. Install level and plumb.

3. All instruments shall be provided with floor stands, stanchions or wall brackets as shown or required for operation.

4. Mounting hardware, stands, channels, and spacers shall be either stainless steel, or non-metallic to match the NEMA rated location.

5. All screws and bolts shall be stainless steel.

E. Wiring and raceway installation methods.

1. Instrumentation wiring shall be carried in conduits provided in compliance with the Division 16. All analog circuits shall be run as twisted pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever three wire circuits are required. Triads are not to be formed by using two pairs. Terminal blocks shall be provided at all instrument cable junctions and all wires shall be identified at such junctions. Instrumentation wiring shall be run without splices between instruments, terminal boxes, or panels.

2. The number of signal wires listed on the drawings is approximate only, and the CONTRACTOR shall determine the required number of signal pairs or triads to properly connect the system furnished, especially when substituting equipment.

F. Wiring, grounding, and shielding methods.

It is important to observe good grounding and shielding practices in the generally noisy environment in this application. The following practices shall be observed unless modified by manufacturer's standards:

1. Each electronic equipment chassis shall be grounded to power ground.

2. All analog signals shall be transferred over shielded twisted pair or triad cables.

3. All communication signals shall be transferred over shielded cables.

4. All shields of analog inputs to the PLC shall be connected at the PLC unit only. They shall not contact ground at any other point including the transmitters.

5. All shields of analog outputs from the PLC shall be grounded only at the receiving device. They shall not contact ground at any other point including the PLC.

6. Status and alarm signals routed through noisy environment shall be transferred over shielded twisted pair cables.

7. Each shield which is not connected to ground shall be covered with a heat shrink insulating boot. Shields shall be connected together at each transition from one cable to another for a continuous effective shield circuit. All shields shall be connected on terminal blocks.

## 3.03 SUPPLIER SERVICES

A. The CONTRACTOR shall be responsible for each supplier of equipment to provide the following minimum services for each type of instrument supplied. The supplier shall use a qualified instrumentation field technician (sales representatives are not acceptable) to perform services listed herein.

1. Advise and instruct CONTRACTOR on application and installation requirements.

2. Check, calibrate, and place equipment in operation.

3. All programmable of field devices shall be programmed and tested prior to startup. Programming shall be adjusted or changed as directed by the OWNER or Engineer, at no additional cost.

4. Coordinate with the OWNER and setup all alarm, process, and operation set points.

5. Perform the acceptance tests.

6. Visit the job as often as required and spend as much time as necessary to ensure an operational instrumentation system.

7. Be readily available by telephone to answer all questions on supplied equipment.

8. Provide training as specified.

B. The CONTRACTOR shall insure each supplier of instrumentation assumes the responsibility for providing primary elements in a timely manner, for insertion into the process line, coordinating size and material type when applicable, overseeing the actual installation, calibration, and acceptance testing.

C. Manufacturer Services

1. The CSS shall obtain factory service from the valve actuator, flow meter, and pressure reducing valve suppliers to:

a. Certify Installation

b. Program the device

c. Calibrate the device

d. Test and Commission

## 3.04 TRAINING

Each supplier shall provide a minimum of one (1) hour of training on each type of instrument to instruct OWNER personnel in the use, operation, calibration, programming, and maintenance on each different type of "field" instrument. There will be a total of two (2) one-hour training sessions, one for CAW and one for CCSD.

## 3.05 SPARE PARTS

Provide additional spare parts as specified in Section 16010.

## 3.06 WARRANTY

A. Provide warranty of a minimum of 12 months after Notice of Completion.

B. Each time the Supplier's repair person responds to a system malfunction during the warranty period, he or she must contact the designated OWNER maintenance supervisor for scheduling of the work, access to the jobsite, and permission to make repairs. Operation of facilities necessary to test equipment shall only be performed by or under the direction OWNER staff. The OWNER reserves the right at its sole discretion to deny operations requested by the Supplier.

## 3.07 FINAL ACCEPTANCE

A. Provide final acceptance as specified in Section 16010.

B. At the end of the project, following the completion of the field tests, and prior to final acceptance, the Supplier shall provide the following to the OWNER:

1. Each "operation and maintenance" manual shall be modified or supplemented by the Supplier to reflect all field changes and as-built conditions.

****END OF SECTION****

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## PART 1 - GENERAL

### 1.1 SCOPE OF WORK

A. The Telemetry Control Panel shall be shall be rated NEMA 4X for outdoor service, as indicated on the Contract drawings. The RTU programming shall provide complete valve control functions, allowing both local (on-site) and remote (via telemetry) operation.

B. The Control System Supplier (CSS) shall furnish and install all necessary control panels complete, assembled, tested and ready for use including all necessary control components, wiring, interconnecting cables, all accessories, and all appurtenances as indicated herein or as required for proper operation of the system.

C. Control panels shall be provided as specified herein and indicated on the contract drawings. Control panels shall be manufacturered by a UL-508 shop and shall be UL listed. Control panel supplier shall submit UL file certification as a listed panel manufacturer.

D. Where indicated, control panels shall be provided with all required taps, fittings, conduit entries, mounting assemblies, control wiring and alarm interlocks. Dimensions shall be in accordance with manufacturer's requirements. Elevations and horizontal spacing shall be subject to OWNERapproval.

E. Panels shall be fabricated, assembled, piped and wired by fully qualified workmen who are properly trained, experienced and supervised. Only field wiring for external connections is allowed; all other wiring shall be done in the UL-508 shop.

F. Control panels shall be provided as required to fully monitor and control each process specified.

G. All panel meters, all instruments, and all other components shall be of the most recent field-proven models marketed by their manufacturers at the time of submittal of the shop drawings unless otherwise indicated. Like equipment shall be provided by a single manufacturer.

H. All materials and components making up the control panel shall be new, of current manufacture, and shall not have been in prior service except as required during factory testing. All active electronic devices shall be solid-state. All relays shall be provided with dust covers.

I. Panel mounted instruments shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be of one manufacturer.

### 1.2 RELATED SECTIONS

Section 133300 – Field Instrumentation

Section 13350 – Programmable Control Systems

Division 16 - Electrical

## 1.3 SUBMITTALS

Submittals shall be provided as specified in Sections 01300, 13300, and 16010.

## 1.4 CONTROL PANEL ASSEMBLY

A. Rear of panel mounted equipment shall be installed with due regard to commissioning adjustments, servicing requirements and cover removal. Components, terminal blocks and equipment items shall be mounted at least 9 inches above the base of the control panel.

B. Control panel components shall be arranged on sub-panels and within the panel to optimize weight distribution, heat dissipation and component spacing for wiring and maintenance. Components and terminal strips shall be vertically and horizontally segregated with wire gutters utilizing a 2.0” minimum spacing between the component terminal connections.

C. All fixed position components shall be mounted utilizing stainless steel screws, brackets and fasteners such that no exterior panel extrusions occur. Backpan components shall be individually identified with a unique identifier per IEEE and ISA recommended practices.

D. Component DIN rails shall be provided for snap on mounting of terminal blocks, fuse blocks, relays, timers, and signal conditioners. DIN rail shall be zinc plated, yellow chromated steel. Twenty five percent additional rail space shall be provided to allow for system expansion.

E. Nameplates for panel-mounted devices shall be laminated plastic, black on white, with engraving through the black surface to form 3/16-inch high white letters. Relays and other devices mounted inside the control panels shall be identified with permanent nonferrous tags. Croy labeling for interior panels where there is space is permitted with approved submittals of layout, etc. All tags shall match device numbers shown on contract plans.

F. Front panel components shall be arranged by function and group with a 2” minimum spacing for panel-mounted devices. Operator switches and pilot lights shall utilize a 2.5” on center minimum spacing for wire connections. Where future provisions are necessary control operator switch and pilot light positions shall be pre-punched and plugged for easy modification and expansion. All front panel mounted components shall be provided with a neoprene gasket seal.

G. To ensure proper grounding within the control panel a copper ground bus bar shall be provided. All grounding terminal blocks, equipment chassis and source grounds shall be connected to the ground bus bar to provide a common ground reference within the control panel.

H. All panels shall be protected from internal corrosion by the use of corrosion-inhibiting vapor capsules and shall be manufactured by Saginaw Control Engineering, Hoffman Engineering, or approved equal.

I. Freestanding and wall mount panels shall be provided with louvers and/or forced ventilation as required to prevent temperature buildup due to operation of electrical devices mounted in or on the panel. Submit analysis of cooling requirements and predictions of temperature rise under operating conditions with planned ventilation.

J. Intake louvers shall be mounted on the lower side, rear or front section of an unobstructed panel face. Louvers shall be provided with removable and washable filter grills mounted on the interior side of the louver. Forced-ventilation exhaust fans, where used, shall be provided at an opposing elevated location from the intake louvers. Unless otherwise indicated, fan motors shall operate on 120-volt, 60-Hz power. For control panels located in control rooms, the total audible sound level of the fans shall be less than 45 dB(A).

K. Minimum wire bending space at terminals and minimum width of wiring gutters shall comply with NEC Tables 312.6(A) and (B).

L. Future device and component mounting space shall be provided on the door, backpan, and subpanel where detailed on the Drawings. Where no detail is shown, provide a minimum of 15 percent usable future space.

M. Equipment provided with status and diagnostic displays, LED’s, programming pads, buttons or dials shall be mounted with the display and keypad facing the panel front. Shelving, brackets and associated mounting hardware shall be provided to mount the equipment in readily accessible and viewable location within the panel.

N. Each cabinet interior shall be equipped with a 120 A fluorescent lamp, one 20-ampere GFCI outlet minimum, and two single pole 120-volt, 20-ampere circuit breakers minimum.

## 1.5 CONTROL PANEL WIRING

A. Control panel shall be wired per the latest revision of NEC, NEMA, IEEE and UL-508 standard wiring guidelines for electrical systems.

B. Wires shall be identified at each end utilizing the specified wire marking procedure. Wire size shall per the latest requirements of NEC or the specification, whichever is the most stringent, based on wire type and application.

C. All internal wiring shall be routed through plastic wire ways (Panduit) and spiral wrapped when transitions to front panels or additional sections are required. Wire routing shall be separated and grouped by function, voltage and signal type to minimize noise and maximize maintainability.

D. Instrumentation signal cables shall be of the type used for process control with shielded pairs or triads with polyvinyl jacket and overall shield over the multiple pairs or triads. The instrumentation cable shall be rated 600 volts at 90°C or better. The size of the instrumentation cable shall be AWG No. 18 minimum, unless otherwise specified elsewhere. All instrumentation cables shall meet all the requirements of IPCEA S-61-402 and shall be UL listed. Instrument cabling shall be isolated from power cabling.

E. Control wiring shall be 600V AWG No. 14 THWN-2. Inner panel control wiring may be 600V AWG No. 14 MTW. Main power (120V AC) to the panels and inner panel utility shall be wired using color coded AWG No. 12 THHN. Wires shall be color coded in accordance with the following table:

| | | |
|---|---|---|
| 1. | Black | L1 (hot) |
| 2. | White | N (neutral) |
| 3. | Red | AC Control Circuits |
| 4. | Violet | DC Control Circuits |
| 5. | Light Blue | DC Signal (+) |
| 6. | Grey | DC Signal (-) |
| 7. | Yellow | Interlock control circuits, Foreign Voltage |
| 8. | Green | Equipment ground |

F. AC Power to all system power supplies, CRTs, printer, and disk drives, shall be accomplished using molded 3-wire plug cords.

G. A maximum of 60 percent plastic (Panduit) of allowable wireway fill shall be maintained to allow for future expansion and panel modification. A minimum 1.5 inch clearance shall be maintained in front of each wireway cover to allow for easy access to panel wiring. All interfacing between the cabinets and the field shall be accomplished at a field connection terminal strip (TB). The terminal strip shall have a dedicated field wiring side; no internal panel wiring shall be connected to terminals on the "field side" of TB. Likewise, no field wiring shall be connected to terminals on the "panel side" of the TB. Power shall not be run in duct with signals.

H. No more than two conductors shall be terminated at a single termination point which shall be rated for two terminations. Terminations shall not be used for more conductors

than their listing permits. A common terminal block shall be provided for every two common or neutral conductors contained within the panel.

I. When required, precision (1%) 250-ohm resistors shall be installed at the panel wiring side terminal strip when each incoming 4-20 mA analog signal is converted to a voltage signal (1 to 5 volt DC) and there is no resistor built into the equipment.

J. Wiring run from components on a swing-out panel to other components on a fixed panel shall be made up in tied bundles. These shall be tied with nylon wire ties and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at terminals. Anchor points shall not be attached with foam adhesive. Epoxy anchors (Click-bond) or mechanical fasteners using drilled and tapped holes in the backpan shall be used.

K. Wiring run to control devices on the front panels shall be tied together at short intervals and secured to the inside face of the panel using Panduit adhesive mounts with Eastman No. 910 adhesive. Wiring to rear terminals on panel-mount instruments shall be run in plastic wireways mechanically secured to horizontal brackets run above or below the instruments in about the same plane as the rear of the instruments.

L. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all shop drawings. These numbers shall be permanently marked on all conductors at every terminal using white numbered wire markers which shall be permanently marked heat shrink plastic.

M. In addition to the spare power termination capacity indicated on the drawings, each panel shall be provided with two spare fused AC power and DC power terminations to power future equipment items and field devices.

1.6 ENVIRONMENTAL

A. The control panel shall be rated for continuous operation under ambient environmental conditions of 0°C to 60°C dry bulb and 5 to 95 percent relative humidity, non-condensing. Instrumentation and control elements shall be rated for continuous operation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified or normally encountered for the installed location.

B. The control panel shall be environmentally controlled with the use of exhaust fans, heaters and AC units as required to maintain the environmental conditions specified. The heating/cooling equipment shall be sized to maintain the temperature below a maximum of 122 degrees and above minimum of 34 degrees Fahrenheit within the control panel. Heating and cooling load calculations shall be provided for review and approval. Calculations shall utilize a maximum ambient temperature of 90 degrees F for indoor application and 120 degrees F for outdoor applications. Calculations shall include watt

loss's for all components and solar heat gain for the area of installation. Ventilation shall be favored over mechanical cooling to control temperature rise provided provision is made to prevent dust accumulation within enclosures.

## PART 2 – PRODUCTS

### 2.1 GENERAL

A. Equipment and materials shall be products of reputable, experienced manufacturers. Similar items in the project shall be the products of the same manufacturer. All equipment shall be of industrial grade, a standard of construction, shall be of sturdy design and manufacture, and shall be capable of long, reliable, trouble-free service.

B. The control panels shall be fabricated to house PLC's, controllers, instrumentation and communications equipment specified elsewhere and as indicated on the contract drawings. Control panels shall be fabricated and wired in accordance with this and applicable specification sections.

C. The manufacture of the control panels shall be UL recognized facility with current UL procedure files listed with UL. The final assembly shall carry a UL 508 listing. All equipment provided shall be UL Listed or Recognized for the intended service and application.

### 2.2 CIRCUIT BREAKERS

Control power and equipment disconnects shall be provided as indicated on the drawings. Circuit breakers shall be the energy limiting design and shall be UL rated for 120/240 VAC/60 VDC with an interrupting rating of 10 kAIC. Circuit breakers shall be sized in accordance with NEC. Disconnects shall be DIN rail mounted. Circuit breakers shall be Allen Bradley 1492-GH or CB, Merlin Gerin Multi 9, or approved equal

### 2.3 TERMINAL BLOCKS

A. General: Terminal blocks, fuseblocks and disconnects shall be shall be specially designed for safety, installation ease, and ruggedness. Features shall include the following:

1. Nickel-plated terminals and stainless steel screws.
2. High copper content copper-alloy.
3. Four-sided wire funnel guides for easy wire insertion.
4. Finger-safe housings to prevent accidental contact with live circuits.
5. Terminal blocks and relays, timers, disconnects, signal conditioners and other such devices shall be DIN Rail-mounted.

6. Self-extinguishing, polyamide 6.6 housing material with UL 94-V2 flammability rating.

7. Backed out screws for fast wiring.

B. Terminal blocks shall be DIN rail mounted, compression clamp style, UL rated for 30 amps at 600 volts. Terminal blocks shall be high-density type molded plastic with barriers and box lug terminals. Terminal marking shall be white marking strips, fastened securely to the molded sections and shall be provided with printed wire numbers or circuit identifications.

C. Power Distribution Fuse blocks (250 Volt and below) shall be DIN rail mounted, compression clamp style, rated for 15 amps at 300 VAC. Fuse-blocks shall be provided to accept 1/4"x1 1/4" fuses. Fuseblocks shall be provided with a swing arm touch safe fuseholder for easy removal of fuses. The fuseblock shall be provided with blown fuse indication.

D. Control outputs and foreign control voltages present within the control panel shall be identified and supplied with disconnecting means. Foreign control voltages shall be supplied with pull-apart or knife edge compression clamp or disconnect plug component terminal blocks, rated for 20 amps at 600 volts and shall be labeled with the voltage, the source of the voltage, and circuit function. Foreign voltages are not allowed in motor controllers except for that from a listed Class 2 power supply. Disconnect terminals shall be DIN rail mounted, compression clamp style, rated for 20 amps at 600 volts. Terminal blocks shall be high-density type molded plastic with barriers and box lug terminals.

E. Ground termination blocks shall be provided for all signal grounding and shield connections. Ground terminals shall be Din rail mounted, compression clamp style, rated for 20 amps at 600 volts. Terminal blocks shall be high-density type molded plastic with barriers and box lug terminals. Ground terminals shall be color-coded green/yellow for grounding identification.

F. Signal and control wiring fuseblocks (120 volt and below) shall be supplied with pull-apart disconnect fuse plug component terminal blocks, rated for 20 amps at 600 volts. Disconnect terminals shall be DIN rail mounted, compression clamp style, rated for 20 amps at 600 volts. Fuseplug shall accept 5 x 20 mm fuses and shall be provided with blown fuse indication. Fuseblocks shall be high-density type molded plastic with barriers and box lug terminals

G. Terminal and fuseblock manufacturer shall be Allen Bradley, Entrelec, Phoenix Contact.

## 2.4 CONTROL RELAYS

A. Control Relays (CR) shall be "ice cube" type general purpose relays utilizing 10 amp rated contacts at the specified control voltage. Relays shall be provided as DPDT or 3PDT to meet application requirements. Relay base configurations shall be DIN rail

mounted touch-safe and selected such that AC and DC control relays are not interchangeable, thereby preventing accidental damage to relay coils as a result of incompatible voltages. Relays shall be provided with one spare NO/NC contact. Relays shall be provided with an operational status LED providing positive status of relay energization. Relays shall be IDEC, RELECO or equal.

B. Control Timers (TD/TE) shall be DIN rail mount solid state adjustable timer circuits supplied as time delay on energize or time delay on de-energize as indicated on the drawings. Timer control voltages shall be as indicated on the drawings and shall be provided with DPDT, form C contacts (a normally open and normally closed contact). Timers shall be 10-ampere, 240-volt, pin or blade style, plug-in type with dust cover, LED "on" and applicable "timeout" indication, and sockets. Timers shall have an adjustable time range and time setting with indication of the full time range and of the time setting. Time delays shall be provided with LED status indicators for energization and timer function status. Solid-state timers shall be IDEC, RELECO or equal.

C. Industrial Control Relays (ICR) shall be provided as indicated on the contract drawings and for loads that exceed the normal contact inrush and constant current capacity rating for "ice cube" type relays. Relays shall be provided with convertible cartridges for NO/NC configuration and shall be stackable to a maximum of eight contacts with the addition of a top mounted expansion module. Contacts shall be 20 amp rated bifurcated spanner and nickel-silver plated. Industrial control relays shall be Allen Bradley 700, Type PK series or equal.

D. Intrinsically Safe Relays (ISR) shall be DIN rail mount provided as indicated on the contract drawings and for all loads contained in designated hazardous locations. ISR components shall be UL or Factory Mutural listed and installed in accordance with UL and NEC requirements for component spacing, isolation for all other systems, and interconnection. Intrinsically safe relays shall be selected for the Class, Division and Group category application of the hazardous equipment location. Input resistance, inductance and capacitance shall be compatible with the switching device and meet the limits for application within the defined hazardous location. Control circuit interface for non-hazardous equipment side terminations shall be voltage/current compatible with the control equipment. Intrinsically Safe Relays shall be TURCK Series MK, GEMS Safepak, or equal.

E. Moisture/Level Probe Relay (MR) shall be DIN rail mount provided as indicated on the contract drawings. The relay shall be an adjustable resistive sensing relay for liquid sensing probe applications. The sensitivity (resistance of liquid) shall be adjustable from 0.2-100 k ohms. The relay shall be provided with coarse settings and fine adjustments potentiometers. The relay shall be provided with an integral time delay function. The output circuit shall consist of a SPDT contact. The relay shall be provided with LED indication for power "ON" and Energized State. Control circuit interface shall be

voltage/current compatible with the control equipment. Intrinsically Safe Relays shall be TURCK Series MK, SSAC Series LLC, or Equal.

## 2.5 OPERATOR CONTROLS AND INDICATORS

A. Operator controls and indicators (switches, push-buttons, pilot lights) shall be 30.5 mm, NEMA type 3R, 4, 4X rated.

1. Pushbuttons, selector switches, and indicating lights shall be heavy-duty oil tight, manufactured to the requirements of NEMA ICS.

2. Unless noted otherwise, pushbuttons shall be momentary contact and shall have the number and type of contacts as indicated or as required. One spare NO and NC contact shall be provided for each pushbutton.

3. Unless noted otherwise, selector switches shall be maintained contact, shall have the number of positions indicated, and shall have the number and type of contacts as indicated or as required. One NO spare contact shall be provided for each switch and position.

4. Indicating lights shall be full voltage high brightness LED push-to-test.

5. Pushbuttons, selector switches, and indicating lights shall be Allen-Bradley Bulletin 800T; Westinghouse Industrial Type PB or equal.

## 2.6 EMI LINE FILTER AND SURGE SUPPRESSION

A. EMI/RFI FILTER

1. Control panels shall be provided with power line filters that are effective in the control of line to line as well as line to ground EMI/RFI interference. The standard line filters shall be rated for 28 dB at 1 MHz Line filters shall be Corcom, or equal.

B. Power Surge Protection

1. The surge protectors shall be tested in accordance with the requirements of ANSI/IEEE C62.41 standards for Categories A, B, and C environments and shall be a UL 1449, latest version, listed component.

2. Surge protection components shall be as manufactured by Leviton, Hubbell or Liebert.

C. Telco/Data communications Line Surge Protection

1. Surge protection devices shall be supplied for the protection of all communications circuits from the effects of lightning induced currents, substation

switching transients and internally generated transients resulting from inductive and/or capacitive load switching.

2. Communication line surge protection shall be UL-497 Listed. The surge protection device shall be sized for voltage, current and frequency requirements listed on the contract plans and shall provide independent conductor-ground surge protection. Surge protection shall be installed on the incoming communications for the control panel.

3. The protector module shall be failsafe and contain a three-electrode Maximum Duty gas tube, a fail short mechanism, and an air gap back-up device, which converts the gas tube protector to an air gap protector in the unlikely event that the gas tube vents.

4. The surge protection shall be TII or equal.

D. Data Highway Communications (Modbus Plus, RS-485)

1. Surge protection devices shall be supplied for the protection of all communications circuits from the effects of lightning induced currents, substation switching transients and internally generated transients resulting from inductive and/or capacitive load switching.

2. Communication line surge protection shall be UL-497B Listed. The surge protection device shall be sized for voltage, current and frequency requirements listed on the contract plans and shall provide independent conductor-ground surge protection. Surge protection shall be installed on the incoming RIO (remote I/O) communications for the control panel.

3. Data highway surge suppressors shall be Leviton 3803-DP, or equal.

## 2.7 POWER SUPPLIES

A. General

1. Power Supplies and converters shall be provided as required to meet the input power, voltage and amperage requirements for the equipment supplied.

B. DC Power Supply

1. Control panel DC power shall utilize linear power supplies for primary control power. Standard power supplies shall be provided with automatic current limit and foldback. Power supplies shall be sized to power the equipment at rated voltage and current with an additional 25 percent power capacity.

2. Power supply voltage shall be as required to power supplied control panel equipment and as indicated on the contract drawings.

3. Powers supplies shall be Power One, Acopian or equal.

C. DC/DC Power Supply

1. DC/DC converters shall maintain the required DC voltage to within the regulated output envelope. The DC conversion step up or step down shall be provided as indicated on the contract drawings and required to provide the supplied equipment input power.

2. The DC output shall be sized to provide 125% of load current required to operate the supplied equipment.

3. The converter shall be EMI/RFI shielded and provided with input filtering and reverse voltage protection. The converter shall be housed in an enclosure with terminal connections for input, output and ground. The DC/DC converter shall be provided as follows:

   a. Accuracy: +/- 1%

   b. Regulation: +/- 0.5%

   c. Isolation Voltage: 500 VDC

   d. Operating Temperature 25 to 85 degrees C

4. DC/DC converter shall be Kepco, Wall, or equal.

## 2.8 PANEL INTRUSION SWITCH

A. Intrusion switches shall be provided for all outdoor control panels. Each panel compartment shall be provided with a panel intrusion switch that provides entry notification to the panel PLC and intrusion notification system.

B. The switch shall activate whenever entry to the panel is made. The switch shall be a magnetic reed switch with 10 amps NO/NC rated.

C. The intrusion switch shall be Sentrol or equal.

## 2.9 CELLULAR COMMUNICATION FOR TELEMETRY

A. The programmable logic controller (PLC) / Remote Terminal Unit (RTU) shall communicate with Cal-Am SCADA system through a cellular modem for the Lapis and Nahua Metering sites.

The CSS shall coordinate the procurement, installation, and programming of the modem with Cal-Am personnel. The cellular modem shall be Sierra Wireless, Model GX450, no exception. Contractor shall verify installation of modem and antenna with Cal-Am.

B. The PLC / RTU at the CCSD Nashua Meter site shall communicate with the CCSD SCADA system through a radio. The CSS shall coordinate the procurement, installation, and programming of the radio with CCSD personnel. The router base station shall be CalAmp Wireless, Model 450-512, Viper SC-400, no exception. Contractor shall verify installation of radio and antenna with CCSD.

C. The CCSD Nashua site shall also include a radio antenna mast, nominal 30 feet high, with guy wires and structural features for local seismic and wind conditions. Provide antenna cable, concrete base, anchor supports, and Yagi directional antenna.

## 2.10 PROGRAMMABLE LOGIC CONTROLLER

The PLC system shall be provided as specified in Section 13350.

## 2.11 SPARE PARTS, CONSUMABLE ITEMS, AND TOOLS

A. For additional spare parts, refer to additional requirements as called for elsewhere in Division 13.

B. Fuses: Provide 20 percent of each size and type used rounded to the next whole number, but no less than five of each size and type.

C. Indicating Light Bulb: Provide 10 percent of each color, size and type used rounded to the next whole number, but no less than 5 of each type. This requirement applies to annunciator light bulbs as well, if any are supplied under this Section.

D. Indicator switch cover plates, two lens covers for each type of switch and color combination shall provided. Lens covers shall not be printed.

E. Spare contact blocks 5 spare NO and NC for each type of switch contact block utilized.

F. Power Supplies: Two of each size and type.

G. Corrosion-Inhibiting Vapor Capsules: Two-year supply.

H. Relays: Provide one relay and timer for each type and voltage utilized.

# PART 3 – EXECUTION

## 3.1 GENERAL

A. The CONTRACTOR shall furnish all installation materials, labor, wiring, cabling, and terminations, for the complete installation and operation of the control panels.

B. Craftsmen skilled in the particular trade shall perform assembly, wire and fabrication in a workmanlike manner. Work shall be performed in accordance with the Plans,

Specifications, manufacturers' recommendations, and the best practice of the trade. Completed work shall present a neat and finished appearance.

C. Qualified, experienced personnel who are technically skilled in their trades, are thoroughly instructed, and are competently supervised shall do all work, including installation, connection, calibration, testing and adjustment. The resulting complete installation shall reflect professional quality work, employing industrial standards and methods. Any and all defective material or inferior workmanship shall be corrected immediately to the Satisfaction of the OWNERs Representative at no additional cost to the OWNER.

A.

## 3.2 FACTORY TESTING

A. Prior to shipment, the control panels shall be thoroughly factory tested. The manufacturer shall notify the OWNER two weeks prior to testing for OWNER witnessing of the test to be conducted.

B. The factory test shall verify installation, conformance with plans, wiring continuity and operation of all panel displays and control components. See testing requirements in Section 13300.

C. Programmed equipment and instruments shall be exercised to verify proper range, scale, and trip points and control functions.

D. Additional factory testing shall be provided as specified in Section 13300 and Division 16.

E. Certified factory test forms shall be provided prior to shipment.

## 3.3 WARRANTY AND CUSTOMER SUPPORT

All control panel assemblies and associated control components shall be provided with a 1 year service and replacement warranty from date of project acceptance.

****END OF SECTION****

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**TECHNICAL SPECIFICATION**
**DIVISION 13: SPECIAL CONSTRUCTION**
**13350**: **PROGRAMMABLE CONTROL SYSTEMS**

## PART 1 – GENERAL

### 1.1 SCOPE OF WORK

A. General: This Section covers PLC based programmable control systems, complete. The Control System Supplier (CSS) shall furnish, install, program, test, calibrate, fully configure and place into operation Programmable Logic Controllers (PLC's), Microcontroller Remote Telemetry Units (RTU's), and PLC communications hardware as specified herein.

B. The CSS shall furnish all necessary interconnecting cables, all accessories, and all appurtenances as indicated herein or as required for proper operation of the system. All major components of the system shall be of the same manufacturer.

C. Programmable control systems are a part of the instrumentation and controls system. In addition to the requirements in this Section, the supplier of the programmable control systems shall meet all the applicable requirements of Section 13300 Instrumentation and Controls, and 13340 Control Panels, except where those requirements are modified by this Section.

D. The CSS shall furnish, install and wire PLC, communications modules, processors and I/O modules as indicated on the contract plans.

E. This section covers the furnishing of PLC hardware, software, firmware, communications addressing and configuration, system software, system installation, implementation, testing and start-up.

### 1.2 RELATED SECTIONS

A. The CSS shall provide hardware and software compatible with equipment, systems and services specified in the following sections:

1. Division 13
2. Division 16
3. Appendix – Control Strategy Memo

### 1.3 SUBMITTALS

A. Submittals shall be supplied in conformance with section 16010 and 13300.

### 1.4 REFERENCED STANDARDS

A. American National Standards Institute (ANSI)/Institute of Electrical and Electronic Engineers (IEEE):

1. C62.90.2, trial-use standard withstand capability of relay systems to radiated electromagnetic interference from transceivers.
4. C62.41, IEEE recommended practice on surge voltages in low-voltage AC power circuits.

5. C62.45, IEEE guide on surge testing for equipment connected to low-voltage AC power circuits.

B. Electronic Industries Association (EIA):

1. TIA-232-E, interface between data terminal equipment and data circuit-terminating equipment employing serial binary data interchange.

2. 422-A, electrical characteristics of balanced voltage digital interface circuits.

C. International organization for standardization (ISO):

1. ISO 9001, quality systems-model for quality assurance in design, development, production, installation and servicing.

D. National Electrical Manufacturers Association (NEMA):

1. ICS 1, general standards for industrial control and systems.

2. ICS 4, terminal blocks for industrial use.

3. ICS 6, enclosures for industrial controls and systems.

4. LS1, low voltage surge protection devices.

5. Publication No.250, enclosures for electrical equipment (1000 V maximum).

E. National Fire Protection Association (NFPA):

1. National Electrical Code (NEC).

F. Underwriters Laboratories, Inc. (UL):

1. UL 1283, standard for safety-electromagnetic interference filters.

2. UL 1449, standard for transient voltage surge suppressors.

## PART 2 - PRODUCTS

### 2.1 GENERAL

A. The PLC system shall operate in ambient conditions of 32 to 140°F temperature and 5 to 95 percent relative humidity without the need for purging or air conditioning.

B. Where the PLC is utilized to control multiple trains of equipment, the PLC components (I/O modules, power supplies, etc.) shall be assigned so that the failure of one component does not affect equipment of all trains. I/O modules shall be segregated on a train basis unless required otherwise for safety reasons.

C. The PLC program module shall dictate control output states to known and safe manner prior to running of control program, under PLC fault conditions, and PLC run errors.

D. Protect access to PLC program loading with password protection or with locked, key operated selector switches.

E. PLC system shall be designed with high noise immunity to prevent occurrence of false logic signals resulting from switching transients, relay and circuit breaker noise or conducted and radiated radio frequency interference.

F. The controller shall be grounded to the panel ground bus with a separate ground conductor sized per the manufacturers grounding requirements the minimum ground connection shall be #12 AWG.

G. All conductors, power, signal, control, etc. shall be rated 600V including network cabling and cabling to operator interface panel.

### 2.2 REMOTE TELEMETRY UNIT (MICROCONTROLLER/PLC)

A. The microcontroller system and subsystem components shall be Allen-Bradley. The PLC at the CAW Lapis and Nashua meter sites shall be CompactLogix L3x controller, as required for CAW-wide system compatibility, with no “or equal”. The PLC at the CCSD Nashua metering site shall be Micrologix 1100, as required by CCSD SCADA system-wide compatibility, with no “or equal”. CSS shall verify make and model number with CAW and CCSD before purchasing.

B. Construction: The microcontrollers shall be of solid-state design. All CPU operating logic shall be contained within an integral control chassis. Microcontroller terminal base units shall allow for the easy removal and replacement of the controller. The controller shall be capable of operating in a hostile industrial environment (i.e., heat, electrical transients, RFI, vibration, etc.) without fans, air conditioning, or electrical filtering (up to 60 degrees C and 95 percent humidity).

C. Power: The Microcontroller and all associated equipment shall be 24 VDC powered. The power shall be conditioned and regulated as required to maintain the voltage within the operating limits of the PLC. A PLC power supply(s) shall be provided to supply 24 VDC power to the PLC system and shall be sized to accommodate the PLC system load plus an additional 50 percent. Power supply shall be a listed Class 2 device to eliminate foreign voltage issues monitoring contacts in motor controllers.

D. Design: The I/O subsystem shall be furnished with I/O (input/output) modules, terminal base and termination blocks suitable for the interface with the specified field devices. The I/O base units shall be 4-20 mA signals for analog input and analog output channels. The discrete I/O shall accept dry contact closure for discrete inputs and relay dry contact for discrete outputs. The I/O processor shall provide internal fault analysis with a fail-safe mode of operation.

E. Input/Output Terminals: All I/O terminal and I/O modules shall be of rugged construction with modules in place. Sufficient input and sufficient output modules shall be provided with the distributed I/O panel to implement the specified control functions plus a reserve capacity of 20 percent of each type provided.

1. Discrete Inputs: Defined as contact closure inputs from devices external to the microcontroller. Input modules shall be shielded from short time constant noise and 60-Hz pickup. Individual inputs shall be optically isolated for low energy common mode transients to 1500 volts peak from user's wiring or other I/O channels. The input channels shall have LED lights to indicate a discrete input.

2. Discrete Outputs: Defined as dry contact closure outputs for ON/OFF operation of devices external to the programmable logic controller module. The outputs shall be integrally fused. The output modules shall be optically isolated from inductively generated, normal mode and low energy, common mode transients to 1500 volt peak. All output modules

shall have LED lights to indicate output has been cycled ON by the controller.

3. Analog Input Modules: Defined as analog inputs for 1 to 5 VDC or 4 to 20 mA dc signals, where an analog to digital conversion is performed and the digital result is entered into the processor. Inputs shall be differentially isolated. The analog input channel shall have a minimum 14 bit resolution.

4. Analog Output Modules: Defined as analog output for 1 to 5 VDC or 4 20 mA dc signals, where a digital to analog conversion is performed and the analog result is produced as an output.

F. Communications ports. The Microcontroller shall be provided with two serial communications ports (RS-232 and RS-485) ports configurable for either Full or Half-Duplex operation, and one Ethernet port.

1. Port one RS-232 shall be configured for serial based communications as an RTU slave responding to polled queries from a SCADA master.

2. Port two shall be configured to interface with a future panel mounted HMI for monitoring and control.

3. The microcontroller shall support MODBUS RTU and DNP communications for use in SCADA systems as a remote terminal unit (RTU). The protocol shall allow the RTU to communicate as a responder (slave) node on a MODBUS master/slave or DNP network. The RTU communications messaging shall be configured for radio based communications with a defined master PLC located where described in the Control Strategy in the appendix.

4. The RTU shall be provided with an Ethernet communications port. Ethernet module communications shall support Ethernet Modbus TCP or DNP communications between the processor modules and SCADA.

## 2.3 CABLING AND CONNECTORS

A. Cables and connector shall rated 600V and shall be supplied by the PLC manufacturer and fabricated for the required interface connection. Cables shall be fabricated at the required length, unspliced with factory installed terminations at both ends.

B. Trunk, bus, drop and tap off cables and conductors shall be factory certified for use with the specified communication and interface media requirements.

C. Termination, Data segment and Tee boxes shall be certified by the manufacturer and installed in accordance with the manufacturer's requirements.

D. Connectors and terminators shall be provided with the correct connection interface without the use of additional adapters or fittings. Terminators shall be installed by the factory at the appropriate cable ends.

E. All terminations shall be provided with screw type terminal connectors.

F. Common Bus Bar connectors shall be utilized for ground and common connections for system power and grounding.

2.4 COMMUNICATIONS EQUIPMENT

A. The Microcontroller/PLC system shall be provided with communications components compatible with the CAW's communications network. The current configuration shall be compatible with a Frame Relay networked system that supports high speed data communications.

B. The communications modem shall support Ethernet communications with a Fiber Optic port for future fiber optic based communications. The Ethernet Module shall be provided with a minimum of 3 Ethernet Ports and one Fiber Optic port.

C. The CSS shall coordinate the interface requirements Multimode or Singlemode with the OWNER based on the type of frame relay interface to be provided.

D. The Ethernet Module shall be B&B Electronics Elinx Series, Lantronixs Xpress-Pro Series, or approved equal.

## PART 3 - EXECUTION

3.1 GENERAL

A. The CSS shall furnish all PLC programming labor, communications wiring, cabling, terminations, equipment, modules, converters and interface components to provide for a complete and operational PLC control and SCADA communications interface.

B. SCADA workstation and Master PLC/RTU controllers shall be reconfigured and programmed to access data from the RTU by CAW. The CSS shall coordinate

the programming requirements with CAW and CCSD SCADA programming staff.

C. The CSS shall conduct two 4-hour meetings dedicated to the coordination and definition of the programming requirements for project operation and its implementation with the CAW and CCSD SCADA systems.

D. The PLC shall be configured and programmed to operate within the existing system infrastructure. General program functions shall include:

1. The programming shall implement the control functions and I/O specified within the process control strategies, shown on the drawings and specified under applicable specification sections.

2. PLC control systems shall be configured to operate independent of SCADA workstation and master PLC status. The PLC shall be configured to operate failsafe in the event of a PLC failure.

3. PLC control system shall communicate with SCADA via the cellular link and an existing SCADA network. The SCADA system shall be programmed and configured by the CSS as required to provide for the SCADA interface to communicate with the site PLC.

## 3.2 PLC APPLICATION PROGRAMMING DOCUMENTATION

A. The CSS, PLC programmer, shall provide programming documentation that fully describes the application program function and application. The programming documentation shall clearly identify all programming functions, configurations, set-up and as-programmed ladder-logic rungs, function blocks, modules and structured text blocks. Documentation shall be prepared to present the information to both an experienced and inexperienced programming audience. Separate documentation shall be prepared for both the CAW and CCSD systems.

Standard self commenting/documenting programs may be utilized to generate the specified lists and cross reference files provided they utilize the ISA tag references, equipment #'s and descriptions specified herein to be included with the documentation. The printouts will not be accepted as a substitute for the required system overview and control description narratives specified.

B. A comprehensive control description shall be provided for operations personnel inexperienced in PLC programming. The control description shall be prepared in a narrative format that explains the operation of the program based on a process-by-process and loop-by-loop basis. The programming documentation shall be

provided in three ring binders with a table of contents and tabbed accordingly. At a minimum the following sections shall be provided for each program:

1. System Overview: The system overview shall briefly describe the primary operation of the PLC and its functions. It shall identify the primary equipment and systems monitored and controlled by the PLC and delineate any communications requirements with additional PLC's or computing systems.

2. Control Descriptions: The control description shall be written as an operator's narrative of the control program broken into process and loop descriptions clearly identifying the operation of each loop. The control descriptions will define the following:

    a. Loop Elements and their function with in the process. Loop elements will include all external and internal PLC references and their limits associated with the control requirements.

    b. Operational setpoints shall be clearly identified by a tag reference their function within program clearly stated. Variables utilized via communications from other PLC's shall be clearly denoted within the control descriptions.

    c. Output controls shall be clearly identified as to what initiates and output command. The output control shall reference all status bits, setpoint trips, faults, overrides, permissive and shutdown conditions both external and internal to the PLC program.

3. Operator Setpoint Cross Reference: All setpoints shall be listed by their tag # with a given range of acceptable input values for operation.

4. PLC I/O Cross Reference: All physical I/O shall be listed with their associated I/O address equipment and ISA tag# and description. In addition analog points shall be clearly labeled by tag#, range of operation and scaling within the control program.

5. PLC Communication Reference: The communications reference shall clearly delineate all points utilized within the control program required for operation that contained within additional PLC accessed via the communications media. The Reference shall clearly identify the source PLC address, register, description, I/O type and tag reference.

6. PLC Configuration: A PLC configuration table shall be provided to identify the hardware and software configurations utilized by the PLC program.

7. PLC Applications Program: A copy of the PLC applications program shall be provided with project specific comments as follows:

   a. Descriptive comments shall be provided for each line of code, task, function block and module utilized within the program. Descriptive operators shall utilize equipment descriptions, ISA tag and equipment numbers to clearly identify the equipment for which the program function operates. Obscure comments, codes or references that are not relevant to a descriptive function of the process shall not be utilized unless clearly defined within a cross reference table.

   b. Each line and ladder rung shall clearly identify the I/O address, equipment descriptor and designation # for which the I/O is associated. Internal bits, registers, timers and counters shall clearly identify their function by description and tag # for which the equipment is operated. Examples:

      1) Input/Output I:00:01 Pump #1 (P001) On, YS-001

      2) Timer Reference T4:19 Pump #1 (P001) On Delay

      3) Internal Bit B:10 Pump #1 (P001) Ready, YL-001

      4) Internal Register N7:30 Pump #1 (P001) Run Time

   c. Read/Write blocks shall clearly identify the data transferred within the block and shall be provided with a unique identifier, sufficient information shall establish the purpose of the block transfer.

   d. Subroutines and function blocks shall identify source and destination tags, pages or sections of code for which they are utilized. Each block shall be provided with a unique identifier and clearly delineate its operation within the program.

## 3.3 FACTORY TESTING

A. Factory testing shall be conducted with the PLC's mounted in their associated control panels fabricated in accordance with Section 13340. The factory test shall be in accordance with Section 16010, 13300 and 13340.

B. The test shall demonstrate all PLC programming and operations.

3.4 IMPLEMENTATION

A. The CSS shall install and test all PLC components and communications equipment contained within their associated control panels. The CSS shall provide a test plan that will address testing of the PLC control strategies and verify PLC communications from each node to the master communications PLC and SCADA servers/workstations.

B. The test plan shall include sign off sheets that will verify operation of the control strategy and the PLC communications integrity. The following tests shall be conducted at each location:

1. PLC system diagnostics

2. I/O Point Testing

3. Control Loop Testing

4. SCADA point testing and control operations

3.5 TRAINING

A. Provide Training per Sections 16010 and 13300.

3.6 WARRANTY AND CUSTOMER SUPPORT

A. All PLC / RTU hardware and software shall be provided with a 1 year replacement warranty from date of project acceptance

B. The CSS shall provide one year of warranty service for the correction of operational errors resulting from configuration and programming errors.

*** * END OF SECTION * ***

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**TECHNICAL SPECIFICATION**
**DIVISION 13: SPECIAL CONSTRUCTION**
**13370: APPLICATION PROGRAMMING**

## PART 1 – GENERAL

### 1.1 GENERAL

A. The Control System Supplier (CSS) shall provide all programming associated with the three meter station's control system PLCs, HMIs and coordinate the programming and communications requirements with California American Water and Castroville Community Services District (CCSD) for access to their respective existing Master PLC and SCADA system components. In this specification, OWNER covers two different entities: CAW and CCSD.

B. The CSS shall provide all programming services referenced and contained within the Project Plans and Specifications, including the project control strategy provided in the appendix. The systems programming effort shall be provided complete, ready for use and operational by the CSS in accordance with the Project Plans and Specifications. In addition to the programming services, the CSS shall provide all services required to complete the following:

1. Local and Master PLC and HMI Programming
2. SCADA and Master PLC Coordination Submittals
3. Factory Testing
4. Operational Testing
5. System Commissioning
6. Operator Training
7. Programming Documentation

C. Provide PLC and HMI programming specified.

D. The CSS shall provide complete and comprehensive services for the programming; implementation and support of a PLC based SCADA system incorporating Allen-Bradley PLCs, Iconics Gen 32 HMI software, and cellular communication software. Programming services shall include the programming, configuration and implementation of the following systems:

1. Meter Station site PLC and HMI programming.

2. SCADA/Master PLC system coordination for communications register configuration.

E. OWNER shall provide the CSS with supplemental data during the course of the contract as required to address alarms, permissives, calibration ranges, and remote reservoir level data. The CSS shall incorporate this data into the final control strategies developed for operation of the SCADA and PLC systems.

F. Development of the final control descriptions for the pump station shall be a coordinated effort between the CSS, Engineer and OWNER. The final control system requirements shall be established with programming configuration meetings and submittals as specified.

1.2 PROJECT MEETINGS

A. The CSS shall provide for a minimum of two (2) PLC, HMI and SCADA configuration meetings with OWNER and OWNER's Operations Personnel to address programming and configuration requirements, submittal review comments and to coordinate project implementation.

B. The CSS shall meet with OWNER to obtain the latest, tagging, HMI and PLC programming formats and configurations for implementation. The CSS shall modify and update the control descriptions and system I/O list in cooperation with OWNER.

C. The CSS shall attend all required programming specific meetings as they pertain to coordination for Factory Testing and Commissioning efforts.

1.3 SUBMITTALS

A. The CSS shall prepare detailed programming submittals for the PLC, HMI and coordination of the SCADA system, hardware and software systems specified. The CSS shall provide the systems submittals as follows:

1. The system configuration submittal shall provide sufficient data to illustrate that the system shall be programmed and configured in accordance with the specified requirements. Configuration submittal shall include a Table of Contents with the following:

a. Drawing Index

2. System Control Descriptions

a. Detailed and comprehensive control strategies shall be developed and submitted for review by the CSS in the specified formats and in accordance with the specifications. The CSS shall detail and delineate all control systems and parameters on a process-by-process, loop-by-loop basis. The control strategies shall include the generalized control requirements, additional support system control requirements, existing control systems and any vendor supplied system controls that are necessary to fully understand the operational parameters and control functions to be provided.

b. The CSS shall provide a SCADA I/O database referencing all PLC I/O points, internal registers accessed by the SCADA and associated PLC setpoints. The Database shall utilize the same format and structure provided by the OWNER in an Excel Spreadsheet.

3. SCADA and HMI System Configuration

a. System Navigational and Graphic Screen Configurations: Sample graphic screen configurations shall be submitted based on the requirements established during the preliminary graphics development meetings and for the displays listed within applicable sections.

b. Two sets of color graphic screens shall be submitted for review.

c. References to either the HMI or the SCADA system within the control descriptions applies to both the HMI and SCADA system for programming and configuration requirements.

4. SCADA SYSTEM I/O DATABASE

a. Physical I/O

b. Internal Registers

c. Communications Registers

5. PLC APPLICATION PROGRAMMING DOCUMENTATION

a. Provide Documentation per Section 13350.

b. The CSS shall provide a PLC applications programming submittal fully documented and annotated as specified in section 13350. Submittal shall be provided in a three ring binder and electronically as a program file.

## PART 2 - STANDARD PROGRAMMING METHODS

### 2.1 GENERAL

A. The pump station's PLC shall be programmed to operate independent of the status of the connected SCADA system. The PLC shall be programmed to provide monitoring and control data to the workstation via the indicated communications network.

### 2.2 CONTROL STRATEGIES

A. These control strategies are not intended to be all-inclusive operational procedures for the complete system. Generalized control strategies for PLC control programs and SCADA configurations are provided (see the Control Strategy Memo in the appendix) to establish a general understanding of system operation and supplement application specific requirements referenced in other sections.

B. The CSS shall be responsible for reviewing the OWNER's existing program and configuration documentation standards and confirming existing systems prior to their modification for implementation within the overall system. The control strategies, Project P&ID's, Plans, Specifications and I/O drawings are complimentary and supplemental to one another. Information contained within these documents shall comprise the requirements for a complete control system.

### 2.3 GENERAL CONTROL AND MONITORING

A. In general, control and monitoring functionality shall be as follows:

1. Provide PLC and HMI programming services for monitoring and control of site specific functions.

2. The CSS shall coordinate all specified configuration and development requirements with the OWNER. Coordination shall be achieved with specified configuration meetings and submittals to establish an acceptable configuration format and operational methods that meet the intent of the contract documents.

3. The CSS shall submit a complete Tag name database for all physical, internal and virtual I/O points for review and discussion with the OWNER. The CSS shall coordinate the I/O functionality, Alarm Priority (Status, Alarm, and Shutdown), event log, log frequency, trending requirements, engineering units and operational function on a point by point basis.

B. The SCADA system shall be configured to access all registers contained within the PLC for Setpoints, Time Delays, Process Data and system I/O. The PLC shall be configured to make all information available to the SCADA.

## 2.4 COMMON SCADA/PLC FUNCTIONS

A. Common functions and terms for basic monitoring and control operations are provided as a standard of implementation for the control system. These terms and functions address items that are typical for process control loops and most operator initiated actions. These functions are not necessarily repeated in each individual control strategy. Unless otherwise stated they are considered a part of each control strategy implemented.

B. The following terms are used in the descriptions of SCADA/PLC functions:

1. Operator Settings (Setpoints): Operator/user set or entered values that are adjustable or set from operator displays. Examples of operator set or entered values are controller Setpoints, batch setpoints, timers, counters, mode selection, etc. Specific values that are normally required to be operator settable shall be noted in the process control strategy descriptions. The CSS shall provide a list of all operator settable parameters that are required for normal monitoring, control, alarming and process troubleshooting to be available at the HMI and SCADA workstations. Operator settable parameters shall be provided for:

   a. Process control setpoints (Flow, Level, Pressure, Analytical)

   b. Process mode selection, equipment sequencing and selection.

   c. Non-critical system control override and manual equipment operation.

   d. Manual control setpoints for equipment speed and stroke operations.

e. High-High, High, Low and Low-Low alarm setpoints that will vary with process dynamics, time of use, energy conservation and seasonal modes of operation.

f. Operational parameters required for providing normal operation of the control system from the SCADA system. The operator shall not be required to leave the control room to conduct any monitoring, control and alarm acknowledgement functions.

2. Tunable Values (Setpoints): Tunable values are setpoints that are adjustable at password protected Engineer level displays without requiring any PLC or SCADA software reconfiguration. Tunable values are also identified and their preliminary values are shown when available. Examples of tunable values are:

   a. Tunable time settings,

   b. Tunable alarm setpoints,

   c. PID tuning constants

   d. Deadband Percentages

   e. Filter Constants

   f. Alarm Enable/Disable Operations

3. Fixed Values: Fixed values are constants that are contained within the PLC or SCADA control logic normally inaccessible by the SCADA system. Modification of fixed values requires a modification to the control logic via the PLC programming, configuration and diagnostics software package.

4. Displayed Values: The term displayed means that the value, or information referred to, is displayed in an easily read and understood format on the HMI and SCADA workstation. Values shall be identified by their device tag reference and associated equipment number. For analog variables the value is tagged (ISA Standard) and its associated engineering units are displayed.

5. Hardware Interlocks: Hardware interlocks refer to interlocks directly wired within the electrical control circuits of equipment that, when activated, will cause the equipment to shut down or otherwise prevent

operation of the equipment. Hardware interlocks do not necessarily pass through or depend on the PLC or SCADA to be operable.

a. Hardware interlocks may also be derived by local control panels or switches wired directly to the PLC to provide direct hardwired alarm status to the PLC for processing.

6. Software Interlocks: Software interlocks refer to interlocks that are generated by the PLC or SCADA logic or otherwise pass through the PLC. Software interlocks are not operable when the PLC is not operable or if for some reason equipment is operated while bypassing the PLC logic.

7. Hardware Generated Alarms: Hardware generated alarms are alarms that are generated external to the SCADA/PLC by equipment such as local control panels, analytical devices and process switches.

a. Direct wired alarms that do not depend on the PLC or SCADA to be operable.

An example would be a High $H_2S$ level signal from the $H_2S$ monitor and wired directly to an alarm light or horn.

D. Direct PLC wired alarms such as a High-High pressure switch that interfaces directly with the PLC inputs.

1. Software Generated Alarms: Alarms that are processed or generated by PLC or SCADA logic are referred to as software generated. Software generated alarms are displayed on the SCADA workstation alarm screens and are available for archiving.

2. Local Manual Control Mode: Local manual control refers to the mode where operators can control equipment from the equipment location. Examples are an air compressor that may be stopped or started from the compressor's local control panel (LCP), or a gate that may be opened or closed from the gate operator.

3. Local Automatic Control Mode: Local automatic control refers to control logic performed in a local control panel independent of the PLC or SCADA. An example is a standalone air compressor package that, when in the local automatic control mode, automatically controls the compressors to maintain air pressure within a fixed deadband.

4. Remote Manual Control Mode: Remote manual control refers to the remote manual control of equipment from the SCADA workstation. In this mode, the operators override the PLC automatic control logic while safety interlock logic remains in effect. The SCADA shall set a control status at the PLC signifying that the SCADA has assumed control of the equipment. The PLC shall provide positive feedback that SCADA is selected and display at the workstation. The SCADA control status shall remain in effect until removed by the SCADA or an override condition occurs.

5. Remote Automatic Control Mode: In automatic mode equipment is controlled automatically per predetermined control schemes residing in the SCADA, without operator intervention. However, in some cases the operators may be required to initiate certain automatic functions. An example of this would be the operator initiation of the pump auto-start command. All setpoint registers shall be contained within PLC logic. PLC logic shall provide automatic control parameters (setpoints, modes of operation, equipment sequences, alarm interfacing, manual controls) and shall be accessible from the SCADA workstation. The SCADA workstation shall have access to all timers, counters, registers and control parameters.

6. SCADA Override Control: SCADA override control refers to the ability to override specific software interlocks and initiate control actions. Software interlocks or permissives that can be overridden are identified within the individual control strategies. Override control is an abnormal control operation and a "SAFETY INTERLOCK OVERRIDE ALARM" shall be initiated for the specific override condition whenever an override command is in effect.

## 2.5 COMMON SCADA/PLC SOFTWARE FUNCTIONS

A. To provide for a standard of implementation various software control and monitoring functions are defined. The standard functions may not be fully delineated within each individual control strategy, however unless otherwise stated to be excluded, the standard functions shall be provided for the defined alarm, action, display, variable or control action.

B. In general all automatic and semi-automatic controls are resident within the PLC. The PLC is configured as the primary control system for all alarm monitoring; pump start/stop sequencing, filter controls, backwash sequencing, shutdown and interlock and basic process control functions.

C. When delineated within individual control strategies as SCADA controlled or SCADA logic, the control program is resident within the SCADA system. Non-control related calculations; status indication, complex pump control algorithms, energy management, optimization algorithms and historical data calculations are normally performed by the Communications Data Concentrator or SCADA system. SCADA logic is noted within the individual control strategies and tables as SCADA Manual or Automatic Control.

D. The following provides for common PLC and SCADA software functions:

1. All equipment status items monitored by the PLC and generated within the PLC control strategies are displayed at the SCADA. Unless otherwise specified the following is displayed for each equipment item:

    a. Equipment REMOTE or AUTO status

    b. Equipment LOCAL or HAND status

    c. Equipment RUNNING or ON status

    d. Equipment READY Status

    e. Equipment OFF status

    f. Equipment OUT OF SERVICE

    g. Specific Equipment Fail Alarm(s) (Overload, High Torque, High Temp)

2. All analog inputs shall have instrument failure alarms when the input is below 0 percent or above 100 percent for a tunable time initially set at 10 seconds.

3. All discrete alarm and failure inputs are alarmed by the PLC application software and displayed at the SCADA. Each discrete alarm input shall have a unique associated alarm delay setpoint that prevents nuisance tripping. A discrete alarm will be generated based on a tunable setpoint [e.g., 10 seconds] time after the discrete event is initiated.

4. Where alarms are specified as shutdown in the control strategy descriptions, those alarms are initiated by the PLC control logic based on the applicable analog input signals.

5. Each alarm shall be provided with an Enable/Disable status at the PLC. When disabled the alarm logic is disabled and the status is indicated only for SCADA monitoring. When the alarm condition is disabled all associated shutdown interlocks are disabled.

6. User adjustable trip points shall be provided for each analog input to establish High-High, High, Low, Low-Low, and Rate-Of-Change events. Each trip point shall be provided with a user tunable deadband for set and reset operations. Individual signal trip points shall be provided with a unique tunable delay to alarm activation.

7. SCADA alarm activation and annunciation shall adhere to a priority hierarchy that is established and maintained at the SCADA system. Each alarm shall have an associated priority level defined as:

    a. Level 0 - Life Threatening or Danger Conditions.

    b. Level 1 – Critical process alarms that will create a plant shutdown condition cause a critical process failure or severely hinder plant operation.

    c. Level 2 – Minor process alarms associated with warning conditions and minor equipment failures.

    d. Level 3 – Informational alarms and status that will not hinder operation or cause equipment failure.

    e. Level 4 – 10 Non-critical alarm and event levels shall be coordinated with OWNER.

8. All process related analog inputs shall be trended based on a continuous one, 12 and 24-hour trends additional trend times may be selected at the discretion of the operator utilizing historical trend configuration and evaluation tools.

9. All flow inputs and equipment run times shall be totalized, recorded and displayed at the SCADA workstation. Totalizers shall be resettable at the engineer level only.

10. Process alarms shall be provided with adjustable setpoints and interlocks to prevent nuisance alarms and totalization operations as follows:

a. When associated flow producing equipment is off, the No Flow Alarm and Flow Totalization shall be disabled and the flow value set to zero.

b. Process related alarms shall be disabled when process is, paused, shutdown or operating in an abnormal mode. Example, filter turbidity, and related filter influent and effluent alarms are disabled during a backwash sequence or the plant is offline.

c. When the flow value is less than a no totalization setpoint value, the flow shall be zeroed to disable totalization when equipment is not operational.

11. Graphic displays shall be grouped functionally for ease of operation. Both analog and discrete functions associated with an item of equipment or a group of equipment shall be provided on the same display and tagged by its associated equipment or ISA reference.

12. Control logic that employs step sequencing of process control equipment such as Filter Backwash and Drain to Waste operations shall be provided with user adjustable step durations for individual step sequences.

13. Discrete output control is processed by the PLC based on the PLC control algorithm or SCADA commands. All interlocks, permissives and start sequences shall be provided at the PLC level. Unless otherwise stated or shown, all discrete outputs shall be provided as follows:

    a. For equipment RUN/START PLC functions, the PLC shall issue a maintained START command until a RUNNING state is no longer detected or the START command is removed.

    b. For equipment OPEN/CLOSE PLC functions, the PLC shall issue a maintained OPEN/CLOSE command until the command is removed.

    c. When a momentary command is required, the PLC shall issue the command for a minimum two (2) seconds, and then remove the signal.

    d. Where pulsed outputs are utilized for valve positioning control, pulse width and rates shall be based on the valve control dynamics. Pulsed controls shall be provided with a user adjustable pulse width in seconds and a minimum off time in seconds.

14. For equipment that the PLC is allowed to control, the PLC shall provide a CONTROL TIME OUT (CTO) alarm if the equipment fails to comply with a PLC command signal (START, STOP, OPEN, CLOSE) that has been present for more than a tunable time period. In this event, the command shall be removed subsequent to the expiration of the tunable time period. Equipment that is operated that has not been commanded to operate by the PLC shall produce an UNCOMMANDED START (UNK) alarm.

15. In the event of a SCADA system failure the PLC will retain the last command from the SCADA system for all equipment that is in service. All PLC interlocks shall remain enabled during a SCADA communications or systems failure.

E. The setpoint controller shall provide a mode status condition to the PLC indicating that is in the local or remote HOST mode of operation.

1. When equipment is tagged OUT OF SERVICE, a SCADA function, all associated equipment and devices are automatically placed in OUT OF SERVICE status and their associated alarms inhibited until the tagged equipment is re-tagged IN SERVICE. The PLC shall receive an “Out of Service” status from the SCADA and remove all associated equipment from operation at the PLC control level.

2. Instrument “OUT OF SERVICE” tagging. When an instrument is failed or removed from service, the operator at the SCADA may block the instrument signal at the PLC to prevent nuisance alarm and abnormal control conditions. When an instrument signal is blocked at the PLC, associated alarms and controls are disabled. The operator shall be capable of entering substitute values for monitoring and control while in the blocked mode of operation.

3. SCADA manual control shall be provided for all PLC controlled equipment. SCADA manual equipment control shall utilize two state (bit) control operation for equipment start-stop and valve open-close functions. When the control action is selected it shall be highlighted in accordance with the OWNER’s standard color code conventions.

4. Equipment operating in SCADA manual mode shall have the manual control action removed when an associated shutdown condition is in effect. On a shutdown condition the equipment shall be stopped and

removed from SCADA manual mode. The operator shall be required to reset the alarm and restart the pump manually in SCADA mode.

5. Valve and gate controls provided with positive feedback for Opened and Closed states shall be provided with the following features:

   c. When commanded to Open/Close and the valve is not Opened/Closed the SCADA shall display an equipment traveling status.

   d. When both the equipment Opened/Closed states are present an equipment alarm shall be generated at the SCADA.

## PART 3 - CONTROL STRATEGIES

### 3.1 GENERAL

A. The meter stations gather flow and pressure data and regulate delivery of water from CAW to CCSD with an actuated butterfly valve. The system operations are described in more detail in the Control Strategy memo in the appendix.

### 3.2 SCADA CONFIGURATION

A. The CSS shall coordinate the SCADA system configuration, complete. Provide communication read and write register for SCADA/Master PLC monitoring and control of the system. The CSS shall coordinate register assignments and SCADA operations requirements with OWNER.

B. The CSS shall furnish all necessary testing and commissioning services necessary to confirm SCADA system operation with OWNER programming staff.

### 3.3 SCADA COMMUNICATIONS MODES

A. The CSS shall provide communications register access based on the requirements of the control systems described in these documents.

*** * END OF SECTION * ***

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**TECHNICAL SPECIFICATIONS**
**DIVISION 15: MECHANICAL**
**15000: PIPING GENERAL**

## PART 1 GENERAL

### 1.01 THE REQUIREMENT

A. The CONTRACTOR shall provide all piping systems indicated, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all piping sections in Divisions 2 and 15.

C. The mechanical drawings define the general layout, configuration, routing, method of support, pipe size, and pipe type. The mechanical drawings are **not** pipe construction or fabrication drawings. Where pipe supports and spacings are indicated on the Drawings and referenced to a Standard Detail, the CONTRACTOR shall use that Detail. Where pipe supports are not indicated on the Drawings, it is the CONTRACTOR's responsibility to develop the details necessary to design and construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide all spacers, adapters, and connectors for a complete and functional system.

D. CONTRACTOR shall conform to the CAW Construction Standards.

### 1.02 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be furnished in accordance with Section 01300 – Contractor Submittals.

B. **Shop Drawings:** Shop Drawings shall contain the following information:

1. Drawings: Layout drawings including all necessary dimensions, details, pipe joints, fittings, specials, bolts and nuts, gaskets, valves, appurtenances, anchors, guides, and material lists. Fabrication drawings shall indicate all spacers, adapters, connectors, fittings, and pipe supports to accommodate the equipment and valves in a complete and functional system.

2. Thermoplastic Pipe Joints: Submit solvent cement manufacturer's catalog indicating that the recommended product is suitable for each fluid service application.

3. Gasket Material: Submit gasket manufacturer's catalog indicating that the recommended product is suitable for each fluid service application.

C. **Samples:** Performing and paying for sampling and testing as necessary for certifications are the CONTRACTOR'S responsibility.

D. Certifications

1. All necessary certificates, test reports, and affidavits of compliance shall be obtained by the CONTRACTOR.

2. A certification from the pipe fabricator that all pipes will be manufactured subject to the fabricator's or a recognized Quality Control Program. An outline of the program shall be submitted to the ENGINEER for review prior to the manufacture of any pipe.

## PART 2 PRODUCTS

### 2.01 GENERAL

A. **Extent of Work:** Pipes, fittings, and appurtenances shall be provided in accordance with the requirements of the applicable Sections of Divisions 2 and 15 and as indicated. Materials in contact with potable water shall be listed as compliant with NSF Standard 61.

B. **Pipe Supports:** Pipes shall be adequately supported, restrained, and anchored in accordance with Section 15006 - Pipe Supports, and as indicated. Supports shall resist stresses created by a seismic load in an amount of 34 percent of maximum weight.

C. **Lining:** Application, thickness, and curing of pipe lining shall be in accordance with the applicable Sections of Division 2 unless otherwise indicated.

D. **Coating:** Application, thickness, and curing of pipe coating shall be in accordance with the applicable Sections of Division 2, unless otherwise indicated. Pipes above ground or in structures shall be field-coated in accordance with Section 09800 - Protective Coating.

E. **Pressure Rating:** Piping systems shall be designed for the maximum expected pressure as defined in Section 01656 - Pressure Pipe Testing and Disinfection, or as indicated on the Piping Schedule.

F. **Inspection:** Pipe shall be subject to inspection at the place of manufacture. During the manufacture of the pipe, the 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 requirements.

G. **Tests:** Except where otherwise indicated, materials used in the manufacture of the pipe shall be tested in accordance with the applicable specifications and standards. Welds shall be tested as indicated. The CONTRACTOR shall be responsible for performing material tests.

H. **Welding Requirements:** Qualification of welding procedures used to fabricate pipe shall be in accordance with the provisions of ANSI/AWS D1.1 - Structural Welding Code. Welding procedures shall be submitted for the ENGINEER'S review.

I. **Welder Qualifications:** Welding shall be done by skilled welders and welding operators who have adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 or the ASME Boiler and Pressure Vessel Code, Section 9, by an independent local, approved testing agency not more than 6 months prior to commencing work on the pipeline. Machines and electrodes similar to those used in the WORK shall be used in qualification tests. Qualification testing of welders and materials used during testing are part of the WORK.

## 2.02 PIPE FLANGES

A. **General:** Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise indicated. Attachment of the flanges to the pipe shall conform to the applicable requirements of ANSI/AWWA C207. Flange faces shall be perpendicular to the axis of the adjoining pipe. Flanges for miscellaneous small pipes shall be in accordance with the standards indicated for these pipes.

B. Pressure Ratings

1. 150 psi or less: Flanges shall conform to either ANSI/AWWA C207 - Steel Pipe Flanges for Waterworks Service--Sizes 4 In. Through 144 In., Class D, or ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings, 150 lb class.

2. 150 psi to 275 psi: Flanges shall conform to either ANSI/AWWA C207 Class E or Class F, or ANSI/ASME B16.5 150 lb class.

3. 275 psi to 700 psi: Flanges shall conform to ANSI/ASME B16.5, 300 lb class.

4. Selection based on test pressure: AWWA flanges shall not be exposed to test pressures greater than 125 percent of rated capacity. For higher test pressures, the next higher rated AWWA flange or an ANSI-rated flange shall be selected.

C. **Blind Flanges:** Blind flanges shall be in accordance with ANSI/AWWA C207, or as indicated for miscellaneous small pipes. Blind flanges for pipe sizes 12-inches and greater shall be provided with lifting eyes in the form of welded or screwed eye bolts.

D. **Flange Coating:** 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.

E. **Flange Bolts:** Bolts and nuts shall conform to Section 05500 - Miscellaneous Metalwork. Studs and bolts shall extend through the nuts a minimum of 1/4-inch. All- thread studs

shall be used on all valve flange connections, where space restrictions preclude the use of regular bolts.

F. **Insulating Flanges:** Insulated flanges shall have bolt holes 1/4-inch diameter greater than the bolt diameter, and shall be in conformance with CAW Construction Standard details.

G. **Insulating Flange Sets:** Insulating flange sets shall be provided where indicated. Each insulating flange set shall consist of an insulating gasket, insulating sleeves and washers and a stainless 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. 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 material. Stainless steel washers shall be in accordance with ASTM A 325 - Structural Bolts, Stainless Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength. Insulating gaskets shall be full-face.

H. Insulating Flange Manufacturers, or equal

1. Calpico

2. Maloney Pipeline Products Co., Houston

I. Flange Gaskets

1. Gaskets for flanged joints used in general water and wastewater service shall be full-faced type, with material and thickness in accordance with ANSI/AWWA C207, suitable for temperatures to 700 degrees F, a pH of one to eleven, and pressures to 1000 psig. Blind flanges shall have gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange. Ring gaskets shall not be permitted, unless otherwise indicated. Flange gaskets shall be as manufactured by **John Crane, Style 2160, Garlock, Style 3000,** or equal**.**

2. Gaskets for flanged joints used in water with chloramines shall be **Gylon, Style 3500** as manufactured by **Garlock** or by **Crane**, or equal.

3. Gaskets for flanged joints used in chemicals, air, solvents, hydrocarbons, steam, chlorine and other fluids shall be made of materials compatible with the service, pressure, and temperature.

## 2.03 THREADED INSULATING CONNECTIONS

A. **General:** 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 involved.

B. **Materials:** 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.

## 2.04 MECHANICAL-TYPE COUPLINGS (GROOVED OR BANDED PIPE)

A. Manufacturers of Couplings for Steel Pipe, or equal

1. Gustin-Bacon (Aeroquip Corp.) (banded or grooved)
2. Victaulic Style 41 or 44 (banded, flexible)
3. Victaulic Style 77 (grooved, flexible)
4. Victaulic Style 07 or HP-70 (grooved, rigid)

B. B. Manufacturers of Ductile Iron Pipe Couplings, or equal

1. Tyler
2. US Pipe

Note: Ductile iron pipe couplings shall be furnished with flush seal gaskets.

C. C. Manufacturers of Couplings for PVC Pipe, or equal

1. Tyler
2. US Pipe

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

## 2.05 SLEEVE-TYPE COUPLINGS

A. **Construction:** Sleeve-type couplings shall be provided where indicated, in accordance with ANSI/AWWA C219 - Standard for Bolted Sleeve-Type Couplings for Plain-End Pipe. Couplings shall be steel with steel bolts, without pipe stop. Couplings shall be of sizes to fit the pipe and fittings indicated. The middle ring shall be not less than 1/4-inch thick or at least the same wall thickness as the pipe to which the coupling is connected. If the strength of the middle ring material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe. The coupling 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, for standard steel couplings, and 16-inches long for long-sleeve couplings. The followers shall be single-piece contoured mill sections welded and cold-expanded as required for the middle rings, and of sufficient

strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket. Bolts and nuts shall conform to the requirements of Section 05500. Buried sleeve-type couplings shall be epoxy-coated at the factory as indicated.

B. **Pipe Preparation:** Where indicated, the ends of the pipe shall be prepared for flexible steel couplings. 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. 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.

C. **Gaskets**

1. 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 suitable elastomer. The rubber in the gasket shall meet the following specifications:

    a. Color - Jet Black

    b. Surface - Non-blooming

    c. Durometer Hardness - 74 plus and minus 5

    d. Tensile Strength - 1000 psi Minimum

    e. Elongation - 175 percent Minimum

2. 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 - Classification System for Rubber Products in Automotive Applications, AA709Z, meeting Suffix B13 Grade 3, except as noted above. Where sleeve couplings are used in water containing chloramine or other fluids which attack rubber materials, gasket material shall be compatible with the piping service and fluid utilized.

D. **Insulating Sleeve Couplings:** Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a sleeve of an insulating compound material compatible with the fluid service in order to obtain insulation of all coupling metal parts from the pipe.

E. **Restrained Joints:** Sleeve-type couplings on pressure lines shall be harnessed unless thrust restraint is provided by other means. Harnesses shall be designed by the pipe manufacturer in accordance with Manual M11, or as indicated. Harness sets shall be designed for the maximum test pressure of the pipe in which they are installed. Where harness sets are installed near the suction and discharge of the pump, harness bolts shall have zero elongation to prevent misalignment of the pump imparted by the thrust within the piping system. Mechanical joint restraints shall be used per the CAW Construction Standards for all buried pipe.

F. Manufacturers, or equal

1. Mega Lug
2. TR Flex
3. Dresser, Style 38
4. Ford Meter Box Co., Inc., Style FC1 or FC3
5. Smith-Blair, Style 411

## 2.06 FLEXIBLE CONNECTORS

A. **Low Temperatures:** Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, and other vibrating equipment, and where indicated. Flexible connectors for service temperatures up to 180 degrees F shall be flanged, reinforced Neoprene or Butyl spools, rated for a working pressure of 40 to 150 psi, or reinforced, flanged duck and rubber, as best suited for the application. Flexible connectors for service temperatures above 180 degrees F shall be flanged, braided stainless steel spools with inner, annular, corrugated stainless steel hose, rated for minimum 150 psi working pressure, unless otherwise indicated. The connectors shall be a minimum of 9-inches long, face-to-face flanges, unless otherwise indicated. The final material selection shall be approved by the manufacturer. CONTRACTOR shall submit manufacturer's shop drawings and calculations.

B. **High Temperature:** Flexible connectors shall be installed in engine exhaust piping and where indicated. Connectors shall be sufficient to compensate for thermal expansion and contraction and also to isolate vibration between the engine and the exhaust piping system. Connectors shall be stainless steel bellows type, flanged, and rated for minimum 150 psi, 2000 degrees F.

## 2.07 EXPANSION JOINTS

A. Piping subject to expansion and contraction shall be provided with sufficient means to compensate for such movement without exertion of undue forces to equipment or

structures. This may be accomplished with expansion loops, bellow-type expansion joints, or sliding-type expansion joints. Expansion joints shall be flanged end, stainless steel, Monel, rubber, or other materials best suited for each individual service. CONTRACTOR shall submit detailed calculations and manufacturer's Shop Drawings of all proposed expansion joints, piping layouts, and anchors and guides, including information on materials, temperature and pressure ratings.

## 2.08 PIPE THREADS

A. Pipe threads shall be in accordance with ANSI/ASME B1.20.1 - Pipe Threads, General

B. Purpose (inch), and be made up with Teflon tape unless otherwise indicated.

## 2.09 PIPE INSULATION

A. Hot and cold liquid piping, flues, and engine exhaust piping shall be insulated as indicated, in accordance. No unprotected hot piping shall be within reach of operating personnel or other persons.

B. Preinsulated pipe for underground service shall be as indicated.

## 2.10 AIR AND GAS TRAPS

A. Air and gas pipes shall slope to low points and be provided with drip legs, shut-off valves, strainers, and traps. The traps shall be piped to the nearest drain. Air and gas traps shall be not less than 150 lb iron body float type with copper or stainless steel float. Bracket, lever, and pins shall be of stainless steel. Drain traps shall have threaded connections.

B. Manufacturers, or equal

1. Armstrong International, Inc.

2. Spirax Sarco, Inc.

# PART 3 EXECUTION

## 3.01 MATERIAL DELIVERY, STORAGE, AND PROTECTION

A. Piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground for protection against oxidation caused by ground contact. Defective or damaged materials shall be replaced with new materials.

## 3.02 GENERAL

A. Piping, fittings, and appurtenances shall be installed in accordance with the requirements of applicable Sections of Division 2 and Division 15. Care shall be taken to insure that piping flanges, mechanical-type couplings, sleeve-type couplings, flexible connectors, and expansion joints are properly installed as follows:

1. Gasket surfaces shall be carefully cleaned and inspected prior to making up the connection. Each gasket shall be centered properly on the contact surfaces.

2. Connections shall be installed to prevent inducing stress to the piping system or the equipment to which the piping is connected. Contact surfaces for flanges, couplings, and piping ends shall be aligned parallel, concentric, and square to each axis at the piping connections.

3. Bolts shall be initially hand-tightened with the piping connections properly aligned.

4. Bolts shall be tightened with a torque wrench in a staggered sequence to the AISC recommended torque for the bolt material.

5. After installation, joints shall meet the indicated leakage rate. Flanges shall not be deformed nor cracked.

B. **Lined Piping Systems:** The lining manufacturer shall take full responsibility for the complete, final product and its application. Pipe ends and joints of lined pipes at screwed flanges shall be epoxy-coated to assure continuous protection.

C. **Core Drilling:** Where core drilling is required for pipes passing through existing concrete, core drilling locations shall be determined by radiograph of concrete construction to avoid damage to embedded raceways and reinforcing bars.

D. **Cleanup:** After completion of the WORK, cuttings, joining and wrapping materials, and other scattered debris shall be removed from the Site. The entire piping system shall be handed over in a clean and functional condition.

**END OF SECTION**

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## PART 1 PART 1 -- GENERAL

### 1.01 THE REQUIREMENT

A. CONTRACTOR shall provide identification for exposed piping and valves, complete and in place, in accordance with the Contract Documents.

### 1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

ANSI A13.1 Scheme for the Identification of Piping Systems

### 1.03 CONTRACTOR SUBMITTALS

A. Submittals shall be in accordance with Section 01300 - Contractor Submittals.

B. Shop Drawings: A list of suggested wording for each valve tag, prior to fabrication.

C. Samples

1. One sample of each type of identification device.

## PART 2 PRODUCTS

### 2.01 IDENTIFICATION OF PIPING

A. Except as indicated below for very short pipe lengths, identify exposed piping larger than 2-inches nominal size for the pipe contents and direction of flow.

1. Marker Type

   a. Snap Around: Vinyl or polyester sheet with UV-resistant ink, preshaped and sized to tightly curl around the pipe and remain in position.

   b. Adhesive: Vinyl or polyester sheet with UV-resistant ink, shaped similar to pipe curvature and coated with pressure sensitive adhesive.

   c. Stencil: Lettering painted directly on surface of pipe inside color coded marker area.

2. Marker Area: Sized per pipe size according to ANSI A13.1; color from the table below.

3. Lettering: Sized per pipe size according to ANSI A13.1; color from the table below.

4. Arrows: at least 2 arrows at each marker area, showing direction of flow.

B. Pipe 2-inches and smaller shall be identified by plastic plates made from laminated 3-layer plastic with engraved black letters on white background.

C. Pipe identification shall be as manufactured by **Brady, Seton,** or equal.

## 2.02 EXISTING IDENTIFICATION SYSTEMS

A. In installations where existing piping identification systems have been established, CONTRACTOR shall follow the existing system. Where existing identification systems are incomplete, utilize the existing system as far as practical and supplement with the indicated system.

## 2.03 IDENTIFICATION OF VALVES AND SHORT PIPE LENGTHS

A. Identifying devices for valves and the sections of pipe that are too short to be identified with markers and arrows shall be identified with metal or plastic tags.

B. Metal tags shall be stainless steel with embossed lettering. Plastic tags shall be solid black plastic laminate with white embossed letters. Tags shall be designed to be firmly attached to the valves or short pipes or to the structure immediately adjacent to such valves or short pipes.

C. Wording on the valve tags shall describe the exact function of each valve, in accordance with the design documents.

# PART 3 EXECUTION

## 3.01 GENERAL

A. Markers and identification tags shall be installed in accordance with the manufacturer's printed instructions, and shall be neat and uniform in appearance. Tags and markers shall be readily visible from all normal working locations.

## 3.02 VALVE TAGS

A. Valve tags shall be permanently attached to the valve or structure by means of 2 stainless steel bolts or screws.

## 3.03 MARKER LOCATIONS

A. Each exposed pipe section shall be marked at:

1. Intervals of 20-feet in straight runs.

2. At least once in every room.

3. Within 2-feet of turns, elbows, and valves.

4. On the upstream side of tees, branches, and other distribution points.

5. On both sides of walls and floors through which the piping passes.

## 3.04 IDENTIFICATION COLORS

A. Conform to the following color codes.

| Color Schedule | | | | |
|---|---|---|---|---|
| Pipe Contents | | Pipe Color | Marker Color | Letter Color |
| Abbreviation | Identification | | | |
| A | Air | | blue | white |
| BD | Bottom drain | | green | white |
| BP | Plant bypass | | green | white |
| C | Condensate | | yellow | black |
| D | Chemical drain and vent | | yellow | black |
| CL | Chlorine (gas or liquid state) | | yellow | black |
| CLS | Chlorine solution | | yellow | black |
| CV | Chlorine vent & detection line | | yellow | black |
| FE | Final effluent | | green | white |
| FI | Filter influent | | green | white |
| FSP | Fire protection sprinkler system | | red | white |
| IA | Instrument air | | blue | white |
| LO | Lube oil | | yellow | black |
| LSP | Landscape sprinkler system | | green | white |
| NG | Natural gas | | yellow | black |
| OF | Overflow | | green | white |
| PA | Plant air | | blue | white |
| PD | Plant drain | | green | white |

| Color Schedule | | | | |
|---|---|---|---|---|
| Pipe Contents | | Pipe Color | Marker Color | Letter Color |
| Abbreviation | Identification | | | |
| PI | Plant influent | | yellow | black |
| PW | Potable water | | green | white |
| RW | Raw water | | green | white |
| SA | Sample lines | | yellow | black |
| SC | Spare chemical | | yellow | Black |
| so | Sanitary drains and vents | | yellow | black |
| SDR | Storm drain | | green | white |
| ss | Sanitary sewer | | yellow | black |

**END OF SECTION**

## PART 1 GENERAL

### 1.01 THE REQUIREMENT

A. CONTRACTOR shall provide pipe supports, hangers, guides, and anchors, complete, in accordance with the Contract Documents.

B. Where pipe support systems are not indicated on the Drawings, the CONTRACTOR shall design and provide the supports in accordance with this Section.

### 1.02 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be in accordance with Section 01300 - Contractor Submittals.

B. **Shop Drawings:** Shop Drawings shall include the following information:

1. Drawings of pipe supports, hangers, anchors, and guides

2. Calculations for special supports and anchors.

## PART 2 PRODUCTS

### 2.01 GENERAL REQUIREMENTS

A. **Code Compliance:** All piping systems and pipe connections to equipment shall be properly anchored and supported to prevent undue deflection, vibration, dislocation due to seismic events and line pressures, and stresses on piping, equipment, and structures. All supports and parts thereof shall conform to the requirements of ANSI/ASME B31.1 - Power Piping, except as supplemented or modified below. Supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code or local administration requirements.

B. **Structural Members:** Wherever possible, pipes shall be supported from structural members. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided by CONTRACTOR. All supplementary members shall be in accordance with the requirements of the building code and the American Institute of Steel Construction and shall be acceptable to ENGINEER.

C. **Pipe Hangers:** Pipe hangers shall be capable of supporting the pipe in all conditions of operation, allowing free expansion and contraction of the piping, and preventing excessive stress on equipment. All hangers shall have a means of vertical adjustment after erection. Hangers shall be designed to prevent becoming disengaged by any movement of the supported pipe. Hangers subject to shock, seismic disturbances, or thrust imposed by the actuation of safety valves, shall include hydraulic shock suppressors. All hanger rods shall be subject to tensile loading only.

D. **Hangers Subject to Horizontal Movements:** At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit such movement. Where horizontal pipe movement is greater than 1/2-inch, or where the hanger rod deflection from the vertical is greater than 4 degrees from the cold to the hot position of the pipe, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the hot position.

E. **Spring-Type Hangers:** Spring-type pipe hangers shall be provided for piping subject to vibration or vertical expansion and contraction, such as engine exhausts and similar piping. All spring-type hangers shall be sized to the manufacturer's printed recommendations and the loading conditions encountered. Variable spring supports shall be provided with means to limit misalignment, buckling, eccentric loading, or to prevent overstressing of the spring, and with means to indicate at all times the compression of the spring. Supports shall be capable of accommodating at least 4 times the maximum travel due to thermal expansion.

F. **Thermal Expansion:** Wherever expansion and contraction of piping is expected, a sufficient number of expansion loops or expansion joints shall be provided, together with the necessary rolling or sliding supports, anchors, guides, pivots, and restraints permitting the piping to expand and contract freely in directions away from the anchored points. All components shall be structurally suitable to withstand all loads imposed.

G. **Heat Transmission:** Supports, hangers, anchors, and guides shall be so designed and insulated, that excessive heat will not be transmitted to the structure or to other equipment.

H. **Riser Supports:** Where practical, risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.

I. **Freestanding Piping:** Free-standing pipe connections to equipment such as chemical feeders and pumps shall be firmly attached to steel frames fabricated from angles, channels, or I-beams anchored to the structure. Exterior, free-standing overhead piping shall be supported on fabricated pipe stands consisting of pipe columns anchored to concrete footings, with horizontal, welded steel angles and U-bolts or clamps securing the pipes.

J. **Materials of Construction:**

1. General: All pipe support assemblies, including framing, hardware, and anchors, shall be steel construction, galvanized after fabrication, unless otherwise indicated.

2. Submerged Supports: All submerged piping, as well as piping, conduits, and equipment in hydraulic structures within 24-inches of the water level, shall be supported with support, assemblies, including framing, hardware, and anchors, constructed of Type 316 stainless steel, unless otherwise indicated.

3. Corrosive: All piping in chemical and corrosive areas shall be supported with support assemblies, including framing, hardware, and anchors, constructed of Type 316 stainless steel or FRP, unless otherwise indicated.

K. **Point Loads:** Any meters, valves, heavy equipment, and other point loads on PVC, FRP, and other plastic pipes, shall be supported on both sides, according to manufacturer's recommendations to avoid undue pipe stresses and failures. To avoid point loads, all supports on PVC, FRP, and other plastic piping shall be equipped with extra wide pipe saddles or galvanized steel shields.

L. **Concrete Anchors:** Unless otherwise indicated, concrete anchors for pipe supports shall be according to the following table. Consult the ENGINEER for any anchor applications not on the table. Anchor embedment shall comply with Section 05500.

| Pipe Support Application | Type of Concrete Anchor |
|---|---|
| New Concrete | Use embedded concrete insert anchors on a grid pattern. Use Grinnell (Anvil International), Tolco, or equal. |
| Existing Concrete | Use non-shrink grouted anchors, metallic type expansion anchors, or epoxy anchors. Exceptions:<br><br>Metallic type expansion anchors and epoxy anchors are not permitted for pipe supports subject to vibrating loads. Epoxy anchors are not permitted where the concrete temperature is in excess of 100 degrees F or higher than the limiting temperature recommended by the manufacturer. Epoxy anchors are not accepted where anchors are subject to vibration or fire. |
| Vibratory Loads and High Temperature Conditions | Use non-shrink grouted anchors |
| Pipe hung under the Monte Road Bridge | See Detail Drawings |

M. **Noise Reduction:** To reduce transmission of noise in piping systems, all copper tubes in buildings and structures shall be wrapped with a 2-inch wide strip of rubber fabric or similar, suitable material at each pipe support, bracket, clip, or hanger.

## 2.02 SUPPORT SPACING

A. Supports for piping with the longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive sag, bending, and shear stresses in the piping, with special consideration given where components such as flanges and valves impose

concentrated loads. Pipe support spacing shall not exceed the maximum spans in the tables below. For temperatures other than ambient temperatures, or those listed, and for other piping materials or wall thicknesses, the pipe support spacings shall be modified in accordance with the pipe manufacturer's recommendations. Vertical supports shall be provided to prevent the pipe from being overstressed from the combination of all loading effects.

B. Where support spacing is not indicated on the Drawings, CONTRACTOR shall use the spacing below.

1. Support Spacing for Schedule 40 and Schedule 80 Steel Pipe:

| Nominal Pipe Diameter (inches) | Maximum Span (feet) |
|---|---|
| 1/2 | 6 |
| 3/4 and 1 | 8 |
| 1-1/4 to 2 | 10 |
| 3 | 12 |
| 4 | 14 |
| 6 | 17 |
| 8 and 10 | 19 |
| 12 and 14 | 23 |
| 16 and 18 | 25 |
| 20 and greater | 30 |

2. Support Spacing for Welded Fabricated Steel Pipe: Maximum Spans for Pipe Supported in Minimum120 degree Contact Saddles (feet)

| Nominal Pipe Diameter (inches) | Wall Thickness (inches) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 3/16 | 1/4 | 5/16 | 3/8 | 7/16 | 1/2 | 5/8 | 3/4 | 7/8 | 1 |
| 24 | 33 | 37 | 41 | 43 | 45 | 47 | | | | |
| 26 | 34 | 38 | 41 | 44 | 46 | 48 | | | | |

| Nominal Pipe Diameter (inches) | Wall Thickness (inches) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 28 | 34 | 38 | 41 | 44 | 47 | 49 | | | | |
| 30 | 34 | 38 | 42 | 45 | 48 | 49 | | | | |
| 32 | 34 | 39 | 42 | 45 | 48 | 50 | | | | |
| 34 | 35 | 39 | 43 | 46 | 48 | 50 | | | | |
| 36 | 35 | 39 | 43 | 46 | 49 | 51 | 55 | | | |
| 38 | 35 | 39 | 43 | 46 | 49 | 51 | 55 | | | |
| 40 | 35 | 40 | 43 | 47 | 49 | 52 | 56 | | | |
| 42 | 35 | 40 | 44 | 47 | 50 | 52 | 56 | | | |
| 45 | -- | 40 | 44 | 47 | 50 | 53 | 57 | | | |
| 48 | -- | 40 | 44 | 47 | 50 | 53 | 58 | 61 | | |
| 51 | -- | 40 | 44 | 48 | 51 | 53 | 58 | 62 | | |
| 54 | -- | 40 | 44 | 48 | 51 | 54 | 58 | 62 | | |
| 57 | -- | 41 | 45 | 48 | 51 | 54 | 59 | 63 | | |
| 60 | -- | 41 | 45 | 48 | 52 | 54 | 59 | 63 | 67 | 70 |
| 63 | -- | 41 | 45 | 49 | 52 | 55 | 60 | 64 | 67 | 71 |
| 66 | -- | 41 | 45 | 49 | 52 | 55 | 60 | 64 | 68 | 71 |
| 72 | -- | 41 | 45 | 49 | 52 | 55 | 61 | 65 | 69 | 72 |
| 78 | -- | 41 | 46 | 49 | 53 | 56 | 61 | 66 | 69 | 73 |
| 84 | -- | 41 | 46 | 50 | 53 | 56 | 62 | 66 | 70 | 74 |
| 90 | -- | 41 | 46 | 50 | 53 | 56 | 62 | 67 | 71 | 74 |
| 96 | -- | 42 | 46 | 50 | 54 | 57 | 62 | 67 | 71 | 75 |

For steel pipe sizes not presented in this table, the support spacing shall be designed so that the stress on the pipe does not exceed 5,000 psi. Maximum deflection of pipe shall be limited to 1/360th of the span and shall be calculated by using the formula:

$$L = (7500tD/(32t+D))^{1/2}$$

where: t = Thickness (inches)
D = Diameter (inches)
L = Maximum span (feet)

3. Support Spacing for Ductile-Iron Pipe:

| Nominal Pipe Diameter (inches) | Maximum Span (feet) |
|---|---|
| All Diameters | Two supports per pipe length or 10 feet (one of the 2 supports located at joint) |

4. Support Spacing for Copper Tubing:

| Nominal Pipe Diameter (inches) | Maximum Span (feet) |
|---|---|
| 1/2 to 1-1/2 | 6 |
| 2 to 4 | 10 |
| 6 and greater | 12 |

5. Support Spacing for Schedule 80 PVC Pipe:

| Nominal Pipe Diameter (inches) | Maximum Span (at 100 degrees F) (feet) |
|---|---|
| 1/2 | 4 |
| 3/4 | 4.5 |
| 1 | 5 |
| 1-1/4 | 5.5 |
| 1-1/2 | 5.75 |
| 2 | 6.25 |
| 3 | 7.5 |
| 4 | 8.25 |
| 6 | 10 |
| 8 | 11 |
| 10 | 12.25 |
| 12 | 13.25 |

6. Support Spacing for Schedule 80 Polypropylene Pipe:

| Nominal Pipe Diameter (inches) | Maximum Span (at 100 degrees F) (feet) |
|---|---|
| 1/2 | 3 |
| 3/4 | 3.5 |
| 1 | 3.75 |
| 1-1/4 | 4 |
| 1-1/2 | 4.25 |
| 2 | 4.5 |
| 3 | 5.5 |
| 4 | 6 |
| 6 | 7.25 |
| 8 | 8 |
| 10 | 8.75 |
| 12 | 9.5 |

7. Support Spacing for Fiberglass Reinforced Plastic (FRP) Pipe:

| Nominal Pipe Diameter (inches) | Maximum Span (at 100 degrees F) (feet) |
|---|---|
| 2 | 8.8 |
| 3 | 10 |
| 4 | 11 |
| 6 | 12.7 |
| 8 | 13.4 |
| 10 | 14 |
| 12 | 15.4 |
| 14 | 16.2 |
| 16 | 17.3 |
| 18 and greater | 18 |

## 2.03 MANUFACTURED SUPPORTS

A. **Stock Parts:** Where not specifically indicated, designs which are generally accepted as exemplifying good engineering practice and use stock or production parts, shall be utilized wherever possible. Such parts shall be locally available, new, of best commercial quality, designed and rated for the intended purpose.

B. **Manufacturers, or Equal:**

1. Basic Engineers Inc., Pittsburgh, PA;
2. Bergen-Paterson Pipesupport Corp., Woburn, MA;
3. Grinnell Corp. (Anvil International), Cranston, RI;
4. NPS Products, Inc., Westborough, MA;
5. Power Piping Company, Pittsburgh, PA.
6. Tolco Incorporated, Corona, CA

## 2.04 COATING

A. **Galvanizing:** Unless otherwise indicated, all fabricated pipe supports other than stainless steel or non-ferrous supports shall be blast-cleaned after fabrication and hot- dip galvanized in accordance with ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

B. **Other Coatings:** Other than stainless steel or non-ferrous supports, all supports shall receive protective coatings in accordance with the requirements of Section 09800 - Protective Coating.

# PART 3 EXECUTION

## 3.01 INSTALLATION

A. **General:** All pipe supports, hangers, brackets, anchors, guides, and inserts shall be fabricated and installed in accordance with the manufacturer's printed instructions and ANSI/ASME B31.1 - Power Piping. All concrete inserts for pipe hangers and supports shall be coordinated with the formwork.

B. **Appearance:** Pipe supports and hangers shall be positioned to produce an orderly, neat piping system. All hanger rods shall be vertical, without offsets. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting, as close to ceilings or roofs as possible, without interference with other work.

## 3.02 FABRICATION

A. **Quality Control:** Pipe hangers and supports shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available. Fabricated supports shall be neat in appearance without sharp corners, burrs, and edges.

**END OF SECTION**

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## PART 1 PART 1 -- GENERAL

### 1.01 SUMMARY

A. This section includes the requirements for copper and fittings.

B. Related Sections:

1. Section 01300 – Contractor Submittals

2. Section 01400 – Quality Control

### 1.02 REFERENCES

A. All copper and copper alloy pipes and fittings shall be manufactured in accordance with one of the following Standard Specifications:

1. ASTM B 152/B 152M (2006ae1) Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar.

2. ASTM B 306 (2002) Standard Specification for Copper Drainage Tube (DWV).

3. ASTM B 42 (2002e1) Standard Specification for Seamless Copper Pipe, Standard Sizes

4. ASTM B 584 (2008a) Standard Specification for Copper Alloy Sand Castings for General Applications.

5. ASTM B 75 (2002) Standard Specification for Seamless Copper Tube.

6. ASTM B 813 (2000e1) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.

7. ASTM B 828 (2002) Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.

8. ASTM B 88 (2003) Standard Specification for Seamless Copper Water Tube.

9. ASME B16.22 (2001; R 2005) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

10. ANSI B 16.18 Standard for Cast Copper Alloy Solder Joint Pressure Fittings.

11. ASME B 16.26 Standard for Cast Copper Alloy Fittings for Flared Copper Tubes.

12. ASME B 16.24 Standard for Cast Copper Alloy Pipe Flanges and Flanged Fittings.

13. ASME B 31.1 Standard for Power Piping.

## 1.03 SUBMITTALS

A. Products:

1. Shop Drawings: Submit Shop Drawings showing piping layouts, sizes, types, valves, drains, and cleanouts.

2. Product Data: Submit manufacturers' product data for specified materials and equipment.

3. Test Reports: Submit certified test results and certificates of compliance as necessary to verify conformance with specified requirements.

B. Installation:

1. Plan: Identify how the quality of materials and installation will be controlled (e.g. measurements, inspections, testing, etc.) in accordance with Section 01400 – Quality Control.

2. Workforce Qualifications: Submit verification that the workforce is qualified to complete the work of this Section (licenses, certifications, etc.) and that the work has been effectively supervised (manager, foreman, etc.).

## 1.04 QUALITY CONTROL

A. Production staff shall check each length of pipe produced for the items listed below. The results of all measurements shall be recorded on production sheets, which become part of the manufacturer’s permanent records.

1. Visually check pipe, inside and out for cosmetic defects (grooves, pits, hollows, etc.).

2. Pipe outside diameter shall be measured using a suitable periphery tape to ensure conformance with ASTM B 42 (2002e1).

3. Pipe wall thickness shall be measured at 12 equally spaced locations around the circumference at both ends of the pipe to ensure conformance with ASTM B 42 (2002e1).

4. Pipe length shall be measured.

5. Pipe marking shall be examined and checked for accuracy.

6. Pipe ends shall be checked to ensure they are cut square and clean.

## 1.05 COMPATIBILITY

A. CONTRACTOR is responsible for compatibility between pipe materials, fittings and appurtenances.

## 1.06 WARRANTY

A. The pipe Manufacturer shall provide a warranty against manufacturing defects of material and workmanship for a period of ten years after the final acceptance of the project by the OWNER. The Manufacturer shall replace at no expense to the OWNER any defective pipe/fitting material including labor within the warranty period.

# PART 2 PRODUCTS

## 2.01 MATERIALS

A. Copper water pipe and tube shall conform to the requirements of ASTM B 88 - Seamless Copper Water Tube. Unless otherwise indicated, copper water pipe and tube shall be of Type K wall thickness.

B. Joints: Copper water tube shall have soldered joints, flared ends and fittings, or compression type joints. Soldered joints shall be made with 95 - 5 percent tin-antimony solder or with silver solder. Buried piping shall have flared or compression type joints. No soft-soldered joints will be allowed on buried piping. No solders containing more than 0.2 percent of lead shall be used.

1. Soldered Fittings: Soldered fittings shall conform to ANSI B 16.18 or ASME B 16.22.

2. Flared Fittings: Flared fittings shall conform to ASME B 16.26

3. Compression Fittings: Compression type fittings shall be brass fittings

4. Flanged Fittings: Cast copper alloy flanges and flanged fittings shall conform with ASME B 16.24

## 2.02 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

B. The use of chains, hooks, or other equipment that might injure the pipe coating/exterior will not be permitted.

C. Stockpiled pipe shall be supported on padded skids, sand or earth berms free of rock exceeding 3-inches diameter, sand bags, or suitable means so that the coating will not be damaged.

D. All materials shall be delivered and distributed at the site by CONTRACTOR. In distributing pipe and fittings at the site of work, each piece shall be unloaded with care opposite or near the place where it is to be laid in the trench. Under no circumstances shall such material be dropped, skidded or rolled against pipe or fittings already on the ground. Should any part of coating or lining of the pipe or fitting be damaged, the repair shall be equal to or better than the original coating or lining and the repair shall be done in accordance with the manufacturers recommendation or in accordance with the applicable standards specified for the work.

## 2.03 BURRIED PIPE WARNING TAPE

A. All buried pipe shall have a plastic warning tape placed at 2-feet above pipe.

# PART 3 EXECUTION

## 3.01 GENERAL

A. Tubing shall be firmly supported with fabricated or commercial hangers, brackets, or supports in accordance with Section 15061, “Hangers and Supports”.

B. Excavation and Backfill. -Excavation and backfill shall conform to the applicable provision of Section 02200, "Excavation, Backfilling, and Compaction". The minimum clear width of trench measured at the horizontal diameter of the pipe shall be 18 inches or one foot greater than the outside diameter of the barrel of the pipe, whichever is greater. The maximum clear width of trench at the top of the pipe shall be not more than the outside diameter of the barrel of the pipe plus 2 feet and shall rise vertically to a height of at least 12 inches above the pipe.

C. Bedding. -Pipe shall be laid on a firm bedding foundation of the type and class as specified on the plans, and shall have a constant bearing for its entire length except at joints. Bells or couplings shall not rest on solid original trench bottoms; bell or coupling holes shall be excavated. Laying of pipe on earth mound or blocking will not be permitted.

D. Placing: According to the class and type of bedding specified, the bedding material may be required to be placed and compacted in more than one lift. Class I material requires little or no compacting. If no imported material is required for bedding the pipe, the initial backfill of the trench shall be native soil carefully shaded around the pipe and carefully compacted to the haunch line of the pipe. Precautions shall be taken to prevent movement of the pipe during placement of initial backfill.

E. Regardless of the type of pipe shown on the plans or specified in the special provisions, the standard procedures for pipe laying specified herein shall apply.

1. Pipe will be carefully inspected by the ENGINEER in the field before and after laying. If any cause for rejection is discovered in the pipe, or its installation, the pipe shall be removed and any corrective action taken subject to the approval of the OWNER's Representative.

2. Laying of pipe and assembly of joints shall be in accordance with the printed instructions of the manufacturer and as specified herein.

3. At the time of laying pipe, the prepared trench shall be in a firm and dry condition. If trench is not in such condition, the contractor shall furnish and operate such pumps or other devices as may be necessary for removing water from trenches during the construction of pipeline system.

4. Necessary facilities shall be provided for lowering and properly placing the sections of pipe in the trench without damage. Each section of pipe, of the diameter as called for shall be laid true to the lines and grades as shown on the plans.

5. Pipe interiors shall be thoroughly cleaned of all foreign matter before being lowered into the trench. At all times when work is not in progress, ends of pipe and fittings shall be securely closed so that trench water, earth, or other substances cannot enter.

6. The pipe shall be laid on a firm bedding foundation of the type and class as indicated on the plans and shall have a constant bearing for its entire length. Wedging or blocking of pipe will not be permitted. Under no circumstances shall pipe be dropped into the trench.

7. Cutting of pipe for closures or other reasons shall be done in a neat and workmanlike manner by methods which will not damage the pipe or cement lining and will leave the cut end smooth and at right angles to the axis of the pipe. Deflections from a straight line or grade resulting from horizontal or vertical curves or offsets shall not exceed the limits recommended by the manufacturer. If the required alignment requires deflections in excess of such limits for standard sections of pipe, special bends or a sufficient number of shorter lengths shall be provided to meet the offset limits.

8. When connections are to be made to any existing pipe or other appurtenances, the actual elevation or position shall be verified before laying any pipe. The Contractor shall notify the OWNER's Representative for inspection of the existing pipe or appurtenance before connection is made. All adjustments in line or grade which may be necessary shall be made.

9. Brazed and Soldered Joints: Brazed and soldered joints shall conform to the manufacturer's recommendations and to the specifications and recommendations of ASME B 31.1. Brazing shall be done by skilled and qualified welders per Section 15001, "Process Piping – General". Prior to the application of flux, the ends of tubes shall be thoroughly dried and cleaned.

## 3.02 FIELD QUALITY CONTROL

A. Quality control will be performed under the provisions of Section 01400.

B. Products: Submit verification that the installed products are authentic (delivery receipts, bill of lading, etc.).

C. Execution: Submit verification that the work was installed correctly (inspection records, as-built drawings, etc.).

1. Provide survey coordinates for all buried tees, bends and valves (top operating nut).

2. Provide photographs for all buried products.

D. Testing and Inspection

1. The Contractor's QC program shall be responsible for the performance of all inspections and testing.

2. The Contractor shall provide access to the ENGINEER or Testing Agency for inspection and testing.

E. Inspections by the Contractor will include:

1. Reviewing manufacturer's recommended application procedures.

2. Continuously inspect installation for conformance with Contract Documents and manufacturer's recommendations.

3. Finished installations shall be carefully inspected for proper joints and supports, anchoring, interferences, and damage to tubing, fittings, and coating. Defective WORK shall be repaired.

F. Field Testing: Prior to enclosure or burying, tubing systems shall be pressure tested as required in the Piping Schedule, for a period of not less than one hour without exceeding the tolerances listed in the Piping Schedule. Where no pressures are indicated, the tubes shall be subject to 1-1/2 times the maximum working pressure.

## 3.03 3.03 SURFACE RESTORATION

A. All pavement, sidewalk, curbing, gutters, fences or other disturbed surfaces or structures shall be restored or replaced to a condition equal to that before the work began. Such work shall be in accordance with the applicable provisions of the OWNER's Standard Specifications.

**END OF SECTION**

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**TECHNICAL SPECIFICATIONS**
**DIVISION 15: MECHANICAL**
**15200: VALVES, ACTUATORS AND SEISMIC JOINTS**

## PART 1 GENERAL

### 1.01 SCOPE

A. CONTRACTOR shall provide all valves, actuators, and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all valves and valve actuators except where otherwise indicated. Valves and actuators in particular locations may require a combination of units, sensors, limit switches, and controls indicated in other Sections of the Specifications.

C. Where a valve is to be supported by means other than the piping to which it is attached, CONTRACTOR shall obtain from the valve manufacturer a design for support and foundation that satisfies the criteria in Section 15006 – Pipe Supports. The design, including drawings and calculations sealed by an engineer, shall be submitted with the Shop Drawings. When the design is approved, the support shall be provided.

D. **Unit Responsibility:** A single manufacturer shall be made responsible for coordination of design, assembly, testing, and furnishing of each valve; however, CONTRACTOR shall be responsible to the OWNER for compliance with the requirements of each valve section. Unless indicated otherwise, the responsible manufacturer shall be the manufacturer of the valve.

E. **Single Manufacturer:** Where two or more valves of the same type and size are required, the valves shall be furnished by the same manufacturer.

### 1.02 REFERENCES

A. American National Standards Institute (ANSI):

1. ANSI B1.1, Unified Screw Threads (UN and UNR Thread Form).

2. ANSI B1.20.1, Pipe Threads, General Purpose (Inch).

3. ANSI B16.5, Steel Pipe Flanges and Flanged Fittings (including ratings for Class 150, 300, 400, 600, 900, 1500, and 2500).

4. ANSI B16.10, Face-to-Face and End-to-End Dimensions of Valves.

5. ANSI B16.11, Forged Steel Fittings, Socket-Welding and Threaded.

6. ANSI B16.15, Cast Bronze Threaded Fittings.

7. ANSI B16.18, Cast Copper Alloy Solder-Joint Pressure Fittings.

B. American Society for Testing Materials (ASTM):

1. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

2. ASTM B61, Specification for Stream or Valve Bronze Castings.

C. American Welding Society (AWS), AWS D1.1, Structural Welding Code.

D. American Water Works Association (AWWA):

1. AWWA C504 – Rubber-Seated Butterfly Valves

2. AWWA C512 Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service

3. AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants

4. AWWA C219, Bolted, Sleeve-Type and Coupling for Plain-End Pipe.

E. California American Water (CAW) Standard Drawings and Specifications (latest version)

## 1.03 CONTRACTOR SUBMITTALS

A. **General:** Submittals shall be furnished in accordance with Section 01300 – Contractor Submittals.

B. **Quality Control:**

1. Identify how the quality of materials and installation will be controlled (e.g. measurements, inspections, testing, etc.) in accordance with Section 01400 – Quality Control.

C. **Product Data:**

1. Submit manufacturer's catalog data and detail construction sheets showing all valve parts. Describe each part by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Identify each valve by tag number to which the catalog data and detail sheets pertain.

2. Show valve linings and coatings. Submit manufacturer's catalog data and descriptive literature.

D. **Shop Drawings:** Shop Drawings shall contain the following information:

1. Valve name, size, Cv factor, pressure rating, identification number (if any), and specification section number.

2. Complete information on valve actuator, including size, manufacturer, model number, limit switches, and mounting.

3. Cavitation limits for all control valves.

4. Assembly drawings showing part nomenclature, materials, dimensions, weights, and relationships of valve handles, handwheels, position indicators, limit switches, integral control systems, needle valves, and control systems.

5. Valve Labeling: A schedule of valves to be furnished indicating the valve location and the proposed wording for the label.

E. **Technical Manual:** The Technical Manual shall contain the required information for each valve.

F. **Spare Parts List:** A Spare Parts List shall contain the required information for each valve assembly, where indicated.

G. **Factory Test Data:** As a minimum, unless otherwise indicated or recommended by the reference Standards, valves 3-inches in diameter and smaller shall be tested in accordance with manufacturer's standard and 4-inches in diameter and larger shall be factory tested as follows:

1. **Hydrostatic Testing:** Valve bodies shall be subjected to internal hydrostatic pressure equivalent to twice the water rated pressure of the valve. Metallic valves rating pressures shall be at 100 degrees F and plastic valves shall be 73 degrees, or at higher temperature according to type of material. During the hydrostatic test, there shall be no leakage through the valve body, end joints, or shaft seals, nor shall any part of the valve be permanently deformed. The duration shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes.

2. **Seat Testing:** Valves shall be tested for leaks in the closed position with the pressure differential across the seat equal to the water rated pressure of the valve. The duration of test shall be sufficient time to allow visual examination for leakage. Test duration shall be at least 10 minutes. Leakage past the closed valve shall not exceed 1 fluid ounce per hour per inch diameter for metal seated valves and drop- tight for resilient seated valves.

3. **Performance Testing:** Valves shall be shop operated from fully closed to fully open position and reverse under no-flow conditions in order to demonstrate the valve assembly operates properly.

4. **Certification:** Prior to shipment, CONTRACTOR shall submit for valves over 12-inches in size, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, or ASTM.

## 1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Preparation for Transport:

Prepare valves for shipping as follows:

1. Ensure valves are dry and protected against internal rust and corrosion.

2. Protect valve ends against damage to threads, flange faces, and weld-end preps.

3. Set valves in best position for handling. Set globe and gate valves closed to prevent rattling; set ball and plug valves open to minimize exposure of functional surfaces; set butterfly valves closed or slightly open; and block swing check valves in either closed or open position.

4. Storage: Use the following precautions during storage:

   a. Do not remove valve end protectors unless necessary for inspection; then reinstall for storage.

   b. Protect valves from weather. Store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement in watertight enclosures.

5. Handling: Use a sling to handle valves whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use handwheels and stems as lifting or rigging points.

## 1.05 WARRANTY

A. Furnish and submit a two-year warranty for all work covered by this Section.

## PART 2 PRODUCTS

### 2.01 GENERAL

A. Valves are identified on the plans.

B. Install valves complete with extension stems and operating nuts required for operation.

C. Valves shall have the name of the manufacturer and the size of the valve cast or molded onto the valve body or bonnet or shown on a permanently attached plate.

D. All packing and gaskets shall be of non-asbestos material.

### 2.02 VALVES

A. Gate Valves:

1. General Requirements

a. Unless otherwise specified below, these requirements shall apply to all gate valves.

b. Gate valves shall meet the requirements of AWWA C500 and AWWA C509 as applicable to the type of valve specified. Gate valves shall also meet the requirements of CAW's standard drawings and specifications.

c. Buried and submerged valves shall be furnished with mechanical, flanged, or push-on joints (as shown in the drawings) and stainless steel hardware; non-rising stem design.

d. All-metal valves shall be manufactured of ASTM A126 Cast Iron, Class B, with bronze mounting design.

e. Non-rising stem valves shall use double O-ring stem seal, except that packing shall be used where geared operators are required.

f. Except as otherwise specified, valves shall be rated for the working water pressures as indicated on the drawings.

g. Flanged valves shall have face-to-face dimensions per ANSI B16.1 and flanges per ANSI B16.10.

h. All valve bodies shall be hydrostatically tested to at least twice the rated working water pressure. In addition, valves shall be seat-tested, bi-directional at the rated working pressure, with seat leakage not to exceed one fluid ounce per inch of valve diameter per hour.

i. All bonnet and packing gland bolts shall be zinc- or cadmium-electroplated steel; packing gland bolts shall have bronze nuts.

j. All valves shall be marked per AWWA Standards, including name of manufacturer, valve size, working pressure and year of manufacture.

k. Unless otherwise indicated, valves 12-in and smaller shall be capable of installation in vertical or horizontal position, and sealing both directions at the rated pressure.

l. Valve operation shall be **counterclockwise**. Provide permanent label showing "OPEN" and arrows.

m. Resilient seated valves shall be coated, interior and exterior, with fusion bonded epoxy per AWWA C550.

2. Valve Applications

a. All Valves

(1) Resilient seated design manufactured by Mueller Company, Model A-2361 or approved equal.

(2) NSF 61 certification for use with potable water.

3. Valve Requirements

a. Resilient Seated

(1) Conform to AWWA C509. Also UL and FM approved.

(2) Internal and external epoxy coating of valve body, including bonnet, per AWWA C550.

(3) Gate shall be encapsulated with synthetic rubber. It shall be bonded and vulcanized in accordance with ASTM B429 Method B.

(4) No recesses in valve body.

4. Buried Valves

a. Conform to the requirements above, except mechanical push-on, or flanged ends per AWWA C111 as shown in the drawings.

(1) All exposed valve hardware (nuts, bolts, washers, etc.) including bonnet, bonnet cover, stiffing box, gear adaptor and joints shall be Type 304 stainless steel.

b. Non-rising stem design, double O-ring seals for non-geared valves and shall incorporate packing for geared valves.

c. Provide valve box, 2-in operating nut, extension stem (as required) and valve box cover.

B. Combination Air/Vacuum Release Valves for Potable Water Service:

1. Standards, Approvals and Verification

a. Valves shall be manufactured and tested in accordance with American Water Works Association (AWWA) Standard C512.

b. Valves used in potable water service shall be certified to ANSI/NSF 61 Drinking Water System Components – Health Effects.

2. Manufacturer shall have a quality management system that is certified to ISO 9001:2000 by an accredited, certifying body.

3. Combination Air Release Valves for normal service shall be manufactured by Val-Matic Series 206C or 256C (single body) as indicated on the drawings.

4. Combination Air/Vacuum Release Valves for Brine and Saltwater Service shall be Val-Matic Model 206CX Water Combination Air Valve, Single

Body Type, Cast Stainless Steel Construction, Rated 150 PSI, 125# Flanged Inlet, 316 Stainless Steel Trim, Resilient seals shall be BUNA Rubber, Stainless Steel Body Fasteners.

C. Rubber Seated Butterfly Valves 25 to 150 psi (AWWA) for Potable Water Service:

1. **General:** Butterfly valves for steady-state water working pressures and steady-state differential pressure up to 150 psi and for fresh water service having a pH range from 6 to 10 and temperature range from 33 to 125 degrees F shall conform to AWWA C504 and be as indicated. Valves subjected to steady state working pressures and steady state differential pressures from 25 to 150 psi in sizes 3-inches through 24-inches shall be rated for Class 150B with actuator sized for Class 150B. Valves 30 inches through 72-inches shall be of the class indicated. Valves larger than 72-inches shall be of the class indicated, designed in accordance with the intent of AWWA C504. If the operating conditions such as flow, velocity, and differential pressures are not indicated, the valve body and shaft shall be sized for the pressure class rating of the valve.

2. **Valves** shall be of the body type, pressure class, end joint, and actuator as indicated on the contract drawings.

3. **Construction:** Unless otherwise indicated, materials of construction shall be in accordance with AWWA C504, suitable for the service. Seats shall be positively clamped or bonded into the disc or body of the valve, but cartridge-type seats that rely on a high coefficient of friction for retention shall not be acceptable. Seat material shall be guaranteed to last for at least 75 percent of the number of cycles in the AWWA C504 proof-of-design test without premature damage.

| Description | Material Standards |
|---|---|
| Valve bodies | Gray iron, ASTM A 126, Class B |
| End flanges | Gray iron, ASTM A 126, Class B |
| Valve shafts | Stainless steel ASTM A 240 or A 276, Type 316 |
| Valve discs | Gray iron, ASTM A 126, Class B |
| Rubber seats | New natural or synthetic rubber |
| Seat mating surfaces | Stainless steel, ASTM A 240 or A 276, Type 316 |

| | |
|---|---|
| Clamps and retaining rings | Type 316 retaining rings and cap screws. |
| Valve bearings | Self-lubricating materials per AWWA C504 |
| Shaft seals | Resilient non-metallic materials suitable for service |
| Painting and coating | Refer to Section 09900 – Protective Coating |

4. **Manual Actuators:** Unless otherwise indicated, manually-actuated butterfly valves shall be equipped with a 2-inch square actuating nut. Screw-type (traveling nut) actuators will not be permitted for valves 30-inches in diameter and larger.

5. **Worm Gear Actuators**: Valves 30-inches and larger, as well as submerged and buried valves, shall be equipped with worm-gear actuators, lubricated and sealed to prevent entry of dirt or water into the housing.

6. Butterfly valves shall be manufactured by Mueller Lineseal III, or approved equal

D. Rubber Seated Butterfly Valves 250 psi (AWWA) for Potable Water Service:

1. **General:** Butterfly valves for steady-state water working pressures and steady-state differential pressure up of 250 psi and for fresh water service having a pH range from 6 to 10 and temperature range from 33 to 125 degrees F shall conform to AWWA C504 and be as indicated. Valves shall be rated for Class 250B with actuator sized for Class 250B. If the operating conditions such as flow, velocity, and differential pressures are not indicated, the valve body and shaft shall be sized for the pressure class rating of the valve.

2. **Valves** shall be of the body type, pressure class, end joint, and actuator as indicated on the contract drawings.

3. **Construction:** Unless otherwise indicated, materials of construction shall be in accordance with AWWA C504, suitable for the service. Seats shall be positively clamped or bonded into the disc or body of the valve, but cartridge-type seats that rely on a high coefficient of friction for retention shall not be acceptable. Seat material shall be guaranteed to last for at least 75 percent of the number of cycles in the AWWA C504 proof-of-design test without premature damage.

| Description | Material Standards |
|---|---|
| Valve bodies | Ductile Iron ASTM A-536 |
| End flanges | Ductile Iron ASTM A-536 |
| Valve shafts | Stainless Steel ASTM A-564 Type 630 Cond. H-1150 |
| Valve discs | Ductile Iron ASTM A-536 Grade 65-45-12, Edge Type 316 Stainless Steel |
| Rubber seats | New natural or synthetic rubber |
| Seat mating surfaces | Stainless steel, ASTM A 240 or A 276, Type 316 |
| Clamps and retaining rings | Type 316 retaining rings and cap screws. |
| Valve bearings | Self-lubricating materials per AWWA C504 |
| Shaft seals | Resilient non-metallic materials suitable for service |
| Painting and coating | Refer to Section 09900 – Protective Coating |

4. **Manual Actuators:** Unless otherwise indicated, manually-actuated butterfly valves shall be equipped with a 2-inch square actuating nut. Screw-type (traveling nut) actuators will not be permitted for valves 30-inches in diameter and larger.

5. **Worm Gear Actuators**: Valves 30-inches and larger, as well as submerged and buried valves, shall be equipped with worm-gear actuators, lubricated and sealed to prevent entry of dirt or water into the housing.

6. Butterfly valves shall be manufactured by Mueller Lineseal XPII, or approved equal.

E. Tapping Valves:

1. Tapping valves shall be Mueller A2360 with flange inlets and mechanical joint outlets and be supplied with 304 stainless steel washers, nuts and bolts.

F. Pressure Relief Valves:

1. Pressure relief valves shall be Cla-Val Model 50-01 series Class 150, globe style, 20 - 200 psi controls, epoxy coated body w/ stainless steel trim & controls.

G. Pressure Reducing Valves:

1. Main Valve: The valve shall be hydraulically operated, single diaphragm-actuated, globe pattern. The valve shall consist of three major components: the body, with seat installed; the cover, with bearings installed; and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the main valve or pilot controls.

2. Main Valve Body: No separate chambers shall be allowed between the main valve cover and body. Valve body and cover shall be made of ductile iron. The valve shall have Class 150 flanged connections. No fabrication or welding shall be used in the manufacturing process. Main valve shall be Hytrol 100-01/100-20 body.

3. The valve shall contain a resilient, synthetic rubber disc, with a rectangular cross-section contained on three and one-half sides by a disc retainer and forming a tight seal against a single removable seat insert. No O-ring type discs (circular, square, or quad type) shall be permitted as the seating surface. The disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the disc firmly in place. The disc retainer shall be of a sturdy one-piece design capable of withstanding opening and closing shocks. Disc retainer shall have straight edge sides and a radius at the top edge to prevent excessive diaphragm wear as the diaphragm flexes across this surface. No hourglass-shaped disc retainers shall be permitted and no V-type or slotted type disc guides shall be used.

4. The diaphragm assembly containing a non-magnetic 303 stainless steel stem with sufficient diameter to withstand high hydraulic pressures shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. No center guides shall be permitted. The stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure.

5. The flexible, non-wicking, FDA approved diaphragm shall consist of nylon fabric bonded with synthetic rubber compatible with the operating fluid. The center hole for the main valve stem shall be sealed by the vulcanized

process or a rubber grommet sealing the center stem hole from the operating pressure. The diaphragm shall withstand a Mullins Burst Test of a minimum of 600 psi per layer of nylon fabric and shall be cycle tested 100,000 times to insure longevity. The diaphragm shall not be used as the seating surface. The diaphragm shall be fully supported in the valve body and cover by machined surfaces which support no less than one-half of the total surface area of the diaphragm in either the fully opened or fully closed position.

6. The main valve seat and the stem bearing in the valve cover shall be removable. The cover bearing and seat in 6" and smaller size valves shall be threaded into the cover and body. The valve seat in 8" and larger size valves shall be retained by flat head machine screws for ease of maintenance. The lower bearing of the valve stem shall be contained concentrically within the seat and shall be exposed to the flow on all sides to avoid deposits. To insure proper alignment of the valve stem, the valve body and cover shall be machined with a locating lip. No "pinned" covers to the valve body shall be permitted. Cover bearing, disc retainer, and seat shall be made of the same material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline. Packing glands and/or stuffing boxes shall not be permitted.

7. Materials of construction shall meet the following requirements:

| Description | Material Standards |
|---|---|
| Body & Cover | Ductile Iron, ASTM A536 |
| Disc Retainer & Diaphragm Washer | Cast Iron |
| Trim: Disc Guide, Seat and Cover Bearing | Stainless Steel |
| Disc | Buna-N Rubber |
| Diaphragm | Nylon Reinforced Buna-N Rubber |
| Stem, Nut and Spring | Stainless Steel |

8. Pilot Control System: The pressure reducing pilot control shall be a direct-acting, adjustable, spring-loaded, normally open, diaphragm valve designed to permit flow when controlled pressure is less than the spring setting. Pilot control system material shall be bronze. Trim shall be stainless steel. Rubber material shall be Buna-N Rubber. The pilot control is held open by the force of the compression on the spring above the diaphragm, and it closes when the delivery pressure acting on the underside of the diaphragm exceeds the spring setting. Adjustment range shall be 30 – 300 psi.

   The pilot control system shall include a fixed orifice. No variable orifices shall be permitted. The pilot system shall include an opening speed control on all valves.

   The pilot control shall have a second downstream sensing port which can be utilized to install a pressure gauge.

9. The valve shall be Cla-Val Co. Model No. 90-01.

10. Where specified, the pressure regulating valve shall be supplied with an additional rate of flow control feature. This valve shall be Cla-Val Co. Model No. 649-01.

## 2.03 VALVE ACTUATORS

A. Provide 2-inch AWWA operating nuts for buried and submerged valves.

B. For buried or submerged service, provide watertight shaft seals and watertight valve and actuator cover gaskets. Provide totally enclosed actuators designed for buried or submerged service.

C. Design actuators on buried valves to produce the required torque on the operating nut with a maximum input of 150 foot-pounds.

D. Valve actuators shall open by turning counterclockwise.

E. Provide one (1) portable electric handheld valve actuator manufactured by Reed Manufacturing Company or equal. The unit shall have spring-loaded valve key clutch, power drive, 2” valve key and valve key extension.

## 2.04 ELECTRIC VALVE ACTUATORS

A. All electric actuators shall conform to the requirements of AWWA Standard C540-93.

B. Actuators shall contain motor, gearing, manual over-ride, limit switches, torque switches, drive coupling, integral motor controls, position feedback transmitter and mechanical dial position indicator.

C. The motor shall be specifically designed for actuator service. The motor will be of the induction type with class F insulation and protected by means of thermal switches imbedded in the motor windings. Motor enclosure will be totally enclosed, nonventilated and epoxy-coated in the factory.

D. Motors will be capable of operating on 460 volt - 3 phase - 60 hertz power except quarterturn valves 16 inches and smaller which shall operate on 120 volt - single phase - 60 hertz power.

E. Actuator enclosure shall be NEMA 4 (watertight). All external fasteners on the electric actuator will be stainless steel. Fasteners on limit switch and terminal compartments shall be captured to prevent loss while covers are removed.

F. All gearing shall be grease lubricated and designed to withstand the full stall torque of the motor.

G. Manual over-ride shall be by handwheel. Manual operation will be via power gearing to minimize required rimpull and facilitate easy change-over from motor to manual operation when actuator is under load. Return from manual to electric mode of operation will be automatic upon motor operation. A seized or inoperable motor shall not prevent manual operation.

H. Limit switches shall be furnished at each end of travel. Limit switch adjustment shall not be altered by manual operation. Limit switch drive shall be by countergear. Limit switches must be capable of quick adjustment requiring no more than five (5) turns of the limit switch adjustment spindle. One set of normally open and one set of normally closed contacts will be furnished at each end of travel where indicated. Contacts shall be of silver and capable of reliably switching low voltage DC source from the control system furnished by others.

I. Mechanically operated torque switches shall be furnished at each end of travel. Torque switches will trip when the valve load exceeds the torque switch setting. The torque switch adjustment device must be calibrated directly in engineering units of torque.

J. All wiring shall be terminated at a plug and socket connector.

K. Quarterturn actuators will be furnished with mechanical stops that restrict the valve/actuator travel.

L. Actuator must be capable of the following valve closing times/operating speeds: quarterturn valves - 60 second closing time, gate valves and sluice gates - 12 inches per minute operating speed.

M. Actuators will be capable of operating in an ambient temperature range of -20 to +175 degrees F (without motor controls) and -20 to +160 degrees F (with motor controls).

N. All actuators in open/close service will be furnished with integral motor controls consisting of reversing starters, control transformer, phase discriminator, monitor relay (to signal fault conditions such as thermal switch trip, torque switch tripped in midtravel, wrong phase sequence or phase failure), "open-stop-close" pushbuttons, "localoff- remote" selector switch in addition to red and green indicating lights. An interface with the control system must be furnished with optical isolators to separate incoming voltage signals from the internal motor controls.

O. Actuators in modulating service will be selected such that the required dynamic valve torque is no more than 60% of the electric actuator’s maximum rated breakaway torque.

P. Power gearing in modulating actuators shall have zero backlash between the motor and actuator output.

Q. All actuators in modulating service will be furnished with a feedback potentiometer in addition to the following motor controls: reversing starters, control transformer, phase discriminator, monitor relay, positioner, "open-stop-close" pushbuttons, "local-offremote" selector switch in addition to red and green indicating lights. The positioner shall be capable of accepting a 4-20mADC command signal and positioning the valve by comparing the command signal with the present valve position as indicated by the feedback potentiometer mounted inside the actuator. The positioner shall be field adjustable to fail to the "open", "closed" or "last" position on loss of 4-20Madc command signal.

R. All actuators shall be manufactured by AUMA Actuators, Inc. of Pittsburgh, Pennsylvania or equal.

## 2.05 SEISMIC JOINTS

A. Seismic joints shall be installed as part of the system for hanging the pipe under the Monte Road Bridge, at each end of the suspended pipe. All flexible expansion joints shall be The Force Balanced double-ball FLEX-TEND No. 412F22, as manufactured by EBAA Iron, Inc. Eastland, TX., U.S.A.,

B. Flexible expansion joints shall be installed in the locations indicated on the drawings

and shall be manufactured of ductile iron conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53. Foundry certification of material shall be readily available upon request.

C. Each flexible expansion joint shall be pressure tested prior to shipment against its own restraint to a minimum of 250 PSI. A minimum 2:1 safety factor, determined from the published pressure rating, shall apply.

D. Each flexible expansion joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of: 25º, 4" - 8"; 20º, 10" - 12"; 15º, 14+" and 8-inches minimum expansion. The flexible expansion fitting shall not expand or exert an axial imparting thrust under internal water pressure. The flexible expansion fitting shall not increase or decrease the internal water volume as the unit expands or contracts.

E. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating shall meet ANSI/NSF-61.

F. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.

G. Polyethylene sleeves, meeting ANSI/AWWA C105/A21.5, shall be included for direct buried applications.

H. Expansion joints shall be installed per manufacturer's requirements and guidelines.

I. Manufacturer Services

1. The CONTRACTOR shall obtain factory service from EBAA to:

    a. Certify Installation

    b. Calibrate the device

    c. Test and Commission

    d. Provide a minimum of one (1) hour of training to the OWNER's personnel on operation, inspection and maintenance procedures, including after a seismic event.

J. Manufacturer's certification of compliance to the above standards and requirements shall be submitted to the OWNER. The purchaser (or owner) shall reserve the right to inspect the manufacturer's facility for compliance.

K. Spare Parts: Provide additional spare parts as specified in Section 16010.

## 2.06 VALVE BOXES

A. All valve boxes shall be Christy G5 Traffic Valve Box with G5C non-locking type metal lid marked "Water". 8" SDR 35 PVC pipe shall be used as extension as shown the drawings.

## 2.07 BOLTS AND NUTS FOR FLANGED VALVES

A. Bolts and nuts for flanged valves shall be provided by CONTRACTOR and meet AWWA and manufacturer requirements for the intended service.

## 2.08 GASKETS AND FLANGES

A. Gaskets for flanged end valves shall be NSF 61 certified and provided by CONTRACTOR. The gaskets shall also meet the manufacturer requirements for the intended service.

## 2.09 PAINTING AND COATING

A. Coat metal valves located above ground or in vaults and structures in accordance with Section 09900, "Paints and Coatings". Apply the specified prime coat at the place of manufacture. Apply intermediate and finish coats in field. Finish coat shall match the color of the adjacent piping.

B. Line the interior metal parts of metal valves 4 inches and larger, excluding seating areas and bronze and stainless-steel pieces, per Section 09900, "Paints and Coatings".

C. Test the valve interior linings and exterior coatings at the factory with a low-voltage (22.5 to 80 volts, with approximately 80,000-ohm resistance) holiday detector, using a sponge saturated with a 0.5 percent sodium chloride solution. The lining shall be holiday free.

D. Measure the thickness of the valve interior linings per Section 09900, "Paints and Coatings". Repair areas having insufficient film thickness per Section 09900, "Paints and Coatings".

## 2.10 PACKING, O-RINGS, AND GASKETS

A. Unless otherwise stated in the detailed valve specifications, packing, O-rings, and gaskets shall be one of the following nonasbestos materials:

1. Teflon.

2. Kevlar Aramid fiber.

3. Acrylic or Aramid fiber bound by nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or equal.

4. Buna-N (nitrile).

## 2.11 RUBBER SEATS

A. Rubber seats shall be made of a rubber compound that is resistant to free chlorine and monochloramine concentrations up to 10 mg/l in the fluid conveyed.

## 2.12 VALVE ACCESSORIES

A. Four (4) tee handles shall be provided to operate buried valves.

B. Valves shall be furnished complete with the accessories required to provide a functional system.

## 2.13 SPARE PARTS

A. CONTRACTOR shall furnish the required spare parts suitably packaged and labeled with the valve name, location, and identification number. CONTRACTOR shall also furnish the name, address, and telephone number of the nearest distributor for the spare parts of each valve. Spare parts are intended for use by the OWNER, after expiration of the correction of defects period.

# PART 3 EXECUTION

## 3.01 VALVE INSTALLATION

A. **General:** Valves, actuating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the manufacturer's written instructions and as indicated. Gates shall be adequately braced to prevent warpage and bending under the intended use. Valves shall be firmly supported to avoid undue stresses on the pipe.

B. **Valve markers:** Valves in open areas not located in streets or paved areas shall have valve markers labeled with “WATER VALVE” and corresponding identification number. Identification numbers are shown on the drawings.

## 3.02 JOINTS

A. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts

and bolts, reseat or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

B. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound to pipe threads before installing threaded valves. Joints shall be watertight.

## 3.03 FIELD QUALITY CONTROL

A. Quality control will be performed under the provisions of Section 01400.

B. Products: Submit verification that the installed products are authentic (delivery receipts, bill of lading, etc.).

C. Execution: Submit verification that the work was installed correctly (inspection records, as-built drawings, etc.).

1. Provide survey coordinates for all buried valves (top operating nut).

2. Provide photographs for all buried products.

D. Testing and Inspection

1. The City will be responsible for all required Special Inspections. CONTRACTOR's QC program shall be responsible for the performance of all inspections.

2. CONTRACTOR shall provide access to the Engineer or Testing Agency for inspection and testing of valves.

E. Inspections by CONTRACTOR will include:

1. Reviewing manufacturer's recommended application procedures.

2. Continuously inspect installation for conformance with Contract Documents and manufacturer's recommendations.

3. Valve Leakage Testing: Test valves for leakage at the same time that the connecting pipelines are tested. Protect or isolate any parts of valves, actuators, or control and instrumentation systems whose pressure rating is less than the pressure test. Valves shall show zero leakage. Repair or replace any leaking valves and retest.

4. Valve Field Testing: Operate manual valves through three full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. Do not backfill buried valves until after verifying that valves operate from full open to full closed. If valves stick or bind, or do not operate from full open to full closed, repair or replace the valve and repeat the tests.

**END OF SECTION**

**TECHNICAL SPECIFICATIONS**
**DIVISION 15: MECHANICAL**
**15201: VALVE AND GATE ACTUATORS**

## PART 1 GENERAL

### 1.01 THE REQUIREMENT

A. The CONTRACTOR shall provide valve and gate actuators and appurtenances, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to valves and gates except where otherwise indicated in the Contract Documents.

C. **Unit Responsibility:** The valve or gate manufacturer shall be made responsible for coordination of design, assembly, testing, and installation of actuators on the valves and gates; however, the CONTRACTOR shall be responsible to the OWNER for compliance of the valves, gates, and actuators with the Contract Documents.

D. **Single Manufacturer:** Where 2 or more valve or gate actuators of the same type or size are required, the actuators shall be produced by the same manufacturer.

### 1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300 - Contractor Submittals and Section 15200 – Valves and Seismic Fittings.

B. **Shop Drawings:** Shop Drawing information for actuators shall be submitted together with the valve and gate submittals as a complete package.

C. **Calculations:** Selection calculations showing dynamic seating and unseating torques versus output torque of actuator.

## PART 2 PRODUCTS

### 2.01 GENERAL

A. Unless otherwise indicated, shut-off and throttling valves and externally actuated valves and gates shall be provided with manual or power actuators. The CONTRACTOR shall furnish actuators complete and operable with mounting hardware, motors, gears, controls, wiring, solenoids, handwheels, levers, chains, and extensions, as applicable. Actuators shall have the torque ratings equal to or greater than required for valve seating and dynamic torques, whichever is greater, and shall be capable of holding the valve in any intermediate position between fully-open and fully-closed without creeping or fluttering. Actuator torque ratings for butterfly valves shall be determined in accordance with AWWA C504 - Rubber-Seated Butterfly Valves. Wires of motor-driven actuators shall be identified by unique numbers.

B. **Manufacturers:** Where indicated, certain valves and gates may be provided with actuators manufactured by the valve or gate manufacturer. Where actuators are furnished

by different manufacturers, the CONTRACTOR shall coordinate selection to have the fewest number of manufacturers possible.

C. **Materials:** Actuators shall be current models of the best commercial quality materials and be liberally-sized for the required torque. Materials shall be suitable for the environment in which the valve or gate is to be installed.

D. **Actuator Mounting and Position Indicators:** Actuators shall be securely mounted by means of brackets or hardware specially designed and sized for this purpose and be of ample strength. The word "open" shall be cast on each valve or actuator with an arrow indicating the direction to open in the counter-clockwise direction. Gear actuators shall be equipped with position indicators. Where possible, manual actuators shall be located between 48- and 60-inches above the floor or the permanent working platform.

E. **Standard:** Unless otherwise indicated and where applicable, actuators shall be in accordance with AWWA C 540 - Power-Actuating Devices for Valves and Slide Gates.

F. Fasteners shall be in accordance with Section 05500 - Miscellaneous Metalwork.

G. Protective coatings shall be in accordance with Section 09900 - Paints and Coatings.

## 2.02 MANUAL ACTUATORS

A. **General:** Unless otherwise indicated, valves and gates shall be furnished with manual actuators. Valves in sizes up to and including 4-inches shall have direct acting lever or handwheel actuators of the manufacturer's best standard design. Larger valves and gates shall have gear-assisted manual actuators, with an operating pull of maximum 60 pounds on the rim of the handwheel. Buried and submerged gear-assisted valves, gates, gear-assisted valves for pressures higher than 250 psi, valves 30-inches in diameter and larger, and where so indicated, shall have worm gear actuators, hermetically-sealed water-tight and grease-packed. Other valves 6-inches to 24-inches in diameter may have traveling nut actuators, worm gear actuators, spur or bevel gear actuators, as appropriate for each valve.

B. **Buried Valves:** Unless otherwise indicated, buried valves shall have extension stems to grade, with square nuts or floor stands, position indicators, and cast-iron or steel pipe extensions with valve boxes, covers, and operating keys. Where so indicated, buried valves shall be in cast-iron, concrete, or similar valve boxes with covers of ample size to allow operation of the valve actuators. Covers of valve boxes shall be permanently labeled as required by the OWNER. Wrench nuts shall comply with AWWA C 500 - Metal - Seated Gate Valves for Water Supply Service.

C. **Floor Boxes:** Hot dip galvanized cast iron or steel floor boxes and covers to fit the slab thickness shall be provided for operating nuts in or below concrete slabs. For operating nuts in the concrete slab, the cover shall be bronze-bushed.

D. **Tee Wrenches:** Buried valves with floor boxes shall be furnished with 2 operating keys or 1 key per 10 valves, whichever is greater. Tee wrenches sized so that the tee handle will be 2 to 4 feet above ground, shall fit the operating nuts.

E. **Manual Worm Gear Actuator:** The actuator shall consist of a single or double reduction gear unit contained in a weather-proof cast iron or steel body with cover and minimum 12-inch diameter handwheel. The actuator shall be capable of 90 degree rotation and shall be equipped with travel stops capable of limiting the valve opening and closing. The actuator shall consist of spur or helical gears or worm gearing. The gear ratio shall be self-locking to prevent "back-driving." The spur or helical gears shall be of hardened alloy steel and the worm gear shall be alloy bronze. The worm gear shaft and the handwheel shaft shall be of 17-4 PH or similar stainless steel. Gearing shall be accurately cut with hobbing machines. Ball or roller bearings shall be used throughout. Output shaft end shall be provided with spline to allow adjustable alignment. Actuator output gear changes shall be mechanically possible by simply changing the exposed or helical gearset ratio without further disassembly of the actuator. Gearing shall be designed for a 100 percent overload. The entire gear assembly shall be sealed weatherproof.

## 2.03 ELECTRIC VALVE ACTUATOR

A. Electric valve actuators shall conform to AWWA C-540 except as modified herein and shall include the motor, actuator unit gearing, limit switch gearing, position limit switches, controls, worm gear reducer, and handwheel as a self-contained unit. Actuator shall be rated for weatherproof NEMA IV operation and mounted in the direction as shown on the drawings. Actuator and gearboxes shall be rated at a minimum 1.5 and 2.0 times the maximum operating torque required by the valve as determined by the valve manufacturer for isolation and modulating valves respectively. Associated valve control panels and devices shall be supplied by the actuator manufacturer as specified in these Specifications and as shown in the Drawings.

1. The actuator motor shall be powered by 3 Phase/60 Hz/230 VAC except quarterturn valves 16 inches and smaller which shall operate on 120 volt - single phase - 60 hertz power.

1. Provide an integral reversing starter with three (3) automatic reset overload relays or thermal protection internal to the motor, a fused control transformer and 24 VDC power supply for internal and external control wiring. A mechanical dial position indicator, gearing and 4-20mA position feedback transmitter powered by the actuators power supply or loop powered shall be supplied. Compression type terminal strips shall be supplied for all remote actuator power, control and indication connections and shall be manufactured by Phoenix Contact. Control terminals shall be rated at 300 Volts and accept an AWG 24-12 wire gauge range. Power terminals shall be rated at 600 Volts and accept an AWG 30-10 wire gauge range. The electrical compartment shall have a

minimum of 3 conduit entries for power, discrete control and instrumentation wiring. A minimum of three (3) 1-1/2-in NPT entries are required. The termination compartment shall be sealed separately from the internal actuator controls compartment to prevent the possibility of water intrusion into the actuator's control compartment from an open conduit or other means. The actuator shall have all necessary limit, torque and control switches and other devices in accordance with current version of AWWA C-540 standards and as otherwise specified herein. The actuator shall employ a continuous duty rated motor and include a phase correction circuit to assure proper output drive sleeve direction for open and close operation regardless of incoming power phase sequence. A phase detector is not acceptable. Anti-condensation heaters for the motor and controls enclosure shall be supplied and wired to the customer terminal strip as shown on the drawings. Heaters shall be suited for 110VAC power. The actuator gear housing shall be either cast or ductile iron; aluminum gear housings are not acceptable. All actuator compartment fasteners shall be stainless steel. Actuators shall have a local actuator control station with Open/Stop/Close pushbuttons, and padlockable 3-position selector switch for Local-Off-Remote mode of operation. The control station shall have 2 lights for open and close. When the selector switch is in Local mode the actuator shall only be operable from the local control station, while in Remote mode it shall be only operable from SCADA or remote control. The actuator shall be equipped to accept 24 VDC remote control open, close, and stop signals.

2. Position limit switches shall be counter gear driven and be an integral part of the valve actuator. Limit switches shall be adjustable, with trip points from fully open to fully closed valve and intermediate valve positions. Gears shall not be subject to breakage or slippage due to over travel and be wired to terminal strip for remote position indication as shown on the drawings. Limit switches shall provide a minimum 8 contact development using 4 contacts with 2 rotors. Limit switches shall be independent from torque switches. Microprocessor or electronically encoded position sensors are not allowed.

3. Valve actuator shall be equipped with a mechanically coupled torque interrupt switch driven directly from the actuator's drive gear. The torque interrupt switches shall stop the control circuit in both the opening and closing directions when valve torque overload occurs or when valves require torque seating in the closed or open position. Microprocessor or electronically encoded based torque sensors are not allowed. The torque switches shall have graduated dials in foot-pounds for both open and closed directions of travel and shall be independently adjustable so the actuator rated output torque is not exceeded. Switch design shall permit visual verification of switch position without disassembly and require no special tools to make adjustments.

4. Actuator shall be supplied with a separate 360-degree self-locking worm gear reducer. The worm shaft gear and associated gearing shall be of hardened alloy

steel. The 360-degree mating worm ring gear shall be of machine cut alloy bronze to allow a new gear segment to be selected if ever required. Non-metallic or cast gearing shall not be allowed. Tapered roller bearings or combination of roller bearings and DU bearings shall be used to provide smooth rotation of the worm. All gearing shall be grease lubricated in a heavy-duty cast iron housing with o-ring and radial seals for permanent lubrication. Adjustable mechanical end stops for 90-degree service shall be supplied to provide positive protection against over travel. All fasteners for adjusting end stops locations shall be stainless steel. A separate removable valve shaft coupling shall be supplied and be splined to provide flexible gearbox mounting locations, to enable ease of installation and removal, and for ease of machining. The gearbox shall have a mechanical dial position indicator graduated in every 10% or 10-degree intervals. The mechanical dial position indicator shall be parallel to the flow direction when the valve is in the fully open position.

5. The actuator shall seal in open and close commands in both local and remote control mode of operation to allow full valve travel unless interrupted by a stop command or the actuator's protection switches. When the valve is operated to full open or closed, jogging shall not be required nor should it be a means of meeting open or close cycle times. The control system shall include provision to convert the controls to operate by momentary or jogging control signals.

6. The actuator shall have a capability of both manual and motorized operation; a handwheel with spindle shall be used for manual operation, which shall not rotate during motor operation. Handwheels shall be side mounted with minimum 2-in clearance from any wiring conduit and accessories of the actuator assembly. Top mounted handwheels directly coupled to the actuator drive sleeve are not allowed. Handwheel finish shall be smooth and free of spokes, and have open direction arrow indicator for counter-clockwise to open operation.

7. Where shown on the Drawings, valve actuators shall include integral controls for modulating position service. The actuator shall be equipped with a position controller that shall accept a proportional 4-20 mA valve position demand set point signal, compare this signal with the integral position feedback, and position the valve to the set point position point within a 1 percent accuracy or better. The controller shall have zero, span, and gain adjustments and provide the following optional selections upon loss of the 4-20 mA demand set point signal: lock valve in position, move valve close, or move valve open. The default setting shall be set at lock in position setting unless specified otherwise.

B. The electric actuators shall be AUMA SA with GS worm gear drive or Limitorque SMB with HBC worm gear drive.

C. The actuator and auxiliary gearboxes shall be sized to operate under the conditions stipulated in 2.01.

D. Opening and closing times shall be from 20 to 25 minutes.

## 2.04 ACTUATOR CONTROL PANELS

A. Actuator control panels shall be supplied and coordinated by the actuator manufacturer. Panel with external dimensions and instruments arrangement is as shown on Drawings except as modified in Cal Am Representative approved shop drawings.

B. Factory Assembly: Assemble enclosures at factory. No fabrication other than correction of minor defects or minor transit damage shall be done on panels at Contract site.

C. Panel Construction and Interior Wiring: In accordance with the National Electrical Code (NEC), state and local codes, and applicable sections of NEMA, ANSI, UL, and ICECA.

D. UL Label for Enclosures: UL 508A label stating "Listed Enclosed Industrial Control Panel." All control panel components shall be UL listed. All control panels shall comply with NEC 2005 Article 409.

E. Wiring within Enclosures:

1. Restrain by plastic ties or ducts or metal raceways. No glue-on type cable ties shall be acceptable.

2. Hinge Wiring: Secure at each end so that bending or twisting will be around longitudinal axis of the wire. Protect bend area with sleeve.

3. Arrange wiring neatly, cut to proper length, and remove surplus wire.

4. Abrasion protection for all wire bundles, which pass through holes or across edges of sheet metal.

5. Connections to Screw Type Terminals:

    a. Furnish locking-fork-tongue lugs.
    b. Use manufacturer's recommended tool with required sized anvil to make all crimp lug terminations.
    c. Wires terminated in a crimp lug, maximum of one.
    d. Lugs installed on a screw terminal, maximum of two.

6. Connections to Compression Clamp Type Terminals:

    a. Strip, prepares, and installs wires in accordance with terminal manufacturer's recommendations.
    b. Wires installed in a compression screw and clamp, maximum of one.

7. Splicing and tapping of wires, allowed only at device terminals or terminal blocks.

8. Terminate 24V DC and analog signal circuits on separate terminal block from ac circuit terminal blocks.

9. Separate all analog and DC circuits by at least 6 inches from all ac power and control wiring, except at unavoidable crossover points and at device terminations.

10. Arrange wiring to allow access for testing, removal, and maintenance of circuits and components.

F. All control panels, shall have a three-point latch with a single handle, so the door can be open/close with a single movement. All control panels shall have hasps for padlocks.

G. Provide heaters with thermostat control 120 volt power shall be wired to terminals for separate source.

H. Enclosure for Actuator Control Panel:

1. All actuator control panels shall be housed in enclosures meeting the environmental design requirements in paragraph 1.08 ENVIRONMENTAL REQUIREMENTS FOR ACTUATOR CONTROL PANELS.

2. Doors:

a. Oil resistant gasket sealed with continuous hinge.
b. Lockable quick release latches.

3. Manufacturers:

a. Hoffman for non-hazardous locations.

I. Control Panel Electrical:

1. Power Distribution within Panels:

a. Feeder Circuits:
(1) One or more 120V AC, 60-Hz feeder circuits as shown on Drawings.
(2) Make provisions for feeder circuit conduit entry.
(3) Furnish terminal board for termination of wires.

2. Signal Distribution:

a. Within Panels: 4 to 20 mA DC signals (may be distributed as 1 to 5V DC with a precision 250 OHM resistor).
b. Outside Panels: Isolated 4 to 20 mA DC only.
c. All signal wiring shall be twisted, shielded pairs, minimum 18 AWG.

3. Signal Switching:

    a. Use dry circuit type relays or switches.
    b. No interruption of 4 to 20 mA loops during switching.
    c. Switching Transients in Associated Signal Circuit:
        (1) 4 to 20 mA DC Signals: 0.2 mA, maximum.
        (2) 1 to 5V DC Signals: 0.05V, maximum.

4. Relays:

    a. General:
        (1) Relay Mounting: Plug-in type socket.
        (2) Relay Enclosure: Furnish dust cover.
        (3) Socket Type: Screw terminal interface with wiring.
        (4) Socket Mounting: Rail.
        (5) Provide hold down clips.
    b. Signal Switching Relay:
        (1) Type: Dry circuit.
        (2) Contact Arrangement: 4 Form C contacts.
        (3) Contact Rating: 0 to 5 amps at 28V DC or 120V AC.
        (4) Contact Material: Gold or silver.
        (5) Coil Voltage: As noted or shown.
        (6) Coil Power: 0.9 watts (dc), 1.2VA (AC).
        (7) Expected Mechanical Life: 10,000,000 operations.
        (8) Expected Electrical Life at Rated Load: 100,000 operations.
        (9) Indication Type: LED indicator lamp.
        (10) Seal Type: Hermetically sealed case.
        (11) Manufacturer and Product: Potter and Brumfield; Series KH/KHA or equal.
    c. Control Circuit Switching Relay, Non-latching:
        (1) Type: Compact general purpose plug-in.
        (2) Contact Arrangement: 3 Form C contacts.
        (3) Contact Rating: 10A at 28V DC or 240V AC.
        (4) Contact Material: Silver cadmium oxide alloy.
        (5) Coil Voltage: As noted or shown.
        (6) Coil Power: 1.8 watts (dc), 2.7VA (ac).
        (7) Expected Mechanical Life: 10,000,000 operations.
        (8) Expected Electrical Life at Rated Load: 100,000 operations.
        (9) Indication Type: Neon or LED indicator lamp.
        (10) Push to test button.
        (11) Manufacturer and Product: Potter and Brumfield; Series KUP or equal.
    d. Control Circuit Switching Relay, Latching:
        (1) Type: Dual coil mechanical latching relay.
        (2) Contact Arrangement: 2 Form C contacts.

(3) Contact Rating: 10A at 28V DC or 120V AC.
(4) Contact Material: Silver cadmium oxide alloy.
(5) Coil Voltage: As noted or shown.
(6) Coil Power: 2.7 watts (dc), 5.3VA (ac).
(7) Expected Mechanical Life: 500,000 operations.
(8) Expected Electrical Life at Rated Load: 50,000 operations.
(9) Manufacturer and Product: Potter and Brumfield; Series KB/KBP or equal.

e. Control Circuit Switching Relay, Time Delay:
(1) Type: Adjustable time delay relay.
(2) Contact Arrangement: 2 Form C contacts.
(3) Contact Rating: 10A at 240V AC.
(4) Contact Material: Silver cadmium oxide alloy.
(5) Coil Voltage: As noted or shown.
(6) Operating Temperature: Minus 10 to 55 degrees C.
(7) Repeatability: Plus or minus 2 percent.
(8) Delay Time Range: Select range such that time delay set point fall between 20 to 80 percent of range.
(9) Time Delay Set Point: As noted or shown.
(10) Mode of Operation: As noted or shown.
(11) Adjustment Type: Integral potentiometer with knob external to dust cover.
(12) Manufacturer and Products: Potter and Brumfield; Series CB for 0.1 second to 100 minute delay time ranges, Series CK for 0.1 to 120 second delay time ranges; or equal.

5. Centralized Power Supplies:

a. Furnish as required to power instruments requiring external DC power, including two-wire transmitters and DC relays.
b. Convert 120V AC, 60-Hz power to DC power of appropriate voltage(s) with sufficient voltage regulation and ripple control to assure that instruments being supplied can operate within their required tolerances.
c. Provide output over voltage and over current protective devices to:
(1) Protect instruments from damage due to power supply failure.
(2) Protect power supply from damage due to external failure.
d. Enclosures: NEMA 1.
e. Mount such that dissipated heat does not adversely affect other components.

6. Fuses: For each DC supply line to each individual two-wire transmitter.

a. Type: Indicating.
b. Mount so fuses can be easily seen and replaced.
c. Manufacturer and Products: (Phoenix Contact)

7. Pushbuttons:

   a. Pushbuttons and Pilot Devices shall be 30.5 mm, heavy-duty, oil-tight type.
   b. Device bodies shall be zinc die cast with chrome plating or cathodic epoxy coating.
   c. Devices shall utilize a single panel gasket and provide integral grounding by means of either a built-in grounding terminal or a pointed grounding surface integral to the device.
   d. Devices shall be UL listed for types 4/13 when mounted in a suitable enclosure with the same ratings.
   e. Devices shall have an operating temperature range of –17 degrees C to 60 degrees C.
   f. Pushbuttons and contact blocks shall have a published mechanical life of not fewer than 5,000,000 operations.
   g. Standard Pushbutton Colors and Inscriptions:
   h. Use following color code and inscriptions for pushbuttons unless otherwise noted:

      Pushbutton Tag Function:

| Tag Function | Inscription(s) | Color |
|---|---|---|
| OC | OPEN CLOSE | Red Green |
| SS | START STOP | Red Green |
| LOCAL | LOCAL | White |

      (1) Unused or Non-inscribed Buttons: Black.
      (2) Lettering Color: Black on white and yellow buttons. White on black, with red and green buttons.

8. Selector Switches:

   a. Selector Switches shall be 30.5 mm, heavy-duty, oil-tight type.
   b. Device bodies shall be zinc die cast with chrome plating or cathodic epoxy coating.
   c. Devices shall utilize a single panel gasket and provide integral grounding by means of either a built-in grounding terminal or a pointed grounding surface integral to the device.
   d. Devices shall be UL listed for types 4/13 when mounted in a suitable enclosure with the same ratings.
   e. Devices shall have an operating temperature range of –17 degrees C to +60 degrees C.

9. Indicating Lights:

a. Indicating lights shall be 30.5 mm, heavy-duty, oil-tight type.
b. Device bodies shall be zinc die cast with chrome plating or cathodic epoxy coating.
c. Devices shall utilize a single panel gasket and provide integral grounding by means of either a built-in grounding terminal or a pointed grounding surface integral to the device.
d. Devices shall be UL listed for types, 4/13 when mounted in a suitable enclosure with the same ratings.
e. Devices shall have an operating temperature range of –17 degrees C to 60 degrees C.
f. Indicating lights shall be push-to-test transformer type. Lens color shall be as indicated on the contract drawings.
g. Standard Light Colors and Inscriptions:
   (1) Use following color code and inscriptions for service legends and lens colors for indicating lights, unless otherwise noted in Instrument List:

| Indicating Light Tag Function | | |
|---|---|---|
| Tag Function | Inscription(s) | Color |
| ON | ON | Red |
| OFF | OFF | Green |
| OPEN | OPEN | Red |
| CLOSED | CLOSED | Green |
| LOW | LOW | Green |
| FAIL | FAIL | Red |
| HIGH | HIGH | Red |
| AUTO | AUTO | White |
| MANUAL | MANUAL | Yellow |
| LOCAL | LOCAL | White |
| REMOTE | REMOTE | Yellow |

   (2) Lettering Color: Black on white lenses. White on red and green lenses.

10. Wires within Enclosures:

a. AC Circuits:
   (1) Type: 600-volt, in accordance with applicable sections in Division 16, Electrical.
   (2) Size: For current to be carried, but not less than No. 12 AWG.
b. Analog Signal Circuits:
   (1) Type: 300-volt stranded copper, twisted shielded pairs.
   (2) Size: No. 18 AWG, minimum.

c. Other DC Circuits:
   (1) Type: 300-volt, Type MTW stranded copper.
   (2) Size: No. 18 AWG, minimum.
d. Special Signal Circuits: Use manufacturer's standard cables.
e. Wire Identification: Numbered and tagged at each termination.
   (1) Wire Tags: Snap-on or slip-on PVC wire markers with legible machine printed markings and numbers. Adhesive or taped-on tags are not acceptable.

11. Wires entering or leaving enclosures, terminate and identify as follows:

    a. Analog and discrete signal, terminate at numbered terminal blocks.
    b. Special signals, terminated using manufacturer's standard connectors.

12. Wiring Interface: Terminate and identify wiring entering or leaving enclosures.

    a. Analog and Discrete Signal Wires: Terminate at numbered terminal blocks as shown on the wiring diagrams.
    b. Wiring for Special Signals: Terminate communications, digital data, and multiplexed signals using manufacturer's standard connectors for the device to which the signals terminate.

13. Terminal Blocks for Enclosures:

    a. Quantity:
       (1) Sufficient to accommodate both present and future indicated needs.
       (2) Wire all spare or unused panel mounted elements to their panels' terminal blocks.
       (3) Spare Terminals: 20 percent of all connected terminals, but not less than 10.
    b. General:
       (1) Connection Type: Screw connection clamp.
       (2) Compression Clamp:
          (a) Hardened steel clamp with transversal grooves that penetrate wire strands providing a vibration-proof connection.
          (b) Guides all strands of wire into terminal.
       (3) Screws: Hardened steel and are captive and self-locking.
       (4) Current Bar: Copper or treated brass.
       (5) Insulation:
          (a) Thermoplastic rated for minus 55 to plus 110 degree C.
          (b) Two funneled shaped inputs to facilitate wire entry.
       (6) Mounting:
          (a) Standard DIN rail.
          (b) A terminal block can be extracted from an assembly without displacing adjacent blocks.

(c) End Stops: One at each end of rail, minimum.

(7) Wire preparation: Stripping only.

(8) Jumpers: Allow jumper installation without loss of space on terminal or rail.

(9) Marking System:

(a) Terminal number shown on both sides of terminal block.

(b) Allow use of preprinted and field marked tags.

(c) Terminal strip numbers shown on end stops.

(d) Terminal block and terminal strip numbers shall be recorded on the Loop Diagrams and Interconnection Diagrams.

(e) Fuse Marking for Fused Terminal Blocks: Fuse voltage and amperage rating shown on top of terminal block.

(10) Test Plugs: Soldered connections for 18-AWG wire.

(a) Pin Diameter: 0.079 inch.

(b) Quantity: 10

(c) Manufacturer: Phoenix Contact.

c. Terminal Block, General Purpose:

(1) Rated Voltage: 600V AC.

(2) Rated Current: 30 amp.

(3) Wire Size: 22 to 10 AWG.

(4) Rated Wire Size: 10 AWG.

(5) Color: Grey body.

(6) Spacing: 0.25 inch, maximum.

(7) Test Sockets: One screw test socket 0.079-inch diameter.

(8) Manufacture: Phoenix Contact.

d. Terminal Block, Ground:

(1) Wire Size: 22 to 12 AWG.

(2) Rated Wire Size: 12 AWG.

(3) Color: Green and yellow body.

(4) Spacing: 0.25 inch, maximum.

(5) Grounding: Ground terminal blocks electrically grounded to the mounting rail.

(6) Manufacturer: Phoenix Contact.

e. Terminal Block, Blade Disconnect Switch:

(1) Rated Voltage: 600V AC.

(2) Rated Current: 10 amp.

(3) Wire Size: 22 to 12 AWG.

(4) Rated Wire Size: 12 AWG.

(5) Color: Grey body, orange switch.

(6) Spacing: 0.25 inch, maximum.

(7) Test Sockets: Two screw test sockets 0.079-inch diameter on each side of switch.

(8) Manufacturer: Phoenix Contact.

f. Terminal Block, Fused, 120V AC:
   (1) Rated Voltage: 600V AC.
   (2) Rated Current: 16 amp.
   (3) Wire Size: 22 to 10 AWG.
   (4) Rated Wire Size: 10 AWG.
   (5) Color: Grey body.
   (6) Fuse: 0.25 inch by 1.25 inch.
   (7) Indication: Neon Lamp 110V AC.
   (8) Leakage Current: 1.8 mA, maximum.
   (9) Spacing: 0.512 inch, maximum
   (10) Manufacturer: Phoenix Contact.

g. Terminal Block, Fused, 120V AC, High Current:
   (1) Rated Voltage: 600V AC.
   (2) Rated Current: 35 amps.
   (3) Wire Size: 18 to 8 AWG.
   (4) Rated Wire Size: 8 AWG.
   (5) Color: Grey.
   (6) Fuse: 13/32 inch by 1.5 inch.
   (7) Spacing: 0.95 inch, maximum.
   (8) Manufacturer: Phoenix Contact.

J. Grounding of Enclosures:

1. Isolated copper grounding bus for all signal and shield ground connections.

2. Ground this ground bus at one common signal ground point in accordance with National Electrical Code requirements. No other connection shall be made to the grounding system but this signal ground point only. There shall be only one jumper between this common signal ground and the facility grounding system.

3. Single Point Ground for Each Analog Loop:

   a. Location: At DC power supply for loop.
   b. Use to ground all wire shields for loop.
   c. Group and connect shields in the following locations:
      (1) Main Control Panel.
      (2) Or as shown on the Drawings.

4. Ground terminal block rails to ground bus.

5. Provide a separate ground bus at each control panel for all AC power. One single jumper shall be from this ground bus to the signal ground bus.

K. Analog Signal Isolators: Furnish signal isolation for all analog signals shown on Drawings that are sent from one enclosure to another. Instruments on different panels, cabinets, or enclosures shall not be wired in series.

L. Factory Finishing:

1. Nonmetallic Panels: Not painted.

2. Steel Panels:

   a. Sand panel and remove all mill scale, rust, grease, and oil.
   b. Fill all imperfections and sand smooth.
   c. Paint panel interior surfaces with one coat of epoxy coating metal primer and two finish coats of two-component type epoxy enamel, white. Exterior, light gray.
   d. NEMA 4X SS 316 Panels: Not Painted

## PART 3 EXECUTION

### 3.01 INSTALLATION

Valve and gate actuators and accessories shall be installed in accordance with Section 15200 - Valves, General. Actuators shall be located to be readily accessible for operation and maintenance without obstructing walkways. Actuators shall not be mounted where shock or vibrations will impair their operation, nor shall the support systems be attached to handrails, process piping, or mechanical equipment.

**END OF SECTION**

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## PART 1 GENERAL

### 1.01 SCOPE OF WORK

A. CONTRACTOR shall provide (furnish and install), complete and ready for use, the electrical systems as specified herein and as shown on the Contract Drawings. This document describes the function and operation of the systems and particular components, but does not necessarily describe all necessary devices. All components and devices shall be furnished and installed as necessary to provide a completely operable and reliable system for accomplishing the functions and meeting the performance requirements set forth hereinafter.

B. Furnish all required labor, materials, project equipment, tools, construction equipment, safety equipment, shipping, transportation, test equipment, incidentals and services to provide complete and operational electrical systems as shown on the Contract Drawings, included in these Specifications, or as necessary for fully operating facilities.

C. CONTRACTOR shall examine the Specifications and Drawings for mechanical equipment and provide all circuit breakers, switches, pushbuttons and appurtenances which are not specified to be with the mechanical equipment. Erect all electrical equipment not definitely stated to be erected by others, furnish and install conduit, wire and cable and make connections required to place all equipment in complete operation.

D. The major areas in the scope of work, as shown on Contract drawings, include both furnishing and installation of the following:

1. Utility Metering, Power Distribution and Control Panel Assembly.
2. Cellular telemetry system, antenna and grounding.
3. Microcontroller/PLC system for monitoring the process.
4. Control Panel, Wireless Communications, PLC System.
5. Coordinate and test in conjunction with Owner PLC programming and SCADA configuration.
6. Instruments and devices supplied under Section 13330 Field Instrumentation.
7. Conduits, grounding system and the field interconnection wiring between the instruments, field devices, and electrical equipment enclosures.
8. All necessary instrument supports, piping and valves to complete installation of any of the instruments listed herein.

9. All necessary miscellaneous shut off, sample and calibration valves to sensors.

10. Trenching, backfilling, compaction and resurfacing for all new underground conduit routes.

11. Coordination with California American Water.

12. Equipment, materials and installation for utility power services.

13. Site power distribution, electrical devices, lights and receptacles.

E. The following specifications incorporate specific equipment and devices that are preferred by the Owner because of their serviceability, because of the local availability of labor, parts and materials, or because of the ability of the Owner to umbrella the equipment under existing maintenance contracts.

F. All electrical equipment and materials, including installation and testing, shall conform to the applicable codes and standards listed in this and other Sections. All electrical work shall conform with the latest National Electric Code (NEC) issue and the California Electrical Code (CEC). Nothing on the Drawings or in the Specifications shall be construed to permit work or materials not conforming to these codes and standards.

## 1.02 RELATED WORK IN OTHER SECTIONS

A. Contract documents are a single integrated document, and as such all divisions and sections apply. It is the responsibility of CONTRACTOR and equipment suppliers to review all sections to insure a complete and coordinated project.

B. The following are covered in other sections in the Contract documents and are part of Divisions 13 and 16.

Section 13300 – Instrumentation and Control General.
Section 13330 – Field Instrumentation
Section 13340 – Control Panels.
Section 16110 – Conduit Raceways.
Section 16120 – Wire and Termination.

C. The contents of this section apply to all "electrical, control and instrumentation" equipment suppliers and manufacturers doing work listed in other sections as required.

## 1.03 CONTRACT DOCUMENTS

A. The Contract drawings and specifications are intended to be descriptive of the type of electrical system to be provided; any error or omissions of detail in either shall not relieve

CONTRACTOR from their obligations there under to install in correct detail any and all materials necessary for a complete operational system, at no additional cost.

B. The equipment specifications have been prepared on the basis of the equipment first named in the Specifications. CONTRACTOR shall note that the second named equipment, if given, is considered acceptable and equal equipment, but in some cases additional design, options, or modifications may be required to meet Specifications all at no additional cost to the Owner.

C. The Contract drawings are generally diagrammatic; exact locations of electrical products shall be verified in the field with the Engineer. Except where special details on drawings are used to illustrate the method of installation of a particular piece or type of equipment or materials, the requirements or descriptions in this Section shall take precedence in the event of conflict.

D. Location at facilities of new equipment, inserts, anchors, panels, pull boxes, conduits, stub-ups, and fittings for the electrical system are to be determined by CONTRACTOR and Engineer at time of installation. CONTRACTOR shall make minor adjustments to locations of electrical equipment required by existing conditions and coordination with other trades at no additional cost.

E. CONTRACTOR shall examine the architectural, mechanical, structural, and electrical and instrumentation equipment provided under other Sections of this Contract in order to determine the exact routing and final terminations for all conduits and cables. The exact locations and routing of cables and conduits shall be governed by structural conditions, physical interferences, and the physical location of wire terminations on equipment. Conduits shall be stubbed up as near as possible to equipment terminals.

F. All equipment shall be installed and located so that it can be readily accessed for operation and maintenance. The Engineer reserves the right to require minor changes in location of equipment, without incurring any additional costs.

G. Where conduits are shown as "home runs" on the Contract drawings or stated to be furnished, but not explicitly shown, as part of the scope of work; CONTRACTOR shall provide all fittings, boxes, wiring, etc. as required for completion of the raceway system in compliance with the NEC and the applicable specifications in this Section.

H. No changes from the Contract drawings or specifications shall be made without written approval of the Engineer. Should there be a need to deviate from the Contract documents, submit written details and reasons for all changes to the Engineer for favorable review.

I. The resolution of conflicting interpretation of the Contract documents shall be as determined by the Engineer.

J. CONTRACTOR shall maintain a neatly and accurately marked full size set of Contract Drawings recording the as-built locations and layout of all electrical and instrumentation equipment, routing of raceways, junction and pull boxes, and other diagram or drawing changes.

## 1.04 COORDINATION

A. CONTRACTOR shall coordinate the electrical work with the other trades, code authorities, utilities, and the Engineer; with due regard to their work, towards promotion of a rapid completion of the project. If any cooperative work must be altered due to lack of proper supervision of such, or failure to make proper provisions, then CONTRACTOR shall bear expense of such changes as necessary to be made in work of others.

B. Manufacturer's directions and instructions shall be followed in all cases where such is not shown on the Contract Drawings or herein specified.

C. CONTRACTOR shall cease work at any particular point, temporarily, and transfer his operations to such portions of work as directed, when in the judgment of the California American Water it is necessary to do so.

D. CONTRACTOR shall schedule a minimum of one (1) mandatory coordination meeting(s) during the submittal phase of the project. The meetings shall be held at the jobsite and include, as a minimum, attendance by CONTRACTOR, and Engineer.

1. The meeting shall be held after the review of the first comprehensive submittal has been completed by the Owner. The purpose of the meeting is to discuss comments made on the submittal package, to update the project schedule, and coordinate the testing, training, and installation phases of the project.

## 1.05 UTILITY SERVICES COORDINATION

A. Service Power

1. Coordinate all work with the serving Power Utility (Pacific Gas and Electric, PG&E) and California American Water (Owner) for the work shown on Contract Drawings. CONTRACTOR shall obtain the required inspections and provide the following:

a. Submit to the Power Utility the proposed metering details and utility service applications. Provide a written statement from the Utility that shows approval of the proposed metering.

b. Coordination of utility service access. CONTRACTOR shall coordinate service location, conduit routing and installation requirements for utility service connection.

c. All work associated with material and installation for the Utility power service not paid by the Utility shall be borne by CONTRACTOR. CONTRACTOR shall provide and install all material, conduits, wiring, pull ropes, pole risers, transformer pads, bollards, etc. as shown on Utility engineered drawings for a new power service.

d. All fees and charges of the Utility power for service hook-up will be paid by CONTRACTOR.

B. Telephone Service (or cellular service)

1. Coordinate all work with the serving Telephone Utility for the work shown on Contract Drawings. CONTRACTOR shall obtain the required inspections and provide the following:

a. Coordination of utility service access. CONTRACTOR shall coordinate service location, conduit routing and installation requirements for telephone utility service connection.

b. All work associated with material and installation for the telephone Utilities not paid by the Utility shall be borne by CONTRACTOR. CONTRACTOR shall provide and install all material, wiring, and devices required for cellular telemetry services.

c. All fees and charges of the telephone Utility service hook-up will be paid by CONTRACTOR.

## 1.06 SUPERVISION

A. CONTRACTOR shall schedule all activities, manage all technical aspects of the project, coordinate submittals and drawings, and attend all project meetings associated with this Section.

B. CONTRACTOR shall supervise all work in this Section, including the electrical system general construction work, from the beginning to completion and final acceptance.

C. CONTRACTOR shall supervise and coordinate all work in this Section to insure each phase of the project, submittal, delivery, installation, and acceptance testing, etc. is completed within the allowable scheduled time frames.

D. CONTRACTOR shall be responsible for obtaining, preparing, completing, and furnishing all paper work for this Section; which shall include transmittals, submittals, forms, documents, manuals, instructions, and procedures.

## 1.07 INSPECTIONS

A. All work or materials covered by the Contract documents shall be subject to inspection at any and all times by the Owner. If any material does not conform to the Contract documents, or does not have a favorably reviewed submittal status; then CONTRACTOR shall, within three days after being notified by the Owner, remove said material from the premises; and if said material has been installed, the entire expense of removing and replacing same, including any cutting and patching that may be necessary, shall be borne by CONTRACTOR.

B. Work shall not be closed in or covered over before inspection and approval by the Engineer. All costs associated with uncovering and making repairs where non-inspected work has been performed shall be borne by CONTRACTOR.

C. CONTRACTOR shall cooperate with the Engineer and provide assistance at all times for the inspection of the electrical system under this Contract. CONTRACTOR shall remove covers, provide access, operate equipment, and perform other reasonable work which, in the opinion of the Engineer, will be necessary to determine the quality and adequacy of the work.

## 1.08 JOB CONDITIONS

A. CONTRACTOR shall make all arrangements and pay the costs thereof for temporary services required during construction of the project, such as temporary electrical power and telephone service. Upon completion of the project, remove all temporary services, equipment, material and wiring from the site as the property of CONTRACTOR.

B. CONTRACTOR shall provide adequate protection for all equipment and materials during shipment, storage and construction. Equipment and materials shall be completely covered with two layers of plastic and set on cribbing six inches above grade so that they are protected from weather, wind, dust, water, or construction operations. Equipment shall not be stored outdoors without the approval of the Engineer.

C. Where equipment is stored or installed in moist areas, such as unheated buildings, etc., provide an acceptable means to prevent moisture damage, such as a uniformly distributed heat source to prevent condensation.

## 1.09 SUBMITTAL REQUIREMENTS

A. GENERAL

1. Shop documents, calculations and drawings shall be submitted for all materials, devices and components in the electrical and instrumentation system.

2. CONTRACTOR shall ensure all equipment suppliers provide the submittal documentation required in this and other related sections. Submittals shall be complete, neat, orderly, and indexed. CONTRACTOR shall check all submittals required under this Division for the correct number of copies, adequate identification, correctness, and compliance with the Contract Specifications and Drawings, and initial all copies certifying compliance.

3. CONTRACTOR shall coordinate submittals with the work so that project will not be delayed. This coordination shall include scheduling the different categories of submittals, so that one will not be delayed for lack of coordination with another. No extension of time will be allowed because of failure to properly schedule submittals.

4. No material or equipment shall be allowed at the job site until the submittal for such items has been reviewed by the Engineer and marked "no exceptions taken" or "make corrections noted".

5. CONTRACTOR shall include in writing on a separate submittal cover sheet any proposed departures from the Contract documents, and the reasons therefore. Incorporate no such departures into the work without prior written approval of the Engineer. The approval of departures which substantially deviate from the Contract documents shall be evidenced by a "change order" directive by the Engineer. Any cost differential associated with this change order must be negotiated with the Engineer to amend the Contract to reflect the costs or savings.

6. Exceptions to the Specifications or Drawings shall be clearly defined by the equipment supplier. Submittal data shall contain sufficient details so a proper evaluation may be made by the Engineer.

7. The decision of the Engineer governs what is acceptable as a substitution. If the Engineer considers it necessary, tests to determine equality of the proposed substitution shall be made, at CONTRACTOR's expense, by an unbiased laboratory that is satisfactory to the Engineer.

B. SUBMITTAL FORMAT

1. Each submittal shall be bound in a three ring binder, which is sized such that when all material is inserted the binder is not over 3/4 full. Binder construction shall allow easy removal of any page without complete manual disassembly; spiral ring type binders are not acceptable.

2. Each binder shall be appropriately labeled on the outside spine and front cover with the project name, contract number, equipment supplier's name, specification section(s), and major material contained therein.

3. An index shall be provided at the inside of the front cover. This index shall itemize the contents of each tab and subtab section. Also list the project name, contract number and equipment supplier's name, address, phone number, and contact person on the index page.

4. Field equipment shop documents, panel equipment shop documents, drawings, and bill of materials shall be grouped under separate tabs. Shop documents shall be ordered in the same sequence as their corresponding Contract specification subsection.

5. Complete Materials list shall be provided at the inside of the front cover. CONTRACTOR shall provide Material list providing name of project, location of equipment, specification section, quantity, description, manufacturer, full part number and tag number.

6. All spare parts shall be listed separately at the end of the Bill of Materials list. Generic names or part numbers used by a distributor or Systems House are not acceptable; originating manufacturer’s name and part number shall be listed.

7. Data summary sheets shall be provided to subtab all shop documents for each individual piece of equipment. Data summary sheets shall be bright yellow or blue for easy identification.

   The data summary sheets shall have the following information preceding their corresponding shop documents:

   a. Product identification; name used herein and on the Contract Drawings.

   b. The manufacturer's model number, part number or other designation. This shall include the specific numbers of all proposed options

   c. Tag name/number per the drawings or schedules.

d. Location of assembly at which it is installed.

e. Range, span, engineering units, input and output characteristics.

f. Contract specification subsection number.

8. Drawings that are "C" or "D" size shall be folded with the title block visible and placed in reinforced clear plastic pockets.

C. EQUIPMENT DATA SUBMITTALS

1. The equipment submittals shall be clean printouts or clearly copied from originals. No facsimile (FAX) copies, reductions or illegible documents are allowed. Color copies shall be provided when black and white copies do not show adequate clarity. Shop documents shall include the following:

a. Complete catalog cuts with full description of equipment. General sales literature will not be acceptable. The part or model number with options to be provided shall be clearly identified. Where more than one item or catalog number appears on a catalog cut, the specific item(s) or catalog numbers(s) proposed shall be clearly identified. Each catalog cut sheet shall be identified with the applicable Section and subsection numbers.

b. Equipment technical specifications, ratings and listings.

c. Physical size with dimensions and mounting details.

d. Quantity and quality requirements for electric power, air, and/or water supply.

e. Materials of components in contact with or otherwise exposed to the process.

f. Calibration, performance or accuracy curves.

D. NAMEPLATE SCHEDULES

1. Submit full size drawing of all nameplates and tags, as specified herein, to be used on project. The Engineer has the right to adjust nameplate engraving titles during submittals at no additional cost to the Owner. Submittal to include the following:

a. Dimensions of nameplate.

b. Exact lettering and font for each nameplate.

c. Color of nameplate.

d. Color of lettering.

e. Materials of construction.

f. Method and materials for attachment.

g. Drawing showing location of nameplate on each panel.

E. SHOP DRAWINGS

1. All drawings shall be generated with a computer utilizing the AutoCAD 2000 or later drafting package. All drawings shall be prepared and engineered specific to the project requirements. Standard preprinted or typical drawings simply marked to indicate applicability to the Contract will not be acceptable.

2. Drawings shall be prepared in a professional manner and shall have borders and a title block identifying the project, system, drawing number, AutoCAD file name, project engineer, date, revisions, and type of drawing. Drawings shall be no smaller than 11" x 17" and printed with a laser jet printer or plotted in ink on vellum. The lettering shall be legible and no smaller than 0.075 inch in height.

3. CONTRACTOR shall submit for approval the proposed drawing format for each type of drawing or diagram specified. CONTRACTOR shall not go into production with the drawings or diagrams for this project until the Engineer has given written approval of the submitted proposed drawing format submittal.

4. All drawings shall be prepared utilizing the Contract Documents naming conventions, equipment numbers and ISA tags specific to the project. Manufacturer standard naming or labeling is not acceptable. Equipment shown on the contracts without a tag shall be tagged in accordance with the contract document naming procedures and conventions.

5. The shop drawings shall include:

   a. Electrical three line diagrams detailing all devices associated with the power distribution system. The following applicable information or data shall be shown on the three-line diagram: location, size and amperage rating of bus; size and amperage rating of wire or cable; breaker ratings, number of poles, and frame sizes; utility metering, voltage, amperage, number of wires and phases; ground size and connections; neutral size and connections; voltage, amperage and wattage monitoring instruments; power fail and other protective devices; fuse size and type; distribution transformers;

panelboards; starters; contactor size and overload range; motor full load amperage of submitted motor and horsepower; rating for miscellaneous loads; etc. Submit of all equipment motor voltage, phase and full load amps provided for this project for verification of accuracy of submitted one line drawings.

b. Enclosure layout diagrams; show all front panel and backpanel devices drawn to scale. Show fabrication methods and details; including material of construction, paint color, support and latching mechanisms, fans and ventilation system, and conduit entrance areas.

c. Control Schematic and Wiring Diagrams

d. Equipment Connection Diagram

1) An equipment connection diagram shall be furnished for each electrical and instrumentation system, even if one was not shown explicitly on the Contract Drawings.

2) The equipment connection diagrams shall be utilized in the preparation of Interconnection Wiring Diagrams and utilized by the electrician during all phases of installation and connection of all conductors to ensure coordination of the equipment interconnect.

3) The connection diagram shall indicate all field connection terminations with a unique label and reference the connection is a from/to format that identifies the field connection point by equipment tag, connection type, voltage and minimum/maximum connection parameters.

6. INTERCONNECTION WIRING DIAGRAMS

a. Interconnection diagrams shall be submitted and approved by the Engineer for each electrical and instrumentation system. CONTRACTOR shall not pull any wires into conduits that do not have approved interconnects. If CONTRACTOR pulls in wire without Engineer approval of associated interconnect drawings, CONTRACTOR will not be reimbursed for labor for re-pulling in wires even if there was an error in wire fill or sizing. Also, if CONTRACTOR pulls in wire without Engineer approval of associated interconnect drawings, then all progress payments for that particular area of work will be withheld until approved interconnect drawings are in use.

b. The diagrams shall show all other Contract and Supplier drawing numbers, for reference, that are associated with each device that is interconnected.

Attached with each interconnect, a copy of all the support documents used in preparing interconnects. This includes current issues of panel schematics, connection diagrams, terminal block diagrams, submittals, contract drawings, vendor drawings and all other data used to develop the interconnection diagram as noted in the "Reference Documents" corner of interconnect drawings.

c. All interconnection diagrams shall be prepared under the supervision of or by a Registered Electrical Engineer and shall bear that Engineer's professional stamp and signature on each and every interconnect drawing submitted for approval and on as-built interconnect drawings. All deletions and additions of equipment, wire and cables shall be clearly shown. Interconnects shall include list of all applicable reference drawings, request for clarifications, field instructions and change orders.

d. Provide a notes section on each interconnect drawing. In the note section list any variances from the Contract conduit schedule necessary for completing the interconnections. Change orders regarding wire fill, conduit schedule and errors in plans regarding conduits and wires may not be processed until interconnect drawings have been received for such work.

e. Interconnections shall be shown point to point with identified lines. Diagrams of the wireless or wire schedule type are not acceptable. Bundled wires shall be shown as a single line with the direction of entry/exit of individual wires clearly shown.

f. All terminations points on the diagram shall be shown with the actual equipment identification terminal number or letter. This identification of terminations includes terminal blocks, junction boxes, all devices, computer I/O points, etc.

g. Diagrams shall include raceway numbers, raceway size, cable numbers, wire color code, and wire numbers.

h. Each wire and cable size and color code shall be shown. Each conduit route with the conduit label and conduit size shall be shown. Wire and cable routing through conduits, wireways, manholes, handholes, junction boxes, terminal boxes and other electrical enclosures shall be shown with the appropriate equipment labels. All spare wires, cable, and termination points shall be shown. Cable shields shall be shown.

i. Labeling codes for terminal blocks, terminals, wires, cables, panels, cabinets, instruments, devices, and equipment shall be shown.

j. Schematic symbols shall be used for field devices, showing electrical contacts. Signal and DC circuit polarities shall be shown.

k. The diagrams shall show all other contract and supplier drawing numbers, for reference, that are associated with each device that is interconnected.

l. Field wiring shall not start before the interconnection drawing have been submitted by CONTRACTOR and approved by the Owner.

m. Do not show the same wires or jumpers on the elementary or loop and interconnection diagrams. All jumper, shielding, and grounding termination details not shown on the connection diagrams shall be shown on the interconnection diagrams.

## PART 2 PRODUCTS

### 2.01 QUALITY

A. It is the intent of the Contract specifications and drawings to secure the highest quality in all materials and equipment in order to facilitate operation and maintenance of the facility. All equipment and materials shall be new and the products of reputable suppliers having adequate experience in the manufacture of these particular items. For uniformity, only one manufacturer will be accepted for each type of product.

B. All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all stresses which may occur during fabrication, transportation, erection, and continuous or intermittent operation. All equipment shall be adequately stayed and braced and anchored and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, and shall be of sturdy and durable construction suitable for long, trouble free service. Light duty, fragile and competitive grade devices of doubtful durability shall not be used.

C. Products that are specified by manufacturer, trade name or catalog number established a standard of quality and do not prohibit the use of equal products of other manufacturers provided they are favorably reviewed by the Engineer prior to installation.

D. Underwriters Laboratories (UL) listing is required for all substituted equipment when such a listing is available for the first named equipment.

E. When required by the Contract Specifications or requested by the Engineer, CONTRACTOR shall submit equipment or material samples for test or evaluation. The samples shall be furnished with information as to their source and prepared in such

quantities and sizes as may be required for proper examination and tests, with all freight and charges prepaid. All samples shall be submitted before shipment of the equipment or material to the job site and in ample time to permit the making of proper tests, analyses, examinations, rejections, and resubmissions before incorporated into the work.

## 2.02 NAMEPLATES AND TAGS

A. Equipment exterior nameplates - Nameplate material shall be rigid laminated black phenolic with beveled edges and white lettering; except for caution, warning, and danger nameplates the color shall be red with white lettering. The size of the nameplate shall be as shown on the drawings. No letters are allowed smaller than 3/16". All phenolic nameplates located outdoors shall be UV resistant. Securely fasten nameplates in place using two stainless steel screws if the nameplate is not an integral part of the device. Epoxy cement or glued on nameplates will not be acceptable. Engrave the nameplates with the inscriptions as approved by the Engineer in the submittal.

1. For each major piece of electrical equipment provide a manufacturer's nameplate showing the Contract specified equipment name and number designation, the manufacturer's name, model designation, part number, serial number, and pertinent ratings such as voltage, amperage, # of phases, range, calibration, etc.

2. For each device with a specific identity (pushbutton, indicator, instrument, etc.) mounted on the exterior or deadfront of a piece of equipment provide a nameplate with the inscription as shown in the Contract documents. Where no inscription is indicated in the Contract documents, furnish nameplates with an appropriate inscription providing the name and number of device.

B. Equipment Tags - When there is no space or it is impractical to attach an engraved phenolic nameplate with screws, as is the case with most field devices and instruments, CONTRACTOR shall attach a tag to the equipment with the same inscriptions as specified above in paragraph A. The tag shall be made from stainless steel material and the size of the nameplate shall be no smaller than 3/8"h x 2"w with 3/16" machine printed or engraved lettering unless otherwise approved by the Engineer. The tag shall be attached to the equipment with stainless steel wire of the type normally used for this purpose.

## 2.03 SITE LIGHTING

A. General

1. Provide site lighting as indicated on contract drawings.

B. Lighting Pole

1. Provide lighting pole, fixture type and orientation as indicated on the contract drawings. Pole shall be installed on a concrete base and anchored in accordance with the seismic and wind loading calculations specified.

2. Lighting pole shall be provided with an integral 20 amp, GFCI receptacle for site power utilization.

C. Fixture

1. Provide lighting fixtures as indicated on the contract drawings.

## 2.04 TELEMETRY CONTROL PANELS

A. General

1. Furnish and install telemetry control panels as indicated on the contract drawings and as required for a complete and operable control system.

2. Panels shall be sized to house the required components to meet the operational requirements indicated.

3. Control components, operator switches and displays shall be furnished, installed and wired to provide for the indicated functionality.

4. Telemetry control panels materials and fabrication methods shall be provided in accordance with Section 13340 Control Panels.

# PART 3 EXECUTION

## 3.01 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards outlined herein.

B. CONTRACTOR shall employ personnel that are skilled and experienced in the installation and connection of all elements, equipment, devices, instruments, accessories, and assemblies. All installation labor shall be performed by qualified personnel who have had experience on similar projects. Provide first class workmanship for all installations.

C. Ensure that all equipment and materials fit properly in their installations.

D. Perform any required work to correct improper installations at no additional expense to the Owner.

E. The Engineer reserves the right to halt any work that is found to be substandard or being installed by unqualified personnel.

F. Keep the premises free from accumulation of waste material or rubbish on a daily basis. Upon completion of work, remove materials, scraps, and debris from the premises and from the interior and exterior of all devices and equipment. Refinish damaged surfaces to new condition using skilled craftsmen of the trades involved at no additional cost to the Owner.

G. All equipment installed by CONTRACTOR shall be in accordance with the Drawings and the manufacturer's recommendations and instructions and shall operate to the Engineer's satisfaction. Follow all manufacturers' instructions for handling, receiving, installation, and pre-check requirements prior to energization. After energization, follow manufacturer's instructions for programming, set-up and calibration of equipment. CONTRACTOR shall be responsible for, and shall correct by repair or replacement, at his own expense, equipment that, in the opinion of the Engineer has been caused by faulty mechanical or electrical assembly by CONTRACTOR. Necessary tests to demonstrate that the electrical and mechanical operation of the equipment is satisfactory and meets the requirements of these Specifications shall be made by CONTRACTOR at no additional cost to the Owner.

## 3.02 CONSTRUCTION METHODS, GENERAL

A. All field wires and panel wires shall have wire markers as specified in the "WIRE" Section.

B. All wire and cable runs shall be continuous without a splice. No wires shall be spliced without prior approval by the Engineer.

C. Where splices are allowed or approved by the Engineer they shall conform with the following:

1. Wire splicing devices shall be sized according to manufacturer's recommendations.

2. Splices of #10 and smaller, including fixture taps, shall be made with see-thru nylon self-insulated twist on wire joints; T & B "Piggys", Ideal "Wing-Nut" or approved equal.

3. Splices of #8 and larger shall be hex key screw two way connectors, with built in lock washers; T & B "Locktite", O-Z type XW or approved equal, insulated with 3M Scotch Super #88, Plymouth or approved equal.

4. Splices in underground pullboxes shall be insulated and moisture sealed with 3M "Scotchcast" cast resin splice kits, Plymouth splice kits, or approved equal and shall have a date marking for shelf life.

D. Equipment shall be wired and piped by the manufacturer or supplier. Major field modifications or changes are not allowed without the written "change order" authority by the Engineer. When field changes are made, the components, materials, wiring, labeling, and construction methods shall be identical to that of the original supplied equipment. Contractor's cost to replace or rework the equipment to match original manufacturer or supplier methods shall be done at no additional cost to the Owner.

E. Mating fittings, bulkhead fittings, plugs, connectors, etc. required to field interface to the equipment and panels shall be provided by the supplier when the equipment is delivered.

F. All electrical and instrumentation drawings associated with the equipment shall be provided with the equipment when it is delivered to the job site. Drawings for each piece of equipment shall be placed in clear plastic packets of sufficient strength that will not tear or stretch from drawing removal and insertion.

## 3.03 DAMAGED PRODUCTS

A. Damage products will not be accepted. All damaged products shall be replaced with new products at no additional cost to the Owner.

## 3.04 FASTENERS

A. Except in listed chemical areas, fasteners for securing equipment to walls, floors, and the like shall be stainless steel. Fasteners shall be sized in accordance with the manufacturer’s installation requirements and per the Seismic anchoring calculations. The minimum size fastener shall be 3/8 inch diameter.

B. Concrete housekeeping pads shall secure freestanding equipment with stainless steel anchor bolts.

## 3.05 INSTALLATION, GENERAL

A. Install all products per manufacturer's recommendations and the Drawings.

1. Contract Drawings are intended to show the basic functional requirements of the electrical and instrumentation system and do not relieve CONTRACTOR from the responsibility to provide a complete and functioning system.

2. Provide all necessary hardware, conduit, wiring, fittings, and devices to connect the electrical equipment provided under other Sections. The following shall be done by CONTRACTOR at no additional cost to the Owner:

    a. Provide additional devices, wiring, conduits, relays, signal converters, isolators to complete interfaces of the electrical and instrumentation system.

b. Changing normally open contacts to normally closed contacts or visa versa

c. Adding additional relays to provide more contacts as necessary.

d. Install interposing relays as required to provide dry contact connection and isolation with packaged system suppliers.

B. Panels and enclosures:

1. Install all panels in accordance with the approved Seismic anchoring requirements.

2. Install panels and enclosures at the general location shown on the plans or approved by the Owner/Engineer.

3. Install all materials level and plumb.

4. Seal all enclosure openings to prevent entrance of insects and rodents.

5. Seal all conduits.

6. Provide sealing fittings rated for the hazardous location and penetration requirements per NEC.

C. Conduits and Ducts:

1. Install all conduits and ducts per Section 16110

D. Wiring, Grounding, and Shielding:

1. Install all wiring and termination per Section 16120

2. It is important to observe good grounding and shielding practices in the generally noisy environment in this application. The shield of shielded cables shall be terminated to ground at one end only, the origination end. The shield at the other end shall be encased in an insulated material to isolate it from ground.

E. Cutting and Patching:

1. CONTRACTOR shall do all cutting and patching required to install his work. Any cutting which may impair the structure shall require prior approval by the Engineer. Cutting and patching shall be done only by skilled labor of the respective trades. All surfaces shall be restored to their original condition after cutting and patching.

F. Cleaning and Touch up:

1. At the completion of the work, all parts of the installation, including all equipment, exposed conduit, and fittings, shall be thoroughly cleaned of grease and metal cuttings. Any discoloration or other damage to parts of the building, the finish, or the furnishings, due to CONTRACTOR's failure to properly clean the system, shall be repaired by CONTRACTOR without cost to the Owner.

2. CONTRACTOR shall thoroughly clean any of his exposed work requiring same.

3. Vacuum and clean the inside of all enclosures prior to applying power.

4. CONTRACTOR shall paint scratched or blemished surfaces with the necessary coats of quick drying paint to match existing color, texture and thickness. This shall include all prime painted electrical equipment including but not limited to enclosures, poles, boxes, devices etc.

## 3.06 MAINTENANCE AND OPERATING INSTRUCTIONS

A. At time of completion, CONTRACTOR shall provide a period of not less than 4 hours training for instruction of operation and maintenance personnel in the use of systems. Instruct all personnel at one time in one session. Make necessary arrangements with manufacturer's representative. Provide product literature and application guides for user's reference during instruction.

B. Provide six (6) Operation and maintenance manuals bound in a three ring binder and shall provide at least the following as a minimum.

1. A comprehensive index.

2. A complete "Record" set of favorably reviewed electrical submittals as provided under subsection 1-9 Submittal and Drawing Requirements llustrating all components, piping, and electrical connections.

3. A complete list of the equipment supplied, including serial numbers, ranges, catalog cuts, and pertinent data.

4. Full specifications on each item.

5. Detailed service, maintenance and operation instructions for each item supplied. Schematic diagrams of all electronic devices shall be included. A complete parts lists with stock numbers shall be provided on the components that make up the assembly. All of these shall be originals, no copies.

6. No photo copies are allowed of standard published manuals available from manufacturers. All of the hardware and software manuals shall be originals.

7. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.

C. At the end of the project these manuals shall be updated to show "as-built" conditions.

D. Provide two (2) sets of compact disk (CD) containing all drawings prepared for this project in AutoCAD format, updated to reflect as-built conditions.

## 3.07 TESTING

A. GENERAL REQUIREMENTS

1. It is the intent of these tests to assure that all equipment is operational within industry and manufacturer's tolerances and is installed in accordance with design plans and specifications.

2. The first set of tests to be performed shall determine the suitability for energization and shall be completed with all power turned off.

3. Prior to any field testing and final inspection, Interconnection Drawings and Operation and Maintenance Manuals shall have been submitted by CONTRACTOR and approved by the Engineer.

4. The test forms shall be completed by the testing person for field checkout, testing and calibration of all equipment. All tests shall be witnessed by the Engineer and/or Owner personnel. All filled in test forms shall be given to the Engineer and/or Owner the day of the test. Fill in two sets of test forms if Contractor wants to keep a copy.

5. CONTRACTOR shall give the Engineer 10 days' notice of the dates and time for inspections and testing.

6. Include test results in the Maintenance Manual.

7. Prepare and submit formal test procedures and start-up forms to the Owner at least two weeks prior to the start of testing. Testing shall not commence until the test procedures have been reviewed and approved by the Owner. Submit separate test procedure submittals for factory and field tests. The factory test procedure shall be in a separate binder from the field test procedure.

8. If the results of any of tests are unacceptable to the Engineer, CONTRACTOR shall make corrections and perform the tests again until they are acceptable to the Engineer; these additional tests shall be done at no additional cost to the Owner.

B. SAFETY

1. Testing shall conform to the respective manufacturer's recommendations. All manufacturers' safety precautions shall be followed.

2. The procedures stated herein are guidelines for the intended tests, CONTRACTOR shall be responsible to modify these tests to fit the particular application and ensure personnel safety. Absolutely no tests shall be performed that endanger personal safety.

3. California Electrical Safety Orders (ESO) and Occupational Safety and Health Act (OSHA): CONTRACTOR is cautioned that testing and equipment shall comply with ESO and OSHA as to safety, clearances, padlocks and barriers around electrical equipment energized during testing.

C. ELECTRICAL FIELD TESTS

1. PRE-ENERGIZATION TESTS: These tests shall be completed prior to applying power to any equipment.

a. INSPECTIONS:

1) Visual and Mechanical:

a) Inspect for physical damage, proper anchorage, and grounding.

b) Compare equipment nameplate data with design plans and starter schedule.

c) Compare overload setting with motor full load current for proper size.

b. TORQUE CONNECTIONS:

1) All electrical, mechanical and structural threaded connections inside equipment shall be tightened in the field after all wiring connections have been completed. Every worker tightening screwed or bolted connections shall be required to have and utilize a torque screwdriver/wrench at all times. Torque connections to the value

recommended by the equipment manufacturer. If they are not available, use NEC 2011 110-14 as guidelines.

c. WIRE INSULATION AND CONTINUITY TESTS:

1) All devices that are not rated to withstand the 500V megger potential shall be disconnected prior to the megger tests.

2) Megger insulation resistances of all 600 volt insulated conductors using a 500 volt megger for ten seconds. Make tests with circuits installed in conduit and isolated from source and load. Each conductor shall be meggered conductor to conductor and conductor to ground. These tests shall be made on cable after installation with all splices made up and terminators installed but not connected to the equipment.

3) Megger insulation resistances of all motor leads using a 500 volt megger for thirty seconds. Make these tests with motors installed in place and not connected to any other wiring. Each motor lead shall be tested conductor to ground.

4) Each megger reading shall not be less than 10 Meg-ohms resistive. Corrective action shall be taken if values are recorded less than 10 Meg-ohms.

5) Continuity Tests: Each instrumentation conductor twisted shielded pair shall have the conductor and shield continuity measured with an ohmmeter. Conductors with high ohm values, that do not match similar lengths of conductors the same size, shall be replaced at no additional cost to the Owner.

6) Values of different phases of conductors in the same conduit run showing substantially different Meg-ohm values, even if showing above 10 Meg-ohms shall be replaced

d. GROUNDING SYSTEM TESTS:

1) Visual and Mechanical Inspection.

a) Verify ground system is in compliance with drawings and specifications.

2) Electrical Tests

a) Before making connections to the ground electrodes, and before placement of sidewalks, landscape and paving, measure the resistance of each electrode to ground using a ground resistance tester. Perform the test not less than two days after the most recent rainfall and in the afternoon after any ground condensation (dew) has evaporated.

d) After all individual ground electrode readings have been made, interconnect as required and measure the system's ground resistance.

e) Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.

f) The grounding test shall be in conformance with IEEE Standard 81.

g) Plots of ground resistance shall be made and submitted to the Engineer for approval.

h) The current reference rod shall be driven at least 100 feet from the system under test.

i) Measurements shall be made at 10 feet intervals beginning 25 feet from the test electrode and ending 75 feet from it in a direct line between the system being tested and the test electrode.

j) The resistance between the main grounding electrode and ground shall be no greater than five ohms for commercial or industrial systems for generating or transmission station grounds per IEEE Standard 142.

3) Test Values

a) Investigate point-to-point resistance values that exceed 0.5 ohms.

e. PANELBOARD TEST:

1) Visual and Mechanical Inspection:

a) Inspect for physical damage, proper anchorage and grounding.

b) Compare equipment nameplate data with design plans and starter schedule.

c) Compare overload heaters with motor full load current for proper size.

d) Check torque of bolted connections.

f. BREAKER TEST:

1) All breakers shall be checked for proper mounting, conductor size, and feeder designation. Operate circuit breaker to ensure smooth operation. Inspect case for cracks or other defects. Check tightness of connection with torque wrench in accordance with manufacturer's recommendations.

2. POST ENERGIZATION TESTS:

a. INSTRUMENTATION TESTS

1) Instrumentation tests shall be conducted per the following criteria:

a) As a minimum, all the tests indicated/specified shall be recorded on a calibration/test form submitted to Engineer for each of the following types of instruments:

i) Level Transmitter.

ii) Pressure Transmitters.

iii) Flow Transmitter

iv) Switching Devices.

2) Test equipment used for testing shall be of suitable quality so as not to mask performance deficiencies. All test equipment shall be traceable to National Bureau of Standards and have been calibrated within six months of test date.

3) Testing shall be accomplished using simulated inputs only with prior written approval of the Owner.

4) The overall accuracy of each instrument loop shall be checked to ensure that it is within acceptable tolerance.

5) All the I/O points for the SLC shall be tested by the CSS with assistance from CONTRACTOR for proper panel wiring. Where practical, the final element shall be used, i.e., trip the intrusion switch or change levels. During this task CONTRACTOR shall have:

   a) Qualified field technician with experience in the startup of similar systems to operate the SLC and other field devices.

   b) Test instruments as required.

   c) A pair of radios for communication.

6) Calibration stickers shall be supplied for all equipment and instruments. Calibration stickers shall list the following information:

   a) Tag number.

   b) Calibrated by whom (name), firm, city and telephone number.

   c) Date calibrated.

   d) Calibration range.

   e) Comments.

7) CONTRACTOR shall provide a minimum of two (2) hours of field acceptance testing for each instrument. If any instrument has not been fully tested during its allotted time, CONTRACTOR shall provide additional hours for finishing testing of the instrument, to be paid by CONTRACTOR.

D. Operational Testing:

1. After all the previous tests in this subsection are complete, CONTRACTOR shall conduct operational testing.

2. For the operational testing the new equipment shall be activated to automatically run for 5 days, Monday through Friday. During this five day period the Owner will run the different combinations of the pump control options. If equipment failure occurs during the 5 days of operational testing, CONTRACTOR shall repair or replace the defective equipment and shall begin another 5 day operational test, Monday through Friday. This shall be continued until the new equipment functions acceptably for 5 consecutive days.

E. Final Acceptance Trial Period:

The system shall not be "final" accepted unless the system functions without hardware failures or software problems during a 30 day trial period, to the satisfaction of the Owner. The Owner reserves the right to restart the 30 day trial period, at their discretion, when a major hardware failure has occurred or a software problem has been identified. The Owner will notify CONTRACTOR when the 30 day trial period has been satisfactory completed.

F. The completion of the above tests does not relieve CONTRACTOR from warranties specified herein.

## 3.08 SPARE PARTS

A. CONTRACTOR shall supply all spare parts prior to start of field tests. All parts shall be sealed in plastic bags and delivered to the site in a heavy duty plastic storage bag. Bag shall be clearly labeled with part name and number and the corresponding equipment tag name.

B. CONTRACTOR shall make available any replacement parts that are not manufacturer's normal stock items for immediate service and repair of all the instrumentation equipment throughout the warranty period.

## 3.09 WARRANTY

A. CONTRACTOR shall warrant all electrical and instrumentation equipment and software for a period of one (1) year from date of final acceptance. Standard published warranties of equipment which exceed the preceding specified length of time shall be honored by the manufacturer or supplier.

****END OF SECTION****

**TECHNICAL SPECIFICATION**
**DIVISION 13: SPECIAL CONSTRUCTION**
**16110: CONDUIT RACEWAYS**

## PART 1 GENERAL

### 1.01 SCOPE OF WORK

A. CONTRACTOR shall provide conduit, devices, boxes, and grounding system as specified herein. This document describes the function and operation of the system and particular components, but does not necessarily describe all necessary devices. All components and devices shall be furnished and installed as required to provide a completely operable and reliable system for accomplishing the functions and meeting the performance set forth hereinafter.

B. Furnish all required labor, materials, project equipment, tools, construction equipment, safety equipment, transportation, test equipment, incidentals, and services to provide a complete and operational conduit, devices, boxes, & grounding system as shown on the Drawings, included in these Specifications, or required for fully operating facilities.

C. Work includes providing Conduits and Raceways for all devices and equipment required by the Contract documents.

D. The conduit, devices, boxes, & grounding system scope of work includes:

1. Provide and install trenching, conduits, junction boxes, field interconnection wiring, and associated hardware.

2. Provide all necessary hardware, conduit, wiring, fittings, and devices to connect the electrical equipment provided under other Sections.

3. Provide disconnect switches at all control panels and motors to disconnect all sources of power.

### 1.02 SUBMITTALS AND DRAWINGS

A. Provide submittals and drawings as specified in Section 16010 – Electrical General.

## PART 2 PRODUCTS

### 2.01 CONDUIT, RACEWAYS, AND WIREWAYS

A. GENERAL - Conduit, raceways, and wireways, wiring methods, materials, installation shall meet all requirements of the NEC, be UL labeled for the application, and meet the minimum following specifications:

1. All wiring shall be installed in conduits, raceways, or wireways when interconnecting equipment and devices.

2. CONTRACTOR shall use special conduit, raceways, wireways, construction methods, and materials as shown on the Contract drawings. Contract drawing special callouts shall take precedence over any general methods and materials specified in this Section.

3. Minimum conduit size:

   a. Exposed RMC (GRC) - ¾”

   b. Underground PVC, RMC-PVC – 1”

4. Conduit stubs for future use shall have pull wire and shall be capped with coupling, nipple, and plug.

5. Conduits to be abandoned that protrude above graded shall be cut flush and filled with grout.

B. CONDUIT MARKING

1. All conduits (except receptacle and lighting) shall have conduit tags at both terminations of each conduit.

2. Tag material shall be rigid laminated red phenolic with white lettering. The size of the tag shall be 2" diameter. No letters are allowed smaller than 7/16". Tags shall be heat and UV resistant, stain proof, electrically non-conductive and non-corroding. Securely fasten tags in place using plastic tie-wraps. Engrave the tags, on both sides, with the conduit number as listed in the Contract Documents. Labeling shall be neatly installed for visibility and shall be clearly legible. Conduit tags shall be Brady Custom B-1 or approved equal.

C. GALVANIZED RIGID STEEL (GRC) or RIGID METALLIC CONDUIT (RMC)

1. Standard weight, zinc-coated on outside by hot-dipping or sherardizing process, with either zinc coated or other approved corrosion resistant coating on inside. Fabrication shall be hot-dip galvanized after fabrication, conforming to NEMA RN 1.

2. Provide galvanized rigid steel factory elbows for 90 degree transitions.

3. Fittings shall be hot dipped galvanized steel or galvanized cast ferrous metal. Provide threaded-type fittings, couplings, and connectors; set-screw type and compression-type are not acceptable.

4. All joints shall be treated with T & B "Kopr-Shield".

5. Conduits entering enclosures shall be fitted with insulated grounding bushing; O-Z "HBLG", Appleton "GIB", or approved equal. All grounding bushings shall be tied to the grounding system with properly sized bonding conductors per the NEC code.

D. RIGID STEEL CONDUIT - PVC COATED (RMC-PVC)

1. Standard weight, galvanized conduit with a 40-mil thick polyvinylchloride coating bonded to both the outside and urethane interior coating. Conduit shall be hot-dip galvanized conforming to NEMA RN 1. GRS-PVC conduit to be Robroy Plasti-bond Red, or approved equal.

2. Provide PVC coated galvanized rigid steel factory elbows for 90 degree transitions.

3. Fittings shall be hot dipped galvanized steel or galvanized cast ferrous metal with a PVC 40 mils thick coating. Provide threaded-type fittings, couplings, and connectors; set-screw type and compression-type are not acceptable.

4. All joints shall be treated with T & B type CP "Kopr-Shield", LPS No. 3 rust inhibitor, or approved equal.

5. All junction and metal pull boxes shall be galvanized with exterior surfaces PVC coated to 40 mils thickness.

6. Conduits entering enclosures shall be fitted with insulated grounding bushing; O-Z "HBLG", Appleton "GIB", or approved equal. All grounding bushings shall be tied to the grounding system with properly sized bonding conductors per the NEC code.

E. PVC CONDUIT (PVC)

Nonmetallic conduit, couplings, bends and expansion fittings shall be polyvinyl chloride (PVC), Schedule 40. Solvent weld plastic fittings with solvent cement and primer in accordance with manufacturer's recommendations. Acceptable manufacturers: Carlon; Condux; or approved equal.

F. LIQUID TIGHT FLEXIBLE METAL CONDUIT (FLEX)

1. Minimum trade size ¾”.

2. Connectors: Appleton "STB" or approved equal through two inches (2") trade size. Appleton "ST", O-Z "4Q", or equal with insulated bushings for over two inches (2") trade size.

3. Suitable for connection of indoor or outdoor motors, controls, and mechanical equipment.

4. Shall be used for conduit coupling to all vibrating and shifting equipment.

5. Flexible conduit lengths shall not be greater than 36 inches.

6. Flexible metallic conduit shall not be considered as a ground conductor, install a separate wire for equipment bonding.

7. Flexible conduit shall only be installed in exposed or accessible locations.

8. Final connections to vibrating equipment such as motors and fans shall be made with flexible conduits.

## 2.02 SEALING FITTINGS

A. Sealing fittings shall be installed in conformance with NEC requirements for hazardous locations and as indicated on the contract drawings. Sealing fittings and compounds shall be certified and UL listed for the Hazardous location class, division and group.

B. Sealing fittings shall be Crouse Hinds EYS, Appleton EYS, or Equal.

## 2.03 PULL BOXES

Above-grade pull boxes for outdoor use shall be manufactured of stainless steel. Cover shall be attached with stainless steel screws. No devices, screws, rivets, or bolts shall protrude through the exterior surface unless specifically shown on the drawings. Boxes shall be Circle AW, or approved equal.

## 2.04 UNDERGROUND BOXES

Underground pull boxes, where shown or required by length of conduit runs, shall be prefabricated concrete type with the size shown on the Drawings or larger to allow for adequate pull area and to meet NEC requirements. Extension sections shall be provided as necessary to reach the depth of underground conduits. All boxes shall have galvanized steel hold down bolts and hardware. Boxes located in paved areas or other areas which vehicles may travel shall be H/20 loading rated and have traffic covers. Steel covers or lids shall be galvanized. Pull box covers shall be labeled power, signal, utility, telephone, whichever applies. Pull boxes shall be Christy Concrete Products, Brooks or approved equal.

## 2.05 GROUNDING SYSTEM

A. The utility service entrance ground bus shall be tied to a ground grid consisting of a ground rod type grounding system per contract E-Series Drawings.

B. The ground rod shall consist of not less than 10 continuous feet of 5/8 inch copper coated electroplated high grade carbon steel. The ground rod shall be a NEHRING type NCC, Weater 348. or approved equal. Ground rods shall extend up for visible connection of a UL approved “ground clamp” to the ground bus.

C. The main ground bonding wire from the ground shall extend up into the utility service entrance switchboard for the visible connection with a UL approved "ground clamp" attached to the ground bus. The main ground bonding conductor shall be #2 copper.

D. Network ground bond wires shall be connected from the switchboard ground bus and other points shown on the Contract drawings. The network ground bonding wires shall be #1/0 copper minimum.

E. Ground clamps shall be bolt-on type as manufactured by ILSCO type AGC, O-Z Gedney type GRC, or approved equal.

F. Equipment grounding conductors shall be sized as shown on the Plans or in accordance with NEC Table 250.122, whichever is larger.

G. Grounding and bonding wires shall be installed in all PVC conduits and nonmetallic raceways and connected to the ground bus and all equipment.

H. Each ground bus shall be copper. Screw type fasteners shall be provided on all ground busses for connection of grounding conductors. Ground bus shall be a Challenger GB series, ILSCO CAN series or approved equal.

I. One side of the secondary on all transformers shall be grounded to the ground bus.

J. All raceway systems, supports, enclosures, panels, motor frames, and equipment housings shall be permanently and effectively grounded.

K. All receptacles shall have their grounding contact connected to a grounding conductor.

L. Attachment of the grounding conductor to equipment or enclosures shall be by connectors specifically provided for grounding. Mounting, support, or bracing bolts shall not be used as an attachment point for ground conductors.

## PART 3 EXECUTION

### 3.01 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Section 16010.

B. The Supplier shall employ personnel that are skilled and experienced in the installation of conduits, devices, boxes, grounding system, accessories, and assemblies. All installation

labor shall be performed by qualified personnel who have had experience on similar projects. Provide first class workmanship for all installations.

C. Ensure that all equipment and materials fit properly in their installations.

D. Perform any required work to correct improper installations at no additional expense to Cal Am.

## 3.02 INSTALLATION

A. System:

1. Install all products per Section 16010.

B. Conduits and Ducts:

1. Except as expressly indicated or approved, all conduits shall be concealed in walls and located below floor slabs. Care shall be exercised to avoid interference with the work of other trades. This work shall be planned and coordinated with the other trades to prevent such interference. Pipes shall have precedence over conduits for space requirements. Exposed conduits shall be neatly arranged with runs perpendicular or level and parallel to walls. Bends shall be concentric.

2. All spare conduits shall have 3/8" nylon pull ropes installed.

C. Excavation and Back Filling:

1. Trenches for all lines below floor slabs and all underground electrical lines shall be excavated to the required depths. Conduits under floor slabs shall have trenches no deeper than is required to properly contain bends within walls.

2. Underground conduits outside of structures, excluding utility conduits, shall have a minimum cover of 18 inches except under roadways where minimum cover shall be 24 inches or when concrete encased. Back filling shall be done only after conduits have been inspected. Material for back filling shall be sand covered by compacted earth back fill. Excavation and back fill of lines and conduits shall conform to the requirements of the Earthwork Section of these Specifications, unless modified on plans, and to other entities as required.

3. At all times during the installation of the electrical distribution system, CONTRACTOR shall provide barricades, fences, guard rails, etc., to safeguard all personnel, including small children, from excavated trenches.

D. Device Mounting Heights:

1. Mounting heights of fixtures and devices shall be as follows unless otherwise indicated or when height has to be adjusted to be over or under counter tops.

| | | |
|---|---|---|
| Wall switches | => | 48 inches |
| Convenience outlets | => | 18 inches |
| Telephone outlets | => | 54 inches |
| Bracket fixtures | => | 7 feet 6 inches |

E. Cutting and Patching:

1. CONTRACTOR shall do all cutting and patching required to install his work. Any cutting which may impair the structure shall require prior approval by ENGINEER. Cutting and patching shall be done only by skilled labor of the respective trades. All surfaces shall be restored to their original condition after cutting and patching.

F. Conduit entrances: Seal each conduit entrance from below grade into the panel and other electrical enclosures with plugging compound sealant to prevent the entrance of insects and rodents. Conduits between the power and control panels shall be sealed with removable plugging compound sealant on each end. Plugging compound sealant shall be Courtaulds Aerospace, Semco PR-868, or approved equal.

## 3.03 WARRANTY

A. Provide warranty as specified in Section 16010 - Electrical, WARRANTY.

****END OF SECTION****

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**TECHNICAL SPECIFICATION**
**DIVISION 13: SPECIAL CONSTRUCTION**
**16120: WIRE AND TERMINATION**

## PART 1 GENERAL

### 1.01 SCOPE OF WORK

A. CONTRACTOR shall provide the electrical and instrumentation system with all conductors, wiring, fuses and terminal blocks as specified herein.

B. Furnish all required labor, materials, tools, test equipment, incidentals, and services to provide a complete and operational electrical and instrumentation system with wire and electrical devices as shown on the Drawings, included in these Specifications, or required for fully operating facilities.

C. Work includes providing wiring and all devices and equipment required by the Contract documents.

### 1.02 SUBMITTALS AND DRAWINGS

A. Provide submittals and drawings as specified in Section 16010.

## PART 2 PRODUCTS

### 2.01 WIRING AND ELECTRICAL DEVICES

A. GENERAL

1. The electrical and instrumentation system vendor shall provide the wiring and electrical devices specified below and install field and internal panel wiring as shown on the Contract Drawings. This section applies to all wires or conductors used internal (non-field) for all electrical equipment or external for field wiring. Wire quantity and size shall be as shown on the Contract Drawings. Contractor shall provide all additional wiring that may be required to complete the operational requirements of the equipment.

B. POWER DISTRIBUTION

1. Each control and instrumentation device shall be wired to terminal blocks and fuses for 120 V AC or 48V DC power supply connections. A spare duplex outlet wired to a separate circuit shall be provided in each control and instrumentation panel. This outlet shall remain available for future use, shall be labeled "CONVENIENCE RECEPTACLE" and shall not be used to power any equipment installed by the Control and Instrumentation panel vendor.

C. ANALOG SIGNALS

1. Analog signal transmission between electric or electronic instruments shall be 4-20 milliamperes and shall operate at 24 volts DC unless otherwise specified. Milliampere signals shall be current regulated and shall not be affected by

changes in load resistance within the unit's rating. Provide isolated current amplifiers wherever the loop load resistance exceeds the current signal transmitter's rating. Associated shunt resistors shall be located on rail-mounted terminal blocks. Exposed resistor leads shall be insulated with heat-shrink tubing.

D. LOW VOLTAGE WIRE AND CABLE (through 600V except instrument signals)

1. General: Low voltage conductors shall be used for power, control, lighting and miscellaneous circuits. This Section applies to all wires or conductors used internal for all electrical equipment or external for field wiring. Wire shall be new, plainly marked with UL label, gauge, voltage, type of insulation, and manufacturer's name.

2. Control and Power Wiring:

   a. NEMA standards WC3 and WC5 UL listed 600V single conductor jacketed flame-retardant cable with rated conductor temperature, 90 degrees C; all cable capable of passing vertical flame resistance test, IEEE 383.

   b. Insulation: Moisture and heat-resistant thermoplastic, Jacket: Neoprene.

   c. Conductors: Annealed copper in accordance with ASTM B3, B33 or B189. Conductor stranding shall be ASTM B8, concentric Class B. Solid conductors may be used for lighting and receptacle circuits.

   d. Insulation type shall be moisture and heat resistant thermoplastic NEC Type THHN /THWN, rated 90 °C in dry locations and 75 °C in wet locations, for #8 AWG or smaller. Conductors #6 AWG and larger shall be XHHW insulation.

   e. Field wire minimum AWG sizes:

      1) #12 for wires used for individual conductor circuits 100 volt and above, except for SLC I/O which may be #14 AWG.
      2) #14 for wires used for individual conductor circuits below 100 volt.

   f. Nonfield or equipment wire minimum AWG sizes:

      1) #16 for wires used for individual conductor circuits 100 volt and above.
      2) #18 for wires used for individual conductor circuits below 100 volt.

   g. Insulation of all conductors and cables shall be rated 600 volt or higher.

3. Instrument wiring:

   a. Field: Instrument cables shall have 600V tray cable rated insulation and 100% individual shielded twisted pair #16 conductors with drain wire. Single twisted shielded pair (TSP) cables shall be Belden 9342, or approved equal.

   b. Non-Field: Instrument cables shall have 300V rated insulation and 100% individual shielded twisted pair #18 conductors with drain wire. Single twisted shielded pair (T.S.PR.) cables shall be Belden 8760, or approved equal.

4. Manufacturer Supplied Cables: Cables and wiring for special systems provided by the manufacturer with the equipment shall be installed per the manufacturer's recommendations.

E. COLOR CODE

1. The color code of all wire shall conform to the following table:

## 2.02 WIRES COLOR CODE TABLE

| Description | Phase/Code Letter | Field Wire Or Tape Color | Non-Field Wire Color |
|---|---|---|---|
| 480 V, 3 PHASE | A | BROWN | BROWN |
| | B | ORANGE | ORANGE |
| | C | YELLOW | YELLOW |
| 240 V or 208 V, 3P | A | BLACK | - |
| | B | RED (ORANGE if high leg) | - |
| | C | BLUE | - |
| 240 / 120 V, 1 P | L1 | BLACK | BLACK |
| | L2 | RED | - |
| 24V POSITIVE | 24P | PINK | PINK |
| 24V NEGATIVE | 24N | BLACK | BLACK |
| AC CONTROL | | VIOLET | RED (YELLOW FOR FOREIGN CIRCUITS) |
| DC CONTROL | | BLUE | BLUE |
| NEUTRAL | N | WHITE | WHITE |
| GROUND | G | GREEN | GREEN |
| SHIELDED PAIR | + | BLACK | BLACK |
| | - | CLEAR (WHITE) | CLEAR (WHITE) |

1. All wires #8 and below shall have wire insulation in the colors specified. Wires #6 and larger may be black with color tape.

2. No other colors shall be used without prior approval of Cal Am.

3. The same color shall be connected to the same phase throughout the panel.

4. All wires shall be properly fused or protected by a breaker at the amperage rating allowed by the NEC.

B. WIRE MARKING

1. All panel, enclosure and field wiring (except receptacle and lighting wiring) shall have wire labels at both terminations of each wire. The wire labels shall be machine printed with indelible ink, heat shrink type by Brady or equal. Labeling shall be neatly installed for visibility and shall be clearly legible. Each conductor of instrument signal wiring shall be labeled.

2. Wire identification - all wires, field and interior to equipment, shall be identified with machine printed sleeve markers or clip-on markers covered with clear plastic heat shrinkable tubing. Hand lettered wire labels are not acceptable and shall be replaced at CONTRACTOR's expense. All wires that are electrically the same (connected to common termination points) and do not pass through a contact or other switching device shall have the same wire identification. The wire labeling code for each end of the same wire shall be identical. Tubing shall be sized for the wire and shrunk into place with the properly sized heat gun.

3. The wire identification code for field and panel wiring shall be the number/letter designated on the "Contract elementary" and "Supplier loop" diagrams. Wire labels shall be T&B SM series, Pass & Seymour CAB3, or approved equal.

4. Wire labeling may be omitted on locally interconnected neutral wires such as jumpers between adjacent auxiliary relay coil neutral terminals. "Locally" is defined as wires no longer than 8".

## PART 3 EXECUTION

### 3.01 WORKMANSHIP

A. All work in this Section shall conform to the codes and standards specified in Section 16010 – Electrical General.

B. CONTRACTOR shall employ personnel that are skilled and experienced in the installation of wire electrical devices, accessories, and assemblies. All installation labor shall be performed by qualified personnel who have had experience on similar projects. Provide first class workmanship for all installations.

C. Ensure that all equipment and materials fit properly in their installations.

D. Perform any required work to correct improper installations at no additional expense to Cal Am.

## 3.02 INSTALLATION

A. System:

1. Install all products per 16010 – Electrical General, INSTALLATION, GENERAL.

2. The panels shall be completely factory wired and tested before shipment.

3. A minimum of 20% spare unwired terminals shall be provided.

B. Wiring Methods:

1. WIRING SEPARATION: Wires carrying 100 volts and above shall be physically separated from lower voltage wiring by using separate bundles or wire ways with sufficient distance to minimize the introduction of noise, crossing only at 90 degree angles.

2. HARNESS: All wiring shall be neatly bundled and laced with plastic tie-wraps, anchored in place by screw attached retainer. Where space is available, all wiring shall be run in slotted plastic wire ways or channels with dust covers. Wire ways or channels shall be sized such that the wire fill does not exceed 60%. Tie-wraps shall be T&B TY-RAP or approved equal.

3. HINGE LOOPS: Where wiring crosses hinged surfaces, provide a "U" shaped hinge loop protected by clear nylon spiral wrap. The hinge loop shall be of sufficient length to permit opening and closing the door without stressing any of the terminations or connections. Spiral wrap shall be Graybar T25N or approved equal.

4. RETAINERS: Wire ways, retainers, and other devices shall be screw mounted with round-head 316 stainless steel screws or mechanically mounted by push-in or snap-in attachments. Glue or sticky back attachment of any type or style shall not be used. Retainers shall be T&B TC series or approved equal.

5. ROUTING: Wiring in panels shall be routed in slotted plastic wire-ways with snap covers. Wires carrying 120 VAC shall be separated as much as possible from other wires and signal cables, and shall be routed only in ducts for 120 VAC. If the power wiring has to cross the signal wiring, the crossing shall be as close to a right angle as possible. Ducts for 24 VDC wiring shall be used for all other wires and cables. Routing of 120 VAC in combined ducts shall be minimized. Wires and cable shall be routed along the shortest route between termination points, excepting routes which would result in routing 120 VAC and other wires and cables in the same duct. Wires and cables shall have sufficient length to allow slack and to avoid any strain or tension in the wire or cable. Wires and cables shall be placed in the ducts in a straight, neat and organized fashion and shall not

be kinked, tangled or twisted together. Additional wire ducting shall be provided for use by the electrical subcontractor for routing field wires to their landing points in the each electrical and instrumentation panel.

Wiring not routed in duct work shall be neatly bundled, treed, and laced with plastic ties. Wiring across door hinges shall be carefully made up and supported to avoid straining and chafing of the conductors or from putting any strain on their terminals.

6. TERMINATIONS: Single wire and cable conductors shall be terminated according to the requirements of the terminal device.

   a. Provide 2-1/2" minimum separation between wireway and terminal blocks. Installation of wireways too close to terminal blocks will be required to be completely reworked to the satisfaction of Cal Am.

   b. For captive screw pressure plate type terminals, the insulation shall be removed from the last 0.25 inches of the conductor. The conductors shall be inserted under the pressure plate to full length of the bare portion of the conductor and the pressure plate tightened without excess force. No more than two conductors shall be installed in a single terminal. All strands of the conductor shall be captured under the pressure plate.

   c. For screw terminals, appropriately sized locking forked spade lugs shall be used. Lugs shall be crimp on type that form gas tight connections. All crimping shall be done using a calibrated crimping tool made specifically for the lug type and size being crimped.

   d. On shielded cables, the drain wire shall be covered with insulating tubing along its full bare length between the cable jacket and the terminal lug or terminal pressure plate.

   e. For screwless terminals, wire shall be stripped back and inserted per the manufacturer's instructions. When stripping insulation from conductors, do not score or otherwise damage conductor.

   f. Heat shrink shall be placed on ends of shielded cable to cover foil.

   g. Additional condulets with terminal blocks shall be supplied for wire termination to devices with leads instead of terminals. (i.e. solenoid valves, level probe, etc.)

## 3.03 WARRANTY

A. Provide warranty as specified in Section 16010 – Electrical General, WARRANTY.

**END OF SECTION**

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