SECTION 02100
DEMOLITION

PART 1 – GENERAL

1.01 DESCRIPTION
A. Section includes regulatory and general requirements for demolition.

1.02 REFERENCE STANDARDS
A. State of California, Department of Transportation Standard Specifications (Caltrans):
   Section 15 Existing Highway Facilities

1.03 RESTRICTIONS
A. Do not sell or burn removed materials on-site.
B. Do not use explosives.

1.04 SUBMITTALS
A. Demolition Plan: Submit demolition plan for approval: Indicate methods to be employed, sequence, equipment, procedures, disposal sites, and proposed haul routes. Indicate safety measures in accordance with applicable codes, including signs, barriers and temporary walkways.

1.05 DELIVERABLES
A. Submit permits and notices authorizing demolition, as required.
B. Submit copies of manifests showing delivery of disposed materials in accordance with permit conditions within 24 hours from time of delivery.

1.06 REGULATORY REQUIREMENTS
A. Perform work of this Section in accordance with applicable laws, ordinances, and requirements of the agencies having jurisdiction.
B. Unless otherwise specified, perform work in accordance with the following:
1.07 PROJECT CONDITIONS

A. Provide and maintain all required temporary construction and facilities for the support and protection of the existing structures to remain.

B. Protection and Interruption of Utilities: Refer to Specification Section 01047, Utilities and Systems Coordination, for location, notification, and protection requirements in regard to existing utilities and systems facilities.

C. Refer to Specification Section 01560, Temporary Controls, for requirements for dust control. Provide continuous dust abatement as required.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Provide temporary or permanent materials as required for the proper execution of the Work of this Section.

2.02 DUNNAGE

A. Provide pallets, sills and other materials for packaging and stacking salvaged items which are clean, free of decay or other defects, and sufficiently sturdy for the service intended.

2.03 MARKING PAINT

A. Marking Paint: Spray marking paint or paint marker, suitable for duration of service required.

PART 3 – EXECUTION

3.01 PREPARATION

A. Inspect existing conditions and note dimensions, clearances, access, utilities, shoring and protection required.

B. Have in place, before demolition begins, required protection measures, protective and regulatory devices, and personnel. Protective measures include barricades, warning and temporary routing signs, lights and similar devices.

C. Where an abutting structure or a part of a structure is to be left in place, make clean, smooth, vertical cuts with a saw or other approved cutting device to lines indicated. If not indicated or otherwise required, demolish structure to a minimum of 18 inches below subgrade.

D. The Contractor may salvage materials from demolition for use in temporary facilities but shall not use the salvaged materials in the Work unless approved in writing by the Engineer for each specific case, or unless specifically called for in the Contract Documents.

E. Obtain utility shut off to safely execute the work.

F. Verify that structures to be removed are cleared of utilities.
G. Provide temporary construction for the maintenance, support and protection of existing adjacent structures and facilities that are to remain.

3.02 DEMOLITION

A. General:

1. Perform work of this Section in conformance with Caltrans Standard Specifications Section 15, Existing Highway Facilities.

2. Do not place demolished material or demolition equipment where it will create excessive loads on any structure.

3. If unforeseen obstructions are encountered, obtain instructions from the Engineer before proceeding with the work.

4. Promptly repair, restore or replace damage, disturbance, or impairment of existing facilities to remain.

5. Repair or replace items to remain or to be salvaged which are damaged during demolition to the satisfaction of the Engineer or private property owner(s).

6. Refer to Specification Section 20200, Track Removal and Salvage, for related requirements in regard to track demolition, as applicable.

B. Salvage:

1. Salvage existing facilities as shown on the Contract Drawings and transport to location designated by the Engineer within 30 miles of the work site.

2. Take necessary precautions to disconnect, remove, protect, transport, and store salvaged items in a manner that will prevent damage.

C. Removal:

1. Remove existing facilities as shown on the Contract Drawings.

2. Wet down concrete materials during demolition to prevent spread of dust and dirt. Do not use water in a manner that would cause damage or contaminate runoff. Refer to Special Conditions Section 01560, Temporary Control, in regard to control or erosion and pollution prevention.

3. Fill below grade areas and voids resulting from removal of below-grade structures and utilities, and compact to indicated grade in accordance with Specification Section 02300, Earthwork.

4. Remove abandoned conduit, wiring and piping to the source of supply, or Limit of Work.

5. Saw cut concrete or asphalt pavement to 3 inches depth, with saw designed for cutting pavements, prior to pavement removal. Cuts shall be straight and free of ragged edges.

6. Remove traffic stripes, pavement markings, and pavement markers in
conformance to Caltrans Standard Specifications, Section 15-2.02B and 15-2.02C.

D. Disposal: Refer to General Provisions 7.16, Disposal of Material Outside of the Work Site.
   1. Do not store or stockpile on Caltrain property material designated for disposal, except as indicated in the Contract Documents.
   2. Removed items that are not scheduled or shown on the Contract Drawings to be salvaged or re-used shall become the property of the Contractor and shall be disposed of outside of the work site.
   3. Keep the project area clear of refuse and rubbish, and maintain the area in a neat condition.

E. Relocation:
   1. Remove and install existing facilities in a new location.

F. Reconstruction:
   1. Remove and disassemble existing facilities as shown on the Contract Drawings and construct again at the existing location or a new location.
   2. Provide new parts or alteration to the existing facility as required.
   3. Protect items removed for reconstruction from damage during removal, disassembly and final construction. Repair or replace any damaged facilities.

G. Modification:
   1. Modify existing facilities as indicated on the Contract Drawings.

3.03 PRESERVATION OF REFERENCE MARKERS

A. Refer to Specification Section 01050, Field Engineering. Make arrangements with the Engineer to replace any survey markers and monuments missing or damaged during construction.

B. Store removed markers and monuments during demolition work.

END OF SECTION
SECTION 02110
SITE CLEARING

PART 1 – GENERAL

1.01 DESCRIPTION
A. Section includes specifications for clearing and grubbing. Perform site clearing in advance of grading and other construction operations.

1.02 REFERENCE STANDARDS
A. State of California, Department of Transportation, Standard Specifications (Caltrans)
   1. Section 16 Clearing and Grubbing

1.03 SUBMITTALS
A. Site Clearing Plan: Indicate location and limits of clearing and grubbing, methods, equipment, procedures, safety and protection measures, and disposal sites.

1.04 DELIVERABLES
A. Submit copies of manifests showing delivery of disposed materials in accordance with permit conditions within 24 hours from time of delivery.

PART 2 - PRODUCTS

2.01 MATERIALS
A. Provide temporary or permanent materials as required for the proper execution of the work of this Section.

PART 3 - EXECUTION

3.01 GENERAL
A. Perform site clearing in accordance with Caltrans Standard Specifications Section 16.
B. Maintain a clear site until covered by new work or until completion of the Work.
C. Clear, grub, prune, remove, and dispose of materials, including bushes, brush, trees, stumps, fallen timber, logs, roots, signs, rubbish, refuse, trash and debris as shown on the Contract Drawings, specified herein, and as required to perform the work of the Contract.
D. Refer to Section 01560, Temporary Controls, for requirements for storm water pollution prevention and dust control.
E. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing improvements indicated to remain in place. Protect improvements on adjacent properties as well as those on PCJPB property. Restore existing improvements damaged by the work to original condition to the satisfaction
F. Refer to Section 02510, Utility Grade Adjustments, for specifications for raising and resetting existing frames, covers, and lids to meet new finish grade elevations.

G. Upon completion of site clearing work, Caltrain property and adjacent areas shall be neat, clean and in condition to receive subsequent work.

H. Carefully remove items to be salvaged, and store where required by the Engineer or where indicated in the Contract Documents.

### 3.02 LIMITS OF SITE CLEARING

A. Perform site clearing sufficient to perform the construction work shown in these Contract Documents. In addition, perform site clearing as follows:

1. Perform site clearing for track construction for a distance of 15 feet measured perpendicular from the centerline of track outward toward the right-of-way, or from the centerline to the right-of-way, whichever is less.

2. Perform site clearing to three (3) feet beyond the toe of new embankments.

3. Perform site clearing at grade crossings to a distance of not less than 100 feet in each direction of approach to grade crossings, within the entire width of the right-of-way, unless otherwise indicated on the Contract Drawings.

### 3.03 CLEARING

A. Cut, remove and dispose of all timber, brush, fallen timber, stumps and rubbish except trees or other vegetation that is designated for preservation on the Contract Drawings. Retain and protect from damage any trees and shrubs that are outside the limits of the required clearing.

B. Completely remove trees, stumps, shrubbery, and brush in areas where embankment will be placed.

C. Remove stumps and roots completely in excavation areas and under embankments where the original ground level is within 3.5 feet of subgrade or slope of embankments. In embankment areas, where the original ground level is more than 3.5 feet below the sub grade or slope of embankment, cut off trees, stumps, and brush to within 6 inches of the ground.

D. Do not start earthwork operations in areas where clearing and grubbing are not complete, except that stumps and large roots may be removed concurrently with excavation.

### 3.04 GRUBBING AND STRIPPING

A. Grubbing: Excavate, remove and dispose of all roots, stumps, and other vegetation to a minimum depth of 30 inches. Measured depth shall be from existing ground surface or new finished grade, whichever is lower. Leave ground surface in a condition suitable for stripping of topsoil.

B. Stripping: Excavate and remove topsoil (including any remaining vegetation) which is not classified as suitable fill material down to suitable fill material, except in plant bed areas. Salvage topsoil if required in the Contract Documents.
3.05 EXISTING TREES AND VEGETATION

A. Protect existing trees indicated to remain in place against cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling building materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary fences, barricades or guards at dripline to protect trees. Trees within limits of contract work shall be watered as required by the Engineer.

B. When it is necessary to cut tree roots to provide room for new construction, cleanly saw tree roots over 1-1/2 inches diameter. Cover exposed roots with wet burlap to prevent roots from drying out.

C. Where trees or shrubbery designated to remain or those in areas outside the area indicated to be cleared and grubbed are damaged in the course of the Work, repair damage to or replace damaged existing trees and shrubbery to the Engineer's satisfaction.

3.06 EXISTING STRUCTURES AND PROPERTY

A. Obtain permission from the Engineer prior to removing signs, posts, catch basin frames and grates, and manhole frames and covers not indicated on the Contract Drawings for removal.

B. Protect existing structures and facilities not to be removed.

C. Store salvaged items in an orderly manner as directed by the Engineer.

D. Protect existing survey monuments. Refer to Section 01050, Field Engineering, for procedures for replacement of disturbed or damaged bench marks or monuments.

3.07 DISPOSAL

A. Disposal: Refer to General Provisions 7.16, Disposal of Material Outside of the Work Site.

1. Do not store or stockpile on Caltrain property material designated for disposal, except as indicated in the Contract Documents.

2. Debris and material that is not scheduled or shown on the Contract Drawings to be salvaged or re-used, shall become the property of the Contractor and shall be disposed of outside of the work site.

B. Keep the project area clear of refuse and rubbish, and maintain the area in a neat condition.

END OF SECTION
SECTION 02200
SUPPORT OF EXCAVATION

PART 1 – GENERAL

1.01 DESCRIPTION

A. Section including specifications for design and installation of excavation support.

B. Section also includes specifications for excavation support systems the design of which is indicated on the Contract Drawings, as applicable.

1.02 GENERAL

A. Refer to General Conditions 7.15, Trench Excavation Safety Plan, for basic requirements related to this Section.

1.03 REFERENCE STANDARDS

A. American Railway Engineering and Maintenance-of-Way Association (AREMA):

B. ASTM (ASTM International):
   1. A36 Specification for Carbon Structural Steel
   2. A53 Specification for Pipe, Steel, Black and Hot Dipped, Zinc-Coated, Welded and Seamless
   3. A252 Specification for Welded and Seamless Steel Pipe Piles
   4. A328 Specification for Structural Steel for Steel Sheet Piling
   5. A500 Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shape
   6. A572 Specification for High-Strength Low-Alloy columbium-Vanadium Structural Steel
   7. A992 Specification for Structural Shapes

C. American Welding Society (AWS):
   1. D1.1 Structural Welding Code

D. American Wood Preservers Association (AWPA):
   1. U1 User Specification for Treated Wood
E. California Code of Regulations (CCR):
   1. Title 8, Chapter 4, Subchapter 4, Construction Safety Orders

F. Caltrain Engineering Standards for Excavation Support Systems

G. State of California, Department of Transportation (Caltrans):

1.04 DEFINITIONS

A. Railroad Zone of Influence: Refer to Caltrain Engineering Standards for Excavation Support Systems.

1.05 DESIGN CRITERIA

A. Temporary excavation support (shoring) shall conform to the requirements in the Caltrans Trenching and Shoring Manual and Caltrain Engineering Standards for Excavation Support Systems.

B. Excavations adjacent to active tracks: Excavations below the Zone of Influence Line indicated in the Contract Drawings shall be supported in accordance with Caltrain Engineering Standards for Excavation Support Systems. The Contractor may request a waiver of railroad loading requirements when excavations are less than 4 feet deep, less than 4 feet square in area and are not closer than 10 feet from the center line at the track.

C. Where physical conditions of design require the placing of excavation support closer than specified herein, the design shall be submitted to the Engineer for review and approval of a waiver.

D. When support of track or tracks is necessary during construction (that is shoring adjacent to active tracks), interlocking steel sheet piling adequately braced and designed to carry Cooper E-80 live load is required. Soldier piles and lagging will be permitted for supporting adjacent track or tracks only when required penetration of steel sheet piling cannot be obtained or when, if approved by the Engineer, steel sheet piling would be impractical to place.

   1. Do not use soldier piles and lagging for any shoring systems within the Railroad Zone of Influence.

E. The excavation support shall allow safe and expeditious construction of the permanent structure and shall be designed to carry the loads imposed upon it, including earth pressures, vehicular traffic loading, railroad loading, utility loads, loads from adjacent structures, ground water pressure, equipment and construction loads, without movement or settlement of adjacent structures, utilities, or tracks.

F. Design splices in structural steel members to develop 100 percent of the strength of the member.
G. Cover excavations. Protect excavations by handrails, barricades, and warning lights.

1.06 SUBMITTALS

A. Excavation Shoring Systems: Submit the following showing the proposed methods of construction, design, and details:

1. Detailed working drawings for temporary shoring including the following: Plans, elevations, sections and details that clearly describe the systems to be installed including the methods and procedures of installation to be followed and a description of each material to be employed. Dimensions and spacing of members shall be clearly noted. Include existing utility locations and temporary supports for utilities.

2. Design computations demonstrating that the required design parameters have been met.

3. Product data for materials and equipment.

B. For Owner-Designed Excavation Shoring Systems, as Applicable: Submit the following:

1. Shop drawings showing excavation support elements, including layout of piles and bracing elements. Identify and show location of existing utilities in both plan and elevation.

2. Include details showing how the excavation support system will be installed around utilities.

3. Design of temporary supports for utilities to be maintained across the excavations.

C. Submit the following as applicable to specific support systems:

1. Construction and installation procedures, excavation sequence, interface details, protection measures for existing structures and facilities, and contingency plans for excessive movement of existing walls and other facilities.

2. Concrete mix designs as specified in Section 03300, Cast-in-Place Concrete.

3. Soil-cement design mixes, including test data demonstrating that the proposed mixes will meet required strength.

4. Quality control/quality assurance plan for soil-mix wall construction. Coordinate with Section 01400, Quality Control and Assurance, suitable for demonstrating that the soil-mix walls have been installed to the required depths and dimensions and will have the required strength, continuity, and permeability at the time of excavation. Include the means of continuously monitoring the slurry injection process during soil mixing, soil-cement sampling methods and frequency, and soil-cement testing methods and frequency.
D. Submit instrumentation and monitoring plan that includes the following information:

1. Drawings showing planned locations and identification numbers for each settlement point, railroad settlement point, and monitoring well.

2. Proposed schedule for installing and for monitoring settlement points, railroad settlement points, inclinometers, and monitoring wells.

3. Descriptions and details for methods and materials to be used in the installation of settlement points, railroad settlement points, inclinometers, and monitoring wells.

4. Manufacturer’s literature including product descriptions, and operation and maintenance procedures for instruments.

5. Details for abandoning instruments at the completion of the Work.

E. Submit as-built drawings of instrumentation installation within 5 days of completion of instrument installation.

1.07 DELIVERABLES

A. Submit written confirmation signed by the Civil Engineer of the temporary shoring systems that the shoring systems have been constructed in accordance with the approved submittals.

B. Submit the following as applicable to specific support systems:

1. Deliverables specified under Section 05200, Structural Steel.

2. Soil-cement testing results within 3 days of tests being performed.

3. Instrument readings within 3 days of the readings being taken.

1.08 QUALITY ASSURANCE

A. Temporary Shoring:

1. Temporary shoring designs including working drawings and calculations shall be prepared, sealed, and signed by a Civil Engineer hired by the Contractor who is currently registered in the State of California, has previous experience in the design of temporary shoring systems, and is qualified as required in the Caltrain Engineering Standards for Excavation Support Systems.

3. Contractor’s Civil Engineer for the shoring design shall inspect the as-built shoring system to verify that the system is constructed in accordance with the approved shoring plans. The number of site visits and the stage or stages of construction at which they shall be performed shall be as required by the Engineer as a condition of approval of the shoring system.

4. Maintain sheeting, bracing and other temporary protective work in place and functioning until temporary protective work is no longer necessary, as determined by the Contractor’s Civil Engineer.
B. Track Monitoring:

1. Railroad tracks shall be monitored in accordance with the requirements outlined in Caltrain Engineering Standards for Excavation Support Systems.

2. Surveying for monitoring settlement points shall be performed by a Land Surveyor hired by the Contractor licensed who is currently registered in the State of California with previous experience surveying for the detection of structural or ground surface movements.

C. Comply with the following regulatory requirements:

1. CCR, Title 8, Chapter 4, Subchapter 4, Construction Safety Orders.

1.09 CONTRACTOR ALTERNATIVES

A. Where excavation support systems and details are shown on the Contract Drawings, the Contractor may propose alternate systems and details provided such systems meet the design requirements and criteria specified herein and shown on the Contract Drawings and the limitations on shoring types specified herein.

B. Alternate excavation support systems and details shall be submitted for the Engineer’s approval as specified herein for Contractor-designed excavation shoring systems.

C. Should the Contractor choose to modify the shoring system, the Contractor does so at the Contractor’s own risk and no claims for additional time or compensation will be allowed as a result of any delays or difficulties suffered.

PART 2 – PRODUCTS

2.01 TEMPORARY SHORING MATERIALS

A. Materials for temporary shoring systems may be new or used, provided they are sound and free from any strength-impairing defects.

B. Materials shall conform to the following specifications as shown on the approved submittals for Contractor-designed systems or as indicated on the Contract Drawings:

1. Structural, Plate, and Tube Steel: ASTM A36, A500, A572, or A992
2. Steel Sheet Piling: ASTM A328 or A572
3. Steel Pipe: ASTM A53 or A252
4. Concrete: As specified in Section 03300, Cast-in-Place Concrete, and shown on the Contract Drawings or in the approved submittals. Lean concrete strength shall be so proportioned that the concrete retains its shape during excavation operations.
5. Timber Shoring Elements: Douglas Fir, No. 2, or better. Timber to remain permanently in place shall be pressure-treated with preservative material in accordance with AWPA U1, User Category UC4B or UC4C.

2.02 INSTRUMENTATION AND MONITORING MATERIALS

A. Settlement Points: For paved areas: An inscribed marking of approved surveyor’s nail driven flush with the pavement surface. For unpaved areas, two (2) by two (2) inch timber stake (hub) driven flush with the ground. Each settlement point shall have an identification tag or marking.

B. Inclinometer shall consist of the following:

1. Inclinometer Casing: A special purpose grooved casing used in inclinometer installations. Casing manufactured by Slope Indicator Company, Geokon, Inc., or Engineer approved equal, including accessories necessary for installation as recommended by the manufacturer. Provide locking cap with padlock for each installed casing.

2. Inclinometer Probe: Digitilt Inclinometer Probe manufactured by Slope Indicator Company, Model 6000 Inclinometer Probe manufactured by Geokon, Inc., Engineer approved equal, including cable, pulley assembly, case and any other necessary accessories.

3. Readout Unit: Digitilt DataMate manufactured by Slope Indicator Company, Model GK-603 Inclinometer Readout manufactured by Geokon, Inc., or Engineer approved equal.

4. Software: Computer software required to reduce, to analyze, and to plot inclinometer data.

5. All inclinometer materials and equipment shall be compatible with all other inclinometer materials and equipment.

C. Monitoring Wells: Provide monitoring well materials in conformance with Contractor’s approved instrumentation and monitoring plan. Provide an instrument suitable for the purpose determining the groundwater elevation in the monitoring well.

PART 3 - EXECUTION

3.01 PREPARATION

A. Implement Instrumentation and Monitoring Program including establishing railroad settlement points by marking locations on the track using means acceptable to the ORR.

B. Prior to placing and driving steel piles or sheeting, hand dig exploratory trenches in areas where railroad underground installations are known to exist. Backfill these trenches immediately after the exploratory work is finished. Perform this work in the presence of the Engineer.

C. Coordinate support of excavation with dewatering specified in Section 02210, Dewatering, as applicable.
3.02 TEMPORARY EXCAVATION SUPPORT SYSTEMS

A. Fill cavities adjacent to the excavation support system created by driving of sheet or soldier piling with sand.

B. Unless otherwise noted or directed, all components of the support system shall be left in place, cut off at the top and the remaining portion removed as the backfill is being placed.

C. Immediately restore and tamp any ballast disturbed during construction of excavation support systems.

D. Remove any bracing tieback anchors or other support devices that are exposed.

E. Immediately fill all voids created by the excavation support members with lean concrete or sand.

F. Perform final backfilling of excavations in accordance with Section 02300, Earthwork.

G. Perform welding in accordance with the provisions of AWS D1.1.

H. Splices in structural steel members shall develop 100 percent of the strength of the member.

I. Maintain sheeting, bracing and other temporary protective work in place and functioning until temporary protective work is no longer necessary. Refer to quality assurance requirements specified herein.

J. If, at any time, existing or new construction, tracks, utilities, or similar facilities appear to be endangered, support such facilities, subject to approval of the Engineer. Provide additional bracing or shoring if considered necessary by the Engineer to safeguard against and prevent movement or settlement.

K. During construction, cut off sheet piling at the elevation of the top of adjacent tie. After construction and backfilling has been completed, remove sheet piling completely unless otherwise required by the Engineer or indicated in the Contract Documents.

L. Protect track ballast against contamination. Replace contaminated ballast.

M. Prevent settlement points from being damaged during construction.

END OF SECTION
SECTION 02210
DEWATERING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Section includes specifications for temporary dewatering systems.

1.02 SYSTEM DESCRIPTION

A. Remove water which accumulates in excavations during the progress of work so that all work can be done in the dry, unless otherwise approved by the Engineer. Keep excavated areas free from water while underground utilities or structures are constructed, while concrete is setting and until backfill or elements of the structure have been placed to a sufficient height to anchor the work against possible leakage or buoyant uplift forces. A height to anchor the work against buoyant uplift forces shall be considered sufficient when the dead load weight of the backfill or elements of the structure exceeds the uplift forces by a minimum factor-of-safety of 1.5.

B. In addition to the other requirements specified herein, design the dewatering systems to perform as follows:

1. Prevent damage to adjacent properties, buildings, structures, utilities, and other work as a result of settlement or other groundwater-related effects.

2. At all times, maintain groundwater levels over the entire excavation a minimum of 3 feet below the excavation grade.

C. At all times, have on the work site sufficient pumping equipment for immediate use, including standby pumps for use in case other pumps become inoperable. Dispose of water in accordance with the detailed requirements specified herein and so as to cause no injury to personnel or the public, damage to public or private property, nor menace to the public health.

D. Design dewatering system to prevent pumping fines from below grade or disturbing materials exposed at the excavation bottom. Wells shall be cased, and filter(s) shall be provided to prevent such pumping of fines.

E. Provide a sufficient number of monitoring wells to confirm the following:

1. The dewatering system is performing as intended and is achieving the specified reduction in groundwater levels.

2. Construction site groundwater levels inside and outside dewatered excavations to determine the acceptability of removing the dewatering system from operation.

F. Furnish container for construction dewatering complete with baffles for the purpose of filtering silt prior to discharge of water. Size container or containers
to suit dewatering and storage demands.

G. If the approved methods include displacing groundwater as concrete or other work is placed in excavations, the dewatering system shall capture groundwater as it is displaced and follow the procedures herein for its containment, analysis, and discharge.

H. Obtain jurisdictional authority’s specific discharge requirements prior to commencement of dewatering.

1.03 SUBMITTALS

A. Submit dewatering plan including shop drawings and design data including the following elements:

1. The proposed type of dewatering system.
2. Arrangement, location, and depths of system components.
3. Complete description of equipment and instrumentation to be used, with installation, operation and maintenance procedures.
4. Types and sizes of filters.
5. Design calculations demonstrating adequacy of the proposed system and equipment.
6. Methods of disposal of pumped water.
7. Method of water quality monitoring.
8. Type of filtration and chemical treatment of contaminated water, as applicable.
9. Well point system design, if proposed: Submit design complete with calculations and shop drawings.
10. Method for establishing and monitoring construction site groundwater levels.
11. Criteria for determining the acceptability of removing the dewatering system from operation.

B. Prior to removing the dewatering system from operation, submit documentation and calculations verifying that the approved criteria for determining the acceptability of removing the system from operation have been met.

1.04 DELIVERABLES

A. Submit copies of permits required for work of this Section.

1.05 QUALITY ASSURANCE

A. Well point design, if applicable, shall be prepared, signed, and sealed by a geotechnical engineer registered by the State of California and qualified and
experienced to perform such design.

PART 2 – PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.01 DEWATERING

A. Except as otherwise indicated in the Contract Documents, perform dewatering to accomplish a lowering of measured static ground water level to an elevation which is suitable for the construction of structures below grade.

B. When pumping is required to reduce groundwater levels, accomplish pumping in a manner that will not disrupt the surrounding environment.

C. Refer to General Provisions 7.10, Sound and Light Control Requirements, for noise control requirements. The Contractor may, during the daylight hours of 8:30 AM to 4:30 PM, use power plants to operate the dewatering pumps. During all other hours, power to run the pumps shall be electric and obtained from the electric power utility in accordance with Section 01590, Construction Facilities, unless otherwise authorized by the Engineer and jurisdictional authorities.

D. If any dewatering well pumps fines, terminate pumping and construct new well at a different location with a revised design which eliminates the pumping of fines.

E. Do not turn off the dewatering system in a manner that the upsurge in water weakens the subgrade for completed excavation and structure foundation work.

F. Remove storage containers, including those cleaned, and other dewatering facilities from the site at the completion of dewatering operations.

3.02 CONTAINMENT, ANALYSIS, AND DISCHARGE OF GROUNDWATER EXTRACTED

A. Containment: Upon extraction, store groundwater extracted in the process of construction dewatering in containers prior to discharge or disposal of water, as applicable. Keep containers locked to prevent accidental or purposeful discharge of the water. Contain and store the water on-site and in such a manner that it will not interfere with the Contractor's existing or continued construction operations.

B. Analysis: Collect and analyze water samples taken directly from each storage container to verify that the extracted groundwater meets applicable discharge requirements. Number of samples taken per container shall be at the sole discretion of the Engineer.

C. Discharge Requirements: Discharge no water which exceeds regulatory requirements or the jurisdictional authority's discharge requirements.

D. Discharge: Obtain jurisdictional authority's specific discharge requirements prior to commencement of dewatering. Subject to the discharge restrictions specified herein and upon written authorization from the jurisdictional authority, discharge
efluent from dewatering directly into existing sanitary manholes, where said sewer system is in operating condition. Provide conduits to carry said effluent to nearest sanitary sewer manhole and drainage to the nearest storm drainage. Confirm that manholes to be utilized are in operating condition. Release water in a manner that will not impact the Contractor’s operations.

E. Disposal: In the event that extracted groundwater does not meet the discharge requirements criteria, provide for the disposal of the extracted groundwater in accordance with General Provisions 7.16, Disposal of Material Outside of the Work Site. Clean dewatering containers, piping, pumps, and other dewatering facilities contaminated as a result of the Work.

F. Use: Extracted groundwater of sufficient quality as shown by test data may be used on site with Engineer’s written approval for those purposes approved by the Engineer.

END OF SECTION
PART 1 – GENERAL

1.01 DESCRIPTION

A. Section includes specifications for earthwork including excavation, trench excavation for underground utilities, ballast and subballast removal, placement of backfill, and construction of embankments. Section also includes requirements for placement of detectable tape for underground utilities.

1.02 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM International):


2. C136 Sieve Analysis of Fine and Coarse Aggregates

3. D422 Particle-Size Analysis of Soils

4. D1556 Density and Unit Weight of Soil in Place by the Sand-Cone Method

5. D1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb./cu. ft.)

6. D2487 Classification of Soils for Engineering Purposes (Unified Soil Classification System)

7. D2922 Test Method for Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)

8. D3017 Test for Moisture Content of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)

9. D3740 Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as used in Engineering Design and Construction

B. State of California, Department of Transportation, Standard Specifications (Caltrans):

1. Section 19 Earthwork

1.03 DEFINITIONS

A. Existing Ballast: Granular material in areas of existing tracks, between top of tie and existing subgrade. The depth of existing ballast varies.

B. Degree of Compaction: A percentage of the maximum density obtained by the test procedure presented in ASTM D1557, Method C.
C. Satisfactory Materials: Any material classified by ASTM D2487 as GW, GP, SW, SP, SC, GM, GC, and SM.

D. Unsatisfactory Materials: Materials that do not comply with the requirements for satisfactory materials. Unsatisfactory materials include those materials containing roots and other organic matter, trash, debris, stones larger than 3 inches, and materials classified in ASTM D2487 as PR, OH, OL, CH, MH, and ML. Unsatisfactory material also includes refuse and other material.

1.04 SUBMITTALS

A. Submit the following pothole shop drawings if specifically required in the Special Conditions. Submit shop drawings of potholed pipes, sewers, utilities and other facilities a minimum of two (2) weeks before beginning shoring excavation or underground construction. Show survey information at each location, and accurately establish the size, location, elevation, and alignment of the facility as well as the existing grade elevations in the vicinity of the potholes. Include the bearing of the facility alignment, coordinates at the centerline of the facility for pipelines, and the coordinates of the corners of boxes, manholes, and other similar types of facilities. Label pertinent information relating to the bent, column, footing, track alignment, and other proposed improvements including new or relocated underground facilities (waterline, sewer, storm drain, combined system duct bank, and underdrain). Include footing dimensions, bent skew, stationing, column offsets, and footing elevations. Proceed with no trenching, excavation, or shoring work until the Engineer has accepted potholing shop drawings. Shop drawings shall be prepared at 1:20 or 1:60 scale, sufficient to show the following information:

1. Topography

2. The entire bent and footings

3. Columns adjacent to the potholes

4. The track alignment

5. Other proposed improvements in the vicinity that might be affected by the location of the existing pipe, sewer, utility or other facility

1.05 DELIVERABLES

A. Submit copies of test reports for material properties and compaction as required in this Section.

1.06 QUALITY ASSURANCE

A. Inspection and Testing Agency retained for inspection and testing specified in this Section shall meet the requirements of ASTM D3740.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Imported Backfill shall consist of well-graded sand, gravel, crushed gravel, crushed stone composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a No. 200 mesh sieve and no less than
95 percent by weight passing the 3/4-inch sieve. The maximum allowable aggregate size shall be 1 inch. Gradation shall be determined in accordance with ASTM C136 or D422, as applicable.

B. The following materials shall be as specified in the respective Sections of the Caltrans Standard Specifications, except as otherwise indicated:

1. Structure Backfill: Section 19-3.06, Structure Backfill
2. Pervious Backfill: Section 19-3.065, Pervious Backfill Material
3. Slurry Cement Backfill: Section 19-3.062, Slurry Cement Backfill

C. Soil Stabilization Geotextile: Tensar Bi-Axial Geogrid reinforcement or Engineer approved equal.


E. Underground Warning or Detectable Tracer Tape: Terra Tape Reinforced Sentry-Line as manufactured by Reef Industries, or Engineer approved equal. Extra stretch is acceptable if Reinforced type is not available for the color. Uniform color code (per APWA) as follows:

<table>
<thead>
<tr>
<th>Identification</th>
<th>Type</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Line</td>
<td>12” wide Reinforced</td>
<td>Yellow</td>
</tr>
<tr>
<td>Water Line</td>
<td>6” wide Reinforced</td>
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<td>Sewer, Drain, Irrigation Line</td>
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<tr>
<td>Fiber Optics, Signal,</td>
<td>12” wide Reinforced</td>
<td>Orange</td>
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<td>Communications Line</td>
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PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

A. Existing Underground Lines and Services: Remove or abandon in place unclaimed, abandoned utilities as indicated on the Contract Drawings.

B. Utilization of Excavated Materials: Use material removed from excavations for backfill, embankment, subgrade, and similar purposes, unless the material is unsatisfactory. Refer to Article entitled “Excess Material” herein for disposal of excess materials.

C. Use existing salvaged ballast for backfill, bedding, embankment, or fill as designated by the Engineer.

D. Erosion Protection: Refer to Section 01560, Temporary Controls, for storm water pollution prevention, dust control, and related requirements. Protect exposed graded areas from wind and water erosion until stabilization is achieved.

E. Perform dewatering as necessary. Refer to Section 02210, Dewatering.

F. Use Soil Stabilization Geotextile for soil stabilization where indicated in the Contract Drawings.
3.02 EXCAVATION

A. Excavate material encountered within the limits of the work, to the lines, grades, and elevations as indicated on the Contract Drawings and as specified herein.

1. In areas where track is to be constructed in the location of an existing track, excavate to the subgrade indicated on the Contract Drawings or bottom of existing ties, whichever is lower.

B. General construction excavation shall not exceed 1 vertical to 1 horizontal slope. If this cannot be accomplished, provide temporary shoring, sheeting and bracing as necessary to retain excavations, maintain banks securely, withstand water pressure, and prevent cave-ins in accordance with Section 02200, Support of Excavation.

C. Perform excavation and placement of fill in a manner and sequence that will provide proper drainage at all times.

D. Surfaces shall be level, or sloped if required, clean, and clear of loose soil. Maintain in good condition until overlying materials are placed.

E. Perform measures to correct over-excavation due to error or careless excavation procedures.

F. Perform structure excavation in accordance with Caltrans Standard Specifications, Section 19-3, Structure Excavation and Backfill.

G. Maintenance of Excavation: When backfill is placed, remove sheeting and bracing in stages so that the walls are supported by the shoring or by newly placed backfill.

3.03 BACKFILL (GENERAL)

A. Place backfill in layers not to exceed 8 inches of loose material, and compact each layer to at least 95 percent laboratory maximum density, in such a manner as to prevent wedging action or eccentric loading.

B. Backfill excavations when installations have been completed, inspected, and approved. Ensure that the following conditions are satisfied prior to proceeding with backfill operations:

1. Concrete has attained sufficient strength to withstand pressure of earth and compacting operation.

2. Excavations are free of forms, debris, and other foreign materials.

C. Place structure, pervious, and slurry cement backfill as specified in the following respective Sections of the Caltrans Standard Specifications, except as otherwise indicated:

1. Structure Backfill: Section 19-3.06, Structure Backfill

2. Pervious Backfill: Section 19-3.065, Pervious Backfill Material

3. Slurry Cement Backfill: Section 19-3.062, Slurry Cement Backfill
3.04 BACKFILL, BEDDING AND FILL FOR CULVERTS, PIPES, AND UTILITIES

A. Bottom of Trench Compaction. Bottoms of excavations shall be firm, undisturbed earth or cut subgrade, clean and free from loose materials, debris, and foreign matter. When bottoms of excavations or trenches are a soft or unstable materials, make bed firm and solid by removing said unstable materials to a sufficient depth and replace same with sand or pea gravel, and compact to a minimum of 90 percent relative compaction. If during construction, soft soils are encountered at depths that make removal impractical, notify the Engineer.

1. Refer to Section 02650, Precast Concrete Culverts, for specific requirements for precast culvert trenches. Refer to Section 15550, Storm Water Lift Stations, for specific requirements for precast vault manhole for pump station.

B. Bedding and Backfill Around Pipes:

1. Before the initial layer of bedding is placed, tamp the bottom surface of the trench or compact bottom surface by plate or other means to provide a base for the bedding.

2. Before the pipe or conduit is laid, place and compact bedding material in conformance to the provisions in Caltrans Standard Specifications, Section 19-3.025, Culvert Beddings. Do not use jetting.

C. Unless specified elsewhere, backfilling for underground utilities shall comply with the following:

1. Replace any unsuitable material with approved backfill material and compact as specified herein. Approved backfill material shall include:

   a. Native excavated material approved to the Engineer

   b. Salvaged track ballast approved by the Engineer

   c. Imported Backfill (if native material or reclaimed track ballast is not available)

2. Place and compact initial lifts in six (6) inch layers maximum uncompacted thickness until 12 inches over pipe. Subsequent lifts may be up to 12 inches in depth prior to compaction. Bring up uniformly on both sides of pipe.

3. Compact foundations for underground utilities and associated structures to not less than 95 percent of the maximum density as determined by ASTM D1557.

4. Place tracer tape (detection tape) one foot above new and recently exposed buried utilities including conduits, fiber optics, communication and signal cables, gas lines, petroleum lines, water lines, and electrical lines. Lay tape flat with three foot of overlap at the end of rolls. If tracer tape depth will exceed tape manufacturer's recommendation, obtain additional instructions from the Engineer before proceeding.

D. Place and compact structure backfill at culverts as specified in this Section under Backfill (General) and as follows:
1. When the level of fill reaches the top of the structure, spread and hand compact two lifts over the structure without traversing the structure with heavy equipment. Begin no compaction with heavy equipment until a minimum of two lifts have been placed, hand compacted, and tested.

2. Back and compact backfill to the same elevation on both sides of the culvert before proceeding to the next layer.

3. When the height of cover indicated on the approved shop drawings or Contract Drawings, as applicable, is 12 inches or less, backfill structure with slurry cement backfill to the top of the structure.

4. In regard to precast concrete culverts, operate equipment over the culvert in accordance with the culvert manufacturer’s recommendation.

E. Keep construction equipment away from edges of excavation a distance equal to the depth of the excavation.

F. Do not place stones larger than 3 inches in backfill around pipes.

G. Refer to compaction and field quality control requirements specified herein for additional requirements.

3.05 EMBANKMENTS

A. Clear and grub ground surface on which embankment fill is to be placed of live, dead, or decayed vegetation including trees; rubbish; debris; and other unsatisfactory material in accordance with Section 02110, Site Clearing.

B. Scarify prepared ground surface and moisten or aerate as required just prior to placement of embankment materials to ensure bond between embankment material and the prepared ground surface.

C. Construct earth embankments from satisfactory materials free of organic or frozen material. Use no rocks greater than 3 inches. Place material in successive horizontal lifts of loose material not more than 12 inches in depth. Prior to placement of each layer, moisten or aerate soil surface as necessary and scarified or otherwise broken up in such a manner that the fill will bond with the surface on which it is placed. Uniformly spread layer. After spreading each layer, plow, disk, or otherwise break up layer; moistened or aerated as necessary; thoroughly mix; and compact to at least 90 percent laboratory maximum density, if more than two (2) feet below subgrade elevation, and 95 percent if within two (2) feet of subgrade elevation.

3.06 GRADING

A. Grading shall conform to the Contract Drawings and the tolerances specified herein. Transport satisfactory excavated materials to and place in fill or embankment within the limits of grading work. Excavate unsatisfactory materials encountered within the limits of the work and replace with satisfactory materials. Remove unsatisfactory materials and dispose of as specified in the Article entitled “Excess Materials” herein.

B. Finish the surface of excavations, embankments, and subgrade to a smooth and compact surface in accordance with the lines, grades, and cross sections or
elevations shown on the Contract Drawings. Finish grade to within 1/2 inch of the grades and elevations indicated. Finish ditches in a manner that will result in effective drainage.

C. Preparation of Subgrade: Shape subgrade to line, grade, and cross section, and compacted as specified. Shaping subgrade shall include plowing, diskng, scarifying existing track subgrade and moistening or aerating required to obtain specified compaction. Remove soft or otherwise unsatisfactory material and replace with satisfactory excavated material or other approved material as directed. Bring low areas resulting from removal of unsatisfactory material up to required grade with satisfactory materials, shape entire subgrade to line, grade, and cross section, and compact as specified. After rolling, the surface of the subgrade shall not show deviation greater than 1/2 inch when tested with a 10-foot straightedge applied both parallel and at right angles to the centerline of the area.

D. Protection and Maintenance of Subgrade:

1. Maintain ditches and drains along subgrade at all times as required to effectively drain the subgrade. Do not disturb finished subgrade by traffic or other operations. Protect and maintain subgrade in a satisfactory condition until ballast, subballast, base, or pavement is placed. Do not store or stockpile materials on the finished subgrade.

2. Obtain Engineer’s inspection and approval of subgrade prior to laying base, subballast, ballast, or pavement. Place no base, subballast, ballast, surfacing, or pavement on a muddy, spongy, or frozen subgrade.

3.07 COMPACTION

A. Do not compact fill or backfill until it has attained the required moisture content. Add an accurately determined and carefully measured amount of water to the materials or surfaces which are too dry. Dry material containing an excess of moisture by manipulation, aeration, drainage, or other means before being compacted. Refer to Field Quality Control field moisture and related testing.

B. When subgrade has been prepared and has reached required grade, proof-roll surfaces to determine if soft spots exist in the material using a 50-ton pneumatic-tired roller or similar approved equipment. If wet or spongy areas are revealed, notify the Engineer so that corrective measures may be determined. Remove soft spots and refill until they meet the required compaction. Proof-roll areas which support the track structure, paving, utility structures, buildings, or other structures in the presence of the Engineer and obtain the Engineer’s approval before further earthwork operations are performed.

C. In addition to proof-rolling, perform field density tests as specified under Field Quality Control herein.

D. Use power-operated or power-driven hand operated equipment wherever possible to compact to requirements specified herein. Do not operate mobile equipment closer to foundation than a horizontal distance equal to the height of backfill above bottom of wall. Accompish compaction using sheep foot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibrator compactors, or other approved equipment well suited to the type of material being compacted.
E. If the degree of compaction is unsatisfactory, make necessary adjustments until specifications are met. Remove material placed over layers not satisfactorily compacted and re-compact unsatisfactory areas.

F. Unless otherwise noted, relative compaction of fill materials composing each layer of fill shall not be less than 95 percent as determined by ASTM D1556.

G. These compaction requirements do not apply to material placed in stockpiles or waste areas.

3.08 EXCESS MATERIAL

A. Dispose of material authorized to be wasted outside the work site in accordance with GP7.16, Disposal of Material Outside the Work Site, or at waste areas designated on the Contract Drawings, if applicable. Do not dispose of any excavated material in such a manner as to obstruct the flow of any stream, impact wetlands, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

B. The following requirements apply to waste sites designated in the Contract Documents for the Contractor’s use:

1. The limits of the storage location will be designated by the Engineer. Keep stockpiles clear of tracks and other facilities, and preventing erosion. Create stockpiles in a manner that does not disturb or damage other work.

2. Construct discrete stockpiles that measure no more than 1000 cubic yards and in a shape that is easily measured by the Engineer or surveyor.

3. Avoid mixing of dissimilar materials. Construct each stockpile of similar material, such as non-impacted overburden soil, obviously compacted soil, or debris. Segregate dissimilar debris materials to facilitate salvage or recycling.

4. Move soil impacted by contaminants around the work site only with the approval of the Engineer.

5. Protect stockpiled soil in accordance with Section 01560, Temporary Controls. Cover stockpiles with plastic sheeting secured against removal by wind or rain. On a daily basis, inspect plastic sheeting covering stockpiles and make necessary repairs.

6. Inform the Engineer each day of the number and locations of stockpiles created that day.

7. When the Engineer has completed sampling from a stockpile, the Engineer will place an identification sign in the stockpile. From that date forward, add no soil to nor remove soil from the stockpile without the approval of the Engineer.

3.09 FIELD QUALITY CONTROL

A. Testing shall be performed by an approved Inspection and Testing Agency retained by the Contractor.
B. Unless otherwise indicated, perform field in-place density testing in accordance with ASTM D1556. Perform field density tests in accordance with ASTM D1556 (Sand-Cone Method). Periodically verify density tests by the nuclear probe method in accordance with ASTM D2922 with density tests from the Sand-Cone method. Minimum number of field density tests shall be as follows:

1. One field density test shall be taken for every 300 linear feet of track for each lift of soil placed and at each grade crossing.

2. One field density test shall be performed for each 1,000 square feet of embankment for each layer of compacted fill.

C. Determine the relative compaction of fill materials composing each layer of fill in accordance with ASTM D1556. Perform testing at same frequency as specified for field in-place density testing.

D. Maximum Dry Density and Optimum Moisture Content: The maximum dry density and optimum moisture content of non-granular soils (greater than 12 percent by weight passing through a No. 200 sieve) shall be determined by one of the methods described in ASTM D1557.

E. Moisture Control: Perform field moisture tests in accordance with ASTM D3017 (Nuclear Probe Method). At the time of compacting, backfill material and the surface on which it is to be placed shall be within plus or minus two (2) percent optimum moisture content and meet specified compaction requirements.

END OF SECTION
SECTION 02310
AGGREGATE BASE COURSES

PART 1 - GENERAL

1.01 DESCRIPTION
A. Section includes specifications for aggregate base courses.

1.02 REFERENCE STANDARDS
A. American Society for Testing and Materials (ASTM International):
   1. D421 Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants
   2. D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
   3. D1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
B. State of California, Department of Transportation Standard Specifications (Caltrans):
   1. Section 6, Control of Materials
   2. Section 26, Aggregate Bases

1.03 DEFINITIONS
A. Aggregate Base: Imported material for use in base courses for trackwork, roadway pavement, grade crossings, permanent platforms, sub-ballast, and other locations indicated on the Contract Drawings.
B. Degree of Compaction: Degree of compaction required is expressed as a percentage of the maximum dry density obtained by the test procedure presented in ASTM D698. The compaction required will be abbreviated hereinafter as a percentage of laboratory maximum density.

1.04 SUBMITTALS
A. Submit test reports for field density tests and source quality control tests.

1.05 DELIVERABLES
A. Submit copies of waybills and delivery tickets during the progress of the work. Before the final payment is made, submit certified waybills and certified delivery tickets for all aggregates actually used.
1.06 DELIVERY, STORAGE, AND HANDLING

A. Before stockpiling of material, clear and slope to drain stockpile sites.

B. Stockpile materials obtained from different sources separately.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Aggregate Base (except as used as sub-ballast): Aggregate shall conform to Caltrans Standard Specifications, Section 26, Class 2 Aggregate Base, 3/4 inch maximum gradation.

B. Aggregate Base used as sub-ballast: Aggregate shall conform to Caltrans Standard Specifications, Section 26, Class 2 Aggregate Base, 3/4 inch maximum gradation. In addition, the aggregate shall meet the following additional requirements:

1. Aggregate for sub-ballast shall consist entirely of crushed stone and have at least two fractured faces. No reclaimed asphalt or concrete shall be included in this material.

2. Composition of the aggregate, in percentages by weight, shall conform to the “Operating Range Aggregate Grading Requirements” per Caltrans Standard Specifications Section 26-1.02A.

3. The aggregate shall conform to the “Contract Compliance Quality Requirements” per Caltrans Standard Specifications Section 26-1.02A.

2.02 SOURCE QUALITY CONTROL

A. Perform sampling and tests of the aggregate base material in accordance with the Test Methods specified in Caltrans Section 6-3 to determine compliance with grading, R-value, Sand Equivalent, and Durability Index. Take samples from material as delivered to the site and prepare samples in accordance with ASTM D421 or applicable Caltrans method.

B. Aggregate grading or sand equivalent test shall represent no more than 500 cubic yards of base course material or one day’s production, whichever is the greater amount.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Request Engineer’s inspection of and obtain Engineer’s written acceptance of the prepared subgrade or subbase before proceeding with the placement of aggregate base course.

B. Confirm that immediately prior to spreading base course, the subgrade or subbase to receive aggregate base course conforms to the compaction and
elevation tolerances indicated for the material involved and is free of standing water and loose or extraneous material. Subgrade shall conform to the requirements of Section 02300, Earthwork.

1. Confirm that underlying material has been excavated to sufficient depth to accept the required base course thickness such that the finished base course with the subsequent surface course will meet the final grade.

### 3.02 PREPARATION

A. Prior to installation of base courses, area shall conform to the lines, grades, cross section, and dimensions indicated.

B. Correct areas of underlying course which exhibit ruts or soft and yielding spots and areas having inadequate compaction as specified in Section 02300, Earthwork. Remove and replace soft and yielding spots and areas having inadequate compact with suitable material. Underlying course may be mechanically stabilized with aggregate prior to placement of the base course. Stabilization may be accomplished by mixing base course material into the underlying course and compacting by approved methods. Properly compacted material will be considered as part of the underlying course and shall meet all requirements for the underlying course in accordance with Section 02300, Earthwork.

C. Prevent disturbance of finished underlying course by traffic or other operations and maintain it in a satisfactory condition until base course is placed.

D. Before placing base course, clean underlying course of foreign substances. When the base is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable.

### 3.03 INSTALLATION

A. Prepare, place, and compact base course in accordance with Caltrans Section 26.

B. Minimum Uniform Compacted Thickness: Minimum compacted thickness shall be 6 inches.

C. The finish of finished aggregate base course at any point shall not vary more than 1/2 inch above or below the indicated grade.

### 3.04 FIELD QUALITY CONTROL

A. Perform field in-place density testing in accordance with ASTM D1556.

B. Frequency of Field In-Place Density Tests: Perform no less than one test for each 2,000 square feet of base course material, per layer or lift.

END OF SECTION
SECTION 02400
UTILITY JACKING AND BORING

PART 1 – GENERAL

1.01 DESCRIPTION
A. Section includes specifications for jack and bore installation of pipe, casing, or conduit.

1.02 SUBMITTALS
A. Obtain Engineer’s approval of the following submittals:

1. Submit working drawings describing the proposed jack and bore. Include arrangement of equipment; location and size of jacking and receiving pits including their relative location to tracks; method of dewatering; method of monitoring for possible settlement; method to prevent loss of the excavation face; method of removing spoils material; and carrier pipe size, method of fusing pipe segments, and carrier pipe end seals. Include sufficient information to show compliance with the Contract Documents.

2. Support of excavation for pits: Submit the proposed methods of construction, design, and details for pit excavation shoring systems. Refer to Section 02200, Support of Excavation, for related submittals for support of pit excavation.

3. Emergency remediation plan:
   a. Identify methods to cut and remove rock, concrete, or timber encountered at the boring face and methods to temporarily bulkhead the face.
   b. Identify remedial measures for limiting damage to existing facilities, impact to tracks, and railroad operations due to ground settlement.
   c. The Contractor must have the resources to execute this plan immediately available.

4. Submit product data including catalog cuts and other descriptive data.

5. Experience: Submit list of references substantiating jack and bore installer’s experience.

1.03 DELIVERABLES
A. Submit copies of test reports for material properties and compaction as required in this Section.

B. Incorporate the following data in Record (As-Built) Drawings: As-built survey drawing of completed jack and bore installation including horizontal and profile drawings.

C. Support of excavation for pits: Refer to Section 02200, Support of Excavation, for
related deliverables for support of pit excavation.

1.04 QUALITY ASSURANCE

A. Jack and bore installer shall have documented experience in successfully completing similar installations within the past five years.

B. Support of excavation for pits: Refer to Section 02200, Support of Excavation, for related quality assurance requirements for support of pit excavation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials shall be as indicated in the Contract Documents and the approved submittals.

B. Cement Slurry, As Applicable: As specified in approved submittals.

PART 3 - EXECUTION

3.01 GENERAL

A. Verify the actual locations (horizontal and vertical) of all utilities prior to beginning work.

B. If utilities are to remain in place, provide protection from damage during construction operations.

C. Excavation and Support of Excavation for jacking and receiving pits shall be in accordance with Section 02300, Earthwork, and Section 02200, Support of Excavation.

3.02 HANDLING OF MATERIAL

A. Handle pipes, conduits, casing, and ancillary items in such a manner as not to damage the material. Damage to the material, including linings or coatings, shall be repaired to the satisfaction of the Engineer or replaced.

B. Do not drop or drag pipes, conduits. Handle with rolling slings on skids or with cranes.

C. Do not use bent or otherwise damaged material shall not be used.

3.03 JACK AND BORE

A. Perform jack and bore operations in accordance with approved submittals and the following requirements:

1. The front of the pipe shall be provided with mechanical arrangements or devices that prevent the auger from leading the casing so that no unsupported excavation is ahead of the casing.

2. The use of water or slurry under pressure (jetting) or puddling shall not be
permitted to facilitate boring, pushing, or jacking operations. Water or slurry used to lubricate the cutter and pipe is acceptable.

3. Unless otherwise indicated in the Contract Documents, or accepted by the Engineer in the approved submittals, pipe, conduit, and casing installation under tracks shall be progressed on a continuous basis without stoppage, except for adding sections, until the leading edge has reached the receiving pit.

B. Stop operations stop for the passage of trains. Employ methods to prevent loss of the excavation face in accordance with approved submittals.

C. Stop operations if ground settlement is detected and employ the emergency remediation plan in accordance with the approved submittals. Repair any damages to the tracks, including track displacement resulting from the construction's operations. The corrective action shall be approved by the Engineer.

D. With the use of spacers, place the carrier pipe in the casing pipe such that there is equal space between the casing pipe and carrier pipe, and fill the space with cement slurry, unless otherwise indicated in the Contract Documents.

3.04 FIELD QUALITY CONTROL

A. Refer to Section 01400, Quality Control and Assurance. Testing shall be performed by an Engineer-approved Inspection and Testing Agency retained by the Contractor.

END OF SECTION
SECTION 02500
UNDERGROUND DUCTWORK AND STRUCTURES

PART 1 – GENERAL

1.01 DESCRIPTION

A. Section includes requirements for conduits, precast concrete structures, cast-in-place concrete ductbank and structures, including frames, covers, gratings, steps and sumps, and cover identification.

1.02 REFERENCE STANDARDS

A. American Society of Testing and Materials (ASTM International):
   1. A48 Specification for Gray Iron Castings
   3. A536 Specifications for Ductile Iron Castings
   5. C33 Specification for Concrete Aggregates

B. California Code of Regulations:
   1. Title 24, Part 3 State Electrical Code

   1. 128 Rules for Construction of Underground Electric Supply and Communications Systems

1.03 SUBMITTALS

A. Submit shop drawings for fabrication and installation of precast concrete structures, cast-in-place concrete structures, and concrete-encased underground ductwork, including the following:
   1. Cast-in-place and precast detailed steel reinforcement drawings; and precast manufacturer’s concrete mix designs for structures and colored concrete as indicated.

B. Submit product data including the following:
   1. Complete materials list of items proposed to be furnished and installed under this Section.
2. Manufacturers' specifications and other data required to demonstrate compliance with these Specifications.

3. Catalog cuts for the following products:
   a. Conduits.
   b. Underground duct system, duct spacers, including manholes, pull boxes, handholes, cable junction boxes, and termination boxes.
   c. Manhole, pull box, and handhole covers and frames.
   d. Related miscellaneous hardware and metal items for cable trenches and wireways.
   e. Trench and wireway covers including composition of FRP materials, divider partition panels, method of joining sections, expansion joint mounting, and support details.

C. Submit concrete mix designs for cast-in-place concrete under Section 03300, Cast-in-Place Concrete. Submit concrete sample showing proposed concrete color for approval.

D. Qualifications: Submit manufacturers’ qualifications.

E. Submit certificates of compliance for all specified products.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the State Electrical Code, and CPUC General Order No. 128. In case of conflict between the State Electrical Code and CPUC G.O. 128, the provisions of CPUC G.O. No. 128 shall govern.

B. Qualification of Manufacturers:
   1. Manufacturers of the products specified for work under this Section shall be in the business of manufacturing similar products and shall be able to provide a history of successful production of the specified products.
   2. Submit a list of five major projects, where similar products have been supplied, which have been in satisfactory use or operation for the past five years.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Conduit and Pull Cord: Provide PVC conduit, minimum Schedule 40, and all necessary fittings, in sizes as indicated, and pull cord as specified in Section 16130, Conduit and Fittings. Provide flared bell ends on conduits and ducts entering manholes, handholes, and pull boxes.
B. Precast Concrete: Provide precast concrete structures in accordance with requirements as indicated in this Section.

1. Precast concrete electrical boxes, pull boxes, ground rod boxes, manholes, handholes, and vaults shall be provided as indicated. Concrete reinforcement shall be that which is regularly provided in standard products of the manufacturer. Standard manufactured structures that meet project requirements will be acceptable. Provide concrete inserts for mounting cable support brackets as indicated.

2. Provide covers with two lifting eyes and two hold-down bolts. Each box shall have a suitable opening for a ground rod, and a drainage opening.

C. Sand: Sand for filler material, where indicated, and for bedding of conduit shall be bedding material specified in Section 02300, Earthwork.

D. Aggregate Base: As specified in Section 02310, Aggregate Base Courses.

E. Cast-In-Place Concrete for Ductbank Encasements, Manholes, Pull Boxes, and Vaults:

1. Concrete shall be Class 3000 in accordance with Section 03300, Cast-in-Place Concrete, for ductbank encasements, manholes, pull boxes, and vaults. Concrete for ductbank encasements shall be colored with a red mineral coloring pigment as specified in Section 03160, Colored Concrete. Color: Red.

2. Formwork and concrete placement shall conform with applicable requirements of Section 03100, Concrete Forming, and Section 03300, Cast-in-Place Concrete.

3. Reinforcing steel, as indicated, shall conform with applicable requirements of Section 03200, Concrete Reinforcing.

2.02 FRAMES, COVERS, STEPS, AND SUMPS

A. Ferrous Castings:

1. Metal used in manufacture of castings shall conform to ASTM A48, Class 35B for Gray Iron, or ASTM A536, Grade 65-45-12 for Ductile Iron.

2. Castings shall be of uniform quality, free from blowholes, shrinkage, distortion or other defects. Castings shall be smooth and cleaned by shotblasting.

3. Minimum tensile strength shall be 35,000 psi.

4. Castings shall be manufactured true to pattern; component parts shall fit together in a satisfactory manner. Round frames and covers shall have continuously machined bearing surfaces to prevent rocking and rattling.

5. Where castings will be subjected to loads of H20 or greater, provide ductile iron castings.
B. Aluminum Castings: Where required to reduce weights of larger covers for ease of handling, such covers may be manufactured of aluminum castings conforming to ASTM B26/B26M, Alloy No. 713.0. Minimum tensile strength shall be 32,000 psi.

C. Manhole Covers: Provide cast, manufactured manhole covers and frames with heavy-duty solid cover (lid) or vented cover (lid). Covers shall be embossed or engraved with nonslip diamond or square cross-hatched pattern.

1. Provide metal covers with embossed or engraved word identification for the enclosed or underground utility.

D. Precast Covers: Precast covers shall have the utility identification stamped into the cover.

E. Cast Iron Manhole Steps: Provide cast, manufactured manhole steps with cross-hatched treads and with anchor configuration appropriate for cast-in-place concrete or precast concrete. Provide steps for installation 12 inches on center in vertical alignment.

F. Ladders: Provide standard-manufactured or custom-fabricated steel ladders as required to meet the conditions indicated. Steel ladders shall be hot-dip galvanized after fabrication.

G. Galvanizing: All ferrous metal items shall be galvanized after fabrication by the hot-dip process in accordance with ASTM A123. Weight of the zinc coating shall conform with the requirements specified under "Weight of Coating" in ASTM A123.

2.03 REINFORCED PLASTIC MORTAR SPACERS (RPM)

A. Duct spacers shall be made from high density polyethylene (not less than 0.96 specific gravity), as manufactured by Formex Manufacturing, Inc., Underground Devices Inc. make, or equal.

B. Duct Spacers:

1. Duct spacers shall be double wall construction. Spacers shall consist of interlocking modules, i.e. bases, intermediates, and caps, designed to provide independent support for each duct.

2. When spacer modules are locked together, openings shall provide approximately 1/16 inch clearance over the outside diameter of the duct. The interior surface of the duct spacer opening shall be convex to prevent kinking of the duct.

3. Configure spacer module openings to ensure the horizontal and vertical separations for each duct as indicated on the Contract Drawings.
PART 3 – EXECUTION

3.01 VERIFICATION

A. Before beginning construction or installation of a section of underground conduit or ductwork, verify that the site is in suitable condition for installing such conduit or ductwork as indicated.

3.02 EXAMINATION AND EXCAVATION, TRENCHING AND BACKFILLING

A. Perform excavation, bedding, and backfilling for underground conduits and structures in accordance with Section 02300, Earthwork, or as indicated.

3.03 INSTALLATION

A. Underground Duct System: Locate duct system, conduit, pull boxes, and manholes as indicated on the Contract Drawings. Comply with applicable requirements of CPUC GO 128.

B. Ductbank Reinforcing Detail:

1. Provide longitudinal reinforcing steel with a minimum total cross sectional area of 0.0018 times the gross area of the ductbank. Maximum spacing of reinforcement bars shall be 18 inches; minimum of one bar in each corner of ductbank.

2. Provide steel tie bars in the transverse direction enclosing the longitudinal bars; minimum size of No. 3 bars; minimum spacing of 12 inches. Minimum clear concrete cover over reinforcement steel shall be 3 inches where concrete is cast directly against earth, and 1-1/2 inches where concrete is cast directly against formwork.

3. Where ductbank enters rigid underground structures, provide reinforcing steel to tie the ductbank to the structure. Provide details indicating method employed to prevent differential settlement from damaging ductbanks.

C. Ducts:

1. Inspect ducts and couplings to ensure that only clean and undamaged pieces are incorporated in the work.

2. Ductbanks or conduits shall have a minimum slope of 3 inches to each 100 feet away from buildings and towards manholes, pull boxes, and handholes, and shall run in straight lines between indicated changes in direction.

3. Individual conduits that are grouped together to form a ductbank shall conform to the standards and requirements specified herein.

4. Accomplish horizontal or vertical changes in direction exceeding ten degrees by long sweep bends having a minimum radius of curvature of 25 feet, except that manufactured bends may be used at ends of short
runs of 100 feet or less, and then only at or within 5 feet of the end of the run. Sweep bends may be made up of curved or straight sections, or combinations thereof. Manufactured bends shall have a minimum radius of 36 inches for ducts of 3 inches in diameter and larger.

5. Terminate conduits in end-bells where duct lines enter vaults.

6. Place spacers or space separators not more than 6 feet apart.

7. Install ducts, joints, and space separators according to manufacturer's printed instructions and recommendations.

8. During non-work hours and at locations where installation of conduits and ducts is temporarily suspended or terminated, close ends of ducts with caps or plugs fitted to prevent entry of water or debris. Use caps or plugs designed for that purpose by the conduit manufacturer.

9. During construction, protect partially completed duct lines from the entrance of debris by means of suitable caps or plugs. As each section of a duct line is completed between manholes, handholes, or pull boxes, draw a mandrel through each conduit as specified in Section 16130, Conduits and Fittings, after which draw a brush with stiff bristles through until the conduit is clear of particles of earth, sand, or gravel. Immediately install conduit caps or plugs.

10. Construct the concrete-encased ductbank with 3 inch minimum cover on all sides.

11. Install 1/8 inch or larger diameter pulling cord in ducts including inner ducts. Fasten each cord to pull iron anchorage in pull box, manhole, or vault with 2 feet minimum slack.

12. Place innerduct in communications conduits avoiding excessive tension and deformation of the innerduct. Replace damaged or necked down innerduct. Conform to the manufacturer's installation instructions.

13. Provide metallic numbering tags indicating the conduit number on both ends of all conduit runs.

D. Concrete Structures, General: Install pull box tops flush with sidewalks or curbs. Install 1-1/2 inches above surrounding grades when remote from curbed roadways or sidewalks.

E. Precast Concrete Structures: Install precast electrical boxes, pull boxes, handholes, manholes, and vaults as indicated. Place boxes on 4 inches of compacted sand bedding. Place manholes on 6 inches of compacted aggregate base. Seal conduit, cable, ground rod entrances, and unused openings with cement mortar.

F. Cast-In-Place Concrete Structures:

1. Obtain Engineer's approval of the location of each pull box, manhole, and vault before construction of such structure is started. Construct top,
walls, and bottom of reinforced concrete. Construct walls and bottom of monolithic concrete.

2. Place concrete for pull boxes, manholes, and vaults on well-compacted soil with a minimum of 6 inches of aggregate base. Seal all sumps.

3. Where duct lines enter pull boxes, manholes, and vaults, the sections of duct may be either cast in the concrete or may enter through a square or rectangular opening of suitable dimensions provided in the utility structure. Install cable-pulling iron anchorage in the wall opposite each ductbank entrance.

3.04 REINFORCED PLASTIC MORTAR SPACERS (RPM)

A. Use base pads to ensure specified dimensions between trench floor and bottom of first tier of ducts. Assemble and anchor ducts and duct spacers using reinforcing bars or trench jack and adjusting wedges in accordance with duct spacer manufacturer’s written instructions. Ensure that duct spacing is maintained and that ducts do not float as a result of concrete pour.

B. For each 20 feet length of duct, provide a minimum of four spacer locations. Place duct spacers not more than six feet apart; transmit no vertical load to conduit.

C. For bore spacers where ductwork is installed in casings, refer to Section 16130, Conduits and Fittings.

3.05 FIELD QUALITY CONTROL

A. Notify the Engineer for inspection and sign-off of the following installations:

1. Completed underground installations: Obtain the Engineer’s inspection and acceptance before installation of cable and equipment.

B. Perform corrective work required to obtain approval of underground construction and ductwork.

END OF SECTION
SECTION 02510
UTILITY GRADE ADJUSTMENTS

PART 1 – GENERAL

1.01 DESCRIPTION
A. Section includes specifications for adjusting existing structures to new finish grade including such structures as manholes, vaults, hand holes, drainage structures, and utility valve structures, including raising or lowering and resetting existing frames, covers, grates, and lids. Including adding or replacing riser collars.

1.02 SUBMITTALS
A. Shop Drawings: Submit shop drawings for approval showing modification for raising and lowering of each type of structure frame and cover impacted by the work of this Contract. Provide documentation that the modification can accommodate all loads resisted by the existing structure.
B. Product Data: Submit product data for approval for cast iron and pre-cast risers for adjustment of frames, covers, lids, and grating.

PART 2 – PRODUCTS

2.01 PRODUCTS
A. Provide cast iron or pre-cast concrete riser collars to suit existing structures, to accommodate loads resisted by the existing structure, and in accordance with the requirements of the jurisdictional authority.
B. Miscellaneous Materials: As required and in accordance with the requirements of the jurisdictional authority and the approved shop drawings.

PART 3 – EXECUTION

3.01 ADJUSTMENT OF MANHOLE COVERS, GRATES, AND SIMILAR FACILITIES TO GRADE
A. Adjust existing facilities as shown on the Contract Drawings by raising or lowering to match the new grade line.
B. Construct or alter the structure to the required line and grade.
C. Use approved cast iron or pre-cast concrete riser collar.
D. Adjust frames and covers to new grade.
E. Perform asphalt pavement work after structures have been adjusted to new pavement grade.
F. Maximum adjustment of manhole covers, drainage grates, and valve covers shall be 12 inches plus or minus, unless noted otherwise.

END OF SECTION
SECTION 02620
SUBDRAINAGE SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION
   A. Section includes specifications for subdrainage systems (underdrains).

1.02 REFERENCE STANDARDS
   A. ASTM International (ASTM):
      1. D1784 Rigid PVC Compounds and CPVC Compounds
      2. D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
      3. F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
      4. F949 PVC Corrugated Sewer Pipe with Smooth Interior and Fittings
   B. State of California, Department of Transportation Standard Specifications (Caltrans):
      1. Section 19, Earthwork
      2. Section 88, Engineering Fabrics

1.03 SUBMITTALS
   A. Manufacturer's data sheet for pipe and fitting materials.
   B. Certificate of compliance of the gradation requirements for the granular backfill material included in this Section.
   C. Manufacturer's data sheet and samples for filter fabric.

PART 2 - PRODUCTS

2.01 MATERIALS
   A. Pipe:
      1. Polyvinyl Chloride (PVC), conforming to ASTM F949, 46 psi pipe stiffness, with double wall construction, PVC resin 12454 B per ASTM D1784.
      2. Joints and Gaskets:
         a. Joints: Push-on type, designed for elastomeric gaskets, ASTM
D3212.

b. Gaskets: Rubber, ring type, ASTM F477.

3. Perforated pipe slot geometry shall provide a minimum inflow area of 0.5 SQ IN per LF. The perforations shall consist of two rows of 3/8" holes at 3" on centers parallel to the longitudinal axis of the pipe. The rows shall be approximately 1-1/2 inches apart but not spaced over more than 155 degrees of the circumference. The rows shall be arranged in a staggered pattern so that all perforations lie at the midpoint between perforations in adjacent rows. The spigot or tongue end of the pipe shall not be perforated for a length equal to the depth of the socket, and perforations shall continue at uniform spacing over the entire length of the pipe.

B. Underdrain Granular Backfill Material: Backfill material for underdrains located within ballasted track areas shall be 3/4-inch round river rocks. Backfill for underdrains located outside ballasted track areas shall conform to the pervious backfill requirements of Caltrans Standard Specification 19-3.065.


D. Cleanouts:

1. Type 1, Schedule 80 PVC, as specified for PVC pipe herein. Provide cast iron bolt down type surface frames and covers adjusted to finish grade.

2. Casting for Cleanouts: Cast Iron Frame and Lid, Neenah Foundry Company Floor Box Frame and Lid, or Engineer approved equal. Lid cast with the designation “Clean Out”. Diameter of frame adequate to fit over outer diameter size of underdrain pipe.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General Requirements:

1. Line excavated trench with filter fabric, as shown on the Contract Drawings.

2. Unless otherwise indicated, excavate trench and backfill in accordance with Section 02300, Earthwork.

3. Cap cleanout within track ballast at the surface opening.

B. Preparation of Trench Bottom:

1. Unless otherwise indicated, excavate trench bottom to an elevation 6 inches below bottom of pipe.

2. Fill trench bottom to the bottom of pipe grade with underdrain backfill.
material to ensure complete and continuous support for the barrel of the pipe.

3. Excavate bell holes to size necessary to accommodate joint.

C. Placement:

1. Lay pipes in the upstream direction to the lines and grades shown, with the bell point upgrade, and with perforations down.

2. Keep interior surfaces of pipes clean during placement. Block pipe ends with pipe caps or plugs to prevent filter material from entering the pipes.


4. Prevent flooding the pipe trench before backfilling operations.

D. Unless otherwise indicated on the contract drawings, place granular backfill material for bedding uniformly along each side of the pipe in minimum widths of 6 inches, and a minimum depth of 12 inches above the top of pipe, after compaction. Space each layer to eliminate voids.

E. Make connections of solid wall outlet pipes to existing structures in accordance with Section 02630, Storm Drainage System.

3.02 FIELD QUALITY CONTROL

A. Notify and obtain Engineer’s approval of pipes and accessories before lowering pipe into the trenches. Replace defective, damaged, or unsatisfactory pipes and accessories.

B. After pipe is laid and joined, notify and obtain Engineer’s approval prior to backfilling. Take up and re-lay or replace, any pipe found to be out of alignment, unduly settled, or damaged.

END OF SECTION
SECTION 02630
STORM DRAINAGE SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Section includes specifications for storm drainage systems including modifications and connections to existing storm drainage systems.

1.02 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO):

1. M36 Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
2. M190 Specification for Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches
3. M218 Specification for Steel Sheet, Zinc-Coated (Galvanized), for Corrugated Steel Pipe

B. American Society of Testing and Materials (ASTM International):

1. A36 Specification for Carbon Structural Steel
2. A48 Specification for Gray Iron Castings
3. A307 Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
5. C76 Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
6. C150 Specification for Portland Cement
7. C270 Specification for Mortar for Unit Masonry
9. C478 Specification for Precast Reinforced Concrete Manhole Sections
10. C882 Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear
11. D1785  Specification for Polyvinyl Chloride (PVC) Sewer Pipe and Fittings
13. D2855  Practice for Making Solvent-Cemented Joints with Polyvinyl Chloride (PVC) Pipe and Fittings

C. American Water Works Association (AWWA):
   1. C111/A21.11  Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
   2. C115/A21.15  Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges

D. State of California Department of Transportation Standard Plans (Caltrans)
E. State of California Department of Transportation Bridge Design Specifications (Caltrans)

1.03 SUBMITTALS

A. Submit manufacturer’s data for pipe, structures, trench drains, and appurtenances.
B. Submit trench drain installation procedure including anchor method.

PART 2 – PRODUCTS

2.01 PIPE

A. Reinforced Concrete Pipe:
   1. Pipe: ASTM C76, bell and spigot type, Class V, Wall C, unless otherwise indicated
   2. Rubber Gaskets: ASTM C443, oil resistant.
   3. Cement for Concrete Pipe: ASTM C150, Type II

B. Polyvinyl Chloride (PVC) Pipe:
   1. Pipe: ASTM D1785, Type I, Schedule 80
   2. Provide fittings, such as adapters, couplings, tees and caps of same material as pipe
   3. Cements: ASTM D2564

C. Ductile Iron Pipe:
1. Pipe: AWWA C151, Class 56. Cement lining is not a requirement for ductile iron being used for storm drainage.

2. Joints: AWWA C111, push-on type.

D. Corrugated Metal Pipe:

1. Pipe: AASHTO M36, Type II. Metal thickness shall be 12 gage for 36 inch diameter pipes or larger and 14 gage for smaller diameter pipe. Pitch shall be 2-2/3 inch by 1/2 inch. Pipe, coupling bands and other components shall be bituminous coated in accordance with AASHTO M190.

2. Corrugated metal coupling bands: AASHTO M36, Section 20. Coupling bands may either be one or two piece construction. Coupling bands shall not be more than two thickness’ (as listed in AASHTO M218, Table 4), lighter than the thickness of the pipe to be connected and in no case lighter than 0.064 inch. Bolts and nuts for coupling bands shall conform to ASTM A307.

2.02 DRAINAGE STRUCTURES

A. Unless otherwise indicated, precast concrete drainage structures shall conform to ASTM C478, supplemented by the following:

1. Portland cement: ASTM C150, Type II A

2. Mastic gaskets at joints of precast concrete sections shall be Kent Seal No. 2 joint sealant or Engineer approved equal.

B. Fabricate precast concrete catch basins to the sizes indicated on Contract Drawings. Unless otherwise indicated by in Contract Drawings, catch basins shall have a minimum sump of 24 inches measured from the lowest inlet/outlet pipe invert indicated on the Contract Drawings to the bottom slab of the structure (interior face).

C. Drainage inlets (Catch Basins or Grate inlets): Caltrans Standard Plans, Drainage Inlet, Standard Type G1, unless otherwise noted. Drainage inlets may be cast-in-place concrete or equivalent precast inlets.

D. Fabricate frames and covers with provisions for adjustment to grade.

2.03 CEMENT MORTAR

A. Cement mortar: ASTM C270, Type M, fabricated with ASTM C150, Type IIA Portland Cement. Use cement mortar for brick and concrete work, grout collars for pipe connections to structures, lifting holes and other locations indicated in the Contract Documents.

2.04 NON-SHRINK GROUT

A. Non-metallic, fast setting, waterproof, non-shrink, cement-based.
B. Minimum compressive strength at 28 days: 5000 psi.

C. Minimum bond strength: As required to store full bond to reinforcing bars and concrete surfaces, but not less than 3000 psi at 7 days per ASTM C882.

D. Wire Mesh Wrapping: 12 gauge galvanized steel; 2 inches square welded grid pattern.

E. Bonding Agent: Solvent-free moisture-insensitive structural epoxy adhesive; recommended for bonding fresh concrete or repair mortar to steel or hardened concrete.

2.05 FRAMES, COVERS, AND GRATINGS FOR DRAINAGE STRUCTURES


B. Provide appropriate Caltrans standard grates for Caltrans standard inlets. Where standard inlets of a jurisdictional authority are used, provide frames, grates, and covers in accordance with that jurisdictional authority’s standards.

C. Place concrete collars around all drainage structure castings.

2.06 TRENCH DRAINS AND DOWN SPOUTS

A. Trench Drain and Down Spout: ASTM A36. Comply with ADA guidelines; 1/2 inch maximum slot openings. Trench trough, overlap splice, anchors, and down spout pipe shall be steel, galvanized after assembly of each trench section. Fabricate trench drain corners using mitered sections of trough, welded. Trench drain trough and trench grate shall be as shown in the Contract Documents or equal.

1. Trench drain trough: 11 gage steel
2. Down spout pipe wall thickness: 0.12 inches
4. Cast aluminum trench grates: ASTM B26

PART 3 - EXECUTION

3.01 PIPE INSTALLATION

A. General:

1. Perform trench excavation, backfill, and related earthwork as specified in Section 02300, Earthwork.
2. Examine each pipe prior to laying. Use no defective or damaged pipe. Lay pipe to the elevations, inverts, grades, and alignment as indicated on the Contract Drawings.

3. Provide proper equipment for lowering sections of pipe into trenches.

4. Under no circumstances lay pipe in water. Do not lay pipe when trench conditions or weather are unsuitable for such work.

B. Laying Pipe:

1. Lay corrugated metal pipe with the outside laps of circumferential joints pointing upstream and with longitudinal laps on the sides. Cut pipe requiring cutting by mechanical means only (no torch burning or cutting is allowed). Remove burrs and ragged edges from edges of cut pipe.

2. Lay pipe upgrade, unless otherwise noted.

C. Joining Pipe:

1. Lay drainage pipe with the separate sections joined firmly together.

2. Keep the space between the pipe and connecting bands or joints free from dirt and grit so that the connections fit snugly.

3. Protect jointing materials from the air and sun to prevent drying or deterioration.

4. Join PVC pipe in accordance with ASTM D2855.

D. Repair or Replacement of Pipe:

1. Repair bituminous coating on corrugated metal pipe and connecting bands that has been damaged or scored during culvert installation equal to original coating prior to backfilling. Make repairs in accordance with the manufacturer’s specifications.

2. Remove and replace pipe which has been damaged to such extent that satisfactory field repairs cannot be made.

3.02 DRAINAGE STRUCTURES

A. Set drainage structures in the proper location at the invert elevations indicated on the Contract Drawings with rim at the proper elevation. Set structures plumb and true on well compacted gravel base. Provide for adjustment of frames and covers using precast concrete rings or bricks, with a cement mortar or non-shrink grout to close the opening between the frame and structure. Under no condition remove a portion of the structure to allow adjustment of the frame and cover or grate to the proper grade.

B. Install precast reinforced concrete drainage structures in a manner to ensure watertight construction. Repair or replace precast concrete units as required to obtain watertight construction. Install risers and tops using approved gaskets.
for sealing joints. Install units level and plumb. Prevent water from rising over newly made joints until after joints have been inspected and accepted. Make joints water tight.

C. Perform field cutting of openings in the precast utility structure risers so as not to damage the riser. Replace damaged risers. Install risers and tops with the steps in alignment.

D. Install catch basins so as to preclude sediment from any tributary areas from entering the basins until such areas have been stabilized.

E. Where new pipe manholes or pipe inlets are located in areas to be paved or surfaced, construct no individual structure to final grade until the paving or surfacing has been completed immediately adjacent to said structure.

### 3.03 EXISTING DRAINAGE SYSTEMS

A. Cleanly cut new openings in existing drainage structures, to accept new pipe. Carefully install the new piping and join the new pipe to the existing structure. Make connection using an appropriate saddle where indicated in the Contract Drawings, or grouted as required to provide a neat, sturdy, watertight connection. Make connection in accordance with the standards of the agency having jurisdiction over storm drainage system. Repair any existing or new pipes or structures damaged as a result of the Contractor’s work.

B. Seal abandoned storm drain lines which are not removed with masonry plugs.

**END OF SECTION**
SECTION 02650
PRECAST CONCRETE CULVERTS

PART 1 – GENERAL

1.01 DESCRIPTION
A. Section includes specifications for concrete three-sided arch culverts with headwalls and wingwalls. Headwalls and wingwalls may be precast or cast-in-place.

1.02 REFERENCE STANDARDS
A. American Railroad Equipment and Maintenance-of-way Association (AREMA):
   1. Manual for Railway Engineering and Maintenance (Manual),
B. American Society for Testing and Materials (ASTM International):
   1. C39 Test Method for Compressive Strength of Cylindrical Concrete Specimens
   2. C497 Test Methods for Concrete Pipe, Manhole Sections, or Tile
C. Caltrain Standards for Design and Maintenance of Structures

1.03 DESIGN REQUIREMENTS
A. Comply with requirements indicated in the Contract Documents.

1.04 SUBMITTALS
A. Shop Drawings. Submit shop drawings for Engineer’s approval including the following information for footings, culvert section, wingwalls, and headwalls, as applicable:
   1. Concrete dimensions, elevations, and reinforcing steel with bar size and spacing indicated. Include elevation, plan, and section views. Include anchorage details, as applicable.
   2. Details for pedestals.
   3. Note actual soil bearing pressure on the footing detail sheets.
   4. Structure backfill type and limits for culvert and wingwalls.
B. Submit manufacturer’s product data of the culvert system for approval. Include adhesive for securing plugs in handling holes.
C. Submit sample showing proposed wingwall finish.
D. Submit design computations for culverts including wingwalls and pedestals. Furnish a longhand example of the design methodology if the design calculations are in a computer printout format.
1.05 QUALITY ASSURANCE

A. Design computations and shop drawings shall be signed and sealed by a professional engineer registered in the State of California.

PART 2 – PRODUCTS

2.01 GENERAL

A. All products necessary to complete the work shall conform to the relevant sections of these technical specifications.

B. Sealer and Waterproofing Membrane: As recommended by culvert manufacturer and approved by the Engineer.

2.02 FABRICATION

A. Handling devices or holes will be permitted in each culvert or wingwall section. However, not more than four holes shall be cast or drilled in each section. Cast holes shall be tapered.

B. Design and form section ends so that when the culvert sections are erected, they shall make a continuous line of culvert with a smooth interior free of irregularities.

C. Joints: Provide keyway joints between culvert sections. Keyway joint shall be a minimum of 4 inches deep by 1-1/2 inches wide.

D. The culvert sections and wingwalls shall be free of fractures. The ends of the culvert sections shall be normal to the walls and centerline, except where beveled ends are specified. The surface of the culvert section shall be a smooth steel form or troweled surface. Trapped air pockets causing defects which do not weaken or make sections more vulnerable to corrosion shall be considered as part of a smooth steel form finish.

E. Provide smooth rubbed finish on wingwalls. Refer to Section 03170, Concrete Finishing.

F. Do not store culvert units in an upright position until the designated handling and storage compressive strength, as shown on the shop drawings, has been achieved.

G. Marking: Clearly mark each culvert section and wingwall with waterproof paint. The following information shall be shown on the inside face of each wingwall and on a vertical leg of each culvert section:

1. Culvert span and rise (culvert sections only)
2. Date of manufacture
3. Name or trademark of manufacturer
4. Design earth cover
5. Location designator for use in field
2.03 SOURCE QUALITY CONTROL

A. Test Specimen: Determine concrete compressive strength from compression tests made on cylinders or cores. For cylinder testing, take a minimum of 4 cylinders during each production run. For core testing, cut one core from a culvert section selected at random from each group of 15 culvert sections or less of a particular size and production run. Cut one core from each group of four or fewer wingwalls. For each continuous production run, each group of 15 culvert sections of a single size or fraction thereof or four wingwalls shall be considered separately for the purpose of testing or acceptance. A production run shall be considered continuous if not interrupted for more than three consecutive days.


C. Acceptability of Cylinders Tests: Failure of one of the 28 day test cylinders to achieve 90 percent of the minimum compressive strength requirement may be cause for rejection.

D. Acceptability of Core Tests: The compressive strength of the concrete in each group of sections as defined above will be acceptable when the core test strength is equal to or greater than the design concrete strength. The Engineer will randomly select and witness testing of the cores taken by the manufacturer.

E. If compressive strength of a core is less than the design concrete strength, the culvert section or wingwalls from which that core was taken will be rejected. The Engineer will select two culvert sections or wingwalls from the remainder of the group at random, and one core shall be taken from each. If the compressive strength of both cores is equal to or greater than the design concrete strength, the remainder of the culvert sections or wingwalls in that group will be acceptable. If the compressive strength of either of the two cores tested is less than the design concrete strength, the remainder of the culvert sections or wingwalls in the group will be rejected. However, at the option of the manufacturer, each remaining culvert section or wingwall in the remainder of the group may be cored and accepted individually. The sections which have cores with less than the design concrete strength will be rejected.

F. Plugging Core Holes in Accepted Units: Plug and cure core holes at place of manufacture in such a manner that the culvert will meet all the test requirements of the specifications. Culvert sections or wingwalls repaired accordingly will be considered satisfactory for use.

G. Test Equipment: Furnish facilities and personnel necessary to conduct the quality control tests required.

2.04 INSPECTION

A. Rejection: Culvert sections or wingwalls will also be rejected due to the following conditions.

1. Fractures or cracks pass through the wall, except for a single end crack which does not exceed half of the thickness of the wall.

2. Defects which indicate proportioning, mixing, or molding which are not in accordance with specifications.
3. Honeycombed or open texture.

4. Damaged section ends, where such damage prevents making a satisfactory joint.

2.05 REPAIRS

A. Repair or replace culvert sections and wingwalls which have manufacturing imperfections or have been damaged. Repairs shall be sound, properly finished and cured, and repaired culvert section or wingwalls complies with the requirements specified herein.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Bottom of Trench Compaction: Compact soils in the bottom of the excavation to 95 percent of the maximum dry density. If 95 percent of the maximum dry density cannot be obtained in the bottom of the excavation or in other areas or if soft soils are encountered at depths that make removal impractical, contact the Engineer for additional requirements.

B. Footings: Footings may be cast-in-place or precast. When a precast footing is utilized, a four (4) inch layer of pervious backfill shall be placed under the full width of the footing. Give footings a smooth form finish. The footing concrete shall reach a compressive strength indicated on the shop drawings before placement of the culvert sections or wingwalls.

C. Pedestals: When a cast-in-place reinforced concrete pedestal is required between the base of the culvert leg and the top of the footing, either provide a culvert with longer legs or construct pedestals, at the Contractor's option.

D. Placement of Culvert Sections and Wingwalls: Set culvert sections and wingwalls on masonite or steel shims. Provide a minimum gap of 1/2 inch between footing and bottom of each section or wingwall. Fill gap with a slurry cement backfill in accordance with Section 02300, Earthwork.

E. Sealing: Apply sealer on the top surface of the culvert section. Such sealer shall extend 5 feet vertically down each vertical leg. Place no sealer material in keyway joints. Provide sealer for the full length of the structure. Prepare surface and apply sealer as recommended by sealer manufacturer.

F. Keep waterproofing membrane in its proper location over joints and protect from damage during the backfilling operation.

G. Prior to backfilling, treat handling holes as follows: Fill tapered holes for handling with Portland cement mortar or precast concrete plugs secured with Portland cement mortar or other adhesive, as approved. Fill drilled holes for handling filled with Portland cement mortar. Prior to backfilling the structure, cover holes with waterproofing membrane with a minimum width of 9 inches.

H. Place and compact structure backfill as specified in Section 02300, Earthwork.

END OF SECTION
SECTION 02700
STATION PLATFORMS, SIDEWALKS, CURBS AND GUTTERS

PART 1 – GENERAL

1.01 DESCRIPTION
A. Section includes requirements for cast-in-place concrete station platforms, sidewalks, curbs, and gutters.

1.02 REFERENCE STANDARDS
A. Standard Specifications for Public Works Construction (SSPWC):
   1. Section 201 Concrete, Mortar, and Related Materials
   2. Section 303-5 Concrete Curbs, Walks, Gutters, Cross Gutters, Alley Intersections, Access Ramps, and Driveways
B. State of California, Department of Transportation, Standard Specifications (Caltrans):
   1. Section 51 Concrete Structures
   2. Section 90 Portland Cement Concrete

1.03 SUBMITTALS
A. Submit concrete mix designs as specified under Section 03300, Cast-in-Place Concrete.
B. For station platforms, comply with the submittal requirements specified in Section 03200, Concrete Reinforcing, Section 03300, Cast-In-Place Concrete, and Section 03160, Colored Concrete.

1.04 DELIVERABLES
A. For station platforms, comply with the deliverable requirements specified in Section 03200, Concrete Reinforcing and Section 03300, Cast-In-Place Concrete.

PART 2 - PRODUCTS

2.01 MATERIALS
A. Sidewalks, Curbs, and Gutters: Materials shall be as specified in SSPWC, Section 201, and as otherwise specified herein.
B. Station Platforms: Materials shall be as specified in Section 03300, Cast-in-Place Concrete, including polypropylene fibers. Concrete shall be integrally colored in accordance with Section 03160, Colored Concrete. Color shall match Quality Concrete Integral Color “Satin Gray”, unless otherwise indicated in the Contract Documents.
Caltrain Standard Specifications

C. Type A Joint Seal Material: As specified in Caltrans Standard Specifications, Section 51-1.12F, Sealed Joints, with the following exception: If two (2) part polyurethane sealant is proposed, it shall be the type specified in Section 51-1.12F or equal.

D. Joint Sealant for Station Platforms: Joint sealants shall be type specified in Section 07920, Joint Sealants. Provide in color to match colored concrete.

E. Moisture Barrier for Contact Joints: Curing compound, conforming to requirements in Caltrans Standard Specifications, Section 90-7.01B.

F. Formwork: As specified in SSPWC, Section 303-5, except as otherwise required by the jurisdictional authority.

G. Reinforcing: Refer to Section 03200, Concrete Reinforcement, for reinforcement of station platforms and concrete pavement, as applicable.

PART 3 - EXECUTION

3.01 GENERAL

A. Construct in accordance with SSPWC, Section 303-5, except as otherwise required by the jurisdictional authority and as otherwise specified herein.

B. Construct station platforms as specified in Section 03160, Colored Concrete.

3.02 SUBGRADE

A. Perform in accordance with the requirements of Section 02300, Earthwork, and the following:

1. Immediately prior to placing concrete, subgrade to receive pavement shall conform to compaction and elevation tolerances specified for the material involved.

2. Construct true to grade and cross sections, thoroughly water and roll, or hand tamp until hard and solid. Remove soft, spongy or other unsuitable material to provide stable subgrade at least 6 inches below required subgrade elevation. Deposit approved fill material in low areas, compact thoroughly and grade to required finish subgrade elevation.

3. Subgrade shall be uniformly moist, and any excess water standing in pools or flowing on the surface shall be removed prior to placing concrete.

B. Provide templates for testing grade and cross section of subgrade. Extend template full width between forms and support on side forms.

3.03 CONTACT JOINTS

A. Contact joints are those made by placing fresh concrete against hardened concrete. Apply moisture barrier to the face of contact joint and allow to dry prior to placing fresh concrete against that joint face.
3.04 CURB CONSTRUCTION

A. Construct top and face of the finished curb true and straight. Construct top surface of curbs a uniform width, free from humps, sags, or other irregularities. When a straightedge 10 feet long is laid on the top face of the curb or on the surface of gutters, the surface shall not vary more than 1/8 inches from the edge of the straightedge, except at grade changes or curves.

END OF SECTION
SECTION 02720
ASPHALT PAVING

PART 1 - GENERAL

1.01 DESCRIPTION
A. Section includes specifications for hot-mix asphalt concrete (HMAC) track underlayment and asphalt concrete (AC) paving. Track underlayment includes all areas under the track, and the HMAC becomes part of the track structure.

1.02 REFERENCE STANDARDS
A. State of California, Department of Transportation, Standard Specifications (Caltrans):
   1. Section 39  Asphalt Concrete
   2. Section 88  Engineering Fabrics
   3. Section 93  Liquid Asphalts
   4. Section 94  Asphaltic Emulsions

1.03 SUBMITTALS
A. Submit Certificate of Compliance confirming that the asphalt concrete mix is in accordance with the requirements of this Section.
B. List of equipment to be used for the placing, spreading, and compaction of asphalt paving on structures. Only equipment approved by the Engineer shall be used.

1.04 DELIVERABLES
A. Submit records of delivery of asphalt materials, identifying shipment numbers, dates and quantities, material designations and temperature at the time of placement.
B. Submit copies of aggregate tests, penetration of the asphalt cement, and percentages by weight and number of pounds of each of the materials making up the batch.

PART 1 – PRODUCTS

2.01 MATERIALS
A. The material for HMAC and AC pavements shall conform to the provisions of Caltrans Standard Specifications, Section 39-2, "Materials”.
B. HMAC pavement for track underlay: Type A with 3/4-inch maximum, coarse aggregate gradation. Asphalt binder shall be steam refined AR-8000 grade in accordance with Section 92 of the Caltrans Standard Specifications.
Caltrain Standard Specifications

C. AC pavement: Type A with 1/2-inch maximum, coarse aggregate gradation. Asphalt binder shall be steam refined AR-4000 or AR-8000 grade in accordance with Section 92 of the Caltrans Standard Specifications.

D. Prime coat: Emulsified asphalt Type RS-2 conforming to Caltrans Standard Specifications, Section 94, Asphaltic Emulsions.

E. Binder coat (tack coat) shall be Type SS-1 conforming to the provisions of the American Asphalt Institute Specifications and Caltrans Standard Specifications, Section 94, Asphaltic Emulsions. Binder coat for use with pavement reinforcing fabric shall also comply with requirements specified in Caltrans Standard Specifications, Section 39-2.


PART 3 – EXECUTION

3.01 PREPARATION

A. HMAC pavement for track underlay: Subgrade shall be prepared and compacted to the requirements of Section 02300, Earthwork. Confirm that immediately prior to spreading HMAC, the subgrade to receive HMAC conforms to the compaction and elevation tolerances indicated and is free of standing water and loose or extraneous material. Request Engineer’s inspection of and obtain Engineer’s written acceptance of the prepared subgrade before proceeding with the spreading of HMAC.

B. Obtain written approval of aggregate base course from the Engineer prior to proceeding with paving. Refer to Section 02310, Aggregate Base Courses.

C. Refer to Section 02510, Utility Grade Adjustments, for related work.

3.02 SPREADING

A. Spread HMAC underlay by either a mechanical spreader or a grader. Maximum length of asphalt mixture placed by an approved mechanical spreader in a continuous strip shall not exceed 800 feet, unless otherwise permitted by the Engineer. Lay adjacent strips subject to the above limitations immediately after the previous strip is placed until the full pavement width has been achieved. Track underlay may be placed in one lift.

B. Place pavement to the depth shown on the Contract Drawings. Lift thickness shall conform to the following:

1. Final Surface Course or Lift: In areas subject to vehicular traffic, the maximum thickness shall be 2 inches. In all other areas, the maximum thickness shall be 3 inches.

2. Lifts Other Than Final: The maximum thickness shall be 3 inches.
C. Use a paver or approved mechanical spreader. Obtain Engineer’s approval for use of other means of spreading and compaction.

D. Prime pavement or concrete contact surfaces before placing asphalt concrete pavement.

E. Apply prime coat and tack coat prior to placing asphalt concrete in accordance to Caltrans Standard Specifications, Section 39-4, Subgrade, Prime Coat, Paint Binder (Tack Coat), and Section 39-5, Pavement Reinforcing Fabric.

F. Hand Laying Surface Mixture: Dump on approved dumping boards or steel plates and distribute immediately by means of hot shovels. Uniformly spread by means of hot iron rakes with tines not less than 1/2 inch longer than the loose depth of mixture to a depth which, after final compaction, shall be of the thickness required. Permit no walking on the surface mixture during the laying operations. If laid by hand, carefully lute surface mixture, after spreading and raking, from the sides before compaction.

3.03 COMPACtion

A. Rollers:

1. Steel-wheeled, tandem type power driven rollers shall provide a pressure of not less than 225 pounds per inch width of main roll. Rolls shall be smooth and without flat spots or other imperfections.

2. Pneumatic rubber-tired rollers shall be self-propelled with wheels mounted, grouped and spaced to provide uniform coverage with each pass. Rear group wheels shall not follow in the tracks of forward group wheel. Maximum wheel load shall be 5,600 pounds. Tire compression on pavement, where the area of contact is measured on a hard, unyielding surface, shall be 80 psi plus five (5) psi for each wheel. The total maximum load per axle, whether single axle or a group of axles in the same alignment, shall be 22,400 pounds. Wheel loads and tire pressures shall be controlled to produce the required degree of compaction without rutting of the surface to be rolled.

B. Rolling:

1. Proceed continuously at the following rates:

   a. For track underlay mixture, when spread by hand, not in excess of 400 square yards per hour, per roller.

   b. For track underlay, when spread by machine, not in excess of 600 square yards per hour, per roller.

   c. For asphalt concrete surface mixtures, when spread by hand, not in excess of 300 square yards per hour, per roller.

   d. For asphalt concrete surface mixtures, when spread by machine, not in excess of 400 square yards per hour, per roller.
2. Immediately after spreading, thoroughly compact by approved tamping irons adjacent to curbs, manholes and rails, by rolling with approved rollers continuously from commencement to final completion at a speed not exceeding three (3) miles per hour.

3. Make initial rolling, using tandem type rollers, parallel to the center line of the paved surface beginning at the curbs or edges of the paved surface and working toward the center, overlapping on successive trips by one-half the rear wheel of the roller. Immediately following the initial rolling, further compact by pneumatic rubber-tired rollers or steel wheel vibratory tandem type rollers a minimum of eight (8) passes, except HMAC track underlay which shall receive 4 passes. Smooth shallow ruts and ridges with tandem rollers immediately following the rubber-tired rolling.

4. First make final roll longitudinally with the paved surface and then diagonally or at right angles. Continue until no further compression results; the mixture has cooled; no marks show under the roller; and the surface is smooth and free from depressions, waves, bunches, and unevenness.

5. Test after the mixture has been rolled with an approved straight edge and surface testing machine laid parallel to the centerline of the paved surface.

3.04 JOINTS

A. Lay surface mixture in a continuous operation and pass the roller over the unprotected end of the freshly laid mixture only when laying of the course is to be discontinued for such length of time as to permit the mixture to become chilled. Provide for proper bond with new mixture by cutting or trimming back the joint to expose an unsealed or granular surface for the full specified depth of the course.

B. At the end of each day's work, form joints by laying and rolling against boards of the thickness of the compacted mixture, placed across the entire width of the pavement.

C. When the laying of the mixture is resumed, remove the boards, paint the exposed edge of the joint with a thin coat of approved hot asphalt cement or liquid asphalt, rake a fresh mixture against the joint, thoroughly tamp and roll. Hot smoothing irons may be used for sealing joints.

3.05 LAYING IN DAYLIGHT, WET WEATHER, COLD WEATHER

A. Schedule placement of asphalt paving material when the precipitation probability within 3 hours prior to the start of such operations is less than 50 percent.

B. Laying of mixtures will not be permitted in wet weather.

C. Except where otherwise permitted by the Engineer, spread no asphalitic mixtures when the asphalt mixture temperature is below 250 degrees F.

D. The Engineer will take surface temperatures at three (3) locations in the area being paved. The controlling temperature shall be the average of the three (3) readings.
3.06 OPENING TO TRAFFIC

A. Repair damage to new pavement caused by construction equipment or by public traffic due to premature opening of the traffic lanes to the satisfaction of the Engineer.

3.07 SURFACE PREPARATION

A. When pavement overlay or new pavement is to be constructed on an existing asphalt concrete, concrete, or brick surface, broom the existing surface clean prior to the application of prime coat. Repair holes and depressions in existing surfaces by removal to sound material and replacing with an asphalt-aggregate patching material. Compact patch to produce a tight surface conforming to the adjacent pavement area. Stabilize rocking Portland cement concrete slabs by undersealing or cracking and seating. Make the necessary repairs before brooming and prime coating. Fill wide joints and cracks with asphaltic concrete/sand mix material and compact as required by the Engineer.

3.08 DEFECTIVE WEARING COURSE

A. Remove portions of the completed wearing course that are defective in finish, compression, composition, or density and replace with suitable material properly laid in accordance with these Specifications.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION
A. Section includes specifications for precast concrete wheel stops for vehicular parking stalls in parking structures and parking lots as indicated.

1.02 REFERENCE STANDARDS
A. State of California, Department of Transportation (Caltrans), Standard Specifications:
   1. Section 95 Epoxy

1.03 SUBMITTALS
A. Shop Drawings: Submit shop drawings of stops, including installation details and attachment details to at-grade concrete and asphalt pavement, for approval.
B. Product Data: Submit manufacturers’ product data of precast stops and epoxy adhesive for approval.

1.04 QUALITY ASSURANCE:
A. Precast wheel stops shall be manufactured for the intended purpose by a company or firm specializing in the manufacture of precast concrete parking appurtenances.

PART 2 - PRODUCTS

2.01 MATERIALS
A. Wheel Stops: Precast, 3.5% minimum air-entrained concrete; 4000 psi minimum compressive strength. Each stop shall be reinforced with two No. 4 deformed steel reinforcing bars, minimum. Provide chamfered corners and drainage slots on underside, and provide holes for dowel-anchoring to substrate. Unless indicated otherwise, provide stops of half octoganal configuration and 36-inch length.

B. Adhesive for Anchoring Stops to Parking Structure Slabs, At-Grade Concrete Pavements, and At-Grade Asphalt Pavements: Epoxy adhesive manufactured for the purpose, similar and equal to the adhesives specified in Caltrans Standard Specifications, Section 95-2.04 or 95-2.05.

C. Adhesive for Bonding Dowel to Wheel Stop: As proposed by Contractor and approved by the Engineer, suitable for application.

D. Steel Bars for Installation: Galvanized 5/8” diameter steel dowels or galvanized
No. 5 steel reinforcing bars.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Securely attach wheel stops into at-grade concrete and at-grade asphalt pavement with not less than two galvanized steel dowels embedded in holes cast into wheel stops. Firmly bond each dowel to wheel stop and to pavement.

B. At concrete pavement, drill holes in pavement for dowels.

C. At parking structure slabs, epoxy to slab.

END OF SECTION
PART 1 - GENERAL

1.01 DESCRIPTION

A. Section includes specifications traffic stripes, and pavement markings, as well as striping and pavement markings for station platforms.

1.02 REFERENCE STANDARDS

A. State of California, Department of Transportation Standard Specifications (Caltrans):

1. Section 84 Traffic Stripes and Pavement Markings

B. State of California, Department of Transportation (Caltrans) Standard Plans.

1.03 DEFINITIONS

A. The following definition augments definitions in the Caltrans Specifications:

1. Platform safety Warning Striping: Yellow warning stripe applied to the platform where indicated on the Contract Drawings.

1.04 SUBMITTALS

A. Submit manufacturer’s product data for materials.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Paint for pavement marking, striping, and platform paint: Paint for traffic stripes as specified in Caltrans Standard Specifications, Section 84-3.

PART 3 - EXECUTION

3.01 PREPARATION

A. Layout of Work: Prior to the application of the striping and pavement markings, mark the location of the striping and pavement markings, and request inspection and obtain Engineer’s approval of the layout before proceeding with the application work.
3.02 APPLICATION

A. Apply paint in accordance with Caltrans Standard Specifications, Section 84-3, Painted Traffic Stripes and Pavement Markings.

END OF SECTION
SECTION 02800
STATION FENCE AND RAILING

PART 1 - GENERAL

1.01 DESCRIPTION
A. Section includes requirements for steel fencing and railing at station platforms, including center fencing, handrailing and platform edge railing.

1.02 REFERENCE STANDARDS
A. American Society for Testing and Materials (ASTM International):
   1. A36 Specification for Carbon Structural Steel
   3. A153 Standard Specification for Zinc Coating (Hot-dip) on Iron and Steel Hardware
   4. A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

1.03 SUBMITTALS
A. Submit shop drawings showing plan layout, grid, spacing of components, accessories, fittings and hardware.
B. Submit manufacturer’s product data.
C. Submit manufacturer’s installation instructions.
D. Submit manufacturer’s color palette to the Engineer for approval.

1.04 DELIVERABLES
A. Submit manufacturer’s certificates of compliance for fence materials.
B. Qualifications: Submit name, business address and telephone number of fabricator’s field representative.
C. Furnish certificate of inspection stating that the material has been sampled, tested and inspected per ASTM A653.

1.05 QUALITY ASSURANCE
A. Obtain the services of fencing fabricator’s field representative to provide advice and assistance on the installation of the fence panels, fasteners, and repair work.
1.06 EXTRA MATERIALS

A. Furnish the following extra materials for center fence, and for platform edge railing as follows. Securely fasten the panels and posts on wooden pallets, and the hardware in plastic container clearly marked "Station Fencing/Railing", and deliver them to the Engineer’s warehouse located within 25 miles of the project site.

1. For station center fence: 2 panels including 2 posts, and all necessary hardware.
2. For station platform edge railing: 4 panels including 4 posts, and all necessary hardware.

PART 2 - PRODUCTS

2.01 FENCE AND GATES

A. Fence panel width, other dimensions, and details including spacing of pickets, rings, posts, details of post caps, fasteners, etc.: see Caltrain Standard Drawing or Contract Drawings.

1. Finished center fence height shall be 6 feet from top of rail of higher adjacent tracks.

B. Posts, rails and hardware:

1. Posts and post caps: Galvanized, square steel tubular members conforming to ASTM A787 and G90 zinc coating.
2. Horizontal rails: Galvanized, square steel tubular members conforming to ASTM A787, 50,000 psi yield strength and G90 zinc coating. Attach rails to posts with tamper resistant fasteners.
3. Hardware (Base Plates, Anchor Bolts, Gate Hardware and Miscellaneous Hardware): ASTM A36.
5. Epoxy Grout: Epoxy grout shall conform to Section 03150, Concrete Accessories.

C. Gate Hardware: Hinges, latches, drop rods, as needed, shall be hot dip galvanized steel in accordance with ASTM A153 and sized to assure proper gate operation.

2.02 CONCRETE

A. Concrete: Concrete shall conform to the following:

1. Portland Cement: ASTM C-150, type 2 or 5 (Low alkali)
2. Aggregates:
   a. coarse aggregates: crushed rock, max 1-1/2 inch, #200: 2% maximum
b. Sand: 3/8 inch maximum, #200: 2% maximum

3. Compressive strength (minimum): 2,500 psi @ 7 days, 4,000 psi @ 28 days

4. Slumps: 2 to 4.5 inches

B. Footing hole shall be clear of roots or other organic materials. Moist hole prior to concrete pour. No water standing at bottom of hole.

C. Consolidate concrete to remove air pockets.

2.03 SHOP FINISHES

A. Galvanizing: Hot dip galvanize fence panels, rails and all associated hardware after fabrication in accordance with ASTM A123. Coating Thickness: Minimum 90 microns, and,

B. Powder Coat: Powder coat all parts of fence including hardware after galvanizing and in accordance with coating manufacturer’s instructions. Powder coat: O’Brien TGIC-Polyster or Engineer approved equal. Color: Black.

PART 3 – INSTALLATION

3.01 INSTALLATION

A. Concrete Footings: Drill or dig holes for post footings in firm, undisturbed or compacted soil or ballast. Towel tops of footings and slope or dome to direct water away from posts. For railing, flush the epoxy with the platform.

B. Field Joints: Field joints shall be kept to a minimum and concealed to the greatest extent possible. Field joints shall be strong, rigid, watertight and flush with hairline fit. Ease sharp corners.

C. Adjust fence for uninterrupted visual continuity and tight, non-rattling connections.

D. For station center fence: Restore ballast to flush with the top of ties.

3.02 REPAIR

A. Welded and abraded areas of galvanized surfaces shall be wire brushed and repaired with 2 coats of cold galvanized compound.

B. Repair abraded or damaged powder-coated per manufacturer's instructions.

END OF SECTION
SECTION 02810
CHAIN LINK FENCE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Section includes requirements for chain link fence and gates (personal, and swing or sliding gates), either hot-dip galvanized or polymer-coated (over hot-dip galvanizing).

B. Polymer-coated (over hot-dip galvanizing) is installed at locations as indicated on the Contract Drawings, such as where the fence is adjacent to bike path.

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM International):

1. A123 Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

2. A153 Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

3. F668 Specification for PolyVinyl Chloride (PVC) - and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric

4. A780 Practice for Repair of Damaged or Uncoated Areas of Hot-Dip Galvanized Coatings

5. F900 Specification for Industrial and Commercial Swing Gates

6. F934 Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials

7. F1043 Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework

8. F1083 Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures

B. Federal Specification:

1. RR-F-191/2C Fencing, Wire and Post, Metal (Chain Link Fence Gates) (Detail Specification)

1.04 SUBMITTALS

A. Submit shop drawings for fencing and gates.

B. Manufacturer's technical data and installation instructions for fencing and gates.
C. Samples: For the polymer-coating, submit manufacturer’s color chart of available colors and physical sample of color.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Fabric: Hot-dip galvanizing conforming to ASTM A123 and A153 as applicable.

1. Mesh Size and Gauge: 2 inches, 8 gauge wire
2. Top and bottom salvages twisted and barbed
3. Tension wire (top and bottom edges): coil spring wire, 7 gauge
4. Use one piece fabric widths

B. If polymer-coated finish is required, Polymer-coated (over galvanizing) conforming to ASTM F668, Class 1, 2, or 2b, and ASTM F1043. Wire gage specified for polymer coated fabric shall be the steel core wire, not the finish coated diameter. Color: Black in accordance with ASTM F934, unless otherwise indicated.

1. Fuse and adhere a minimum 10-mil (0.254 mm) PVC coating or polyolefin coating to the zinc exterior coating of the framework.
2. Polymer coated gate frames and gateposts: Match the coating type and color specified for the fence framework. Moveable parts such as hinges, latches and drop rods may be field coated in lieu of factory coated. Field Coating: Liquid polymer field touch up coating.

C. Round Steel Pipe and Rail: Schedule 40 ASTM F1083, Grade 1A, regular standard weight. 1.8 oz/sq ft hot-dipped galvanized zinc exterior and interior per ASTM A125.

D. Miscellaneous Hardware, Fittings and Appurtenances: Manufacture to industry standards, commercial quality, and suitable for the purpose used.

E. Terminal Posts, Rails, Brace assembly: see Caltrain Standard Drawing or Contract Drawing for details and dimensions.

F. Post Caps: Cast or malleable iron ball or acorn shape. Caps shall have opening for through rail where top rails are indicated.

G. Wire Ties shall be as follows:

1. For tying fabric to tension wires: 11 gauge hog rings spaced 24 inches on center
2. For tying fabric to line posts: 9 gauge wire spaced 12 inches on center
3. For tying fabric to rails and braces: 9 gauge wire spaced 24 inches on center.
H. Bands: Use 14 gauge by 1 inch wide steel bands spaced 15 inches on center for securing stretcher bars to end, corner, pull and gate posts. Bands may be used in conjunction with special fittings for securing rails to end, corner and pull posts. Chamfer or ease projecting edges of bands.

I. Sleeves for Anchoring Railing Posts in Concrete: Galvanized standard pipe sleeves with welded on bottom plates, or 24 gage galvanized sheet metal sleeves with bottoms.

J. Galvanizing: Hot dip galvanize ferrous materials after fabrication per ASTM A125 or A153 as applicable. Repair zinc coating damaged in shop or during field erection by recoating with hot repair compound, applied per manufacturer’s recommendations.

K. Hot Repair Compound: Re Galv, Galvalloy, Galweld alloy, or Engineer approved equal.


M. Gates shall be swing type or sliding type as indicated in the Contract Drawings, furnished complete with all hardware and accessories as required for a complete installation.

1. Gate Frames: Frames shall be fabricated with materials as specified for fence framework and fabric.

2. Fabrication: Conform to applicable requirements of ASTM F900, Federal Specification RR-F-191/C, and the following:

   a. Assemble gate frames by welding or with fittings and rivets for rigid connections. Attach hardware with rivets or by other means that will provide security against removal or breakage.

   b. Provide additional horizontal members, vertical members, and diagonal cross bracing to ensure proper gate operation, frame rigidity without sag or twist, and for attachment of fabric, hardware, and accessories.

3. Gate Hardware:

   a. Swinging Gates: Provide gate hinges, latch, stop, and keeper for each gate leaf, conforming to applicable requirements of ASTM F900 and Federal Specification RR-F-191/2C. Provide latch with provision for locking gate with a padlock.

   b. Sliding Gates: Provide manufacturer’s standard rubber-tired rollers and roller track for floor-supported sliding gates. Include intermediate rollers or casters where required to prevent gate sag or deflection. Provide locking device and padlock eyes as part of latch for locking gate with a padlock.
2.02 CONCRETE

A. Concrete: Concrete shall conform to the following:

1. Portland Cement: ASTM C-150, type 2 or 5 (Low alkali)

2. Aggregates:
   a. Coarse aggregates: crushed rock, max 1-1/2 inch, #200: 2% maximum
   b. Sand: 3/8 inch maximum, #200: 2% maximum

3. Compressive strength (minimum): 2,500 psi @7 days, 4,000 psi @ 28 days

4. Slumps: 2 to 4.5 inches

B. Footing hole shall be clear of roots or other organic materials. Moist hole prior to concrete pour. No water standing at bottom of hole.

C. Consolidate concrete and remove air pockets.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Alignment and Grade: Verify horizontal alignment and grades as established by survey and plan dimensions and elevations. Securely set posts in alignment at proper depth and height, and rigid bracing where needed.

B. Concrete Footings: Drill or dig holes for post footings in firm, undisturbed or compacted soil. Depth and post embedment as indicated in the Caltrain Standard Drawing. Trowel tops of footings and slope or dome to direct water away from posts. Slope, do not dome, in pedestrian paving.

C. Setting Posts:

1. Set in concrete footings, plumbed vertical. Post depth and spacing as indicated on the Standard Drawing or Contract Drawing. Space posts at lesser distance between centers to compensate for terrain variation such as sharp variations in incline or decline.

2. Grout posts in concrete walls and curbs in sleeved holes with non-shrink grout. If built in without sleeves, set posts in vertical and top edge alignment, hold in place until concrete has set.

D. Fit posts with post caps, line post caps, or barbed wire extension arms, as applicable. Snugly fit fittings over posts and exclude moisture.

E. Top Rail: Pass top rails through the line post caps and form a continuous brace from end to end of each stretch of fence. Join top rail lengths with sleeves. Securely fasten top rail to terminal posts by means of rail ends and brace bands. Provide expansion couplers as recommended by the fence manufacturer.

September 30, 2011
CHAIN LINK FENCE
F. Horizontal Braces and Truss Rods: Securely fasten brace to the line post and terminal post by rail ends and brace bands. Install a truss rod, including tightening device, from the end of the brace on the line post to the terminal post just above the bottom of fence fabric using brace bands.

G. Diagonal Braces: Install the diagonal brace with rail ends and brace bands. Fasten the brace at the locations described for a truss rod.

H. Tension Wire: Stretch tension wire out between terminal posts and secure at the terminal posts by means of tension bands.

I. Fence Fabric: Pull fabric taut and tie to posts, rails and tension wires. Fabric shall remain under tension after pulling force is released.

J. Tie Wires: Use U-shaped wires, same diameter as pipe to which attached, clamping pipe and fabric firmly with ends twisted two full turns minimum. Bend ends of wires to prevent hazard to persons or apparel.


L. Gates shall be installed plumb, level, and secure for full opening without interference. Install ground-set items in concrete as recommended by the fence manufacturer. Adjust hardware for smooth operation and lubricate. Sliding gates shall operate smoothly and easily under minimum pressure.

3.02 REPAIR

A. Repair abraded or damaged galvanized surfaces with hot process field galvanizing in accordance with ASTM A780 and manufacturer’s published instructions.

B. For polymer-coated panels, prepare and recoat damaged PVC coatings, including where component has been cut, in accordance with manufacturer’s instructions.

END OF SECTION
SECTION 02820
EXPANDED METAL MESH FENCE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Section includes specifications for expanded metal mesh fence and gates (personal, and sliding or swing gates).

1.02 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM International):


3. A1011 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

4. F626 Specification for Fence Fittings

5. F1083 Specification for Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded, for Fence Structures

6. F1267 Specification for Metal, Expanded, Steel

1.03 SUBMITTALS

A. Submit shop drawings showing plan layout, grid, spacing of components, accessories, fittings and hardware.

B. Submit manufacturer’s product data.

C. Submit manufacturer’s installation instructions.

1.04 DELIVERABLES

A. Submit manufacturer’s certificates of compliance for fence materials.

B. Qualifications: Submit name, business address and telephone number of manufacturer’s field representative. Include certification by the manufacturer that proposed field representative is qualified to provide specified services.

C. Certification of Installation: Subject affidavit by the manufacturer’s field representative certifying that the installation of the expanded metal mesh fence meets the Contract requirements.
1.05 QUALITY ASSURANCE

A. Obtain the services of fencing manufacturer’s field representative to provide the following services:

1. Supervise the entire installation of the fence
2. Render advice and assistance on the installation of the fence panels, posts, and fasteners

1.06 EXTRA MATERIALS

A. Extra materials shall match that installed in the Work. Furnish the following extra materials for every 1,000 linear feet (or fraction thereof) of each separate height and type of fence:

1. Two panels, with required number of fittings for installation, including 2 line posts fitted with caps.
2. Fittings (in addition to fittings furnished with extra panels): 20 - 2-1/2 inches clamps; 20 - 1 5/8 inch clamps; 20 – 2-1/2 inches line rail clamps; 20 back straps.

PART 2 - PRODUCTS

2.01 RIGHT-OF-WAY FENCE

A. Secura Expanded Mesh Fence System as manufactured by Alabama Metal Industries Corporation (AMICO), or Engineer approved equal.

B. Fabric: Type I (expanded), Class 2 (hot-dip galvanized), Grade A (0.06 mm minimum coating thickness) Carbon HSLA steel conforming to ASTM A1011. Sheet steel slit and stretched into a rigid, open mesh diamond shape openings.

1. Maximum carbon content of 0.15 percent
2. Tensile strength shall be at least 40,000 psi with typical yield point of 38,000 psi
3. Mesh Strand (nominal minimum): 0.1 inch (width and thick)
4. Short way of diamond run horizontally.

C. Terminal Posts: Posts shall comply with ASTM F1083, and the following:

1. Mesh configuration, terminal posts, bracing, railings, etc.: see Caltrain Standard Drawing or Contract Drawing for details and dimensions.
2. Terminal Posts (end, corner, gate, line posts): 4 inch nominal diameter, schedule 40 pipe. Each cap shall have a cap to seal out moisture.
3. Post Cap: Pressed steel dome cap
4. Base Plates and Miscellaneous Hardware: ASTM A36
D. Horizontal Rails: Rails shall comply with ASTM F1083. All rails shall be cut between and securely fastened to the posts using the proper sized 11 gage line rail clamps.

E. Fasteners and Fittings: Manufacturer fittings, and all hot-dip galvanized.

1. Fittings: "No Access Fittings", heavy pressed steel construction conforming to ASTM F626
2. Bands: Secura Bands: 11 gauge by 1 inch steel with 3 inch neck and slotted hole
3. Clamps: Secura Clamps: 11 gauge by 1 inch steel with 2 slotted holes
4. Back Straps: Secura Back Straps: 11 gauge by 1 inch steel with 2 slotted holes
5. Bolts: Carriage bolts 3/8 inch by 2 inch to secure fittings. Tighten securely and peen or scarf threads to prevent removal.

F. Gate Hardware: Hinges, latches, drop rods, as needed, shall be hot dip galvanized steel and sized to assure proper gate operation. Finish to match the fabric.

2.02 CONCRETE

A. Concrete: Concrete shall conform to the following:

1. Portland Cement: ASTM C-150, type 2 or 5 (Low alkali)
2. Aggregates:
   a. Coarse aggregates: crushed rock, max 1-1/2 inch, #200: 2% maximum
   b. Sand: 3/8 inch maximum, #200: 2% maximum
3. Compressive strength (minimum): 2,500 psi @7 days, 4,000 psi @ 28 days
4. Slumps: 2 to 4.5 inches

B. Footing hole shall be clear of roots or other organic materials. Moist hole prior to concrete pour. No water standing at bottom of hole.

C. Consolidate concrete and remove air pockets.

2.03 SHOP FINISHES

A. Zinc: Hot dip galvanized posts and expanded metal mesh after fabrication in accordance with ASTM A123.
PART 3 - INSTALLATION

3.01 INSTALLATION

A. Alignment and Grade: Verify horizontal alignment and grades as established by survey and plan dimensions and elevations. Securely set posts in alignment at proper depth and height, and rigid bracing where needed.

B. Concrete Footings: Drill or dig holes for post footings in firm, undisturbed or compacted soil. Depth and post embedment as indicated in the Caltrain Standard Drawing. Trowel tops of footings and slope or dome to direct water away from posts. Slope, do not dome, in pedestrian paving.

C. Posts: Set in concrete footings, plumbed vertical. Post depth and spacing as indicated on the Standard Drawing or Contract Drawing. Space posts at lesser distance between centers to compensate for terrain variation such as sharp variations in incline or decline.

D. Fabric Panel to Post Attachment:

1. Attach panels to posts with bands sized to fit posts and spaced per manufacturer’s recommendation.

2. To each terminal post, lap fence fabric over one half the width of the post to prevent any open space between the post and the fabric.

3. To each line post with the cant side of the fence fabric oriented in the same the same direction. Overlap fabric panels a minimum of three diamonds. Secure fabric panel to line posts using a minimum of seven (7) clamps, evenly spaced, per post with one above the top rail and one below the bottom rail.

4. Panels shall be placed within 2 inches of ground. High points which interfere with the placing of mesh panels shall be excavated to provide the clearance indicated on the Contract Drawings.

E. Fence Fabric: Pull fabric taut and tie to posts, rails and tension wires. Fabric shall remain under tension after pulling force is released.

F. Fabric to Horizontal Rail Attachment: Use a minimum of six (6) clamps per rail per panel. Evenly space clamps between posts.

G. Panel to Panel Attachment: Overlap fabric a minimum of 6 inches (three diamonds). Fasten using a minimum of six (6) back straps, evenly space, with one above the top rail and one below the top rail.

H. Gates shall be installed plumb, level, and secure for full opening without interference. Install ground-set items in concrete as recommended by the fence manufacturer. Adjust hardware for smooth operation and lubricate. Sliding gates shall operate smoothly and easily under minimum pressure.

3.02 REPAIR

A. Repair abraded or damaged galvanized surfaces with hot process field galvanizing in accordance with ASTM A780 and manufacturer’s published instructions.
END OF SECTION
SECTION 02830
WELDED WIRE MESH FENCE

PART 1 - GENERAL

1.01 DESCRIPTION
A. Section includes requirements for furnishing and installation of welded wire mesh fence and gates (personal, and swing or sliding gates). The Section includes furnishing extra materials.

1.02 REFERENCE STANDARDS
A. American Society for Testing and Materials (ASTM International):
   1. A36 Specification for Carbon Structural Steel
   3. A500 Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
   4. A501 Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
   5. F626 Standard Specification for Fence Fittings
   6. F1083 Standard Specification for Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded, for Fence Structures
   7. D2201 Practice for Preparation of Zinc-Coated and Zinc-Alloy-Coated Steel Panels for Testing Paint and Related Coating Products

1.03 SUBMITTALS
A. Submit shop drawings showing plan layout, grid, spacing of components, accessories, fittings and hardware.
B. Submit manufacturer’s product data.
C. Submit manufacturer’s installation instructions.
D. Submit manufacturer’s color palette to the Engineer for approval.

1.04 DELIVERABLES
A. Submit manufacturer’s certificates of compliance for fence materials.
B. Qualifications: Submit name, business address and telephone number of manufacturer’s field representative. Include certification by the manufacturer that proposed field representative is qualified to provide specified services.
C. Certification of Installation: Subject affidavit by the manufacturer’s field representative certifying that the installation of the welded wire mesh fence meets the Contract requirements.

1.05 QUALITY ASSURANCE

A. Obtain the services of fencing manufacturer’s field representative to provide the following services:

1. Supervise the entire installation of the welded wire mesh fence.
2. Render advice and assistance on the installation of the welded wire mesh fence panels, fasteners and bracing; clip installation and fastening to post; and on tensioning of panels.

1.06 EXTRA MATERIALS

A. Extra materials shall match that installed in the Work. Furnish the following extra materials for every 1,000 linear feet (or fraction thereof) of each separate height and type of fence.

1. Two panels, including 2 line posts, including caps
2. Fittings (in addition to fittings furnished with extra panels): 20 each hat brackets; 20 each gouge ties; 20 each fasteners.

B. The panels shall be rolled and tightened with the posts; all hardware shall be in plastic or steel container(s) clearly marked “Fence and year of project”. Deliver these materials to the Engineer’s warehouse within 25 miles from project site.

PART 2 - PRODUCTS

2.01 RIGHT-OF-WAY FENCE

A. Typhoon style welded wire mesh fence system as manufactured by Secure Technology, or by CE Shepard, or Engineer approved equal.

B. Mesh configuration, terminal posts, bracing, railings, etc.: see Caltrain Standard Drawing or Contract Drawing.

C. Wire: Hardened elongated, 7 gage, stretched diameter.

1. The material breaking point of the welded mesh shall be at least 62,000 psi
2. The tensile strength of the wire mesh shall be at least 71,000 psi
3. The elongation factor of the wire mesh shall be 7 percent
4. Welding points shall be able to withstand force of at least 1200 lbs
D. Terminal Posts:
1. The square steel tubing can be substituted with schedule 40 steel pipe only if the fence manufacturer has confirmed in writing that the tubular member is compatible to installation of the mesh fence panels.
2. Post Caps: Each post shall have a square cap to seal out moisture. Flat and form plastic to the shape of the post. Coating to match the fabric.

E. Bottom Rails and Bracing:
1. The rectangular steel tubing can be substituted with schedule 40 steel pipe only if the fence manufacturer has confirmed in writing that the tubular member is compatible to installation of the mesh fence panels.

F. Fence hardware: Manufacturer fittings, and all hot-dip galvanized.
1. Fasteners Connecting Panels to Each Post: 3 mm diameter “U” shaped wire fastener.
2. Hat brackets (horizontal connectors of the welded wire mesh fence): 0.05-inch thick by 1.18 inches long pre-molded clip fastener.
3. Gouge ties (vertical connectors of the welded wire mesh fence): 0.05-inch thick by 0.59 inches long pre-molded clip fastener.

F. Gate Hardware: Hinges, latches, drop rods, as needed, shall be hot dip galvanized steel and sized to assure proper gate operation. Finish to match the fabric.

2.02 CONCRETE

A. Alignment and Grade: Verify horizontal alignment and grades as established by survey and plan dimensions and elevations. Securely set posts in alignment at proper depth and height, and rigid bracing where needed.

B. Concrete: Concrete shall conform to the following:
1. Portland Cement: ASTM C-150, type 2 or 5 (Low alkali)
2. Aggregates:
   a. Coarse aggregates: crushed rock, max 1-1/2 inch, #200: 2% maximum
   b. Sand: 3/8 inch maximum, #200: 2% maximum
3. Compressive strength (minimum): 2,500 psi @7 days, 4,000 psi @ 28 days
4. Slumps: 2 to 4.5 inches

C. Footing hole shall be clear of roots or other organic materials. Moist hole prior to concrete pour. No water standing at bottom of hole.

D. Consolidate concrete and remove air pockets.
2.03 SHOP FINISHES

A. Zinc: Hot dip galvanized posts and welded wire mesh after fabrication in accordance with ASTM A123.

PART 3 - INSTALLATION

3.01 INSTALLATION

A. Concrete Footings: Drill or dig holes for post footings in firm, undisturbed or compacted soil. Depth and post embedment as indicated in the Caltrain Standard Drawing. Trowel tops of footings and slope or dome to direct water away from posts. Slope, do not dome, in pedestrian paving.

B. Posts: Set in concrete footings, plumbed vertical. Post depth and spacing as indicated on the Standard Drawing or Contract Drawing. Space posts at lesser distance between centers to compensate for terrain variation such as sharp variations in incline or decline.

C. Install welded mesh panels according to manufacturer's instructions and generally as follows:

1. Begin at corner/start post. Layout each piece of the welded wire mesh fence. Connect mesh panels with a minimum of 8 junction clips per panel.

2. Connect one end of tensioning device to the intermediate post that is fastened to support brace. Connect other end of tensioning device to the connected panels. Tension mesh panels with 2000 lb. pull in tensioning device. Leave tensioning device connected until the adjacent section is installed and tensioned. Repeat this operation until the welded mesh fence is installed from corner post to corner post.

3. Trim panels as needed for landscaped purposes.

D. Fence Fabric: Pull fabric taut and tie to posts, rails and tension wires. Fabric shall remain under tension after pulling force is released.

E. Gates shall be installed plumb, level, and secure for full opening without interference. Install ground-set items in concrete as recommended by the fence manufacturer. Adjust hardware for smooth operation and lubricate. Sliding gates shall operate smoothly and easily under minimum pressure.

3.02 REPAIR

A. Repair abraded or damaged galvanized surfaces with hot process field galvanizing in accordance with ASTM A780 and manufacturer's published instructions.

END OF SECTION
SECTION 02900
PLANTING

PART 1 – GENERAL

1.01 DESCRIPTION

A. Section includes requirements for landscaping, including furnishing and installing topsoil, soil amendments, mulch, trees, shrubs, groundcovers, tree staking, and header boards.

1.02 REFERENCE STANDARDS

A. American National Standards Institute (ANSI):
   1. Z60.1 American Standard for Nursery Stock

B. ASTM International (ASTM International):
   1. A641 Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
   2. D5268 Specification for Topsoil Used for Landscaping Purposes

1.03 DEFINITIONS

A. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than sizes indicated. Stock shall be wrapped, tied, rigidly supported, and drum-laced conforming to the requirements in ANSI Z60.1.

B. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for kind, type, and size of exterior plant required.

C. Finish Grade: Elevation of finished surface of planting soil.

D. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

E. Subgrade: Surface or elevation of subsoil remaining after completing excavation or top surface of a fill or backfill before placing planting soil.

1.04 SUBMITTALS

A. Submit product data for each type of product.

B. Samples for verification for each of the following:
   1. One pound of bark mulch in labeled plastic bags
C. Submit certificates of compliance for each type of manufactured product, signed by product manufacturer, certifying the following:

1. Manufacturer's certified analysis for standard products
2. Analysis of other materials by a recognized laboratory conforming to methods established by the Association of Official Analytical Chemists, where applicable.

D. Material test reports for existing surface soil, imported topsoil, and soil amendments. Include laboratory reports for topsoil including analysis and recommendation.

E. Qualification data for landscape installer and soil-testing laboratory.

F. Maintenance instructions listing recommended procedures to be established by the Owner for maintenance of exterior plants during a calendar year; submit before expiration of required maintenance periods.

1.05 DELIVERABLES

A. Planting schedule indicating anticipated planting dates for exterior plants. Coordinate planting schedule with Progress Schedule.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of exterior plants. Installer shall possess a State of California Landscape Contractor's license and meet the State of California Licensing Requirements for the application of herbicides.

B. Installer's Field Supervision: Installer shall maintain an experienced full-time supervisor on site when exterior planting is in progress.

C. Soil-Testing Laboratory Qualifications: An independent laboratory recognized by the State Department of Agriculture with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

D. Pre-Installation Conference: Conduct pre-installation conference at project site. Schedule conference in coordination with the Engineer. Attendees shall include Contractor, planting installer, landscape irrigation installer, and the Engineer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver exterior plants freshly dug.

B. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of exterior plants during delivery. Do not drop exterior plants during delivery.

C. Handle planting stock by root ball.

D. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set
exterior plants and trees in shade, protect from weather and mechanical damage, and keep roots moist.

1. Do not remove container-grown stock from containers before time of planting.

2. Water root systems of exterior plants stored on-site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

E. Store fertilizers and soil amendments in a dry place and protect from intrusion of moisture.

1.08 COORDINATION

A. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.

B. Proceed with planting only when existing and forecasted weather conditions permit.

1.09 WARRANTY

A. Refer to General Provisions GP4.3, Guaranty of Work. The Guaranty of Work shall include the following provisions in regard to planting including plant materials.

1. Warrant against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, or incidents that are beyond the Contractor’s control.

2. Remove dead exterior plants immediately, and replace immediately unless required to plant in the succeeding planting season.

3. Replace exterior plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.

4. A limit of one replacement of each exterior plant will be required, except when losses or replacements are due to failure to comply with requirements.

1.10 MAINTENANCE

A. Maintenance Period: 12 months from date of Substantial Completion.

B. Trees and Shrubs: Perform maintenance throughout the maintenance period including pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades and vertical position as required to establish healthy, viable plantings. Spray as required to keep trees and shrubs free of insects and disease. Restore or replace damaged tree wrappings.

C. Ground Cover and Plants: Perform maintenance throughout the maintenance period including watering, weeding, fertilizing, and other operations as required to establish healthy, viable plantings:
PART 2 - PRODUCTS

2.01 GENERAL

A. Provide quality, size, genus, species and variety of exterior plants indicated conforming to the requirements in ANSI Z60.1.

B. Selection of exterior plants shall be made in conjunction with the Engineer, who will witness tagging plants at their place of growth before they are prepared for transplanting.

C. Measure trees and shrubs according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches above ground for trees up to 4-inch caliper size, and 12 inches above ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

D. The Engineer may observe trees and shrubs either at place of growth or at site before planting for compliance with requirements for genus, species, variety, size, and quality. The Engineer retains the right to observe trees and shrubs further for size and condition of balls and root systems, insects, injuries and latent defects, and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from the project site.

1. Notify the Engineer of sources of planting materials 7 days in advance of delivery to site.

2. Make no plant substitutions.

2.02 TREE AND SHRUB MATERIAL

A. Furnish nursery-grown trees and shrubs conforming to the requirements in ANSI Z60.1 with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions and disfigurement.

B. Provide trees and shrubs of sizes and grades conforming to the requirements in ANSI Z60.1 for type of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to the Engineer with a proportionate increase in size of roots or balls.

C. Label each tree and shrub with securely attached, waterproof tag bearing legible designation of botanical and common name.

D. If formal arrangements or consecutive order of trees or shrubs is shown, select stock for uniform height and spread, and number label to assure symmetry in planting.

2.03 SHADE AND FLOWERING TREES

A. Shade Trees: Single-stem trees with straight trunk, well-balanced crown and intact leader, of size indicated, conforming to the requirements in ANSI Z60.1 for type of trees required.

1. Branching height shall be 1/3 to 1/2 of tree height
2. Provide container-grown trees

B. Small Upright or Spreading Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height and branching conforming to the requirements in ANSI Z60.1.

1. Stem form shall be multi-stem, clump, with 2 or more main stems
2. Provide container-grown trees

2.04 GROUND COVERS

A. Provide ground cover of species indicated, established and well-rooted in pots or similar containers, conforming to the requirements in ANSI Z60.1.

2.05 TOPSOIL

A. Topsoil shall conform to the requirements in ASTM D5268, pH range of 6.0 to 6.8, fertile, friable, natural topsoil of sandy loam character, without admixture of sub-soil material, obtained from a well drained arable site, reasonably free from clay, lumps, coarse sands, stones, plants, roots, sticks and other foreign materials.

1. Identify source location of topsoil proposed for use in the Work.
2. Provide topsoil free of substances harmful to the plants which will be grown in the soil.

B. Furnish topsoil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of topsoil.

1. Include suitability of topsoil for plant growth. State recommended quantities of nitrogen, phosphorus, potash nutrients and soil amendments to be added to produce satisfactory topsoil.

2.06 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through one-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and the following:

1. Organic Matter Content: 50 to 60 percent of dry weight
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste

B. Peat: Sphagnum peat moss, partially decomposed, finely divided or granular texture, with a pH range of 3.4 to 4.8.

C. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste of uniform texture, free of chips, stones, sticks, soil or toxic materials.

1. In lieu of decomposed wood derivatives, mix partially decomposed wood derivatives with at least 0.15 lbs of ammonium nitrate or 0.25 lbs of...
ammonium sulfate per cubic foot of loose sawdust or ground bark.

D. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed and material harmful to plant growth.

2.07 FERTILIZER

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous and potassium in the following composition:

1. Nitrogen, phosphorous and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus and potassium in the following composition:

1. Nitrogen, phosphorous and potassium in amounts recommended in topsoil analysis.

2.08 PLANTING SOIL

A. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

2.09 MULCHES

A. Organic mulch shall be free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Medium fir bark or wood chips
2. Rock mulch: As specified in the Contract Documents

2.10 STAKES

A. Metal Stakes for 15 gallon can and 24 inch box trees: Schedule 40 steel, 9-foot length, 3/4 inch diameter, with screw in auger-type tip, adjustable height 'T'-bar, UV-resistant vinyl tubing, 3 cable ties, anti-rotational tab and pin, powder coated black. As available from Decorations for Generations, Inc. Guy and Tie Wire: Conform to ASTM A641, Class 1, galvanized-steel wire, 2-strand, twisted, 0.106-inch in diameter.

2.11 MISCELLANEOUS PRODUCTS

A. Anti-desiccant: Water-insoluble emulsion, permeable moisture retarder, film forming for trees and shrubs. Deliver in original, sealed and fully labeled containers and mix according to manufacturer’s written instructions.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to receive exterior plants for compliance with requirements and
conditions affecting installation and performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect structures, utilities, sidewalks, pavements and other facilities, and lawns and existing exterior plants from damage caused by planting operations.

B. Refer to Section 01560, Temporary Controls, for requirements to prevent erosion, displacement of soils, discharge of soil-bearing water runoff, and airborne dust.

C. Lay out individual tree and shrub locations, and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain acceptance of the layout by the Engineer before planting. Make adjustments as required.

D. Apply anti-desiccant to trees and shrubs using power spray to provide an adequate film over trunks, branches, stems, twigs and foliage to protect during digging, handling and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with anti-desiccant at nursery before moving and again 2 weeks after planting.

3.03 PLANTING BED ESTABLISHMENT

A. Loosen subgrade of planting beds to a minimum depth of 8 inches. Remove stones larger than one inch in any dimension and sticks, roots, rubbish and other extraneous matter.

1. Apply superphosphate fertilizer directly to subgrade before loosening.

2. Spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil mix.

a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days

b. Mix lime with dry soil before mixing fertilizer

B. Topsoil Amendment, Topsoil Placement, and Fine Grading:

1. Place and spread topsoil to a minimum uniform thickness of 4 to 5 inches throughout areas designated to receive landscape planting, allowing for addition of amendments and plant materials, and mulch where indicated.

a. Provide imported topsoil needed to fill remainder of site planting areas to finish grade.

2. Amend new topsoil according to the following: At each 1,000 square feet or per 20 cubic yards, spread 6 cubic yards soil amendment, 15 pounds commercial fertilizer, 10 pounds soil sulfur and 10 pounds iron sulfate evenly over topsoil at rates and depths indicated, then uniformly and thoroughly incorporate into the upper 6 inches of soil to obtain a homogeneous soil mix. Topsoil shall be in a moist condition at time of mixing.

a. Amendment and fertilizer may be premixed prior to placement of
topsoil.

b. Modify quantities of soil sulfur, iron sulfate, and soil amendment in accordance with recommendations in topsoil analysis.

3. Deposit and spread topsoil using methods that will prevent excessive compaction of topsoil.

4. Provide a smooth finish grade by blading, dragging or other methods acceptable to the Engineer. Remove high spots and fill depressions. Place grades, slopes and mounds to drain as shown on the Contract Drawings.
   a. Finely finish surfaces by raking smoothly and evenly, removing all exposed, extraneous matter one inch or larger in size to facilitate natural runoff. Drag areas for smooth surface.
   b. Slope finish grades to drain without water pockets or irregularities (bumps or hollows). Finish grades shall meet all existing controls and shall be 3 inches below adjacent top of paving, curbs or sidewalks to allow for top dressing mulch or 5 inches below top of paving, curbs or sidewalks to allow for rock mulch. Grades shall be of uniform slope between points of fixed elevation. Establish vertical curves or roundings at abrupt changes in slope.
   c. Obtain the Engineer’s review and approval of finish grades prior to commencing the planting operations.

C. Restore planting beds if eroded or otherwise disturbed after finish grading and before planting.

3.04 TREE AND SHRUB EXCAVATION

A. Excavate circular pits with sides sloped inward. Trim base leaving center area raised slightly to support root ball and assist in drainage. Do not further disturb base. Scarify sides of plant pit smeared or smoothed during excavation.
   1. Excavate approximately 3 times as wide as ball diameter for container-grown stock.
   2. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
   3. If drain tile is shown or required under planted areas, excavate to top of porous backfill over tile.

B. Do not use subsoil removed from excavations as backfill. Use planting soil (see definitions).

C. Notify the Engineer if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations. Make adjustments to location of pit in consultation with the Engineer and excavate new pit.

D. Notify the Engineer if subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.

E. If hardpan layer is encountered, drill 6-inch diameter holes into free-draining strata
or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

F. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.05 TREE AND SHRUB PLANTING

A. Set container-grown stock plumb and in center of pit or trench with top of root ball one inch above adjacent finish grades.

1. Carefully remove root ball from container without damaging root ball or plant.

2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.

B. Apply 2 inches average thickness of organic mulch extending 12 inches beyond edge of planting pit or trench. Do not place mulch within 3 inches of trunks or stems.

3.06 TREE AND SHRUB PRUNING

A. Prune, thin and shape trees and shrubs according to standard horticultural practice.

B. Prune trees to retain required height and spread. Do not cut tree leaders; remove only injured or dead branches from flowering trees. Prune shrubs to retain natural character. Shrub sizes indicated are sizes after pruning.

3.07 STAKING

A. Upright Staking and Tying: Stake trees of 2 inches through 5 inches caliper. Stake trees of less than 2 inches.

B. General: Stake or guy trees immediately after planting. Make modifications to staking procedures as required to accommodate field conditions.

1. Allow 1 to 3 inches sway in trunk or branches; do not pull tight

C. Guying and Staking: Staking (metal): Stake trees according to tree stake manufacturer’s recommendations.

3.08 GROUND COVER AND PLANTING

A. Set out and space ground cover and plants as shown on the Contract Drawings. Place 12 inches apart if no other spacing is shown on the Contract Drawings.

B. Dig holes large enough to allow spreading of roots and backfill with planting soil.

C. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

D. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
E. Protect plants from hot sun and wind. Remove protection if plants show evidence of recovery from transplanting shock.

3.09 PLANTING BED MULCHING

A. Mulch backfilled surfaces of planting beds and other areas indicated.

B. Organic Mulch: Apply 2 inches average thickness of organic mulch and finish level with adjacent finish grades. Do not place mulch against plant stems.

3.10 CLEANUP AND PROTECTION

A. During exterior planting, keep adjacent paving and construction clean, and work area in an orderly condition.

B. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and any other adjacent work. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged exterior planting.

3.11 DISPOSAL

A. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash and debris, dispose of it in accordance with GP7.16, Disposal of Material Outside the Work Site.

END OF SECTION
SECTION 02910
PLANTING IRRIGATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Section includes specifications for automatic irrigation system.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM International):


2. D1785 Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

3. D2241 Specification for Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)


5. D2466 Specification for Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40

B. National Sanitation Foundation (NSF)

1.03 SUBMITTALS

A. Materials list: Submit materials list. Include manufacturer, model number and description of all materials and equipment. Include sealants, cements, lubricants and other proprietary items.

B. Shop drawings: Submit shop drawings for assemblies not detailed on the Contract Drawings. Include mounting details for rain shutoff.

C. As-Built Planting Irrigation Drawings: Submit as specified in Section 01720, Contract Record Documents. The following requirements are in addition to those specified in Section 01720, Contract Record Documents:

1. Show every change from Contract Drawings and Specifications and exact as-built locations, sizes and kinds of equipment.

2. Dimension from 2 permanent points of reference such as building corners, sidewalks, road intersections or monuments to the following items:

   a. Connection to water source
b. Valves (ball valves, remote control valves, quick coupling valves)

c. Routing of pressure lines

d. Controller

D. Operation and Maintenance Manuals: Submit as specified in Section 01730, Operations and Maintenance Manuals. Include the following data:

1. Copy of Controller Charts: Include full size and reduced versions of each chart as mounted in Controllers. Reduced versions shall be either 8 1/2 inches by 11 inches or 11 inches by 17 inches sheets, folded. Fold full size version and enclose in clear plastic pocket in manual binder.

1.04 QUALITY ASSURANCE

A. Installer of irrigation systems shall be a licensed Landscape Contractor.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic piping protected from direct sunlight. Support piping to prevent sagging and bending.

1.06 SEQUENCING AND SCHEDULING

A. Coordinate sprinkler piping with planting work specified in Section 02900, Planting.

B. Coordinate sprinkler piping with grading and utility work.

1.07 WARRANTY

A. Refer to General Provisions GP4.3, Guaranty of Work. The Guaranty of Work shall include the following provisions in regard to planting irrigation system:

1. Agree to repair or replace defective Work including adjacent work which is damaged by such defects, with the exception of ordinary wear and tear, abuse or neglect. This includes damage to site improvements caused by settlement of improperly compacted trench backfill.

1.08 MAINTENANCE MATERIALS

A. Special tools: Deliver two sets of special tools as required to operate, adjust, dismantle or repair equipment. Include tools not normally found in possession of maintenance personnel. At minimum provide the following:
1. Two sets of special tools and valve keys required for operating, removing, disassembling and adjusting each type of valve supplied on the Project.

2. Two quick coupler keys and matching hose swivels.

1.09 MAINTENANCE SERVICE

A. Maintain irrigation system in working order from beginning of work until the end of the Maintenance Period specified in Section 02900, Planting. Maintenance of system includes, for example, the following work: Flushing system and adjusting heads; providing optimum amounts of water to plants; replacing lost, stolen or damaged equipment; reprogramming controller.

1. In addition to hand watering required in Section 02900, Planting, for plant establishment. During any times when irrigation is not available due to maintenance of irrigation system, hand water as required for maintaining plants.

PART 2 - PRODUCTS

2.01 PVC PIPE AND FITTINGS

A. Polyvinyl Chloride (PVC) Pipe: NSF approved, Type 1, Grade 1 PVC compound; ASTM D1784, ASTM D1785 and ASTM D2241.

B. Pipe shall bear the following markings:

1. Manufacturer’s name
2. Nominal pipe size
3. Schedule or class
4. Pressure rating in PSI
5. Date of extrusion

C. Pressure Main Line Pipe: PVC 1120 plastic pipe: Class 315 for 1 1/2 inch and larger; schedule 40 for 1 1/4 inch and smaller.


E. Sleeves (Twice the diameter of working pipe):

1. Water lines: Schedule 40 PVC 1120
2. Electrical lines: Gray, schedule 40 PVC conduit
3. Caps: Schedule 40 PVC
F. **Fittings:**

1. Solvent weld socket fittings: Schedule 40, Type 1, Grade 1, NSF approved, ASTM D2466. Schedule 80, ASTM D2464. Fittings shall bear manufacturer's name or trademark, material designation, size, applicable IPS schedule and NSF seal of approval.

2. Solvent cement and primer for PVC solvent-weld pipe and fittings shall be of type and installation methods recommended by pipe manufacturer.

G. **Risers:** Schedule 80 PVC threaded nipples and elbows.

### 2.02 OTHER PIPING MATERIALS

A. **Pipe upstream of (backflow preventer/master valve):** Schedule 40 galvanized steel.

B. **Pipe Wrapping Tape:**

1. Metal pipe: 2-inch wide, 20 mils thick, black PVC, all weather corrosion-resistant tape with high tack adhesive formulated to resist corrosion. Use same manufacturer's pipe primer to seal pipe and prepare for tape wrapping.

2. PVC pipe: As above, except primer is not required.

C. **Pipe Joint Compound:** Non-hardening, non-toxic, designed specifically for use on PVC and metal threaded connections in water carrying pipe and as recommended by pipe manufacturer.

D. **Flexible Riser/Connector:** EPDM rubber hose, PVC ends, with stainless steel bands. Product specifically marketed for irrigation systems such as Flex-Riser, King Brothers Industries, or Engineer approved equal.

E. **Provide dielectric fittings where dissimilar metals come into contact.**

F. **PVC Sleeves:** Schedule 40 PVC.

G. **Galvanized Steel Sleeve:** ASTM A53

### 2.03 VALVES

A. **Ball valve:** Brass construction, stainless steel ball, two-piece body, threaded connections, with teflon seats and full port.

B. **Plastic electric remote control valve:**

1. Heavy-duty, stainless steel fasteners, nylon-reinforced rubber diaphragm

2. Normally closed with manual internal bleed; self-flushing stainless steel screen and brass flow control stem
3. Rated to 150 psi
4. 24 Vac solenoid actuated

C. Quick coupling valves: Bronze construction, 1 inch connection, two-piece body, yellow vinyl locking top, single slot and lug. Size: As indicated on the Contract Drawings.

D. Inline Wye Filter
1. Specifically for low flow applications
2. Rated to 150 psi
3. Standard 200 mesh screen
4. Shall not exceed 5 inches high, 6 inches long, and 2 1/2 inches wide

E. Inline Pressure Regulator: Rated not less than 80 psi.

2.04 VALVE BOXES

A. High Density Polyethylene (HDPE), green, UV resistant, with stainless steel bolt-down mechanism and heat-branded letters, minimum 2 inch height.
2. Quick coupling valve (QCV): Round, 10 inch diameter, series 910. Letters: "QCV".

2.05 SPRINKLER HEADS

A. Spray Sprinkler:
1. Matched precipitation rate, seamless molded plastic, with stainless steel adjustment screw and retraction spring.
2. Pressure activated wiper seal and removable flushing plug.
3. Pop-up body shall have pressure regulator for 30 psi pressure regulation to nozzle and integral check valve capable of preventing low-head drainage up to 8 feet of head.
4. Pop-up height: 6 inches in shrub and groundcover areas.
5. Nozzle: As shown on the Contract Drawings. Provide pressure compensating screen where required to reduce radius.

2.06 SUBSURFACE DRIP SYSTEM EQUIPMENT

A. Provide all components required for complete system to suit field conditions. All components shall be of single manufacturer.
1. Pressure regulator: Plastic, in-line serviceable, with built-in gauge, rated for 2.0 to 20 gpm.


3. Air relief valve: Plastic, 1/2 inch MPT

4. Tubing: Low density 5/8 inch polyethylene with Rootguard; 0.71 O.D.; 0.62 I.D. Shall have integral, pressure compensating, self-cleaning emitters, 12 inches on center. Emitter flow: 1.02 gph. Shall maintain constant flow at inlet pressure of 5 to 50 psi. Provide fittings, staples adapters and other components of same manufacturer.

5. Line flushing valve: Plastic, 1 gpm, 1/2 inch MPT inlet, shall flush automatically at start of each cycle.

6. Stainless steel clamp: Type 304 stainless steel, screwed hose clamps, as recommended by manufacturer of subsurface irrigation system.

7. Emitter – Multi-Outlet Device – 8 Port, with 1/2 inch inlet

2.07 BACKFLOW PREVENTION DEVICE

A. Reduced pressure type, bronze with 304 stainless steel springs, with two (2) ball valves, pressure rated to 175 psi, 1-inch size.

2.08 CONTROLLER

A. UL listing; pedestal mount, as shown on the Contract Drawings. Controllers shall be factory mounted in manufacturer's enclosure unless otherwise shown.

B. Solid state, microprocessor-based, capable of fully-automatic, semi-automatic or manual operation.

C. Programming: 24 Station. Station timing: 1 minute to 99 minutes in 1 minute increments. Non-volatile memory.

D. Master valve/pump start circuit and valve test function

E. Water budgeting: 0 - 200 percent

F. 6 starts per program per day

G. Standby watering schedule

H. Rainbird, ESP-LX Series with locking steel cabinet, or Engineer approved equal

I. Controller charts: Provide controller charts the maximum size that the controller door will allow, showing areas covered by each controller. Color code area of coverage of each valve and enlarge valve sequence to be readable when
drawing is reduced. Reduce approved As-Built drawings and seal between two 20-mil plastic sheets; install inside door.

2.09 FLOW SENSOR

A. Schedule 80 PVC with removable, non-magnetic sensing mechanism. Rated to 100 psi at 140 degrees F.

B. Sensing mechanism: Electronic detector, glass reinforced polyphenylene sulfide housing with glass reinforced nylon impeller, UHMWPE bearing, tungsten carbide shaft, and EPDM O-rings.

2.10 CONTROL WIRE

A. Control wire: Soft-annealed, uncoated copper, single conductor, with PVC insulating jacket, UL approved for direct burial, size and color as follows:

1. Common ground: White, size #12 AWG-UF
2. Control wire: Color other than white, size #14-1 AWG-UF

B. Provide separate common ground for each controller.

C. Connections: Gel-sealed waterproof connector kit, UL listed for direct burial splices, with spring connector, vinyl insulator and moisture proof snap top packet. DBY/DBR connector sealing packs, as manufactured by 3M Company, Austin, TX, or equal.

2.11 RAIN SENSOR

A. Rain Sensor: Hygroscopic disks housed in UV stabilized, thermoplastic housing with weatherproof switch mechanism and 6 inch aluminum mounting bracket, with automatic return to normal watering cycle, as manufactured by Glen Hilton, Products, Inc, Richmond, VA, or equal.

B. Click stop settings shall measure rainfall in quantities of 1/8 to 1 inch and shut off watering cycle during rain. Set device to shut off system when rainfall reaches 1/2 inch.

C. Shall be low voltage, UL listed, with 25 feet of No. 20 AWG 2 conductor wire and lead wire for normally open wiring. Provide additional mounting hardware and wiring to suit project conditions.

2.12 TRENCH BACKFILL

A. Trench backfill in planting areas shall be planting mix specified in Section 02900, Planting.

B. Trench backfill under paving shall meet requirements of Section 02300, Earthwork.
2.13 OTHER MATERIALS

A. Concrete: As specified in Section 03300, Cast-in-Place Concrete. Minimum compressive strength: 3,000 psi.

B. Drain rock: 3/4 inch washed drain rock.

PART 3 - EXECUTION

3.01 COORDINATION

A. Protect existing and new above and below ground features.

B. Coordinate placement of items to be embedded into concrete work or installed under paving.

C. Design pressure is as shown on Contract Drawings. Verify static pressure at point of connection (POC) before starting construction and notify the Engineer if it is different from the design pressure.

D. Irrigation demand is shown on the Contract Drawings. Verify at POC before starting construction.

3.02 LAYOUT

A. Drawings: For purposes of clarity and legibility, the Contract Drawings are diagrammatic to the extent that many offsets, bends, unions, special fittings, and exact locations of items are not indicated, unless specifically dimensioned. Exact routing of piping, conduits and wiring shall be governed by actual site conditions.

1. Provide necessary fittings and offsets to adapt to existing conditions and prevent conflicts with other work and existing improvements.

B. Before installation, stake layout of pressure supply lines and valves for review. Coordinate with staked layout of trees provided under Section 02900, Planting. Adjust as required to ensure coverage, to avoid interference with planting.

3.03 BACKFILLING

A. Backfill with specified material after testing pipe. Compact backfill to a density equal to adjacent soil, or as specified in Section 02300, Earthwork.

B. Correct subsequent settlement of trenches, and correct any damage caused by settlement.

3.04 SLEEVES AND CONDUITS

A. Provide sleeves and conduit of sufficient size and quantity to accommodate all pipe and wiring. Install sleeves where control wires and pipe pass through or under walls and under paving. Provide galvanized steel pipe sleeves where sleeves are installed by jacking or boring.
B. Install minimum 7 inches below bottom of pavement base, and at least as deep as required depth of pipe.

C. Sleeves and caps: Extend minimum 12 inches beyond edge of pavement. In-line fittings are not permitted in sleeves less than 20 feet long. Cap ends of sleeves hand tight until pipe is installed.
   1. Install sleeves and conduit level and in a straight line.

D. Backfill with 4 inches clean sand on all sides of sleeves, and compact by tamping.

E. Mark locations of sleeve ends with 2 x 4 stake extending 6 inches above finish grade, for future location during construction. Label stake clearly with letter "I". Remove stake when assembly is completed.

3.05 POINT OF CONNECTION/WATER METER

A. Make arrangements and pay costs for installation of water meters at locations indicated on Contract Documents. Coordinate with the jurisdictional authorities and the Engineer.

3.06 BACKFLOW PREVENTION DEVICE

A. Connect backflow prevention device to water supply line in approximate location shown on Contract Drawings.

B. Arrange and pay for tests and certificates required by jurisdictional authorities.

3.07 PIPE

A. General:
   1. Install pipe under existing paving by jacking or boring.
   2. Do not use pipe joint compound on sprinkler bases or remote control valves.
   3. Cap open pipe ends as pipe line is assembled to keep out soil or debris. Remove caps only when necessary to continue assembly.
   4. Sleeve pipe under paving. Where pipes or control wires pass through sleeves, provide removable non-decaying plug at ends of sleeves to keep soil out.
   5. Pipe wrapping: Wrap galvanized pipe and fittings in contact with soil and to 3 inches above soil line. Overlap tape 1/2 its width.
   6. Provide check valve where required to prevent erosion from low head drainage.
B. Solvent-weld PVC:

1. Install plastic pipe as recommended by manufacturer, including accommodating expansion and contraction.

2. Install PVC pipe in trench with manufacturer's markings facing up.

3. Cut pipe ends square and remove burrs. Pipe and fitting shall be free of dirt, dust and moisture.

4. Dry-insert pipe into fitting to check fit. Pipe should enter fitting 1/3 to 2/3 depth of socket.

5. Apply primer to socket and pipe end. Apply heavy coat of cement to pipe end. Apply light coat of cement to inside of socket and second coat to pipe end.

6. Insert pipe into fitting and turn 1/4 turn until pipe seats to the bottom of the socket. Check alignment of pipe and fitting.

7. Hold joint still for 30 seconds and remove excess cement.

8. Cure joint minimum 30 minutes before handling and 6 hours before filling with water.

C. Threaded joints:

1. Field threading of plastic pipe or fittings is not permitted. Use factory-made threads only.

2. Use factory-made metal nipples wherever possible. Field cut threads in metal pipe may be used only where approved by the Engineer. Cut threads accurately on axis with sharp dies.

3. Apply pipe joint compound to male threads and first 3 female threads.

4. On metal to metal joints, no more than 3 full threads shall show when joint is complete.

5. When assembling threaded plastic fittings, tighten joint no more than one (1) full turn beyond hand tight. Use strap type friction wrench only; do not use metal-jawed wrench.

3.08 VALVES

A. General:

1. After pipe and risers are in place and connected and before installation of valves, flush out system with a full head of water. Lines shall be free of soil or debris.

2. Locate and install as shown. Obtain Engineer’s approval of location of valves and alignment of boxes.
B. Valve Box Installation, General:

1. Install boxes 18 inches from walk or header and 12 inches apart. Short side of rectangular boxes shall be parallel to walk or header. Install boxes 2 inches above finish grade in groundcover areas; flush in lawn areas.

2. Install common bricks as shown and as required to keep box stable. Place 3/4 inch drain rock inside box for drainage as shown.

3. No soil or accumulated water is permitted in valve boxes. Install PVC tape over box side cutouts.

C. Remote Control Valve:

1. Install where shown on Contract Drawings; group boxes together and install in groundcover areas wherever possible.

2. Install separate box for each valve.

3. Provide a separate riser and connection to mainline for each remote control valve shall have. Do not manifold valves to a single riser from mainline unless shown on the Contract Drawings.

4. Number valves in sequence shown on the Contract Drawings.

5. Label each valve with controller and station number on 2-1/4 inches by 2-3/4 inches polyurethane tag attached to control wire.

D. Quick coupling valve: Set valve perpendicular to finish grade, unless otherwise shown.

3.09 SPRINKLERS

A. Thoroughly flush lines before installing sprinkler heads.

B. Locate and install heads, risers and fittings as shown. Notify the Engineer and adjust layout and provide additional heads, as required, where field conditions or obstructions prevent adequate coverage.

C. Set heads perpendicular to finish grade, unless otherwise shown.

D. Adjust sprinkler heads for proper distribution and trim, providing complete coverage with minimal overspray.

3.10 CONTROLLER

A. Refer to the Sections of Division 16, Electrical, for specifications for power to the controller.
B. Install in approximate location shown on the Contract Drawings. Obtain Engineer's acceptance of exact location. Connect to disconnect switch.

C. Mount enclosure as shown.

D. Connect control wires to controller according to valve numbers shown, in sequence shown on the Contract Drawings. Label each control wire with permanent label showing station number of valve controlled.

E. Rain sensor: Mount in location accepted by the Engineer, as shown on approved shop drawings. Connect according to manufacturer's instructions and wiring diagrams.

F. Control wire:
   1. Run lines along mains wherever possible. Provide separate conduit for wires under paving. Tie wires in bundles with 1-inch wide electrical tape at 10-foot intervals and allow slack for contraction between strapping. Tape is not required in sleeves.
   2. Loop three (3) feet of extra control and ground wires in 1-inch diameter coil, at each valve, at 100 foot intervals along wire runs, and at changes of direction.
   3. Splicing is not permitted.
   4. Install spare control wire of different color for each controller along entire main line.

G. Programming: Perform programming throughout construction and maintenance period. Provide optimum amounts of water for each plant type to maintain plants in vigorous healthy condition. Reprogram as required at end of maintenance period.

3.11 TESTING PIPE

A. Center-load pipe with approved backfill to anchor pipe before testing. Do not cover fittings.

B. Before testing, bleed air out of lines at line pressure. Provide vertical pipe at high points during installation.

C. Do not cover or enclose work until tests are approved by the Engineer.

D. Solvent weld pipe: Test hydrostatically after joints have cured at least 24 hours. Provide caps, pumps, pressure gauges and other equipment required to perform test.
   1. Test pressure mainline at 150 psi for 4 hours and prove watertight.
   2. Cap sprinkler risers and test lateral lines at line pressure. Review system for leaks.
E. Repair leaks and repeat tests until system is proven watertight.

F. Remake faulty joints with new materials. Do not use cement or caulking to seal leaks. Perform repairs in conformance with the Contract Documents.

### 3.12 DRIP SYSTEM POST-INSTALLATION CHECK

A. Immediately after installation, flush lateral line piping by removing the last emitter from each line.

B. Clean filter screens. Open filter flush valve for at least 10 seconds. Clean or replace clogged elements.

C. Operation check: While system is operating, check pressure gauge downstream from filter. Pressure shall be minimum 80 percent of supply pressure and minimum 10 percent above the setting of the pressure regulator.

D. Clean or replace filter element as required to obtain specified pressure

E. Adjust pressure regulator to system design pressure.

F. Verify that emitters are producing specified water output. If not, replace emitters, check filter element, check pressure at emitters, and review system for clogs and leaks. Correct deficiencies.

### 3.13 FIELD QUALITY CONTROL

A. Progress observations: In addition to the observations specified below, the Engineer will make periodic progress observations.

B. Notify the Engineer in advance of the following observation meetings, as indicated:

1. Field layout: 3 days
2. Pressure supply line installation and testing: 48 hours
3. Controller installation: 48 hours
4. Coverage test: 48 hours
5. Maintenance period observations: 7 days
6. Final observation: 7 days

### 3.14 SYSTEM ADJUSTMENT

A. Flush and adjust sprinkler heads for optimum performance. Prevent overspray onto walks, roadways, paving and buildings. Adjust nozzle sizes and degree of arc, and install pressure compensating screens, as required to cover planting areas without overspray. Adjust valve flow controls.
B. Test and adjust entire system at completion of each phase or section of work.

C. Perform coverage test in the presence of the Engineer to establish that coverage of all planting areas is complete and adequate. Correct deficiencies and repeat test until approved by the Engineer.

3.15 ACCEPTANCE

A. Obtain Engineer’s acceptance of irrigation system after irrigation work is complete and after acceptance of planting work as specified in Section 02900, Planting.

B. Operate system during observation by the Engineer.

3.16 OPERATION INSTRUCTION

A. Refer to Section 01730, Operations and Maintenance Manuals. Provide six (6) hours instruction in operation and maintenance of system to Owner’s maintenance personnel, after completion and acceptance of irrigation system by the Engineer. Provide instruction by manufacturer’s representative where Contractor is not expert in operation of equipment.

END OF SECTION