Zone 2 Water Reservoir - Final Design Report

prepared for

Irvine Ranch Water District
Irvine, CA
&
Kennedy/Jenks Consultants
Irvine, CA

by

Beaver Away Inc. [Team # W2], Irvine CA.

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Specifically, Beaver Away Inc, would like to thank the help and assistance that was received from Bruce Thomas, P.E., Raymond Lyons, P.E., and Stephen Esaki at Kennedy/Jenks client consultants.
Executive Summary

The report that is being presented to the Irvine Ranch Water District (IRWD) summarizes a final design report for the construction of a 1 million gallon (1 MG) potable reservoir tank for the IRWD under the close supervision of Ray Lyons and Bruce Thomas from the Kennedy/Jenks Consulting firm. The site is located in Zone 2 of Irvine, California off of the 241 toll road and Portola Parkway.

Our main objective in this report is to design a potable water reservoir that will help satisfy the water demands in this area. In addition to the reservoir, we were tasked with creating a 15 ft wide access road that is not in plain view of the public and will accommodate large maintenance trucks and construction vehicles. This road will lead directly to the reservoir. The key tasks of this project include: site location, grading, road layout, piping, drainage, valve vault, cost estimate, specifications and scheduling.

This final design report is an improvement and refining of the preliminary design report which was submitted in March of 2009. The first task we accomplished was the refining of the access road. Because the original was deemed functional and practical in the preliminary report, the tasks that needed to be completed to finish the road were CAD drawing details including curve dimensions, pipe specifications, and drainage areas.

The next task that was completed was the design of the valve vault. Preliminary dimensions and material design were refined and enlarged to accommodate the necessary valves for both the storm drain pipe and the inlet/outlet pressure pipe. CAD drawings were designed in both the plan and profile view and enhanced to 100% design.

The cost estimate also had to be adjusted. In the preliminary design, the cost estimate did not accurately reflect the true cost of the project. The original estimate was very low. Now, it is an accurate estimate of 2.56 Million dollars which includes a more modest 10% contingency and the contractor’s 15% overhead and profit. 8.75% sales tax was applied to all materials needed and a 5% mobilization/demobilization was also added. A detailed report of the entire cost estimate broken down into each category (pressure pipe, storm drain, tank, valve vault, road, and miscellaneous costs) can be viewed in the appendix.

The original construction schedule estimated the reservoir needed approximately four months to be completed. This time frame was updated and refined to yield a more accurate time frame of ten months. Each individual task has a time estimate and many of these depend upon the road placement, so that will be a priority. The project, if all goes according to plan, will begin in June of 2009 and will end in April of 2010.

The final task to be completed for the final design of the reservoir project is the comprehensive compilation of design specifications for each element in the water reservoir. There are specifications for piping, concrete structures, roads, etc. These are essential to all design projects and this one is no different. They specify exactly what is necessary for each element and dictate limitations, requirements, and procedures needed to actually build each piece in the project.
There are hundreds of pages of specifications, and special care was taken to compile a unique list of what is needed out of these pages specifically for this reservoir project. This set of specifications can be viewed in a separate section after the appendix of the report.

This FDR includes a 100% design drawing set in the appendix which details each element in the reservoir project. The team of Beaver Away is eager to take on this project and will work diligently until the reservoir is completed.
1. Introduction

Purpose of Report

Beaver Away Inc has been assigned by the Irvine Ranch Water District (IRWD) to complete a final design report (FDR) for the Zone 2 Reservoir construction project. The provided FDR will present the feasibility of the planning project, and will be the primary opportunity for the IRWD to understand the proposed design, estimated cost and construction time for the reservoir.

Restrictions to the Zone 2 site are also going to be presented with respect to environmental concerns and local requirements. In the final section of the report, a cost estimate will be given based on costs of previous projects, and data coming from the construction industry. The FDR presented is based on the preliminary design report (PDR) which was submitted to the IRWD on March 19, 2009. The FDR specifications will address issues of alternatives, constraints and calculations. These are to include but not be limited to:

- Calculations of piping layout, access road, valve locations and tank placement
- Grading and earthwork design for construction activities and final design
- Review of water quality and the necessary precautions taken in the tank design for this factor
- Review and recommend scheduled maintenance issues
- Recommend landscaping and visual components of the site
- Identify environmental concerns and permitting needed for construction
- Review impact to the nearby community
- Prepare an estimate of construction costs
- Prepare a final construction schedule

Project Background

The IRWD has investigated the water demands of a new development, and has concluded that a 1 million gallon circular pre-stressed concrete tank will be sufficient in the Zone 2 area. This alternative was selected for several reasons which includes, but is not limited to:

- Tanks are high strength and high quality
- The low initial and maintenance cost of a concrete tank
- The District maintains several pre-stressed tanks and is comfortable with the maintenance of the tank
- Tanks hold a watertight seal
- Tanks have an acceptable life cycle
- Concrete Tanks provide for an acceptable aesthetic appearance

In January of 2009, Beaver Away Inc was contacted by the IRWD to prepare a preliminary design report for the project. Working closely with the community, it was determined that for visual aesthetics a one MG tank would be partially buried. The tank project will require an
access road connecting the structure to the service road and pipeline near the base of the hill in Zone 2.

The tank structure will be designed by a subcontractor once the project is bid based on Beaver Away Inc’s specifications plans. Beaver Away Inc is designing the tank placement size, pipe network and respective roadway access. The base of the tank has been evaluated by a geotechnical engineer, and Beaver Away Inc will utilize this information in their design.

Objectives of Project

Beaver Away Inc has set out to design a water reservoir system that remains in compliance with district specifications and suffices the needs of the Zone 2 community. The proposed water reservoir will be a gravity controlled system that takes groundwater supplied by the IRWD and assists in distributing it to the region. The water reservoir is going to provide an extra one million gallons of potable water to the local area, and allow for future development in the general vicinity.

The inflow to the Water Reservoir will be designed for 1,000 gpm, which is the proposed pump station design that supplies the water to the structure. The reservoir will also allow for a peak outflow of 3,500 gpm which is the peak demand established in the Zone 2 requirements. Lastly, the project will be able to handle a fire flow condition outflow of 6,000 gpm to meet uniform fire flow requirements.

Project Team

The associates of Beaver Away Inc are comprised of four individuals that specialize in water system design. The preliminary design report was prepared under the direction of project managers Brandon Vargo and Danielle Morris, both of whom represent Beaver Away Inc. For the final design report AutoCAD specialists and design engineers Terrence Salonga and Alex Welsh took on the task of project management to lead Beaver Away Inc. to project completion. Individual aspects of project design have been noted accordingly in each section of the FDR.

Project Description

The project presented to Beaver Away Inc includes, but is not necessarily limited to:

- Construction of a one million gallon partially buried pre-stressed concrete tank
- Construction of the pipeline required to provide the inflow and outflow to the tank
- Design and construction of overflow and drain lines into a nearby storm channel
- Construction grading and final grading of the Zone 2 area to provide the necessary slopes for tank placement
- Construction of an access road that allows for the maintenance of the water reservoir
- Design of a berm that limits any negative aesthetics
- Consideration to draining facilities and landscaping on the final site
- Installation of gates and fencing for security purposes
2. Existing Site Constraints

Site Boundaries and Description

(Morris, D.)

The existing site as is, is mostly natural vegetation, in addition to avocado groves in the immediate vicinity. The site is located between the 241 Toll Road and Portola Parkway with housing directly beyond the south end of the property. Because of this, efforts in the form of a 10 foot berm will be made to shield the tank from the publics’ view. There is a small hill towards the north east section of the property where the tank will actually be placed. In addition, an access road will be placed through the northern section of the property that will lead to the reservoir.

The elevations throughout the site vary from being steeper at the west end of the hill and at the site where the tank will be placed. There are also areas that are also almost flat. Grading will be conducted to properly level the tank site and the line where the road will be placed.
3. Tank Design

Structural Design Criteria

There were predetermined requirements for the tank before the design began based off of existing conditions from the existing pump and population demands. The maximum inflow from the connecting pump is 1,000 gallons per minute (gpm), and the maximum peak hour outflow is 3,500 gpm. During fire conditions, the maximum outflow will increase to 6,000 gpm therefore increasing the necessary size of the pipe. With too much increase, however, the velocity of the water within the pipe will decrease enabling the water to become stagnant (it should not fall below two feet per second (fps)). Therefore, the sizing of the pipes must take everything into consideration to find the best combination. The optimum velocity was found to be between three and four fps with the maximum velocity not to exceed five fps, excluding fire flow conditions when this restriction will be relaxed to eight fps.

Predetermined heights for the low and high water levels were given to be 620 ft and 650 ft respectively, allowing the calculations to be made to determine the diameter, and therefore the dimensions of the reservoir tank itself. Additional requirements, such as the height of the freeboard and the overflow drain were given at the initial design phase. Please reference the appendix for more information regarding these calculations.

Specific requirements for the grading and site access were also provided by the IRWD.

Geotechnical Investigation

The geotechnical investigation of the site soil and composition has already been completed and the project has been given the green light to begin construction.

Structural Design

The tank will be thirty-five feet tall with a seventy-six foot diameter. The thirty-five foot height was chosen to allow sufficient room for the overflow drain, freeboard space and space enough for maintenance personnel to maneuver comfortably. It will be circular and made of pre-stressed concrete and be partially buried. There will be a connecting inlet/outlet pipe with an additional drain pipe that will have two connections to the tank itself. One will be at the top at the overflow drain, and one will be at the bottom that will allow the tank to be drained within two days time. The inlet/outlet pipe will have a connection to an existing pipe which will be its source.

Storage Capacity and Dimensional Parameters

The tank will be a one million gallon (1MG) potable water reservoir. As stated above, it will be thirty-five feet tall and seventy-six feet in diameter. More details on the parameters are stated in section six.
Tank Alternative Locations

(Morris, D.)

There was one alternative location for the tank location. It was located at the top of the hill in the lower west side of the property. This location was changed to the one it is in now because of issues with grading. It was determined that it would be overly intensive and unnecessary in the old location compared to the location it is in now.
4. Site Improvements And Design Considerations

Site Access

For construction purposes, the proposed site of the reservoir will be accessed by a preliminarily-designed road. Once the construction on the reservoir is complete, a final access road will be paved using the construction road’s horizontal alignment. The access road will allow for maintenance and operation of the reservoir. The road will be paved with 4-inches of asphalt concrete pavement over 6-inches of base material, covering the road’s 15-feet width and about 1,204.72-feet length. It will begin at an existing dirt road at about 516 feet above mean sea level and end at a point 630 feet above mean sea level. The road will be designed to fulfill grade requirements of 10-15% grade for no more than 150 feet while at the same time matching the existing elevations of the hillside. The proposed road will alternate between a 9% grade and a 15% grade for the first 800 feet, and will then alternate between a 1% and 4-5% grade. The roads will also serve as the cover for the 18-inch ductile iron (DI or DIP) inlet/outlet piping and 18-inch polyvinyl chloride (PVC) storm drain piping.

Site Grading

Grading is required for the access road and the reservoir pad. Grading on this site will primarily employ a cut-and-fill approach for the access road which may require needed or excess soil to be either hauled onto the site or off the site. For the reservoir pad grading, a cut-only approach will be utilized in order to avoid compaction and a possibly weak soil foundation. The cut slopes will not be steeper than 1.5 H: 1.0 V, and fill slopes will not be steeper than 2.0 H: 1.0V. The reservoir pad will require a construction and final grading as the reservoir itself will be partially buried. The construction grading will cut the existing soil on the pad site to a level 620 feet in order to prepare for the partial bury. The final grading will consist of a low point of 630 feet, and a berm that will cover slightly less than 180 degrees of the pad (from the northern side extending counterclockwise to the south). The pad will include a 12 foot buffer in order to allow for access for regular maintenance. The site for the pad itself will slope slightly downwards for drainage purposes, which will be covered in the following section on site drainage.

Site Drainage

The pad site and the access road will be paved with asphalt concrete pavement, allowing for a primarily impervious area for precipitation to accumulate into runoff. The reservoir pad will be slightly sloped in order to allow runoff to accumulate in the v-ditch that encircles the reservoir pad. The v-ditches will lead the runoff into the catch basins on the reservoir pad. The pertinent area for drainage in this region includes the reservoir-facing half of the top of the berm. The size of the catch basin is yet to be determined.

The access road will slope from centerline to edges with a 2% grade. Alongside the access road, two v-ditches will catch and handle the calculated maximum runoff of 2.36 cfs (1.42 cfs per v-ditch). Two local depressions will be placed at the lower end of the v-ditches, one on either side, to allow the runoff to accumulate and drain into their respective catch basins. These catch basins
will introduce the storm water into the 18-inch PVC storm drain pipe located beneath the access road. Riprap will be necessary to dissipate the velocity of the storm water prior to reaching the catch basins.

The storm drain piping itself will be, as mentioned earlier, an 18-inch PVC pipe, sized for maintenance purposes. Although the storm drain pipe follows the access road, the pipe will extend further past the lower end of the road in order to allow for proper discharging of storm water at the low point in the area. Riprap will be placed at this end of the pipe in order to dissipate velocity.
5. Water Quality

Flow Modeling (Salonga, T.)

Flow is based on an 18-inch ductile iron pipe for the inlet/outlet piping and an 18-inch polyvinyl chloride (PVC) pipe for the storm drainage piping. For flow calculations reference the appendix.
6. Tank Layout

Yard Piping

There will be one pipe to fill and empty the reservoir. This line will be constructed using 18” inside diameter ductile iron pipe. The ductile iron was specified by the client for its strength and other desirable mechanical properties. Since ductile iron is about 4 times stronger than PVC for hydrostatic burst pressure capacity, the client is moving in a direction of safety, service and reliability. The size of 18” takes into account the velocity, flow, and fire flow constraints of this project. This line will leave the one MG tank from the southeast and will be directed to the valve vault which is located just a few feet away from the tank. This line will then follow the access road with at least three feet of cover to the surface of the road. Appropriate bedding for the pipe will be provided to ensure the structural integrity of the piping infrastructure. This line will tie into the existing main line using an altitude valve.

There will be another line which will be used to drain the reservoir for maintenance and service. This line will be constructed of 18” DIP pipe to satisfy the regulations for minimum tank evacuation time. This line will travel from the center of the tank and will travel towards the valve vault but will not enter the vault. The valve that will control this flow will be buried and will require a special tool to open and close. The drain line will travel alongside the vault and will connect to a catch basin. This catch basin will connect the drain line with the runoff from the v-ditch gutter which surrounds the outside perimeter of the access road. This network of storm drain and tank drain lines will provide efficient transportation of water from the site in the most cost effective manner.

Both the inlet/outlet and the drain line will follow underneath the access road. These two lines will be separated by at least 10’ at all times to meet the health code requirements. The purpose of this regulation is to provide a large enough distance so that water quality will not be compromised in the event of a pipe failure. Each pipe line will require at least 3’ and proper bedding material to ensure the reliability and service of the lines. The installation of the two lines will be done separately, requiring two separate excavations. Backfill and compaction will be required on each line, and a relative compaction of 95% is expected. Manholes will be placed at the beginning of curves for maintenance and service.

On-Site Water Supply

The on-site water supply will come from the existing line which runs a few hundred feet away from the site of the tank. This is the most efficient way to provide water to the site since this connection will eventually be needed in order to connect the reservoir. By taking care of this installation early, the project will be completed in a more efficient manner than spending the time and resources to make water trucks travel from offsite to fill up. The water trucks will be able to fill up on site to control dust during grading and excavation. Once the project nears completion this line will be connected to the tank inlet/outlet line and will conclude that phase of the project.
Site Security (Welsh, A.)

The goal with security is to build the site in such a way that limits the tank’s vulnerability. There will be a ten foot tall chain link fence surrounding the tank with a twelve foot wide double gate at the entrance. All piping will be underground and will require special keys and tools to open. The valve vault will house the most crucial aspect of the tank, the inlet/outlet valves. This vault will have a manhole and hatch with locks to prevent unwanted access. Finally, there will be a cage surrounding the overflow pipe gap to ensure safety.
7. Valve Vault

Valve Vault and Metering Facilities

The valve vault will be placed in the Southeast side of the tank 68 degrees from the north. It will be offset from the tank 5’. The dimensions of the vault will be 8’ high by 12’ wide by 21’ long (inside dimensions). The walls of the vault will all be one foot thick and the vault will either be built by the contractor or specified pre-cast. The bottom elevation of the pipe will be 618’, slightly lower than the bottom elevation of the tank to account for the inlet/outlet piping which will come from underneath the tank. An aggregate base foundation will be provided with up to 1’ of ½” crushed rock. This will provide the support for the vault to ensure it will maintain its position. The vault will be completely under backfill, but a hatch and a manhole will be installed to provide access. There will be a sump which will empty any water into the ground below. A ladder will be installed in order to provide easy entrance and exit through the manhole.

The Equipment used in the vault will ensure that the flow of the inlet/outlet pipeline is safe and reliable. There will be a check valve to make sure water traveling into the tank does not flow through the outlet portion of the tank. There will be two butterfly valves which will be placed around the one altitude valve to provide the necessary stops to flow if maintenance is required. The altitude valve will control flow into the reservoir by measuring pressure on the other side, able to detect water elevation. This allows for a precise calculation of water storage to ensure that inlet flow is occurring only when necessary. There will be reducers on either side of the altitude valve to reduce the pipe from 18” to 12” so that a 12” altitude valve can be used. This reduction in size will reduce cost without negatively affecting performance. Dismantling joints will be installed throughout the vault to assist installation of the overall piping system. There will also be 4 pipe supports which will hold the pipe system in place for any thrust or seismic event.
8. Community Impacts

Environmental Impact Research

Beaver Away Inc has incorporated all aspects of environmental concerns into their design of the Zone 2 water reservoir. An environmental impact report has been completed by an independent consulting firm, and was provided to Beaver Away Inc at initiation of the project. The surrounding area will receive minimal environmental effect from the water reservoir structure and the CEQA has resultanty been approved by the Irvine Ranch Water District.

Construction Activities

Upon the approval of the final AutoCAD drawings, the project will go out to bidding procedures for Public Works. The lowest responsible bidder will be approved by the IRWD at a Board Meeting, and construction activities will commence immediately. A tentative date has been set for the reservoir construction beginning on June 15, 2009. A schedule of construction activities can be reviewed in section ten of the FDR. The proposed length of the project is expected to take approximately nine to ten months.

The construction grading and final earthwork design will have separate grading plans specific to its activities and each can referenced in the appendix. Overall, construction activities will be coordinated to maximize efficiency and minimize cost at the expense of the IRWD.

Lastly, throughout the duration of the project Beaver Away Inc. has taken initiative to utilize “Best Management Practices” (BMP’s). These practices are those that limit the cost of construction to the community. There will be constant control of dust management, the proper disposal of waste products, utilizing a storm water pollution plan and AQMD pollution control.

Visual Impacts

Visual impacts of the intended project have been taken into account on multiple levels of the design. A reason in the IRWD’s decision to select a concrete water reservoir is in response to limit visual eyesores. The tank will be painted to reduce visibility, and the concrete structure will be able to resist corrosion and rusting unlike its steel counterpart. The concrete tank also typically blends in with the surrounding land.

Another step that has been taken to limit visual stress that the community may observe was in the design of the access road. The road has been placed in a position that is generally out of sight from the nearby community, and isn’t in distinctive view of the nearby freeway. Landscaping will be recommended in the final design of the project, and all views of the tank will be kept to a minimum.

A final consideration to visual impacts will be addressed with a 10 foot berm surrounding the concrete structure. The berm will block the tank from view of the community, and respective residents of Irvine. This aspect of design is in conjunction with partially burying the tank, and
removing it from the typical line of sight. Any issue of visibility will be further enhanced with landscaping of the site and berm upon completion.

**Community Outreach**

Beaver Away Inc. has worked closely with the IRWD to abide by all specifications set forth in its design criteria and meets all standards of community involvement. The local community has been contacted regarding the construction, and its input was included in the design process. The visual impacts to the community have been minimized and many factors have been considered in creating a construction schedule. These factors are discussed in the following paragraph.

Construction will only occur during designated times as to not disturb the local residents. In most circumstances, the hours of construction will be Monday-Friday 7AM - 4PM. There will be no weekend work without permission from the IRWD. Furthermore, all waste will be properly disposed of both during and after construction. Beaver Away Inc. will work with the contractor, IRWD construction staff and public relations to minimize construction disturbances and complaints. Restrictions are primarily based on those set forth on required permits and existing regulations for noise, dust and other issues.
9. Permitting

There are various tasks, permits, and notices needed to properly complete the Zone 2 water reservoir listed below. Because this is a project that involves significant grading and altering of land, significant land alteration and storm water drainage, there will be multiple permits and tasks that need to be obtained and completed.

**Regional Water Quality Control Board NPDES Permit** - This permit allows for the discharge of groundwater at the construction site as well as construction water discharge. Pressure testing and disinfection of pipe and reservoir is needed after construction is completed. If there is any possibility that groundwater will runoff the site, then this permit is needed.

**Construction General Permit Notice of Intent (NOI)** - If storm water has a possibility of running off construction site this permit is needed. This is very similar to the permit above, but this is specifically for the construction portion of the project.

**Construction Phase Storm Water Pollution Prevention Plan (SWPPP)** - This is an implementation plan by the contractor that protects the storm water from pollution. The contractor promises to perform best management practices (BMPs) that will help protect the water from being contaminated.

**Water Quality Management Plan (WQMP)** - This involves proper management to protect storm water by the owner. This is a plan that is submitted to the Irvine Ranch Water District that is signed off and approved that binds the owner to certain practices that protect the water. This is covered by the plan above.

**City Irvine Encroachment Permit** - This is needed only if the public right of way will be hindered during the construction of the reservoir. If the right of way is not obstructed, then it is not needed.

**City of Irvine Transportation Permit** - This is needed when transporting oversized loads to a specific site. The reservoir contains many large components that render this permit necessary.

**Department of Public Health review** - This protects the potable water pipes from the storm water pipes and possible contamination if the storm pipe ever fails. There is a required 10 foot distance between the piping, unless prior approval is obtained. The reservoir system will be added to the Irvine Ranch Water District’s permit once the plans are approved with the proper distances applied. This is required for pipes less than ten ft diameters.

**CEQA** - The CEQA checklist is an environmental checklist that assesses a project’s impact on the environment. It asks pertinent questions such as if the project will violate any clean water act or if it substantially affects groundwater runoff in the area. This aspect has been previously completed, and Beaver Away Inc was required to follow the guidelines, restrictions, and mitigation efforts.
10. Construction Cost Estimate And Schedule

Estimate of Construction Cost

(Morris, D.)

The following section displays a detailed cost estimate report for the reservoir project. The total estimated cost of the project is 2.56 million dollars.

The reservoir itself, being pre-stressed concrete has an aggregate cost of $900,000 which does not include tax.

The first addition is a 5% mobilization/demobilization to accommodate the cost of the mobilization and demobilization of the construction site and equipment. The second addition is the 15% contractor fee, which covers the profit that will be made by the contractor. The third addition will be the required 8.75% California sales tax. Finally, the last addition will be the 10% contingency that will accommodate any unforeseen complications that could happen during the course of construction of the reservoir.

A breakdown of the costs per element of the project is displayed in Figure 1 below:

![Figure 1: Cost Estimate Breakdown](image)

Tables 1 through 6 on the following pages show a detailed cost estimate report for the reservoir project. Furthermore, Table 7 on the following page displays a total estimated cost of the project at approximately 2.56 million dollars. Reference the appendix for a complete cost breakdown of each section of the project.
### Table 1: Road Final Cost Estimate

<table>
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<td>250.00</td>
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Nominal Subtotal $129,710.65 $101,368.84
Plus 5% Mobilization $136,196.19 $106,437.28
Plus 15% Contractor OH And Profit $156,625.61 $122,402.87

### Table 2: Press Pipe Final Cost Estimate

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<th>Item</th>
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<th>Inst Cost</th>
<th>Quantity</th>
<th>Mat Total</th>
<th>Inst Total</th>
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<tbody>
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<td>Excavate</td>
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<tr>
<td>Shoring</td>
<td>CY</td>
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<td>4.63</td>
<td>1004.16</td>
<td>1486.15</td>
<td>4649.25</td>
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<td>18&quot; Ductile Iron Pipe</td>
<td>LF</td>
<td>57.50</td>
<td>31.25</td>
<td>1204.75</td>
<td>69273.13</td>
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<td>Bedding</td>
<td>CY</td>
<td>47.30</td>
<td>20.45</td>
<td>254.20</td>
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<td>12.30</td>
<td>19.30</td>
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<td>Flanged 18&quot; Tee</td>
<td>EA</td>
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<td>471.00</td>
<td>1.00</td>
<td>4900.00</td>
<td>471.00</td>
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Nominal Subtotal $95,907.25 $64,856.67
Plus 5% Mobilization $100,702.62 $68,099.50
Plus 15% Contractor OH And Profit $115,808.01 $78,314.43

### Table 3: Storm Drain Final Cost Estimate

<table>
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<th>Item</th>
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<th>Mat Total</th>
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<td>18&quot; PVC Pipe</td>
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<td>6.00</td>
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<td>CY</td>
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<td>20.45</td>
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<td>CY</td>
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<td>19.30</td>
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<td>Manholes</td>
<td>EA</td>
<td>1100.00</td>
<td>434.50</td>
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<td>4'x4' Drop Inlets</td>
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Nominal Subtotal $63,838.00 $60,264.58
Plus 5% Mobilization $67,029.90 $63,277.81
Plus 15% Contractor OH And Profit $77,084.38 $72,769.49
### Table 4: Miscellaneous Final Cost Estimate

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<td>Riprap</td>
<td>TON</td>
<td>40.00</td>
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<td>10.00</td>
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<td>EA</td>
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<td>810.00</td>
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Nominal Subtotal: $105,930.00  $25,018.05
Plus 5% Mobilization: $111,226.50 $26,268.95
Plus 15% Contractor OH And Profit: $127,910.48 $30,209.30

### Table 5: Tank Final Cost Estimate

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<th>Item</th>
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<th>Inst Cost</th>
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<th>Inst Total</th>
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<tr>
<td>Fill</td>
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Nominal Subtotal: $673,792.88  $301,286.62
Plus 5% Mobilization: $707,482.52 $316,350.95
Plus 15% Contractor OH And Profit: $813,604.90 $363,803.60

### Table 6: Valve Vault Final Cost Estimate

<table>
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<th>Item</th>
<th>Unit</th>
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<th>Inst Cost</th>
<th>Quantity</th>
<th>Mat Total</th>
<th>Inst Total</th>
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<tr>
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<td>18'' AirVac Valve</td>
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<td>18'' Butterfly Valve</td>
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<td>280.00</td>
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<td>17925.00</td>
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<td>18'' Check Valve</td>
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Nominal Subtotal: $77,810.50  $17,279.30
Plus 5% Mobilization: $81,701.03 $18,143.27
Plus 15% Contractor OH And Profit: $93,956.18 $20,864.75
Table 7: Total Cost Estimates

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<td>Plus 8.75% Sales tax</td>
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<td>Plus 10% Contingency</td>
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<td>Total Estimate:</td>
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Construction Schedule

The following Gantt Chart seen in Figure 2 on the following page outlines the duration of the construction project for the Zone 2 Water Reservoir. The time table is a final estimate presented by Beaver Away Inc. The start date occurs on June 15, 2009, and an estimated completion date for construction occurs on April 16, 2009. The approximate duration of the project is 10 months.

The following aspects are included in the schedule:

The surveying aspect of the project includes a complete surveying of the site. This includes surveying for the access road, pipelines and tank location. The surveying aspect will also include elevation locations. Surveying will continue throughout the duration of the project, however, preliminary surveying to the site will last 15 days in which no construction will be able to begin until completed.

The preliminary grading will establish rough elevations and slopes for the access road and tank location. This section will not include the final grading of the berm. This step simply establishes access for construction work. It will also allow for materials and equipment to be transferred to the tank site.

Tank construction will commence once the access road is completed. This will include all structural components including construction of the valve vaults.

The storm drain construction and inlet/outlet pipe construction includes, but is not limited the digging of trenches, laying of pipe, and covering of the pipe. These two pipes will be laid simultaneously.

Access road construction will begin once final grading is complete.

Once the tank is complete berm construction will commence and this will include the landscaping of the site. This is also the stage where security features will be added such as lighting and the chain link fence.
Site clean-up will commence simultaneously with implementation of the proposed project. The tank will be filled in these final stages, and all equipment and materials will be demobilized. Final approval will also occur, with an inspection from Beaver Away Inc jointly with the IRWD.

All aspects of the project are tentatively set for completion on April 16, 2010. The work week is only five days long and does not include weekends unless otherwise approved by the IRWD. Figure 2 displays a gantt chart of the project, while Table 8 provides the necessary completion dates.

Figure 2: Gantt Chart of Construction Project

<table>
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<th>Task Name</th>
<th>Duration (Days)</th>
<th>Start Date</th>
<th>End Date</th>
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<td>17-Aug-09</td>
<td>18-Dec-09</td>
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<td>Final Grading</td>
<td>15</td>
<td>21-Dec-09</td>
<td>8-Jan-10</td>
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<td>11-Jan-10</td>
<td>5-Feb-10</td>
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<tr>
<td>Inlet/Outlet Pipe Construction</td>
<td>20</td>
<td>8-Feb-10</td>
<td>5-Mar-10</td>
</tr>
<tr>
<td>Road Construction</td>
<td>15</td>
<td>8-Mar-10</td>
<td>26-Mar-10</td>
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<tr>
<td>Berm Construction</td>
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<td>29-Mar-10</td>
<td>9-April-10</td>
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<td>12-April-10</td>
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<tr>
<td>Implementation</td>
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<td>12-April-10</td>
<td>16-April-10</td>
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Table 8: Estimated completion dates
11. Specification Guides Index

Recommended Specification Divisions (Vargo, B.)

The following specifications seen in Table 9 will be required in the respective divisions throughout the duration of the Zone 2 Reservoir Project:

**Table 9: Specification Guides Index**

<table>
<thead>
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<th>Division 2-Site Work</th>
<th>Division</th>
<th>Specification</th>
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<td>Controlled Low Strength Material</td>
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<td>02080</td>
<td>Precast Concrete Sectional Manholes</td>
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<td>02370</td>
<td>Slope Protection</td>
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<td></td>
<td>02510</td>
<td>Water System Piping and Accessories</td>
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<td>Sewers</td>
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<td>Paving and Surfacing (Short Form)</td>
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<td>02820</td>
<td>Fences and Gates</td>
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<td>Chain Link Mesh Enclosures</td>
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<td>Landscape Planting and Irrigation</td>
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<td>Protective Coatings</td>
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<td>Division 15-Mechanical</td>
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<td>Piping, Valves and Accessories (Use for Storm Drain)</td>
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*Note—Some divisions have been excluded by Beaver Away Inc. at request of management at our client/consultants and IRWD.

For the complete specification please reference the section 16. Each of the specifications has been compiled and edited by Brandon Vargo, using the standards provided by Kennedy/Jenks.
12. References


13. Glossary

*The following Terms and Abbreviations were provided to Beaver Away Inc. from Kennedy/Jenks Consultants*

Alignment Terminology
- **Right-of-Way** (ROW or R/W) – describes the land owned. For a street typically includes the street and some distance beyond on each side.
- **Easement** – area that is owned by someone else but which used by an entity. It can be permanent, i.e. for pipeline or other facility or temporary (i.e. a construction easement).
- **Legal Description** – A document that describes a ROW or easement.

Trench Detail Terminology
- **Cover** – refers to the distance between the top of pipe and the ground line. Typically it is 3-4 feet for water lines and 6-8 feet for sewer lines.
- **Bedding** – refers to the area below the pipe.
- **Pipe Zone** - refers to the area from the bottom of the pipe to typically 12-inches above the pipe.
- **Backfill Zone** – refers to the area from the top of the pipe zone to the bottom of the street zone.
- **Street Zone** – refers to the area above the backfill zone, including the sub-base, base and pavement.

Pipeline Materials
- **Ductile Iron Pipe (DI)** – is pipe used for water, wastewater and recycled water. Typically lined with polyethylene or polyurethane or mortar.
- **Polyvinyl Chloride (PVC)** – is pressure pipe used for water, recycled water or wastewater (AWWA C900) which is thick walled or for wastewater which is thin-walled.
- **Concrete Pipe** - comes in a variety of types and typically used for water pipelines (24” and above) and sewer pipelines (24” and above). For the latter it is typically lined with PVC. Pressure pipe is often concrete cylinder pipe.
- **Steel Pipe** – is typically used for water or recycled water (16” and above). Most often it is lined and coated with mortar.
- **Vitrified Clay Pipe (VCP)** – is only for wastewater and only for non-pressure installations.
- **Asbestos Cement Pipe (ACP)** – seldom used any more but historically used extensively for water pipelines and some sewer pipelines.

Valves/Fittings
- **Gate Valves (AWWA 504)** – used for isolation of system
- **Resilient Wedge Gate Valve** – used for isolation of system. They function like a gate valve and are becoming more popular because of their reliability.
- **Butterfly Valves** – used for isolation of system. They are more expensive than other valves and are used less in the distribution system, but more in transmission systems.
- **Elbows, Tees, and Crosses** – are all fittings at pipe intersections.
**Sewer Terminology**

- **Manhole** – typically entry points to sewers and also at locations where 2 sewers connect.
- **Lateral** – Is the line off the main line to a particular property. They are typically 4” or 6” in diameter.

**Street Zone Materials**

- **Asphaltic Concrete Pavement (AC Pavement)** – typical asphalt pavement
- **Portland Cement Concrete Pavement (PCC Pavement)** – concrete pavement
- **Crushed Aggregate Base (CAB)** – base material under the pavement.
14. Appendix

- G1-Cover Sheet (Salonga, T.)
- P1-Plan & Profile: Storm Outlet to Station 15+40 (Salonga, T.)
- P2-Plan & Profile: Station 15+40 to End (Salonga, T.)
- C1-Rough Grade (Welsh, A.)
- C2-Finish Grade (Welsh, A.)
- C3-Reservoir Plan and Section (Salonga, T.)
- D1-Miscellaneous Details (Salonga, T.)
- D2-Miscellaneous Details (Salonga, T.)
- D3-Miscellaneous Details (Salonga, T.)
- S1-Vault Plan (Welsh, A.)
- S2-Vault Profile A-A (Welsh, A.)
- S3-Vault Profile B-B (Welsh, A.)
- S4-Vault Roof (Welsh, A.)
15. Sample Calculations

Pipe Flow Calculations (Welsh, A.) ................................................................. SC-1
Cut and Fill Calculations (Salonga, T.) ............................................................ SC-3
Rough Grade-Cut Calculations (Welsh, A.) ....................................................... SC-6
Thrust Block Calculations (Welsh, A.) ............................................................ SC-9
## 16. Specifications

(Vargo, B.)

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SECTION 02065
CONTROLLED LOW STRENGTH MATERIAL

PART 1 - GENERAL

1.01 SUMMARY
A. Section Includes: This Section covers the work necessary for backfilling in confined areas around structures, pipelines or trenches, where specified or where access for compaction equipment is limited.
B. Related Sections:
   1. Section 03300: Cast-in-Place Concrete

1.02 REFERENCES
A. American Society for Testing and Materials (ASTM) Standard Specification or Test Method:
   1. ASTM C33 Concrete Aggregates
   2. ASTM C94 Ready-Mixed Concrete
   3. ASTM C143 Slump of Hydraulic-Cement Concrete
   4. ASTM C150 Portland Cement
   5. ASTM C260 Air-Entraining Admixtures for Concrete
   6. ASTM C618 Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
   7. ASTM C685 Concrete Made by Volumetric Batching and Continuous Mixing
   8. ASTM D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
   9. ASTM D4832 Preparation and Testing of Soil-Cement Slurry Test Cylinders
B. American Concrete Institute (ACI):
   1. ACI 229 Controlled Low Strength Materials (CLSM)
   2. ACI 304 Guide for Measuring, Mixing, Transporting and Placing Concrete
C. State of California, Department of Transportation (CALTRANS):
   1. Section 19-3.062 Slurry Cement Backfill
   2. Section 19-3.025 Soil Cement Bedding

1.03 DEFINITIONS
A. Controlled Low Strength Material (CLSM): A mixture of portland cement, fly ash, aggregates and admixtures proportioned to provide a nonsegregating, self-consolidating, free-flowing and hand-excavatable material, which will result in a hardened, dense, nonsettling fill.

1.04 SUBMITTALS
A. Submit in accordance with Section 01300.
B. Product Data:
   1. Concrete mix product certification: Submit certified laboratory test results that the mix proportions and materials comply with these Specifications. Submit certification on cementitious products and aggregates performed within the past 6 months.
      a. Cementitious materials.
      b. Coarse and fine aggregates.
      c. Admixtures.
      d. Water.
C. Quality Assurance/Control Submittals:
   1. Design Data: Submit a mix design for the material to be used.
   2. Test Reports: Submit trial laboratory and testing data with cylinder breaks performed at 7, 14, and 28 days.
1.05 QUALITY ASSURANCE
   A. Certifications:
      2. Mix Designs: By an independent commercial testing laboratory, complying with ASTM C1077 and favorably reviewed by the Engineer. Mix design proportions shall be established on the basis of field experience and trial mixtures with the materials to be employed in accordance with UBC Section 1905.
      3. Mix Test Results.
         a. Submit result statistics of satisfactory mix designs if available from prior projects. Comply with UBC Section 1905.3.
         b. Submit test results of trial batches prepared for this project. Comply with UBC Section 1905.3.
         c. Allow adequate time for review of submittals and adjustments to comply with the Specifications.

PART 2 - PRODUCTS
2.01 MATERIALS
   A. Materials shall conform to the following:
      1. Portland Cement: ASTM C150, Type II or V.
      2. Aggregate: Comply with ASTM C33. Aggregate shall consist of fine aggregate, with or without coarse aggregate, with a minimum size of 1-inch, free of clay, organics, and other deleterious materials. Less than 10 percent by weight shall pass the No. 200 sieve, and material passing the No. 40 sieve shall be nonplastic as determined in accordance with ASTM D4318.
      5. Admixtures: Air entraining; ASTM C260. Air content limited to 6% unless demonstrated to avoid segregation. Provide a liquid admixture such as DaraFill manufactured by W.R. Grace when air contents from 15-35% are required.

2.02 MIXES
   A. Performance Requirements: The CLSM shall be proportioned to be a nonsegregating, free-flowing, self-consolidating, low-shrink slurry.
   B. Mix Design Requirements: The Contractor and its supplier shall determine the materials and proportions used to meet the requirements of the Specifications. The mix design shall be prepared for a range of aggregate gradations that are expected to be used.
   C. Strength: The unconfined compressive strength at 28 days shall be 100 psi (min 50 psi) [50 psi or less excavated manually, 100 to 200 psi excavated with mechanical equipment] as per ASTM D4832.
   D. Flowability: The slump shall be 7 inches (min 1 inch) [low flowability minus 6 inches, high flowability plus 8 inches] as per ASTM C143.
   E. Density: The density shall be between 115-145 lb/ft³ [90 to 100 lb/ft³ with flyash only].
   [F. Minimum Cement Content: For compliance with Caltrans 185 lb/cy (110 kg/m3) for slurry cement backfill, 295 lb/cy (175kg/m3) for soil cement bedding.]

2.03 SOURCE QUALITY CONTROL
   A. Mix, transport, and place CLSM in accordance with the methods and procedures in ACI 304 and ASTM C94.

PART 3 - EXECUTION
3.01 EXAMINATION
A. Site Verification of Conditions: CLSM batching, mixing, and placing may be started if the weather conditions are favorably and when the air temperature is $34\,\text{°F}$ and rising. At the time of placement, the CLSM must have a temperature of at least $40\,\text{°F}$. Mixing and placing shall stop when the air temperature is $38\,\text{°F}$ or less and falling.

B. Subgrade on which CLSM is to be placed shall be free of disturbed or softened materials, debris, and water.

3.02 PREPARATION

A. Protection: Take appropriate precautions to prevent pipe displacement and/or flotation.

3.03 CONSTRUCTION

A. Special Techniques: Contain CLSM in trench sections using bulkheads or fill materials to confine the flow of material.

B. CLSM shall be placed in lifts not exceeding 6 feet in height, with a time interval of not less than 1 hour between lifts.

3.04 FIELD QUALITY CONTROL

A. Field Control Testing: Performed by the Contractor:

1. After completion of the trial mix work, and prior to CLSM placement operations, the Contractor shall prepare field trial mixes. The initial mix shall be based on the design mix. Additional trial mixes may be made by varying the proportions as may be required to produce a dense, homogenous material with good workability.

2. Manufacture of the field trial mixes shall be accomplished utilizing the equipment that will be used on the job.

3. Compressive strength: A set of six standard 6 inch x 12 inch cylinders will be cast for each mix.
   a. Making, storing and initial cure of cylinders: ASTM C94 or C685. Provide site storage and initial cure, 16 hours minimum and 24 hours maximum.
   b. Testing laboratory: Provided by Contractor.
   c. Final cure and tests of cylinders: ASTM D4832. Testing laboratory will transport cylinders from site, cure, test and provide report. Test one specimen at 7 days, one at 14 days, one at 21 days, and two at 28 days. One specimen shall be held as a “spare” and may be used in the event of questionable results from one of the scheduled tests.

B. Site Tests: Performed by the Engineer:

1. Test frequency: Each mix type placed, each day placed.

2. Compressive strength: A set of four standard 6-inch x 12-inch cylinders will be cast for each mix and for 100 cubic yards or fraction thereof.
   a. Making, storing and initial cure of cylinders: ASTM C94 or C685. Provide site storage and initial cure, 16 hours minimum and 24 hours maximum.
   b. Testing laboratory: Provided by Owner.
   c. Final cure and tests of cylinders: ASTM D4832. Testing laboratory will transport cylinders from site, cure, test and provide report. Test one specimen at 7 days, and two at 28 days. One specimen shall be held as a “spare” and may be used in the event of questionable results from one of the scheduled tests.

3. Slump: Test will be performed on each 50 cubic yards or fraction thereof. Test each sample used for strength tests.
b. Results outside the limits indicate possible cause for rejection of concrete. The Engineer shall be the sole judge.

3.05 PROTECTION
A. When backfilling against retaining walls or other below grade structures, protection shall be provided to the wall or structure from the lateral pressures exerted by the material.
B. Protect facilities from bleed water. Make provisions for runoff of bleed water.
C. Provide steel plates to span trenches and prevent traffic contact if necessary. No traffic or construction equipment shall be allowed on CLSM for at least 24 hours after placement, or until the material is hard enough to prevent rutting or damage.

END OF SECTION
SECTION 02080
PRECAST CONCRETE SECTIONAL MANHOLES

PART 1 - GENERAL
1.01 SUMMARY
A. Section Includes:
   1. Precast reinforced concrete cylindrical sectional manholes, complete with
      openings, inserts, ladder rungs (where specifically called for), hardware, drains,
      covers and frames.
   2. Precast reinforced concrete manhole bases and tops.
B. Related Sections:
   1. Section 02083: Precast Concrete Junction Boxes
   2. Section 02085: Precast Concrete Utility Vaults
   3. Section [02301], [02302]: Earthwork
   4. Section 03300: Cast-In-Place Concrete

1.02 REFERENCES
A. American Society for Testing and Materials (ASTM), Standard Specifications:
   1. A36 Structural Steel
   2. A48 Gray Iron Castings
   3. C150 Portland Cement
   4. C478 Precast Reinforced Concrete Manhole Sections
B. American Association of State Highway and Transportation Officials (AASHTO),
   Standard Specifications for Highway Bridges.
   Expansion Joints and Pipe Joints.
   [D. American Iron and Steel Institute (AISI).]
   [E. American National Standards/National Sanitation Foundation International

1.03 SUBMITTALS
A. Submit in accordance with Section 01300.
B. Product Data:
   1. Descriptive details of the manufacturer’s proposed standard products, including:
      a. Precast manhole sections.
      b. Precast roof slab or cone section.
      c. Precast base slab.
      d. Steps, ladder rungs and other hardware.
      e. Minimum concrete 28-day compressive strength.
      f. Cement certification.
      g. Manhole cover and frame.
   2. Shop drawings, including:
      a. Design criteria.
      b. Reinforcing steel location and concrete cover.
      c. Layout of all inserts, attachments and openings.
      d. Location and type of joints.

1.04 QUALITY ASSURANCE
A. Provide products of a manufacturer who has been regularly engaged in the design
   and manufacture of the product.
B. Demonstrate to the satisfaction of the Engineer that the quality is equal to the
   product made by those manufacturers specifically named herein, if an alternate
   product manufacturer is proposed.

PART 2 - PRODUCTS
2.01 DESIGN CRITERIA
Zone 2 Reservoir Specifications

2.02 PRECAST SECTIONS

A. General:
   2. Cement: ASTM C150, Type II, low alkali.
   3. Roof slab opening: Size to support the manhole cover frame.
   4. Lifting eyes: Provide for each section.

B. Manufacturer: Hanson Concrete Products, Inc., Milpitas, CA; Santa Rosa Cast Products Company, Santa Rosa, CA; or equal.

2.03 SEALANT GASKETS

A. Type: Preformed, continuous rope form plastic material, protected by removable two-piece wrapper.

B. Sealing Compound: Reinforced hydrocarbon resins blended with plasticizing compounds and reinforced with inert mineral filler. No solvents, irritating fumes or obnoxious odors.

C. Adhesive and Cohesive Strength: Not dependent on oxidizing, evaporating, or chemical action.


E. Comply with ANSI/NSF 61.

F. Provide: RAM-NEK as manufactured by K. T. Snyder Company, Inc., Houston, TX; QUIKSEAL as supplied by Associated Concrete Products, Santa Ana, CA; or equal.

2.04 FRAMES AND COVERS

A. Material: Cast iron; ASTM A48, Class 30B.

B. Marking: In raised letters, as specified, on manhole cover.

C. Coating: Bituminous paint, black.

D. Size: [24-inch]-diameter cover.

E. Pick Hole: Closed, [side].

F. Vent Holes: Two, 1-inch-diameter.

G. Connection: Bolt down cover into frame with four 1/2-inch-diameter stainless steel bolts, coarse thread, flush with top. Seal with 1/8-inch-thick, 1/2-inch-wide continuous circular neoprene gasket.

H. Seal: Provide continuous 1/4-inch-diameter neoprene “o” ring between frame and cover.

I. Manufacturer: South Bay Foundry, Hayward, CA.; Alhambra Foundry Company Ltd., Alhambra, CA; or equal.

2.05 LADDER RUNGS

A. General: ASTM C478.

B. Material: Copolymer polypropylene plastic molded on steel reinforcing bar [stainless steel, AISI Type 316; ASTM A36, galvanized].

2.06 ACCESSORIES

A. Inlet Grates and Frames:
   1. Material: ASTM A48, Class 30B.
   2. Coating: Bituminous paint, black.
   3. Loading: 300 lb/sq. ft. [AASHTO Loading Class HS20-44]

B. Sump Grates and Frames:
   1. Material: ASTM A48, Class 30B.
   2. Coating: Bituminous paint, black.
3. Loading: 300 lb/sq. ft. [AASHTO Loading Class HS20-44]

2.07 SOURCE QUALITY CONTROL
A. Precast Sections:
   1. Verify concrete compressive strength test results are satisfactory for the sections supplied.
   2. State the curing method. Identify the start and end dates for the sections supplied.
B. Frames and Covers:
   1. Verify cast test bar tensile strengths are satisfactory.

PART 3 - EXECUTION
3.01 INSTALLATION
A. Compact subgrade to 95% relative density for 6-inch minimum depth.
B. Provide a 6-inch gravel layer under the base slab and compact to 95% relative density prior to placement.
D. Apply primer to joint surfaces in accordance with manufacturer's instructions. Make all joints watertight with sealant gaskets.
E. Backfill around the manhole with [Structural Backfill] material. Compact the backfill material to 95% of relative density from the pipe bedding and base slab up to final finish grade, over an area defined as being within a distance of 4 feet from the exterior walls of the manhole.
F. Accurately locate and place the manhole frames to within 1/8-inch vertical elevation in paved areas and to 1/2-inch in other areas. Coordinate the activities of all trades so that this tolerance is achieved.
G. Install the manhole cover in the frame. Machine the cover if necessary to obtain a solid fit, without rattling under load.

3.02 FIELD QUALITY CONTROL
A. Verify all precast sections are continuously sealed with gaskets.
B. Verify all manhole covers fit quietly in the frames.

3.03 TEST FOR MANHOLES
A. Furnish and dispose of water used for testing.
B. Hydraulically test all manholes installed.
C. After all pipe has been laid, backfilling has been completed, and after the testing of the pipes, plug the end of the pipe stubs in each manhole with flexible-joint caps, or acceptable alternate, securely fastened.
D. Fill the manhole with water and measure leakage over a period of not less than one hour.
E. Allowable Leakage: less than one (1) gallon per hour per 10-foot depth of manhole.
F. When leakage from the manhole exceeds the above amount, determine the source or sources of the leakage, and repair or replace defective materials and workmanship.
G. The completed pipe and manhole installation shall pass this test before the project can be accepted.

END OF SECTION
SECTION 02085
PRECAST CONCRETE UTILITY VAULTS

PART 1 - GENERAL
1.01 SUMMARY
A. Section Includes:
   1. Precast reinforced concrete box structures for utility service, complete with
      openings, inserts, ladder rungs (where specifically called for), hardware and
      sumps.
   2. Manhole covers and frames.
B. Related Sections:
   1. Section 02080: Precast Concrete Sectional Manholes
   2. Section 02083: Precast Concrete Junction Boxes
   3. Section [02301], [02302]: Earthwork
   4. Section 03300: Cast-In-Place Concrete
   5. Section 05500: Metal Fabrications

1.02 REFERENCES
A. American Society for Testing and Materials (ASTM), Standard Specifications:
   1. A36 Structural Steel
   2. A48 Gray Iron Castings
   3. C150 Portland Cement
   4. C857 Minimum Structural Design Loading for Underground Precast Concrete
      Utility Structures
   5. C858 Underground Precast Concrete Utility Structures
   6. C891 Installation of Underground Precast Concrete Utility Structures
B. American Association of State Highway and Transportation Officials (AASHTO),
   Standard Specifications for Highway Bridges.
   Expansion Joints and Pipe Joints.

1.03 SUBMITTALS
A. Submit in accordance with Section 01300.
B. Product Data:
   1. Descriptive details of the manufacturer’s proposed standard products, including:
      a. Precast tank sections.
      b. Steps, ladder rungs and other hardware.
      c. Minimum concrete 28-day compressive strength.
      d. Cement certification.
      e. Manhole cover and frame.
   2. Shop drawings, including:
      a. Design criteria.
      b. Reinforcing steel location and concrete cover.
      c. Layout of all inserts, attachments and openings.
      d. Location and type of joints.

1.04 QUALITY ASSURANCE
A. Provide products of a manufacturer who has been regularly engaged in the design
   and manufacture of the product.
B. Demonstrate to the satisfaction of the Engineer that the quality is equal to the
   product made by those manufacturers specifically named herein, if an alternate
   product manufacturer is proposed

PART 2 - PRODUCTS
2.01 DESIGN CRITERIA
A. General: ASTM C857, C858, and also:
   2. Backfill material: Backfill
   3. Buoyancy

2.02 PRECAST SECTIONS
A. General:
   2. Roof slab openings: Size to support the manhole cover frame [and hatch covers].
   3. Lifting eyes: Provide for each section.

2.03 SEALANT GASKETS
A. Type: Preformed, continuous rope form plastic material, protected by removable two-piece wrapper.
B. Sealing Compound: Reinforced hydrocarbon resins blended with plasticizing compounds and reinforced with inert mineral filler. No solvents, irritating fumes or obnoxious odors.
C. Adhesive and Cohesive Strength: Not dependent on oxidizing, evaporating, or chemical action.
E. Provide: QUIKSEAL as supplied by Associated Concrete Products, Santa Ana, CA; RAM-NEK as manufactured by K. T. Snyder Company, Inc., Houston, TX; or equal.

2.04 FRAMES AND COVERS
A. Material: Cast iron; ASTM A48, Class 30B.
B. Marking: In raised letters, as specified, on manhole cover.
C. Coating: Bituminous paint, black.
D. Size: [24-inch]-diameter cover.
E. Pick Hole: Closed, [side].

2.05 HATCH FRAMES AND COVERS
A. See Section 05500.

2.06 LADDER RUNGS
A. Material: Copolymer polypropylene plastic molded on steel reinforcing bar
B. Conform to OSHA requirements.

2.07 SOURCE QUALITY CONTROL
A. Precast Sections:
   1. Verify concrete compressive strength test results are satisfactory for the sections supplied.
   2. State the curing method. Identify the start and end dates for the sections supplied.
B. Frames and Covers:
   1. Verify cast test bar tensile strengths are satisfactory.

PART 3 - EXECUTION
3.01 INSTALLATION
A. General: ASTM C891 and also:
   1. Compact subgrade to 95% relative density for 6-inch minimum depth.
   2. Provide a 6-inch gravel layer under the base slab and compact to 95% relative density prior to placement.
   3. Apply primer to joint surfaces in accordance with manufacturer's instructions. Make all joints watertight with sealant gaskets.
4. Backfill around the tank with Backfill material. Compact the backfill material to 95% of relative density from the base up to final finish grade, over an area defined as being within a distance of 4 feet from the exterior walls of the vault.

5. Accurately locate and place the manhole frames to within 1/8-inch vertical elevation in paved areas and to 1/2-inch in other areas. Coordinate the activities of all trades so that this tolerance is achieved.

6. Install the manhole cover in the frame. Machine the cover if necessary to obtain a solid fit, without rattling under load.

3.02 FIELD QUALITY CONTROL
A. Verify all precast sections are continuously sealed with gaskets.
B. Verify all manhole covers fit quietly in the frames

END OF SECTION
PART 1 - GENERAL
1.01 SUMMARY
A. Section Includes:
   1. Site preparation shall consist of all clearing, grubbing, stripping, (demolition),
      and related work necessary to prepare the project site for construction
      operations.
   2. No open burning of debris, lumber, or other scrap will be permitted.
   3. Trees and vegetation to be left standing shall be protected from damage
      incident to site preparation and construction operations by the erection of
      barriers or by such other means as the circumstances require.

PART 2 - PRODUCTS
Not used

PART 3 - EXECUTION
3.01 DEMOLITION
A. Demolish and remove any fences, posts, poles, or other structures from within the
   project site, areas to be cut or areas to receive fill, and pipeline alignments.

3.02 CLEARING
A. Clearing shall consist of the felling, trimming and cutting of trees, and the removal of
downed timber, shrubs, grasses, debris and rubble from Zone 2 Reservoir Project
site which will obstruct or otherwise impede construction operations.

3.03 GRUBBING
A. Grubbing shall consist of the removal and disposal of stumps, roots larger than
   3 inches in diameter, and matted roots from the construction area. This material,
   together with logs and other organic debris, shall be excavated and removed to a
   depth of not less than 18 inches below the original surface level of the ground in
   areas indicated as construction areas under this Contract, such as areas for
   structures, pavement, fills. Depressions made by grubbing shall be filled with
   structural backfill material and compacted to make the surface conform with the
   original adjacent surface of the ground, unless further excavation is required. Grub
   borrow areas to the extent necessary to obtain material free of stumps and roots.

3.04 STRIPPING
A. Strip the upper [2 to 6] inches of soil containing vegetation and root matter from
   all areas to receive fill and from all areas to be excavated.

3.05 DISPOSAL
A. Felled Trees and Downed Timber: Cut up and stockpile where directed by the
   Engineer.
B. Strippings: Stockpile stripped material and use it to restore the site.
C. Dispose of remaining vegetation and debris in accordance with [Section 01140].
SECTION 02302
EARTHWORK [FOR PIPELINES]

PART 1 - GENERAL

1.01 SUMMARY
A. Section Includes: Perform all excavation, shoring, dewatering, backfilling, compaction and grading necessary or required for the construction of the work as covered by these Specifications and indicated on the Drawings. The excavation shall include, without classification, the removal and disposal of all materials of whatever nature encountered, including water and all other obstructions, that would interfere with the proper construction and completion of the required work.

1.02 REFERENCES
B. State of California, Department of Transportation, Standard Specifications (Standard Specifications) [July 1992].
C. State of California, Department of Transportation, Manual of Test (California Test).

1.03 SUBMITTALS
A. Submit in accordance with Section 01300.
B. Submit the following under the Product category.
   1. Sheeting and Shoring Plan: Refer to Paragraph 1.08 below [and Section 01040, paragraph 1.14].
   2. Potholing Report as described in Paragraph 3.02.
   3. Potholing Report as described in Paragraph 3.02.
   4. Samples and Test Results: Furnish, without additional cost to the [Owner], such quantities of import materials as may be required by the Engineer for test purposes. Cooperate with the Engineer and furnish necessary facilities for sampling and testing of all materials and workmanship. Submit test results for import materials. Tests shall be performed within 60 days of the submission. All material furnished and all work performed shall be subject to rigid inspection, and no material shall be delivered to the site until it has been favorably reviewed by the Engineer, or used in the construction work until it has been inspected in the field by the Engineer.

1.04 QUALITY ASSURANCE
A. Source Quality Control: Test import materials proposed for use to demonstrate that the materials conform to the specified requirements. Tests shall be performed by an independent testing laboratory.
B. Field Quality Control:
   1. The IRWD will:
      a. Review and test materials proposed for use.
      b. Inspect foundations, site grading and borrow operations.
      c. Inspect placement and compaction of fill.
      d. Test soils during placement of fill.
   2. Contractor shall excavate holes for in-place soil sampling. Contractor shall be responsible for costs of additional inspection and re-testing resulting from non-compliance.
C. Testing Methods:
   1. Durability Index: Manual of Test, State of California, Department of Transportation.
   3. Laboratory Compaction: ASTM D1557, Method A or C.
   4. In-Place Density: ASTM D1556 or ASTM D2922.
5. Particle Size Analysis of Soils: ASTM D422.
7. Soil Classification: ASTM D2487.
8. In-Place Moisture Content: ASTM D3017.

D. Definition:
1. Relative Compaction: In-place dry density divided by the maximum dry density laboratory compaction expressed as a percentage.

1.05 EXPLOSIVES
A. The use of explosives will not be permitted on this project, unless specifically authorized, in writing, by the Engineer.

1.06 SUBSURFACE INVESTIGATIONS
A. Geotechnical investigations for design purposes for this project were made for the IRWD by Kennedy/Jenks in a report dated 1/14/2009.
B. This report is available for examination by bidders from the IRWD. While the records of data obtained may be considered by the Contractor to be correct, any conclusions or recommendations made in the reports are for information to the Design Engineer and are not a part of the Contract Documents. Copies of the boring [and test pit] logs are in the Appendix of these Specifications and their locations are shown on the Drawings.
C. The bidders may make additional subsurface investigations at the site prior to the bidding of the project. Prior to making any drillings or excavations, the bidder shall secure permission from the IRWD and property owners if on private property.

1.07 REFERENCE SPECIFICATIONS
A. Whenever the words "Standard Specifications" are referred to, the reference is to the State of California, Department of Transportation, Standard Specifications dated July 1992 (or latest edition).

PART 2 - PRODUCTS
2.01 MATERIALS
B. Bedding Materials:
3. Pea Gravel: River run, rounded pea gravel with a maximum dimension no larger than 1/2-inch, and with no more than 10% passing the No. 200 sieve.
   The material shall have a durability index of 40 or higher.
C. Import Backfill: Imported non-expansive soil with liquid limit no greater than 40% and a plasticity index no greater than 15%, free from clods or rocks larger than 2 inches in greatest dimension, and free from organic material.
D. Native Backfill: Native soil prepared as necessary to be free from clods or rocks larger than 2 inches in greatest dimension, and free from organic material.
E. Impervious Material: Clay with a minimum percentage of material passing the No. 200 sieve of 50%. The material shall be free of organics, rocks, or clods greater than 4 inches in diameter.
F. Water: The water used shall be reasonably free of objectionable quantities of silt, oil, organic matter, alkali, salts and other impurities. Water quality must be acceptable to the Engineer.
G. Aggregate Base: Refer to Section 02700.
H. Warning Tape: 3-inch-wide, inert, fade-resistant plastic film resistant to acids, alkalis, and other components likely to be encountered in soil. Tape shall be blue, imprinted with “[CAUTION WATER MAIN BELOW].”

I. Detection Tape: Plastic metallic type consisting of a blue color coded polyethylene or melinex film, a solid core aluminum foil detection layer and other layers as required. The tape shall be resistant to acids, alkalines and other components likely to be encountered in soils. It shall be designed for both conductive and inductive locating procedures. The tape shall be blue, imprinted with “[CAUTION WATER MAIN BELOW].” Terra Tape “D” by Griffolyn Company; Detectatape by Allen Systems; or equal.

PART 3 - EXECUTION

3.01 CONTROL OF WATER

A. All excavations shall be kept free from water and all construction shall be in the dry.
   1. It should be presumed that the presence of groundwater will require dewatering operations. Furnish, install, maintain, and operate all necessary pumping and other equipment for dewatering all excavations. At all times have on the project sufficient pumping equipment for immediate use, including standby pumps for use in case other pumps become inoperable.
   2. Provide a sufficient number of pumps so as to hold the groundwater level at an elevation of not less than 1 foot below the lowest elevation of the pipe.
   3. Dispose of water in such a manner as to cause no injury or nuisance to public or private property, or be a menace to the public health.
   4. The dewatering operation shall be continuous, so that the excavated areas shall be kept free from water during construction, while concrete is setting and achieves full strength, and until backfill has been placed to a sufficient height to anchor the work against possible flotation.
   5. Continue dewatering during backfilling operations such that the groundwater is at least 1 foot below the level of the compaction effort at all times. No compaction of saturated materials will be allowed.
   6. Dewatering devices must be adequately filtered to prevent the removal of fines from the soil.
   7. The Contractor shall be responsible for any damage to the foundations or any other parts of existing structures or of the new work caused by failure of any part of the Contractor’s protective works. After temporary protective works are no longer needed for dewatering purposes, they shall be removed by the Contractor.
   8. If pumping is required on a 24-hour basis, requiring engine drives, then engines shall be equipped in a manner to keep noise to a minimum. [Refer to Section 01140 for noise control requirements.]
   9. Prevent disposal of sediments from the soils to adjacent lands or waterways by employing whatever methods are necessary, including settling basins.

B. The Contractor shall be responsible for furnishing temporary drainage facilities to convey and dispose of surface water falling on or passing over the site.

3.03 GENERAL CONSTRUCTION REQUIREMENTS

A. Site Access: Access to the site will be over public and private roads. Exercise care in the use of such roads and repair at own expense any damage thereto caused by Contractor’s operations. Such repair shall be to the satisfaction of the owner or agency having jurisdiction over the road. Take whatever means are necessary to prevent tracking of mud onto existing roads and shall keep roads free of debris.
B. Traffic Regulation: Provide such flagmen, patrols, pilot cars, drivers, lighted barricades, flares, lights, warning signs, and safety devices as may be required for control of traffic adjacent to all areas of work.  *[A minimum of one lane of traffic shall be kept open at all times on public roads, refer to Section 01550 for Traffic Regulation.]*

C. Barriers: Barriers shall be placed at each end of all excavations and at such places along excavations as may be necessary to warn all pedestrian and vehicular traffic of such excavations. Lights shall also be placed along excavations from sunset each day to sunrise of the next day until such excavation is entirely restored.

D. Access: Free access must be maintained to all fire hydrants, water valves and meters, and private driveways.

E. Open Trench Limitations: The Engineer shall have the authority to limit the amount of trench to be opened or left open at any one time. In public roads, excavation and pipe laying shall be coordinated to the end that a minimum of interference with public traffic will result. In existing streets, no more than 200 feet of trench shall be open at any time on any single heading. An open trench in existing streets shall be defined as any trench which has not been completely backfilled, satisfactorily compacted, and capped with at least 1-inch of temporary paving (cutback). In the remaining areas of the project, no more than 1,000 feet of trench shall be open at any one time on any single heading.

F. Demolition of Pavement: Where trenching or excavation occurs in paved areas, the pavement shall be scored and broken ahead of the trenching or excavation operation. The extent of paving removed shall be limited to the minimum necessary for the excavation.

G. Dust Control: Take proper and efficient steps to control dust.

H. Permits: Refer to General Conditions, Paragraph [5.10].

I. Storage of Materials: Excavated materials unsuitable for backfill shall not be stored on existing streets, and shall be disposed of immediately. Neatly place excavated materials far enough from the excavation to prevent stability problems. Keep the materials shaped so as to cause the least possible interference with drainage or the normal use of adjacent properties, structures or roadways.

J. Temporary Pavement: Place temporary pavement [or first lift of permanent pavement] on trenches in existing streets within 24 hours after the trench has been backfilled. Maintain temporary pavement until permanent pavement is to be placed.

3.04 TRENCH EXCAVATION

A. Excavation for pipe shall be in open cut. The trench shall be as wide as necessary for sheeting and bracing and the proper performance of the work up to the maximum width permitted by the typical cross-sections shown on the Drawings. The sides of the trenches shall be vertical in existing streets. The bottom of the trench shall be constructed to the grades and shapes indicated on the Drawings. Should the Contractor desire to use other equivalent methods, he shall submit his method of construction to the Engineer for favorable review prior to its use.

B. Take care not to overexcavate. Accurately grade the bottom of the trenches to provide uniform bearing and support for each section of the pipe at every point along its entire length, except for the portions of the pipe sections where it is necessary to excavate for bell holes and for the proper sealing of pipe joints, and as hereinafter specified. Dig bell holes and depressions for joints after the trench bottom has been graded, and, in order that the pipe rest on the bedding for as nearly its full length as practicable, bell holes and depressions shall be only of such
length, depth and width as required for properly making the joint. Remove stones as necessary to avoid point bearing.

C. Backfill and compact overexcavations to 95% relative compaction with bedding material. There shall be no additional payment to the Contractor for over-excavations not directed by the Engineer. Remove unsatisfactory material encountered below the grades shown as directed by the Engineer and replace with [bedding material]. Payment for removal and replacement of such unsatisfactory material directed by the Engineer shall be made in accordance with the provisions of the General Conditions.

D. Grade trenches so that they are uniformly sloped between the pipe elevations shown on the Drawings. Comply with the minimum and maximum trench widths shown on the Drawings. Notify the Engineer if the trench width exceeds the maximum allowable width for any reason.

E. Provide ladders for access to the trench by construction and inspection personnel.

3.05 EXCAVATION FOR STRUCTURES

A. All excavation for structures shall be done to the dimensions and levels indicated on the Drawings or specified herein. Excavate to such width outside the lines of the structure to be constructed as may be required for proper working methods, the erection of forms and the protection of the work.

B. Take care to preserve the foundation surfaces [shown on the Drawings] in an undisturbed condition. If the Contractor overexcavates or disturbs the foundation [surfaces shown on the Drawings or specified herein], without written authorization of the Engineer, he shall replace such foundations with concrete fill or other material approved by the Engineer in a manner which will show by test an equal bearing value with the undisturbed foundation material. No additional payment will be made for the added quantity of concrete fill or other material used because of overexcavation.

C. Inspection of Excavation: Notify the Engineer when excavation for the structure is complete. No forms, reinforcing steel, concrete, or precast structure shall be placed until the excavation has been inspected by the Engineer.

D. Where unsatisfactory material is encountered below the grades shown for structural excavations, it shall be removed and replaced with selected material as directed by the Engineer and compacted. Payment for removal and replacement of such unsatisfactory material directed by the Engineer shall be made in accordance with the provisions of the General Conditions

3.06 BACKFILL AND COMPACTION

A. Place bedding and backfill materials true to the lines, grades, and cross-sections indicated on the Drawings and compacted to the degree specified on the Drawings. Place bedding and backfill materials in horizontal lifts not to exceed 6 inches in thickness measured before compaction. The difference in level on either side of a pipe shall not exceed 4 inches.

B. Backfill material shall not be placed over the pipe until after it has been inspected by the Engineer.

C. It shall be incumbent upon the Contractor to protect the pipe from damage during the construction period. It shall be his responsibility to repair broken or damaged pipe [or duct] at no extra cost to the [Owner]. Tamping of backfill over the pipe shall be done with tampers, vibratory rollers and other machines that will not injure or disturb the pipe [or duct]. Carefully place backfill around and over the pipe.

D. Do not allow construction traffic nor highway traffic over the pipe trench until the trench backfill has been brought back even with existing adjacent grade.
E. Add water to the backfill material or dry the material as necessary to obtain the optimum moisture content for the compaction shown on the Drawings or specified. If the Engineer determines that the nature of the ground in which the trench lies precludes compaction of the backfill to the specified density, the backfill shall be compacted to the maximum practicable density. Employ such means as may be necessary to secure a uniform moisture content throughout the material of each layer being compacted. After the material has been moisture conditioned, compact it with compaction equipment approved by the Engineer to achieve specified compaction. The Contractor shall be responsible for obtaining the densities specified. Should he fail, through negligence or otherwise, to compact to specified density, or to backfill and compact to surface grade, thus permitting saturation of the backfill material from rains or from any other source, the faulty material shall be removed and replaced with approved material which shall be compacted to the specified density at optimum moisture content, and no additional payment will be made for doing such work or removal and replacement.

F. Compaction by flooding, ponding or jetting will not be permitted.

G. For all piping or conduits to be placed in any excavated and backfilled area, such as at manholes or for building connections, the structural backfill shall be first compacted to a level at least 3 feet from the top of the piping or conduit elevation and then retrenched to pipe grade.

H. Compact backfill for structures to 95% relative compaction.

3.07 SUPPORT OF EXCAVATIONS

A. Adequately support excavation for trenches and structures to meet all applicable requirements in the current rules, orders and regulations. Excavation shall be adequately shored, braced and sheeted so that the earth will not slide or settle and so that all existing structures and all new pipe and structures will be fully protected from damage. Keep vehicles, equipment and materials far enough from the excavation to prevent instability.

B. Take all necessary measures to protect excavations and adjacent improvements from running, caving, boiling, settling, or sliding soil resulting from the high groundwater table and the nature of the soil excavated.

C. The support for excavation shall remain in place until the pipeline or structure has been completed. During the backfilling of the pipeline or structure, the shoring, sheeting and bracing shall be carefully removed so that there shall be no voids created and no caving, lateral movement or flowing of the subsoils.

3.08 ROCK SUBGRADE UNDER STRUCTURES

A. Place a 6-inch layer of crushed rock, compacted to 95% relative compaction, under structures.

3.09 FINISH GRADING

A. Except where shown otherwise in the Drawings, restore the finish grade to the original contours and to the original drainage patterns. Grade surfaces to drain away from structures. The finished surfaces shall be smooth and compacted.

3.10 DISPOSAL OF EXCAVATED MATERIAL

A. Dispose of unsuitable material or excavated material in excess of that needed for backfill onsite in accordance with the requirements of [Section 01140].

END OF SECTION
SECTION 02370
SLOPE PROTECTION

PART 1 - GENERAL
1.01 SUMMARY
A. Section Includes: Provide all labor, materials, and equipment for seeding and placing riprap slope protection.

1.02 REFERENCES
A. State of California, Department of Transportation, Standard Specifications (Standard Specifications) [July 1992].

1.03 SUBMITTALS
A. Submit in accordance with Section 01300.
B. Submit the following under the Product category.
   1. Samples: Furnish such quantities of construction materials as may be required by the Engineer for test purposes. The Contractor shall cooperate with the State and furnish necessary facilities for sampling and testing of all materials and workmanship. All materials furnished and all work performed shall be subject to rigid inspection, and no materials shall be used in the construction work until it has been inspected by the Engineer.
   2. Submit a signed certification from each source of supply for each material indicating that the material meets the Specification requirements.

PART 2 - PRODUCTS
2.01 SEEDING
A. Seeding Mixture: Minimum, 85% germination.
   1. Erosion Control Seed Mix: Apply mixture at the rate of 50 pounds per acre. The seed mix shall be as follows:
      a. Blando Brome - 10 lbs/acre.
      b. Zorro Annual Fescue - 20 lbs/acre.
      c. Inoculated Clover - 20/lbs/acre.
      d. Fertilizer: Commercial fertilizer with the following guaranteed chemical analysis. Apply at a rate of [300] lbs/acre.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percentage</th>
</tr>
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<tbody>
<tr>
<td>Nitrogen</td>
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<tr>
<td>Phosphoric Acid</td>
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<tr>
<td>Water Soluble Potash</td>
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</tr>
</tbody>
</table>

2.02 RIPRAP
A. Riprap:
   1. Durable rock, free from cracks and seams shall conform to the quality requirements of the Standard Specifications, Section 72-2. Neither the breadth nor the thickness of any piece of riprap shall be less than one-third its length.
   2. Grade the riprap to conform to the following class for Method B placement in the Standard Specifications, Section 72-2, Light Class.
B. Filter Blanket: Clean, hard, durable sand and gravel free of organic material, clays or other deleterious substances, with a minimum Durability Index of 40 and a minimum specific gravity of 2.5. The material shall conform to the following gradation. It shall not be gap graded.
<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 inch</td>
<td>100</td>
</tr>
<tr>
<td>1-1/2 inch</td>
<td>80 - 100</td>
</tr>
<tr>
<td>3/8 inch</td>
<td>45 - 100</td>
</tr>
<tr>
<td>No. 4</td>
<td>30 - 70</td>
</tr>
<tr>
<td>No. 8</td>
<td>20 - 65</td>
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<tr>
<td>No. 30</td>
<td>0 - 20</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 - 5</td>
</tr>
</tbody>
</table>

2.03 EROSION CONTROL MATTING
   A. Use either jute matting or excelsior matting at the Contractor’s option.
   B. Jute Matting:
      1. Material: Cloth of a uniform plain weave of undyed and unbleached single jute yarn.
      2. Width: 48 inches ± 1 inch.
      3. Weight: 1.2 pounds per lineal yard ± 5%.
      4. Yarn: Loosely twisted of not less than 1.6 turns per inch. Thickness shall not vary by more than one-half its normal diameter.
   C. Excelsior Matting:
      2. Width: 48 inches ± 1 inch.
      3. Weight: 0.8 pounds per square yard ± 10%.
      4. Reinforcement: Cover excelsior with photo-degradable plastic mesh.
   D. Staples: “U” shaped, 6 to 10 inches long, of at least No. 11 gauge wire.

PART 3 - EXECUTION
3.01 SEEDING
   A. Preparation of Slopes:
      1. Dress and grade the slopes to provide a uniform surface and slope. Do not compact the surface.
      2. Thoroughly water the slopes for one week prior to seeding. Take care not to cause erosion or otherwise damage the slope profile and integrity.
   B. Seeding Installation:
      1. Drill erosion control seed mix at the rate of 50 pounds per acre.
      2. Apply fertilizer at the specified rate immediately after seeding. Do not drill the fertilizer with the seed.
      3. Apply straw at a rate of one to two tons per acre. Hold straw in place in accordance with Standard Specifications, paragraph 20-3.03.

3.02 RIPRAPP INSTALLATION
   A. Foundation Preparation: Trim and dress the slopes to conform to cross sections shown on the Drawings. Where such areas are below the allowable minus tolerance limit, they shall be brought to grade by filling with earth similar to the adjacent material and compacted to a comparable density. Immediately prior to placing the filter rock, the prepared base will be inspected by the Engineer, and no material shall be placed thereon until that area has been approved.
   B. Filter Blanket: Spread filter uniformly on the prepared base to the slope lines and grades indicated on the Drawings. Placing of material by methods, which will tend to segregate particle sizes within the filter rock layer will not be permitted. Any damage to the surface of the base during placing of the filter layer shall be repaired before proceeding with the work. Compaction of the filter rock layer will not be
required, but it shall be finished to present a reasonably even surface free from mounds or windrows.

C. Riprap: Place rock for riprap on the filter blanket in such a manner as to produce a reasonably well graded mass of rock with the minimum practicable percentage of voids. Comply with the following tolerance to the lines and grades shown on the Drawings. A tolerance of plus 3 inches or minus 0 inches from the slope lines and grades shown on the Drawings will be allowed in the finished surface of the riprap. Place riprap to its full course thickness in one operation and in such a manner as to avoid displacing the filter rock material. Distribute the larger rocks over the entire surface. The entire mass of rocks in their final position shall be roughly graded to conform to the gradation specified. The finished riprap shall be free from pockets of small stones and clusters of larger stones. Placing riprap in layers will not be permitted. Placing riprap by dumping into chutes or by similar methods likely to cause segregation of the various sizes will not be permitted. Placing riprap by selective loading of the material at the quarry or other source; by controlled dumping of successive loads during final placing; or by other methods of placement, which will produce the specified results. Rearranging of individual stones by mechanical equipment or by hand will be required to the extent necessary to obtain a reasonably well-graded distribution of rock sizes as specified above. Maintain the riprap protection until the Contract is accepted. Replace any material displaced by any cause to the lines and grades shown on the Drawings.

3.03 INSTALLATION OF EROSION CONTROL MATTING

A. Install the matting downhill. Bury the top end in a narrow trench 6 inches deep. Apply the matting smoothly, in contact with the ground, but do not stretch. Place the excelsior matting with the plastic mesh on top. Lap sides and ends 4 to 6 inches.

B. Staple the matting in the trench prior to backfill at 6-foot intervals. Staple the ends, overlaps, and centers at 2-foot intervals.

END OF SECTION
SECTION 02510
WATER SYSTEM PIPING AND ACCESSORIES

PART 1 - GENERAL
1.01 SUMMARY
A. Section Includes: Furnish and install all piping, including fittings, valves, and accessories as shown on the Drawings, described in the Specifications and as required to completely interconnect all piping for a complete and operable system.
B. Related Sections:
   1. Section 02302: Earthwork

1.02 REFERENCES
A. American Association of State Highway and Transportation Officials (AASHTO)
B. American National Standards Institute (ANSI)
C. American Society of Mechanical Engineers (ASME)
D. American Society for Testing and Materials (ASTM)
E. American Water Works Association (AWWA)
F. Cast Iron Soil Pipe Institute

1.03 SUBMITTALS
A. Submit in accordance with Section 01300.
B. Shop Drawings:
   1. Layouts and schematics: Submit detailed installation drawings of all piping and connected equipment. The drawings shall include each pipe, all fittings, valves, and other appurtenances.
   2. Submit data to show that the following items conform to the Specification requirements:
      a. Pipe, fittings, and accessories.
      b. Fitting, joint fabrication and handhole details for pretensioned concrete cylinder pipe if used.
      c. Design calculations for pretensioned concrete cylinder pipe if used.
      d. Flexible couplings and flanged coupling adapters.
      e. Restrained joints.
      f. Valves.
      g. Air release valves.
      h. Pressure relief valves.
      i. Pressure reducing valves.
   3. Submit certified test reports as required herein and by the referenced standard specifications.
   4. Disinfection schedule and procedures including:
      a. "Normal" disinfection procedure.
      b. Emergency disinfection procedure for mains and services which must be returned to service immediately.
      c. Disinfection schedule including number and type of services and length of disruption of service.
      d. Disinfecting agent(s).
      e. Method of disposal of chlorinated water.
C. Manuals: The Contractor shall furnish manufacturer's installation and operation manuals, bulletins, and spare parts lists for the following items:
   1. All valves over 4-inch size.
   2. Air release valves.
   3. Pressure relief valves.
4. Pressure reducing valves.
5. Water meters.

D. Affidavits: Submit affidavits from the manufacturer of the following valves and meters:
   1. Butterfly valves.
   2. Gate valves.
   3. Air release valves.
   4. Pressure relief valves.
   5. Pressure reducing valves.

E. The preceding submittals shall be in the Product Information Category except where noted.

1.04 QUALITY ASSURANCE
A. All materials and equipment furnished under this Section shall: (1) be of a manufacturer who has been regularly engaged in the design and manufacture of the materials and equipment [for at least 5 years] and (2) be demonstrated to the satisfaction of the Engineer that the quality is equal to the materials and equipment made by those manufacturers specifically named herein, if an alternate product manufacturer is proposed.

1.05 POTHOLING (CHECK ON LOCATIONS)
A. Do not prepare any shop drawings for, or make final order for, or design any pipe materials for any particular section of pipeline until all utilities in that section of pipeline have been exposed, as specified in paragraph [3.02] of Section [02302] and until such time as no interferences are found between said existing utilities and the proposed pipeline alignment. If interferences are found in any particular section of pipeline, do not prepare any shop drawings for, or make final order for, or design any pipe materials for that particular section of pipeline until the pipeline alignment has been modified by the Engineer to eliminate all such interferences.

1.06 CONSTRUCTION SCHEDULING/SEQUENCING
A. Construction under this Contract involves expansion and/or modification of the existing water system which must continue to provide service to all buildings during construction.

B. Connections and utilities changes must be programmed to provide the least possible interruptions of service. Prior to any shutdown all materials, fittings, supports, equipment and tools shall be on the site and all necessary labor shall be scheduled prior to starting any connection work. The Contractor shall notify the Engineer in writing at least 7 days in advance of any required shutdowns so that affected customers may be notified. In general, shutdowns shall not exceed four hours in duration unless specifically authorized or indicated in the suggested construction sequence. If a shutdown of more than four hours is required, the Contractor shall first install temporary water service connections to all affected houses and other buildings. All temporary piping shall be disinfected in accordance with Paragraph [3.06] before being put into service.

C. All work under this Contract shall be conducted in a manner which will minimize shutdowns, open roadways, or traffic obstructions caused by the construction. Shutdowns causing damage to adjacent public and private property shall not be permitted, and any damage resulting shall be the sole responsibility of the Contractor.

D. Planned utility service shutdowns shall be accomplished during periods of minimum use. In some cases this will require night or weekend work, which shall be at no additional cost to the IRWD. The Contractor shall program his work so that service
will be restored in the minimum possible time, and shall cooperate with the IRWD in reducing shutdowns of the utility system to a minimum. No utility interruption will be permitted without the prior approval of the Engineer.

PART 2 - PRODUCTS

2.01 GENERAL
A. Pipe and valve sizes are nominal inside diameter unless otherwise noted.
B. All materials delivered to the job site shall be new, free from defects, and marked to identify the material, class, and other appropriate data such as thickness for piping.
C. Acceptance of materials shall be subject to strength and quality testing in addition to inspection of the completed product. Acceptance of installed piping systems shall be based on inspection and leakage and bacteriological tests as specified hereinafter.
D. Buried nuts and bolts for flanges and couplings shall be Type 304 stainless steel unless otherwise specifically specified herein.
E. Fusion Epoxy Coating: Materials and application shall be in accordance with AWWA C213, except application shall be by the fluid bed method only unless the greatest dimension of the article to be coated exceeds 10 feet, in which case electrostatic spray method may be used.

2.02 PIPING MATERIALS
A. Pipe Designation: Piping materials for miscellaneous small piping are designated on the Drawings. New water transmission mains shall be the ductile iron pipe system, except that for main 18 inches and larger, the Contractor may furnish the pipe system. Some of the corrosion protection and monitoring features required for pipe will not be required for ductile iron pipe as specified and as shown on the Drawings.
B. Pipe Systems: Each designation identifies not only the pipe itself, but the entire system as well as including the associated fittings, appurtenances, and installation and test procedures.
C. Ductile Iron (DI):
   1. Pipe: Ductile iron, thickness Class [50], AWWA C151.
      b. Restrained joints: Where required by the Drawings, provide restrained joints capable of deflection [after the restraint is installed]. Joints shall not separate under an internal pressure of 250 psi. TR-FLEX by United States Pipe & Foundry Company; equivalent by American Cast Iron Pipe Company; or equal.
   3. Fittings: Ductile iron or cast iron push-on joints, AWWA C110.
      a. Special Fittings: Special fittings not available in ductile iron or cast iron pipe may be fabricated of fusion epoxy lined and coated welded steel pipe with a design pressure of [250] psi. Design and wall thickness shall be submitted to the Engineer for review.
D. Polyvinyl Chloride Pipe:
   1. Pipe: Polyvinyl chloride pressure pipe, cast iron pipe outside dimensions. Pipe shall be UL listed or Factory Mutual Approved.
      a. 4-inch through 12-inch: AWWA C900.
   2. Joints:
      a. Unrestrained joints: Bell and spigot, gasketed; or twin gasket coupling.
      b. Restrained joints: Bell and spigot (push-on) gasketed, or mechanical joints; both using ductile iron clamp-on restraining devices.
1) Restraining devices: Ductile iron with ductile iron or corr-ten rods and bolts. Pressure rating of at least 150 psi. Series 1500 by EBBA Iron; equivalent by Uni-Flange; or equal for bell and spigot joints. Series 500 by EBBA Iron; equivalent by Uni-Flange; or equal for mechanical joints.

3. Gaskets: Submit two sample gaskets of each gasket type with an explanation of the markings.

5. Fittings: Push-on cast iron, AWWA C110, with hubs cast and/or ground as required for pipe furnished

2.03 PIPE COUPLINGS

A. General: For typical pipe joints refer to pipe material specifications. Other joint devices shall be furnished where called for as specified below.

B. Flexible Couplings and Flange Coupling Adaptors:
   1. Sleeve: Cast iron or fabricated steel.
   2. Followers: Cast iron, ductile iron, or steel.
   3. Sleeve bolts: ASTM A325, Type 3; malleable iron; or equivalent.
   4. Coating: Fusion epoxy line and coat sleeve and followers.
   5. Pressure rating: 250 psi.
   6. Buried flexible coupling sleeve: Long barrel
   7. Manufacturers:
      a. Flexible couplings:
         1) Connecting pipe with identical outside diameters: Smith-Blair 411 or 431, Dresser Style 38 or 53, or equal.
         2) Connecting pipe with slightly different outside diameters: Smith-Blair 413 or R 441, Dresser Style 162, or equal.
      b. Flange coupling adaptors:
         1) Connecting new pipe or new pipe to existing non-ferrous pipe: Smith-Blair 912 or 913, Dresser Style 127 or 128, or equal.

8. Gaskets: Oil and grease resistant; Smith-Blair Grade 60; or equal.

9. Joint restraint: Provide joint harnesses (tie rod lug or attachment plate assemblies) across flexible couplings and flange coupling adaptors where indicated on the Drawings. For flanged coupling adaptors, anchor studs may be substituted for the harnesses on pipe up to 12-inch. Design restraint in accordance with AWWA M-11 for 250 psi if size of the rods are not indicated on the Drawings.

10. Protection for buried connectors and adaptors:

2.04 VALVES AND ACCESSORIES

A. General Requirements for Valves:
   1. All valves of each type shall be the product of one manufacturer.
   2. All valves shall be furnished with control assembly, operators, handwheels, levers, or other suitable type wrench including handles as specified herein or as shown on the Drawings.
   3. All threaded stem valves shall open by turning the valve stem counterclockwise.
   4. The exterior of all valves and valve operators shall be painted with two coats of Tape Coat Mastic; Protecto Wrap CA1180 Mastic; or equal, except where otherwise indicated.

B. Valves and Accessories:
   1. Butterfly valves:
      a. Rating: 150 psi water. Leaktight in both directions.
b. Type: Flanged body, or as shown on the Drawings, AWWA C504, geared operator, resilient seated, 90 degree seating.

c. Connections: [Flange] [Mechanical joint], as shown on the Drawings.

d. Materials: Cast iron body; cast iron or ductile iron disc with Ni-Chrome or Type 316 stainless steel edge; Type 304 stainless steel shaft; disc to be secured to shaft with Type 304 stainless steel taper pins.

e. Operator: Traveling-nut type, 2-inch standard AWWA nut, designed for buried service, watertight to 10 psi with extension stem as detailed on the Drawings. Provide [three] valve operator tee handles to the [Owner].

f. Valve seat: Buna-N seat shall be applied to the valve body.

g. Bearings: Self-lubricating and corrosion resistant.

h. Finish: Internal, asphalt varnish in accordance with AWWA C504; external, factory applied coal tar epoxy, 16 mils minimum thickness.

i. Manufacturers: Pratt Groundhog, equivalent by DeZurik, or equal.

2. Gate Valves:

a. Rating: 200 psi water

b. Type: Resilient seated, non-rising stem, AWWA C509, as modified herein

c. Connection: [Flanged] [Mechanical joint], or as shown on the Drawings

d. Stem seal: O-ring

e. Finish: Fusion epoxy

f. Manufacturers: American Darling CRS-80; equivalent by Kennedy; or equal.

2.05 SERVICE CONNECTIONS

A. General: All corporation stops, service clamps or saddles, and service connection accessories shall be the product of one (1) manufacture.

B. Service Clamps:

1. Type: Bronze, double strap, retained o-ring gasket, rolled strap threads, and tapping boss with full length threads.

2. Manufacturer: Mueller Co., H-16130; equivalent by Clow; or equal.

C. Corporation Stops:

1. Rating: 100 psi water

2. Type: Thread inlet; compression connection outlet

3. Manufacturer: Mueller Co. equivalent by Ford; or equal.

D. Curb Stops:

1. Rating: 100 psi water

2. Type: copper service thread both ends

3. Manufacturer: Mueller Co., [H-1502-2]; equivalent by Ford; or equal.

E. Meter Boxes

1. Type: Plastic structural foam box with [plastic locking cover] having a hinged plastic reader lid and a metal base plate.

2. Manufacturer: Mueller Co., [H-1310 and H-1312]; equivalent by Clow; or equal.

2.06 APPURTENANCES

A. Provide all necessary assembly bolts, washers and nuts, thrust blocks, supports, gaskets, flanges, and all other appurtenant items shown on the Drawings, specified or required for the proper installation and operation of the piping, and devices included in or on the piping, equipment, and piping accessories.

PART 3 - EXECUTION

3.01 PIPING INSTALLATION

A. General Handling and Placing:
1. Exercise great care to prevent injury to or scoring of the pipe lining and coating, as applicable, during handling, transportation or storage. Handle fusion epoxy coated pipe in accordance with AWWA C213. Pipe shall not be stored on rough ground and rolling of the pipe on the coating will not be permitted. Repair any damaged pipe sections, specials, or fittings or replace at the direction of the Engineer.

2. Inspect each pipe fitting, valve and accessory carefully before installation. Inspect the interior and exterior protective coatings and patch all damaged areas in the field or replaced at the direction of the Engineer.

3. Place or erect all piping to accurate line and grade and backfill, support, hang, or brace against movement as specified or shown on the Drawings, or as required for proper installation. Remove all dirt and foreign matter from the pipe interior prior to installation and thoroughly clean all joints before joining.

4. Use reducing fittings where any change in pipe size occurs. Bushings shall not be used, unless specifically noted on the Drawings. Use eccentric reducing fittings wherever necessary to provide free drainage of lines.

5. Connections between ferrous and non-ferrous piping and accessories shall be made using a dielectric coupling, union, or flange.

B. General Buried Piping Installation:
1. Trenching, bedding, and backfill for buried piping shall be as shown on the Drawings and as specified in Section 02302.
2. Where no grade elevations are shown on the Drawings, buried piping shall have at least 3 feet of cover.
3. Provide each pipe with a firm, uniform bearing for its full length in the trench except at field joints. Do not lay pipe in water or when trench conditions or weather are unsuitable for such work.
4. Protect buried piping against thrust by use of restrained pipe joints, or thrust blocks if shown on the Drawings. Securely brace all exposed free pipe ends.
5. Do not pull bell and spigot, gasketed joints more than 75% of the maximum deflection permitted by the pipe manufacturer.

C. Water Main Installation:
1. The Contractor is advised that precautions taken to keep the pipeline clean during construction will facilitate achieving the disinfection requirements of this project with a minimum of effort and expense. Compliance with these suggested minimum procedures will not relieve the Contractor of the disinfection requirements.
2. Prior to installation, thoroughly clean the interior of each length of pipe and each fitting or valve and inspect to ensure that no foreign material remains. Cover both ends with plastic and do not uncover them until just prior to completing the joint.
3. Whenever pipe laying is discontinued for short periods, or whenever work is stopped at the end of the day, close the open ends of the pipe with watertight plugs or bulkheads.
4. Provide adequate trench pumping to ensure against groundwater contacting the inside of the pipeline at any time. Do not lower any pipe or fitting into a trench where groundwater is present and may enter the pipe. When necessary, pump the water from trenches and keep the trench dry until the joints have been completed and the open ends of the pipe have been closed with a watertight plug. Do not remove the plug until the trench has again been pumped dry.
5. Keep new pipe sections clean and dry.
6. When making the connection between a new pipeline and an existing pipeline, or when repairing a damaged pipe, take the following extra precautions:
   a. Clean the exterior of the existing pipeline of all dirt and debris, and spray or swab with a standard 5.25% or stronger chlorine solution (as specified) in the immediate vicinity of the work. Clean equipment and materials, including new pipe and fittings, to be used in making these connections of all dirt and debris and disinfect them. Allow at least 30 minutes contact time for disinfection before the chlorine solution is diluted or rinsed off. Provide sufficient trench pumps to prevent flooding of the trench.
   b. When an old line is opened, either by accident or by design, the excavation may be wet or badly contaminated from groundwater. Apply liberal quantities of standard chlorine solution or tablets to the open trench areas to lessen the danger from such pollution. Tablets are recommended because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation. Scatter liberally around and locate the tablets so that flow entering the work site will contact the disinfecting agent. Trench application should be done very carefully to avoid contact by skin and clothing with chlorine solution. Minimally, safety dictates wearing safety goggles and rain gear.
   c. When excavating a leaking or broken pipeline, "valve-off" the system gradually to less than watertightness. This is to prevent causing areas of zero pressure which would allow entry of foreign material. A flow should be maintained which is slightly less than trench pump capability. Once the break is exposed and cleaned to disallow site contamination, the valving can then be made watertight.

E. Installation Specifics:
   1. Ductile Iron Pipe:
      a. Buried pipe shall be installed in accordance with AWWA C600.
      b. [Where required.] Wrap buried pipe with 8 mil polyethylene film in accordance with AWWA C105. Continuously seal seams and overlaps with tape. Seal circumferential overlaps with two turns of tape, half lapped. Gather excess polyethylene on top of pipe so as not to block backfill material from getting under bottom of pipe. Use caution so as not to rip or cut the polyethylene film. Seal any rips or cuts in the film with tape.
      c. Wherever the pipeline crosses over or under a sewer main or house service lateral, center a standard length pipe, 18-foot minimum, on said sewer main or lateral so as to have the pipeline joints as far as possible away from the sewer. This may require field cutting of some pipe pieces.
      d. Flanged Joints: Flanged joints shall be made up tight with care being taken to avoid undue strain in the flanges, fittings, and other accessories. Bolt holes shall be aligned for each flanged joint. Bolts shall be full size for bolt holes; use of undersize bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Adjoining flange faces shall not be out of parallel to such a degree that the flanged joint cannot be made watertight without over-straining the flange. Replace any flanged pipe or fitting whose dimensions do not allow the making of a proper flanged joint as specified herein by one of proper dimensions. Clean flanges prior to making joints.
      e. Restrained Joints: Install in accordance with manufacturer's instructions. Pull slack out of joint after makeup.
2. Polyvinyl Chloride Pipe: Installation shall conform to AWWA M23, Chapters 6 and 7, as modified herein.

3.02 COUPLING INSTALLATION
   A. Flexible Couplings and Flange Coupling Adaptors: Prior to installation, thoroughly clean oil, scale, rust, and dirt from the pipe to provide a clean seat for the gasket. Care shall be taken that the gaskets are wiped clean before they are installed. If necessary, flexible couplings and flanged coupling adapter gaskets may be lubricated with soapy water or manufacturer's standard lubricant before installation on the pipe ends. Install in accordance with the manufacturer's recommendations. Bolts shall be tightened progressively, drawing up bolt on opposite sides a little at a time until all bolts have a uniform tightness. Workers tightening bolts shall be equipped with torque-limiting wrenches or other favorably reviewed type. Anchor studs on restrained flanged coupling adapters shall be installed so as to lock into holes drilled through pipe wall in accordance with manufacturer's recommendation.
   B. Flexible Expansion Joints: Install in accordance with manufacturer's instructions [unless otherwise shown, install flat, with 1/2 the maximum expansion].

3.03 INSTALLATION OF VALVES AND ACCESSORIES
   A. Wrap buried valve bodies as specified for flexible couplings and flanged coupling adapters.
   B. Use reducing fittings where any change in pipe size occurs between valves or accessories and the attached pipeline. Bushings shall not be used, unless specifically noted on the Drawings. Use eccentric reducing fittings wherever necessary to provide free drainage of lines. Inspect each piece of pipe and each fitting carefully to see that there is no defective workmanship on pipe, or obstructions in pipes and fittings.

3.04 FIELD QUALITY CONTROL
   A. The IRWD will:
      a. Inspect field welds and test the welds if it is deemed necessary.
      b. Perform bacteriological analysis for pipelines to be disinfected.
   B. Factory Quality Control: The Contractor shall test all products as required herein and by the reference specifications.
   C. The Contractor shall:
      a. Perform leakage tests.
      b. Be responsible for the costs of additional inspection and retesting by the IRWD resulting from non-compliance.

3.05 CLEANING
   A. Prior to testing, the inside of each completed pipeline shall be thoroughly cleaned of all dirt, loose scale, sand and other foreign material. Cleaning shall be by sweeping, flushing with water internal cleaning device or "pig" or blowing with compressed air, as appropriate for the size and type of pipe. Flushing shall achieve a velocity of at least [3] feet per second. The Contractor shall install temporary strainers, temporarily disconnect equipment or take other appropriate measures to protect equipment while cleaning piping. Cleaning shall be completed after any repairs.

3.06 FIELD TESTING
   A. General: Perform leakage tests on all pipe installed in this project. Furnish all equipment, material, personnel, test media and supplies to perform the tests and make all taps and other necessary temporary connections. The test pressure, allowable leakage and test medium shall be as specified. Perform leakage tests on all piping at a time agreed upon and in the presence of the Engineer.
B. Buried Piping: Perform the leakage test for buried piping after all pipe is installed and backfilled. However, preliminary tests may be conducted prior to backfill. If preliminary tests are conducted, provide any necessary temporary thrust restraint.

C. Accessories: It is the responsibility of the Contractor to block off or remove equipment, valves, gauges, etc., which are not designed to withstand the full test pressure.

D. Testing Apparatus: Provide pipe taps, nozzles and connections as necessary in piping to permit testing, addition of test media, and draining lines and disposal of water, as is necessary. Plug these openings in a manner favorably reviewed by the Engineer after use. Provide all required temporary bulkheads.

E. Correction of Defects: If leakage exceeds the allowable, repair or replace the installation and repeat leakage tests as necessary until conformance to the leakage test requirements specified herein have been fulfilled. All visible leaks shall be repaired even if the pipeline passes the allowable leakage test.

F. Reports: Keep records of each piping test, including:
   1. Description and identification of piping tested.
   2. Test pressure.
   3. Date of test.
   4. Witnessing by Contractor and Engineer.
   5. Test evaluation.
   6. Remarks, to include such items as:
      a. Leaks (type, location).
      b. Repairs made on leaks.
      c. Submit test reports to the Engineer.

G. Venting: Where not shown on the Drawings, the Contractor may install valved "TEES" or corporation stops and saddles at high points on piping to permit venting of air. Valves shall be capped after testing is completed.

H. Testing Specifics:
   1. Water Transmission Mains:
      a. Method: AWWA C600, as modified herein.
      b. Duration: Four hours.
      c. Pressure: 150 psi measured at lowest point of section of pipeline being tested.
      d. Medium: Potable water.
      e. Allowable Leakage: Leakage shall be defined as the quantity of test medium that must be added to the section of pipeline being tested to maintain the specified test pressure for the specified test duration. Maximum allowable leakage shall be as specified in AWWA C600.

3.07 DISINFECTION OF POTABLE WATER SYSTEMS

A. Disinfect all water mains and interconnected piping after testing and before being placed into service to ensure their bacteriological safety. Disinfection shall be accomplished under the supervision of the Contractor by a person skilled and experienced in the operation of water systems. Following disinfection and flushing, the [Owner] will take water samples for bacteriological analysis of the water. If the specified bacteriological requirements are not satisfied, the disinfection procedure must be repeated until the requirements are met.

B. Mains:
   2. Forms of Chlorine: Sodium hypochlorite or calcium hypochlorite.
C. Small Pipelines (less than 3 inch):
   1. Preparation: Provide the system with a 1-inch minimum service cock or valve or other means to inject chlorine solution at a point within 2 or 3 feet of its junction with the supply source. When system is complete thoroughly flush it by fully opening every outlet until clear water flows from all of them.
   
   2. Disinfecting Agent: Sodium hypochlorite or calcium hypochlorite in sufficient quantities to produce chlorine concentration of at least 50 parts per million in the system.
   
   3. Disinfecting Procedure:
      a. Connect a hand-operated pump, or other means of injecting the disinfecting agent, to 1-inch minimum service cock or valve or other injection device. Pump must provide a pressure greater than that of supply of system.
      b. With system completely full of water and supply valve open, proceed to adjust every outlet of system so that a trickle of water flows from each.
      c. Inject disinfectant slowly and continuously at an even rate, not in slugs, until a test at each outlet shows a free chlorine residual concentration of at least 50 parts per million.
      d. Close all outlets and valves, including valve connecting to supply line and 1-inch minimum service cock on solution injection connection. Maintain condition for 24 hours. After 24 hours test for residual chlorine at each outlet. The free residual chlorine concentration indicated should be not less than 10 ppm. If the indicated free chlorine concentration is less than 10 ppm, the disinfection procedure must be repeated until an approved result is obtained.
   
   4. When the above procedure has been completed to the satisfaction of the Engineer, flush out entire system with fresh water until tests at all outlets show a residual of not more than 0.5 ppm.


E. Bacteriological Analyses of Water: After the completion of disinfecting procedure, including the final flushing as described heretofore, the Engineer will obtain water samples from this system for bacteriological analyses. Requirements for satisfactory disinfection of water supply are that bacteriological analyses (Heterotrophic plate count) indicate that water samples are negative for coliformnerogenes organisms, and that total plate count is less than 100 bacteria per cubic centimeter. If bacteriological analyses do not satisfy the above requirements, then disinfection procedure must be repeated until these requirements are met.

F. Disposal of Disinfection Solution: [Dechlorinate and] dispose of disinfection solution in accordance with applicable regulations [and Section 01140]. Take care to assure that chlorinated water is not spilled in drains.

END OF SECTION
SECTION 02530
SEWERS

PART 1 - GENERAL
1.01 SUMMARY
A. Section Includes: Furnish and install all piping as shown on the Drawings, described in the Specifications and as required for a complete and operable system.
B. Related Sections:
1. Section 02080: Precast Concrete Sectional Manholes
2. Section 02302: Earthwork

1.02 REFERENCES
A. American Society for Testing and Materials (ASTM):
1. A74 Specification for Cast Iron Soil Pipe and Fittings
2. C76 Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe
5. C564 Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
7. C923 Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
8. D3034 Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
10. F477 Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
11. FC79 Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
B. Cast Iron Soil Pipe Institute.

1.03 SUBMITTALS
A. Submit in accordance with Section 01300.
B. Submit the following in for review:
1. Potholing Report: Verify by excavation, inspection and measurement all installation conditions, including existing utilities and structures, for buried pipe before preparation of Shop Drawings. Submit field measurements, elevations, station locations, and photos. See also paragraph 3.02, Existing Utilities, of Section 02302.
2. Shop Drawings: Submit data to show that the products specified in this Section conform to the Specification requirements.
4. Samples: Submit two sample gaskets of each type to be used with an explanation of the markings.
5. Test Results: As required herein.

1.04 QUALITY ASSURANCE
A. All materials and equipment furnished under this Section shall be of manufacturers who have been regularly engaged in the design and manufacture of the materials
B. Factory Quality Control: The Contractor shall test all products as required herein and by the reference specifications.
C. Field Quality Control:
1. The Contractor shall:
   a. Perform leakage tests
   b. Perform mandrel tests

1.05 POTHOLING (CHECK ON LOCATIONS)
A. Do not prepare any shop drawings for, or make final order for, or design any pipe materials for any particular section of pipeline until all utilities in that section of pipeline have been exposed, as specified in paragraph [3.02] of Section [02301, 02302], entitled Existing Utilities, and until such time as no interferences are found between said existing utilities and the proposed pipeline alignment. If interferences are found in any particular section of pipeline, do not prepare any shop drawings for, or make final order for, or design any pipe materials for that particular section of pipeline until the pipeline alignment has been modified by the Engineer to eliminate all such interferences.

PART 2 - PRODUCTS

2.01 GENERAL
A. Pipe sizes are nominal inside diameter unless otherwise noted.
B. All materials delivered to the job site shall be new, free from defects, and marked to identify the material, class, and other appropriate data such as thickness for piping. Acceptance of materials shall be subject to strength and quality testing in addition to inspection of the completed product. Acceptance of installed piping systems shall be based on inspection and leakage tests as specified hereinafter.

2.02 POLYVINYL CHLORIDE PIPE (PVC)
A. Pipe and Fittings: Polyvinyl chloride sewer pipe.
   1. Four-inch through 15-inch nominal size: ASTM D3034, SDR 35.
C. Gaskets: Nitrile, ASTM F477.
   1. Gasket Tests: Test 3 gaskets of each size for all properties noted in Section 7 of ASTM F477.

2.06 CONNECTION DEVICES
A. Transition Couplings: Transition couplings shall be elastomeric plastic or synthetic rubber resistant to sewage and grease, chemicals and normal sewer gases. Couplings shall be designed to slip over the outside of the pipes being connected with a snug fit. Coupling shall be held in place and sealed with a stainless steel band clamp around each end. Couplings shall be specifically manufactured for making the transition between various types of pipe with different outside diameters. Couplings shall meet the requirements of the Uniform Plumbing Code. Fernco; Indiana Seal; or equal.
B. Transition Donuts: Transition donuts shall be elastomeric plastic resistant to sewage and grease, chemicals and normal sewer gases. They shall be designed to be inserted in the bells of sewer pipe to adapt the bell to accept the spigot of a smaller size spigot. They shall have reversed fins on the inside and outside to grip the bell and spigot. Transition donuts cast or grouted into concrete pipe or manhole sections shall have an outside diameter at least 2 inches greater than the inside diameter. Fernco; Indiana Seal; or equal.
C. Manhole Adaptors: Manhole adaptors shall be SBR rubber manhole waterstops for use with PVC sewer pipe, Fernco, or equal.
D. Flexible Manhole Connectors: ASTM C923
E. Other Devices: Other equivalent connection devices will be considered provided that they are made of elastomers resistant to sewage and grease, chemicals and normal sewer gases. Metallic parts shall be stainless steel.

2.07 APPURTENANCES
A. Furnish and install all necessary guides, inserts, anchors and assembly bolts; washers and nuts, hangers, supports, gaskets, and flanges; all other appurtenant items shown on the Drawings, specified or required for the proper installation and operation of the piping; devices included in or on the piping equipment; and piping accessories.

PART 3 - EXECUTION
3.01 FLOW CONTROL
A. Divert sewage flows and storm water around all sewer and drain replacement work areas, including building connection sewer replacement. Furnish, install, and operate pumps, plugs, conduits, and other equipment to divert the flow of sewage around the pipeline reach in which work is to be performed. Plugs shall be designed so that all or any portion of the sewage can be released. The plug shall be provided with a tag line. The pumping system shall be of sufficient capacity to handle existing flow plus additional flow that may occur during a rainstorm. If pumping is required on a 24-hour basis and engine drives are required, engines shall be equipped in a manner to keep noise to a minimum. Refer to Section [01140] for noise control requirements. Standby pumps shall be provided as required. Pumping shall be done in such manner as will not damage public or private property or create a nuisance or health menace. After the work has been completed, flow shall be restored to normal. Existing sewers to be abandoned shall be disconnected after the new service is operating.

B. Notify residents of the impending work and request their cooperation to minimize flows shortly before working in each area.

3.02 BUILDING CONNECTION REPLACEMENT
A. Locate and replace all existing building connection sewers from the main to the property line.

B. Locations:
1. The exact locations of building connection sewers are not known.
2. The Contractor shall maintain a log to record the method used to determine the status of all existing connections to the sewer mains. The log shall record the location of building connection sewers, reconnected or abandoned, and shall record the address(es) served by "live" connections.

C. Replacement Connections: Install replacement building sewers on the most direct alignment between the property line and the main sewer, unless otherwise directed by the Engineer. The Contractor shall connect the building connection sewers to manholes when so directed by the Engineer. Provide outside drops when the invert of building connection sewer is 18 inches or more higher than the top of the main sewer. Payment for drops when a building sewer is connected to a manhole will be in accordance with [Article 9 of the General Conditions].

D. Sizes: 4-inch minimum diameter or match the size of the existing building sewer, whichever is larger.

E. Cleanouts: Provide new cleanouts on each building sewer behind the curbs near the property line as shown on the Drawings.

F. Pipe Laying:
1. Line and Grade: Lay the pipe on a uniform grade between the tee, wye, or the top of the riser section and the end of the existing house connection sewer at
the point of reconnection. Minimum slope shall be 1/4-inch per foot unless otherwise permitted by the Engineer. Control the grade by means of a good-quality builder's level, not less than 24 inches in length.

2. Fittings: Maximum deflection permissible with one fitting shall not exceed 45 degrees except at vertical laterals, and shall be accomplished with long-radius elbows. Short-radius elbows will not be permitted, except by permission of the Engineer.

3. Field cuts of existing building connections shall be performed in a neat and workmanlike manner providing a clean, flush, saw-cut end.

4. Any building connection sewer pipe upstream of the reconnection, which is damaged or loosened by the Contractor’s operation, shall be replaced or repaired at the Contractor’s expense.

3.03 PIPING INSTALLATION

A. Storage and Handling:
1. Great care shall be exercised to prevent damage to the pipe during handling, transportation or storage. Pipe shall not be stored on rough ground and rolling of the pipe on the coating will not be permitted. Any damaged pipe sections shall be repaired or replaced at the expense of the Contractor as satisfactory to the Engineer.
2. Store polyvinyl pipe under opaque covers, which do not transmit ultraviolet light.
3. Each pipe section shall be carefully inspected before installation, and all damaged areas patched in the field or replaced as satisfactory to the Engineer.

B. General Piping Installation:
1. Trenching, bedding, and backfill for buried piping shall be as shown on the Drawings and as specified in Section [02302, Earthwork [For Pipelines]].
2. The profile drawings show invert elevations at certain structures and may show pipe slopes. In case of any conflicts the invert elevations shall govern over slopes. Install pipe with straight grades between indicated invert elevations.
3. Manhole locations are identified on the plan drawings by coordinates and by station. In case of any conflicts the coordinates shall govern over the stations.
4. Lay each length of pipe on a firm bed with a true bearing for its entire length between bell holes. Excavate holes of only sufficient size to accommodate the bell at each joint location. Adjust line and grade by scraping away, filling in and tamping the earth to provide true grade to fit the barrel of the pipe. No wedging or blocking up of the pipe will be permitted. The trench and bell holes shall be kept free from water during the laying of the pipe.
5. Except when noted specifically otherwise on the Drawings, whenever piping leaves a structure, concrete encasement, or concrete bedding, a joint capable of angular deflection shall be provided within 12 inches of the structure, encasement or bedding.
6. All dirt and foreign matter shall be removed from the pipe interior prior to installation and all joints shall be thoroughly cleaned before joining.
7. Plug open ends of pipe when construction is not underway.
8. Lay pipe upgrade with bell end forward, unless specifically shown otherwise.
9. After making each joint, rigidly secure the pipe in place by backfilling to the top of the pipe at the center, but not as to fill the bell hole nor interfere with the next jointing operation.

C. Installation Specifics:
1. Reinforced concrete pipe:
a. Before joining the spigot into the bell of the previously laid pipe, the spigot groove, the synthetic rubber gasket and the bell shall be thoroughly cleaned. The spigot groove, synthetic rubber gasket and bell shall then be lubricated in accordance with the manufacturer’s recommendations. Gasket shall be properly placed into the gasket groove on the spigot before joining.

b. Pipe shall be jointed together to provide the proper space between abutting ends of pipe. In pipelines 24-inches and larger, metal or wooden spacers shall be placed against the inside shoulder of the bells at the springline.

c. After a joint is assembled, a thin metal feeler gauge shall be inserted between bell and spigot and the position of the rubber gasket checked around the complete circumference of the pipe. If gasket is not in proper position, the pipe shall be withdrawn, the gasket checked to see that it is not cut or damaged, the pipe relaid, and the gasket position again checked.

2. Polyvinyl chloride pipe:
   a. Install pipe in accordance with the manufacturer’s instructions.
   b. Place pipe within the installation areas at least 24 hours prior to installation to permit temperature equalization.
   c. Cut pipe ends squarely, ream and deburr inside and out.
   d. Clean pipe ends and bells of dirt, grease and other foreign materials prior to making the joint.

3.04 CLEANING
   A. Prior to testing, the inside of each main sewer shall be thoroughly cleaned of all dirt, loose scale, sand and other foreign material. Cleaning shall be by flushing with water or balling as appropriate for the size and type of the pipe.

3.05 PERMANENT PLUGS
   A. Clean interior contact surfaces of all pipes to be cut off or abandoned. Construct a concrete plug in the end of all pipe 18 inches or less in diameter. Minimum length of concrete plugs shall be 8 inches. For pipe 21 inches and larger, the plugs may be constructed of common brick or concrete block. The exposed face of block or brick shall be plastered with mortar. All plugs shall be watertight and capable of withstanding all internal and external pressures without leakage.

3.06 LEAKAGE TESTS
   A. General:
      1. Perform leakage tests on all sanitary sewer mains, building connection sewers, and storm drains installed in this project.
      2. Furnish all equipment, materials, personnel, and supplies to perform the tests.
      3. Pressure gauges and metering devices shall be of a type, accuracy and calibration acceptable to the Engineer. The Engineer may require certification of the gauges and meters by an independent testing firm at the Contractor's expense.
      4. Leakage tests shall be performed on all piping at a time agreed upon and in the presence of the Engineer.
   B. The leakage test shall be made after all pipe is installed and backfilled, but prior to placing permanent resurfacing. The Contractor may conduct preliminary tests prior to backfill. If the Contractor elects to conduct preliminary tests, he shall provide any necessary temporary thrust restraint, and shall retest as set forth herein prior to surfacing placement.
   C. Test Procedure: Leakage tests shall be air pressure tests conducted as follows:
1. Furnish all materials, equipment and labor for making an air test. Air test equipment shall be favorably reviewed by the Engineer.

2. The Contractor may conduct an initial air test of the sewer mainline after densification of the backfill but prior to installation of the house connection sewers. Such tests will be considered to be for the Contractor’s information and need not be performed in the presence of the Engineer.

3. Each section of sewer shall be tested between successive manholes, or in sections if favorably reviewed by the Engineer, by plugging and bracing all openings in the sewer mainline and the upper ends of all building connection sewers. Prior to any air pressure testing, all pipe plugs shall be checked with a soap solution to detect any air leakage. If any leaks are found, the air pressure shall be released, the leaks eliminated, and the test procedure started over again. The Contractor has the option of wetting the interior of the pipe prior to the test.

4. The final leakage test of the sewer mainline and building connection sewers, shall be conducted in the presence of the Engineer in the following manner:

5. Air shall be introduced into the pipeline until 4.0 psi (27kPa) gage pressure has been reached; or if groundwater is present, 4.0 psi (27kPa) above the computed pressure exerted by the average adjacent groundwater. Reduce the flow of air and maintain the air pressure within plus or minus 0.5 psi (3kPa) for at least 2 minutes to allow the internal air temperature to reach equilibrium. Pressure in the pipeline shall be constantly monitored by a gage and hose arrangement separate from hose used to introduce air into the line. A blowoff valve shall be provided on the test apparatus to prevent over pressurizing the pipeline.

6. After the temperature has stabilized and no air leaks at the plugs have been found, the air pressure shall be permitted to drop until the internal pressure has reached 3.5 psi (24kPa) gage pressure; or when groundwater is present, 3.5 psi (24kPa) above the computed pressure exerted by the average adjacent groundwater. A stopwatch or sweep-second-hand watch shall be used to determine the time lapse required for the air pressure to decrease an additional 1.0 psi (7kPa).

7. If the time lapse (in seconds) required for the air pressure to decrease the additional 1.0 psi (7kPa) exceeds that shown in Table, Low Pressure Air Test for Sewers, in the Standard Specifications for Public Works Construction the pipe shall be presumed to be within acceptance limits for leakage.

8. If the time lapse is less than that shown in this table, the Contractor shall make the necessary corrections to reduce the leakage to acceptance limits without additional compensation.

\[ T = \text{Time in seconds for pressure to drop to 2.5 psi (17kPa) gage pressure.} \]

\[ D = \text{Inside diameter of pipe in inches (mm).} \]

D. Correction of Defects: If leakage or infiltration exceeds the allowable, the installation shall be repaired or replaced and leakage tests shall be repeated as necessary until conformance test requirements specified herein have been fulfilled. All detectable leaks shall be repaired, regardless of the test results.

E. Reports: Keep records of each piping test, including:

1. Description and identification of piping tested.
2. Description of test procedure.
3. Date of test.
4. Witnessing by Contractor and Engineer.
5. Test evaluation.
6. Remarks, to include such items as:
   a. Leaks (type, location).
   b. Repairs made on leaks.
7. Test reports shall be submitted to the Engineer.

3.07 MANDREL TEST OF POLYVINYL CHLORIDE PIPE
A. Following the placement and densification of backfill by at least 30 days, and prior to the placing of permanent pavement, all reaches of new mainline sewer constructed of polyvinyl chloride shall be cleaned and then mandrelled to measure for obstructions and pipe deflections.
B. A standard, commercially-manufactured, rigid, odd-numbered-leg (9 legs minimum) mandrel, with a circular cross section having a diameter of at least \(95\%\) of the specified average inside diameter, shall be pulled through the pipe by hand. The minimum length of the circular portion of the mandrel shall be equal to the nominal diameter of the pipe. Proof rings for verification of mandrel diameters shall be available at all times during mandrel tests. Rings shall be a standard product of the mandrel manufacturer.
C. Obstructions or deflection of the pipe barrel resulting in a reduction of the inside diameter by more than 5% encountered by the mandrel shall be corrected by the Contractor. The method employed to correct obstructions or excessive deflections shall be favorably reviewed by the Engineer prior to its implementation. The use of vibrating rerounding devices will not be permitted.

END OF SECTION
SECTION 02705
PAVING AND SURFACING

PART 1 - GENERAL

1.01 SUMMARY

A. Furnishing all labor, material, equipment, tools and services required for the placing and compacting of asphalt concrete pavement for airfields, roadways, parking lots and walkways to the lines, grades and dimensions shown on the Drawings and as specified herein.

1. Also included shall be the repair and resurfacing of existing roadway and area paving damaged or removed during construction.

2. Also included shall be applying penetration treatment to aggregate base surfaces shown on the Drawings.

B. Related Sections: Repair or replace concrete curbs, gutters and sidewalks damaged by the work in accordance with Section 02775.

1.02 REFERENCE SPECIFICATIONS

A. Whenever the words "Standard Specifications" are referred to, the reference is to the State of California, Department of Transportation, Standard Specifications dated [July 1992] (or latest edition).

B. American Society for Testing and Materials (ASTM):

1. D422 Test Method for Particle-Size Analysis for Soils

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

3. D2027 Specification for Cutback Asphalt (Medium Curing Type)

4. D2922 Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

C. California Department of Transportation (CALTRANS):

1. California Test 216 Method of Test for Relative Compaction of Untreated and Treated Soils and Aggregates

2. California Test 231 Method of Test for Relative Compaction of Untreated and Treated Soils and Aggregates by the Area Concept Utilizing Nuclear Gauges

1.03 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Submit the following under the Product category.

1. Samples: Furnish, without additional cost to the Owner, such quantities of construction materials as may be required by the Engineer for test purposes. The Contractor shall cooperate with the Engineer and furnish necessary facilities for sampling and testing of all materials and workmanship. All materials furnished and all work performed shall be subject to rigid inspection, and no materials shall be used in the construction work until it has been inspected by the Engineer.

2. Submit a signed verification from each source of supply for each construction material employed on this project indicating that the materials meet the Specification requirements.

3. Mix design for asphalt concrete.

4. Submit manufacturer's certification of the actual volatile organic compounds (VOC) content for all pavement paints and bituminous pavement sealers proposed for use on this project. Submit certification of the actual VOC content
for coatings manufactured after 1 September 1987. For coatings manufactured before 1 September 1987, submit VOC content and date of manufacture. VOC content shall be measured in grams per liter by weight of coating as applied excluding water and color added to the tint base.

5. Submit verification that bituminous pavement sealers and paint products furnished meet applicable [BAAQMD] regulations as to allowable VOC content for the time and place of application and use intended.

1.04 QUALITY ASSURANCE
A. Comply with "Standard Specifications" of State of California, Department of Transportation CALTRANS, [July 1992].
B. All pavement stripe painting shall be performed by competent and experienced Equipment operators and painters using proper equipment, tools, stencils, templates and shields in a workmanlike manner.

1.05 REGULATORY REQUIREMENTS
A. All work, material, procedures and practices under this Section shall conform with requirements of the California Air Resources Board (CARB) and the [Bay Area Air Quality Management District (BAAQMD)].

PART 2 - PRODUCTS

2.01 ASPHALT CONCRETE
A. Asphalt Concrete shall conform to the applicable requirements of Section 39 of the Standard Specifications. Asphalt binder shall be paving asphalt or liquid asphalt (cutback). Mineral filler shall consist of portland cement or mechanically reduced rock. Proportioning shall be as set forth in Paragraph “D” below.
B. Paving asphalt AR [4000] [8000] conforming to the requirements of Section 92 of the Standard Specifications shall be used as the asphalt binder.
C. Liquid asphalt (cutback) MC-800 or SC-800 conforming to the requirements of Section 93 of the Standard Specifications shall be used as the asphalt binder.
D. Mineral filler shall be mechanically reduced rock, conforming to the following gradations when tested in accordance with ASTM D422:

<table>
<thead>
<tr>
<th>Particle Size</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passing No. 200 sieve</td>
<td>75-100</td>
</tr>
<tr>
<td>Finer than 0.05 mm</td>
<td>65-100</td>
</tr>
<tr>
<td>Finer than 0.02 mm</td>
<td>35-65</td>
</tr>
<tr>
<td>Finer than 0.01 mm</td>
<td>26-35</td>
</tr>
<tr>
<td>Finer than 0.0005 mm</td>
<td>10-22</td>
</tr>
</tbody>
</table>

E. Mix Design:

<table>
<thead>
<tr>
<th>Mix</th>
<th>Type</th>
<th>Grade</th>
<th>Binder Content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>A</td>
<td>3/4&quot; max.</td>
<td>4.5 to 6.5</td>
</tr>
<tr>
<td>Patching</td>
<td>A or B</td>
<td>No. 4 max.</td>
<td>4.8 to 7.5</td>
</tr>
<tr>
<td>Open graded</td>
<td>--</td>
<td>3/8&quot; max.</td>
<td>5.0 to 8.0</td>
</tr>
</tbody>
</table>

2.02 TACK COAT
A. Material for tack coat shall be [SS-1, SS-1h] or [CSS-1 or CSS-1h] grade emulsified asphalt conforming to Section 94 of the Standard Specifications.
2.03 FOG SEAL
   A. Fog seal shall be SS-1, SS-1h, CSS-1 or CSS-1h asphaltic emulsion fog seal conforming to the requirements of Sections 37 and 94 of the Standard Specifications.

2.04 PRIME COAT (PENETRATION TREATMENT)
   A. Material for prime coat shall be liquid asphalt \[SC-70, SC-250, MC-70 or MC-250\] conforming to the requirements of Sections 92 and 93 of the Standard Specifications and ASTM D2027.

2.06 HEADERS
   A. At straight sections, wood headers shall be constructed of 2-inch x 6-inch construction heart redwood, held in place by 2-inch x 4-inch stakes, of the same materials, 2 feet long and set at 8-foot centers.
   B. At curved sections, wood headers shall be constructed of three 1/2-inch x 4-inch construction heart redwood bender boards. Boards shall be lapped at one-third of the length of individual boards, with no two boards lapped at the same place. Hold boards in place with stakes same as above.

2.07 AGGREGATE BASE
   A. Aggregate base shall conform to the applicable requirements of the Standard Specifications Section 26, for Class 2 or 3 aggregate base. The aggregate base shall conform to that specified for the \[1-1/2-inch or 3/4-inch maximum\], unless otherwise indicated. Paragraphs 26-1.06 and 26-1.07 are not applicable.

2.08 PARKING STRIPES
   A. Parking stripes paint shall be non-reflective Sherwin Williams Series 338-116(W), 338-117(Y) and 338-333(B), or Pervo Paint Company No. 4773-A(W), 4473-4A(Y) and 473-5A(B). Paint shall be stored at the project site in the manufacturer's sealed and labeled containers. Labels shall clearly identify the manufacturer, specification number, batch number, intended use, quantity and contract number.

2.09 TRAFFIC STRIPES AND PAVEMENT MARKINGS
   A. Thermoplastic material and glass beads shall comply with paragraphs 84-2.02 and 84-2.03 of the Standard Specifications.

2.10 TEMPORARY PAVEMENT (COLD MIX)
   A. Temporary pavement shall consist of No. 4 sieve maximum aggregate size, graded in accordance with Section 39 of the Standard Specifications. The aggregate shall be blended with 5-8% SC-800 liquid asphalt.

2.11 LIQUID ASPHALT DISTRIBUTOR
   A. The distributor used in applying all liquid asphalt shall be of the self-propelling type, of sufficient power and capacity to apply the asphalt under pressure uniformly and at the proper rate with not more than 10% variation therefrom. The distributor shall be equipped with tachometer and charts, pressure gauge, thermometer well, and thermometer; and shall have adjustable length spray bars of sufficient length to cover one-half of the roadbed at one time. The spray bars shall be adjustable vertically to permit application of the asphalt at the height above the surface approved by the Engineer and shall be of the full-circulating type with satisfactory cutoff device at each nozzle. The use of trailer-type distributors will not be permitted.
   B. A trough shall be located under the sprays, properly arranged to be swung out of the way after the sprays are operating in a uniform manner at the desired pressure or, in lieu thereof, building paper shall be spread over the treated surface for a sufficient length back so that the sprays are operating properly when the uncovered surface is
reached. If the cutoff is not sufficiently positive, the similar use of paper may be required at the end of the area being covered. The distributor shall be operated in such a manner that liquid asphalt will not be splashed on adjacent guardrails or structures. Any asphalt so splashed may be removed at the expense of and by the Contractor.

PART 3 - EXECUTION

3.01 GENERAL

A. This Specification shall cover newly paved areas as well as existing pavement restoration.
B. Where trenching or other construction activity has resulted in damage to a localized area of pavement, the damaged pavement shall be cut back 6 inches and shall be removed and replaced.
C. Where the damaged area extends over more than 50% of the road width or paved area, as determined by the Engineer, the full pavement width or area shall be cut away, removed and repaired.
D. Structures such as valve boxes, manhole frames and covers, and electrical vaults shall be adjusted to grade as necessary within paved areas.
E. Existing asphalt pavement islands of 50 ft² or less and strips 18 inches or less in width shall be removed and replaced.
F. Adjust existing manholes, meter boxes, cleanouts, etc. to match the new grade.

3.02 PAVEMENT CUTTING

A. After backfilling and prior to paving, proper tools and equipment shall be used in marking and breaking so that the pavement shall be cut accurately and on neat lines parallel to the trench. The asphalt pavement shall be saw cut (using a concrete saw) to a minimum depth equal to or greater than one-half the thickness thereof. The pavement shall be cut back 6 inches on each side of the trench or excavation wall. Any pavement damaged outside these lines shall be re-cut and restored at the expense of the Contractor. Should voids develop under existing pavements during construction, those affected pavements shall be neatly saw cut in straight lines and replaced after the voids have been filled.
B. Construct joints between successive runs vertical and at right angles to the line of the improvement. Exercise care in construction of all joints to ensure that the surface of the pavement is true to grade and cross-section. Lapped joints will not be permitted.

3.03 PLACEMENT OF AGGREGATE BASE

A. Subgrade Preparation: The subgrade shall be watered or dried as required to bring the soil, as close as practicable, to the optimum moisture content for proper compacting and then compacted, as specified, to a relative compaction of not less than 95% in the upper 6 inches. When compaction of the subgrade areas on fill and embankments has been properly obtained, only such additional rolling will be required as necessary to obtain a thoroughly compacted subgrade immediately prior to placing the aggregate base thereon.
B. Aggregate Base Tolerance: The aggregate base shall not be placed before the subgrade is approved by the Engineer. The finished aggregate base shall not vary more than 0.05 foot above, nor 0.10 foot below, the planned grade.
C. Aggregate Base Placing: The aggregate base material shall be spread on the prepared subgrade by means of approved spreading devices subject to approval by the Engineer; the aggregate base material may be dumped in piles upon the subgrade and spread by bulldozing ahead from the dumped material. Each layer shall not exceed 0.50 feet. Segregation of large or fine particles of aggregate shall
be avoided, and the material as spread shall be free from pockets of large and fine material.

D. Compaction: The relative compaction of each layer of compacted aggregate base material shall not be less than 95% as determined by California Test 216 or ASTM D1556 (Sand Cone), or California Test 231 or ASTM D2922 (Nuclear method when approved by the Engineer). Compaction shall be in accordance with Section 26-1.05 of the Standard Specifications. Aggregate base, after compaction, shall be watered as provided in Section 17 of the Standard Specifications. Paragraph 17-1.04 is not applicable.

3.04 PRIME COAT APPLICATION
A. Prime Coat: In advance of spreading paving materials, a prime coat of liquid asphalt shall be applied to all base course surface areas to be covered with asphaltic concrete.
   1. Preparation of Base Course: Immediately before applying the prime coat, the area to be surfaced shall be cleaned of all loose material by means of hand brooms.
   2. Application: Liquid asphalt shall be applied by pressure distributors at a temperature between 125 and 200°F. The Engineer reserves the right to require an adjustment of the temperature of the liquid asphalt at the time of placement. The rate of application shall be between 2/10 and 3/10 gallon per square yard. Excess liquid asphalt, which has failed to penetrate the base, shall be covered with fine sand. All loose sand shall be removed from the treated areas before placing any surfacing material thereon. Liquid asphalt shall not be applied when the atmospheric temperature is below 50°F. The prime coat shall be applied at least 24 hours in advance of paving. Immediately in advance of paving asphalt concrete surfacing, additional prime coats shall be applied, as directed by the Engineer, to areas where the prime coat has been damaged.

3.05 TACK COAT APPLICATION
A. Tack Coat: In advance of spreading bituminous material upon an existing bituminous or portland cement concrete surface, a tack coat shall be applied to all areas to be surfaced and to all vertical surfaces of existing pavement, curb, gutters and construction joints in the surfacing against which additional material is to be placed. When two or more lifts of asphaltic concrete are required, a tack coat shall be applied between each lift.
   1. Preparation: Immediately before applying a tack coat, the area to be surfaced shall be cleaned of all loose material.
   2. Application: The tack coat shall be applied by means of pressure distributors by pressure hand-spray equipment. The rate of application shall be 1/20 gallon per square yard. Emulsified asphalt shall not be applied when the atmospheric temperature is below 40°F. If emulsified asphalt Type SS-1 is used, it may be diluted with an equal part of water. The rate of application of the dilution shall be such that the rate of application of undiluted emulsion shall be within the tolerances specified.

3.06 PLACEMENT OF ASPHALT CONCRETE
A. Delivery and Spreading: Bituminous mixtures shall be delivered to the roadbed at temperatures specified in the Standard Specifications. Spreading of the mixture shall be in accordance with Section 39 of the Standard Specifications. Paragraph 39-8 does not apply. All loads shall be covered with tarpaulin or other material during transportation. The top layer of asphalt concrete shall not exceed
0.20 feet in compacted thickness. The next lower layer shall not exceed 0.25 feet in compacted thickness, and any lower layers shall not exceed 0.50 feet in compacted thickness.

B. Compaction: Initial or breakdown rolling and the final rolling of the uppermost layer of the asphalt concrete shall be compacted in accordance with Section 39 of the Standard Specifications. Paragraph 39-8 does not apply. Compaction by vehicular traffic shall not be permitted. The Engineer reserves the right to require an adjustment of the temperature of the asphalt concrete at the time of placement.

C. Pavement Thickness: Pavement shall match the existing adjoining pavement in thickness, or as indicated on the Drawings, or as specified, whichever is greater.

D. Joining Pavement: The joints between old and new pavements or between successive days' work shall be carefully made in such manner as to ensure a continuous bond between old and new sections of the course. Edges of existing pavement shall be exposed and cleaned and edges cut to straight, vertical surfaces. All joints shall be painted with a uniform coat of tack coat before the fresh mixture is applied.

E. Protection of Pavement: After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until it has cooled and hardened and in no case less than 6 hours.

3.07 APPLICATION OF FOG SEAL

A. A fog seal shall be applied to the upper surfaces of all installed asphalt concrete. It shall be applied in accordance with the applicable requirements of Section 37, BITUMINOUS SEALS, of the Standard Specifications, Seal Coats. Subparagraphs 37-1.08 and 37-1.09 are not applicable.

3.08 PAVEMENT RESTORATION

A. Final pavement restoration shall be made as soon as practicable after backfilling. In that period of time between backfilling and final pavement restoration, the trench shall be maintained level with the adjacent pavement and shall be covered with a 1-inch minimum layer of cutback. Prior to placing the final pavement, the temporary pavement shall be removed, the aggregate base excavated to the lines indicated on the Drawings, and the existing pavement edges saw cut as herein specified. The final asphalt pavement shall not be placed before the primed aggregate base surface is approved by the Engineer.

3.09 PENETRATION TREATMENT APPLICATION

A. Preparation of Base Aggregate Surface: Immediately before applying the first coat of the penetration treatment, the area to be treated shall be cleaned of all loose material.

B. Application:
   1. The penetration treatment shall be applied in three applications. The first application shall be applied at the rate of 0.5 gallon per square yard, and the second and third applications shall be applied at the rate of 0.25 gallons per square yard. The second and third application shall be placed two to three weeks apart as approved by the Engineer and after the previous applications have thoroughly penetrated the base.
   2. Liquid asphalt shall be applied by pressure distributors at a temperature between 140 and 255°F. The Engineer reserves the right to require an adjustment of the temperature of the liquid asphalt at the time of placement. Excess liquid asphalt, which has failed to penetrate the base in the third application, shall be covered with fine sand. Liquid asphalt shall not be applied when the atmospheric temperature is below 50°F.
3.10 SLURRY SEAL APPLICATION
A. A slurry seal shall be applied to the upper surface of all existing asphalt pavement prior to placing of the overlay. If the slurry seal is placed shortly before the overlay, and is cured, a tack coat may not be required. The slurry seal shall be applied in accordance with the applicable requirements of Section 37-2 of the Standard Specifications. Subparagraphs 37-2.07 and 37-2.08 are not applicable.

3.11 HEADERS
A. Install wood headers along pavement edges bordered by soil. Install new headers where existing wood headers are damaged during construction, or removed for construction. Install headers with uniform slope between spot elevation indicated on the Drawings or to conform to existing grades.

3.12 PAVEMENT MARKINGS
A. Preparation: Immediately before applying the paint, the pavement surface shall be thoroughly cleaned of all dust, dirt, scale, curing compound, oil, grease, or other objectionable matter as directed by the Engineer. Solvent material that will damage the pavement shall not be used as a cleaning agent.
B. Tolerances: Marking and striping shall be within 2 inches of the correct alignment. Dimensions of marking and stripings shall be within 1/2-inch.
C. Mixing: Mechanical mixers shall be used to mix paint. Prior to applying, the paint shall be mixed a sufficient length of time to thoroughly mix the pigment and vehicle together, and shall be kept thoroughly agitated during its application.
D. Application: Pavement marking shall be applied only on dry surfaces and only during periods of favorable weather. Painting shall not be performed when the atmospheric temperature is below 40°F when using solvent-borne paint or below 50°F when using water borne paint; when freshly painted surfaces may become damaged by rain, fog, or condensation; nor when it can be anticipated that the atmospheric temperature will drop below said 40°F or 50°F temperatures during the drying period.
   1. Immediately following the preparation of the pavement, the paint shall be applied. The paint shall be applied at the rate of 100 to 110 square feet per gallon of paint. The stripe painting machine shall have a compressor capacity of at least 105 cubic feet per minute and be capable of operating at an air pressure of 125 psi. The paint shall be mechanically agitated while the machine is in operation. The striping machine shall be equipped with a guide post so designed that the machine will hold exactly to the alignment. The propelling vehicle shall be equipped with a guide post so designed that the machine will hold exactly to the alignment. The propelling vehicle shall be equipped with a speedometer or tachometer, and with a suitable device for determining the quantity of paint in the container. The paint container and spray nozzles on the machine shall be thoroughly cleaned before starting each day's work. The stripe shall be of the required width, with clean, true edges and without sharp breaks.
   2. Allow ten days between the application of a bituminous seal coat and the permanent pavement marking. The paint shall not bleed, curl or discolor when applied to bituminous surfaces. If bleeding or discoloring occurs, apply an additional coat of paint.
   3. Remove existing permanent or temporary markings and striping which are to be abandoned or obliterated, by wet sandblasting or other favorably reviewed methods. Dry sandblasting may be used in selected areas only with prior approval of the Engineer and with approval of the air pollution control authority.
having jurisdiction over the area in which the work will be performed. Obliteration of traffic striping with black paint or light emulsion oil shall be done only with the prior favorable review shall not be used as a removal agent.

E. Provide all warning devices required to protect the painting operation and the finished work. Repaint, to the applicable specifications, any portion of the stripe damaged by any type of traffic within 24 hours after the stripe has been applied. For striping less than 50 feet in length, favorably reviewed portable painting equipment may be used.

END OF SECTION
PART 1 - GENERAL

1.01 SUMMARY
A. All materials and work required for the furnishing and installation of barbed wire fence, chain link fence, gates, gate operators, barbed wire and appurtenances, including temporary fence.
B. Related Sections:
   1. Section 03300: Cast-In-Place Concrete

1.02 REFERENCES
A. American Society for Testing and Materials (ASTM):
   1. A53 Specification for Pipe, Steel Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
   2. A121 Specification for Zinc-Coated (Galvanized) Steel Barbed Wire
   3. A702 Specification for Steel Fence Posts and Assemblies
B. State of California, Department of Transportation, Standard Specification (Standard Specification) [July 1992]

1.03 STANDARD SPECIFICATIONS
A. All work and materials shall conform to the requirements of Section 80 of the Standard Specifications, except as modified herein. Paragraphs 80-3.03, 80-3.04, 80-4.03 and 80-4.04 do not apply. In case of any conflict between the Standard Specifications and the Contract Plans and Specifications, the latter shall control.

1.04 SUBMITTALS
A. Submit in accordance with Section 01300.
B. Submit in the Product category complete descriptive information and technical specifications on the chain link fence, gates, gate operators, barbed wire and appurtenances.

PART 2 - PRODUCTS

2.01 TEMPORARY FENCING
A. Temporary fencing shall consist of hot-dip galvanized or painted steel, or pretreated or untreated wood posts and braces of suitable length and strength to provide for cantilever support of 5 strands of barbed wire with top strand placed 4 feet above the ground surface. Bottom wire shall be not more than 9-1/2 inches above ground surface and the remaining strands between top and bottom strands shall be equally spaced.

2.03 CHAIN LINK FENCING
A. Chain link fence fabric shall be 10 feet high and shall conform to Section 80-4.01B of the Standard Specifications except that larger mesh shall be provided as required to accommodate redwood privacy slats where slats are shown on the Drawings. Fabric shall have [twisted top and bottom knuckled top and bottom twisted top and knuckled bottom knuckled top and twisted bottom] selvages.
B. Unless otherwise shown on the Drawings, the fence shall have [top and bottom tension wires top rail and bottom tension wire], and outbound extension arms with three strands of barbed wire.

2.04 GATES
A. Gates shall be installed in the sizes and at the locations as shown on the Drawings.
B. Unless shown otherwise on the Drawings, gates for temporary fences and barbed wire fences shall be of the "cowboy" type as detailed for barbed wire fence gateways on the State of California, Department of Transportation, Standard Plans, [July 1992], Plan A86.
C. Unless shown otherwise on the Drawings, gates in chain link fences, or chain link gates in barbed wire fences, shall be of the same height as the adjacent fence. Fabric shall conform to Section 80-4.01B of the Standard Specifications. Gates shall be in accordance with Section 80-4.01D of the Standard Specifications, except as modified herein. Gate frames shall be of all welded construction and shall be hot-dip galvanized after construction. Top and bottom horizontal rails and vertical end members shall be 1-1/2-inch-diameter Schedule 40 steel pipe. On gates more than 8 feet wide, equally spaced interior vertical members of 1-1/2-inch-diameter Schedule 40 steel pipe shall be added such that no gate frame panel will be more than 8 feet wide. Gate frames shall have 3 strands of barbed wire across the top. Gates shall be furnished complete with all necessary hardware, including hinges, latches and stops.

1. Swinging Gates: All swinging gate panels shall be cross trussed with 3/8-inch-diameter truss rods with turnbuckles. Gates shall be hinged to swing open 180 degrees. All gates shall be furnished with a keeper and a plunger-bar type latch with provision for a padlock. On double swing gates the plunger-bar shall drop into a buried center stop when the gate is closed. Latches and padlocks shall be accessible from both sides of the gate.

2. Rolling Gates: All gate frames shall have 1-inch Schedule 40 steel pipe diagonal braces inside each gate panel. Diagonal braces shall be installed such that the high end of the braces shall be toward the forward end of the gate as the gate rolls closed (i.e., high end of the braces toward the end of the gate that rolls on the ground and low end of the braces toward the end of the gate that is supported on the adjacent stationary fence). Gates shall have two wheels that travel on two 1-1/4-inch-diameter Schedule 40 galvanized steel pipe rails attached to the adjacent stationary fence. These rails shall have stops to prevent the gate wheels from rolling off the back end of the rails when the gate is fully opened. The opposite end of the gate shall have a rubber wheel on grade and a grooved wheel that travels on a 2-inch by 2-inch steel angle inverted and set in the pavement. A 1-inch by 1-inch galvanized steel angle shall be welded to the back of the gate frame to support the operator drive chain. Coordinate with the gate operator manufacturer.

PART 3 - EXECUTION

3.01 TEMPORARY FENCING
A. Where it is necessary to temporarily remove or alter portions of the existing fence, the Contractor shall install adequate bracing to maintain original tension in the remaining fence. Temporary fencing shall be installed to maintain security. The fencing shall be of adequate design to prevent inadvertent access by either people or livestock. Upon completion of the work, remove the temporary fencing and rebuild and restore all fences to their original position, or revised position as shown on the Drawings, using all new material. Salvaged existing materials may be used if undamaged and if approved by the Engineer.

3.04 INSTALLATION OF CHAIN LINK FENCING
A. Install chain link fencing and gates at the locations shown on the Drawings and in accordance with Section 80-4.02 of the Standard Specifications. Chain link fabric and barbed wire shall be stretched with mechanical equipment.

B. The area to be fenced shall be uniformly and smoothly finish graded before beginning the fence installation. Fence shall be installed after roadway surfacing has been completed. Except where crossing a drainage ditch, the finish grade shall
not deviate from a straight line by more than 3 inches. Where crossing a drainage
ditch, a line post shall be provided at the top of slope on each side and the fabric
shall follow a straight line between the posts. Within the ditch, short post sections shall
be embedded to a depth of 4 feet at a maximum spacing of 12 inches on center
across the ditch. Posts shall be long enough to overlap the fabric by 12 inches, and
each post shall be fastened to the fabric by a minimum of 3 tie bands.

C. Corner and end post assemblies and the panels on each side of all gates shall be
as detailed on the State of California, Department of Transportation, Standard
Plans, [July 1992], Plan A85. Line posts at 1,000-foot maximum intervals shall
have top braces and cross truss rods with turnbuckles as detailed on Standard
Plan A85 even though fabric is stretched with mechanical equipment. Top brace
shall remain in place after fence is completed.

D. All posts shall be embedded into the ground in concrete footings as shown on the
Drawings. Install fence posts at 6-foot maximum spacing in the area of travel of
rolling gates. Allow concrete footings to cure for seven days before installing fence.

E. Fence fabric shall be securely fastened to the outward side of the posts with the
lower edge at the ground level. Fencing and gates shall be properly braced to
prevent sagging. Redwood privacy slats shall be installed vertically.

F. Demonstrate that all gates swing smoothly or roll freely without binding or dragging,
that all gates are lockable, and that all gate hardware operates properly.
Demonstrate that all automatic gate operators function properly.

G. Surplus excavated material remaining after the fence has been constructed shall be
disposed of as specified in Section [01140].

END OF SECTION
SECTION 02835
CHAIN LINK MESH ENCLOSURES

PART 1 - GENERAL
1.01 SUMMARY
A. Section Includes:
   1. Chain link fences and gates
B. Related Sections:
   1. Section 02830: Fences and Gates
      2. Section 10605: Wire Mesh Partitions

1.02 SUBMITTALS
A. Submit the following for Product Review in accordance with Section 01300.
B. Submit Product Data fully describing every item proposed for use.
C. Submit project specific shop drawings showing custom fabricated and manufactured items and assemblies.
D. Samples of wire chain link fabric in each of the manufacturers standard colors.

1.03 QUALITY ASSURANCE
A. Qualifications:
   1. All work under this Section must be furnished, fabricated and installed by a single subcontractor who must have at least 10 years experience fabricating and installing special purpose chain link enclosure. The subcontractor must have made at least three installations similar to the work required for this project for zoos within the last three years.
B. Regulator Requirements:
   1. Comply with the applicable sections of the adopted edition of the Building Code [and the California Building Standards Code].
   2. Comply with requirements in the California Code of Regulations (CCR) Title 8 and Federal OSHA.
C. Pre-Installation Meetings:
   1. Attend a pre-installation meeting with the Contractor [and Engineer] [and Construction Manager].

PART 2 - PRODUCTS
2.01 MANUFACTURERS/INSTALLERS
A. Acceptable manufacturers/installers are:
   1. Anchor Fence: 415-588-5000;
   2. AMICO Secure Fence: 301-927-4080;
   3. Or equal.

2.02 MATERIALS AND FABRICATED COMPONENTS
A. Chain link fabric shall be 11-gauge and have maximum 1-inch by 1-inch openings. Fabric shall have a thermally fused and bonded vinyl coating (ASTM F668, Class 2B) over galvanized steel wire. Color shall be selected from manufacturer’s standard colors. Furnish fabric in widths required to cover panels without joints or in widest available widths to minimize joints. Fabric shall be helically wound and woven to the width required by the panels shown on the drawings.
B. Fences shall have a top and bottom pipe rail.
C. Fence posts, braces, and top rails and mid-rails shall be Schedule 40 galvanized steel pipe ASTM A120. Line posts shall be the size required by the height of the post, but not less than 2.875 inches in diameter. Corner and end posts shall be the size required by the height of the post, but not less than 4 inches in diameter. Gate posts shall be a minimum of 6 inches in diameter. Braces and top rails shall be not less than 1.66 inches in diameter. Posts shall have galvanized caps to exclude
moisture. Truss rods shall be 3/8-inch-diameter galvanized steel. Turnbuckles, tension wires, tie wires, hog rings, hardware, and other accessories shall be as recommended by the manufacturer.

D. Provide fabricated truss bars to support chain link top cover. Design truss to support the greater of a line (roof) load of 10 lbs. per square foot or a concentrated load of 1,500 lbs. Trusses shall have a 2-inch minimum diameter Schedule 40 top and bottom chord at least 12 inches apart with welded diagonal members at least 1-1/4-inch Schedule 40.

E. Finish: All materials other than chain link fabric (posts, rails, gate frames, tension wire, tie wires, etc.), except nuts and bolts, shall be clad with polyvinyl chloride over galvanized steel in accordance with ASTM F668, Class 2B. Nuts and bolts shall be galvanized and have a baked-on enamel coating. Color of coating shall match color of fabric.

2.03 GATES

A. Gates shall be installed in the sizes and at the locations as shown on the Drawings.

B. Unless shown otherwise on the Drawings, gates in chain link fences shall be of the same height and materials as the adjacent fence. Gate frames shall be of all welded construction and shall be hot-dip galvanized after construction. Top and bottom horizontal rails and vertical end members shall be 1-1/2-inch-diameter Schedule 40 steel pipe. On gates more than 8 feet wide, equally spaced interior vertical members of 1-1/2-inch Schedule 40 steel pipe shall be added such that no gate frame panel will be more than 8 feet wide. Gates shall be furnished complete with all necessary hardware, including hinges, latches, padlock hasps, and stops. Fabric shall be the same as specified in paragraph 2.02 A of this Section. Finish on non-fabric parts shall be the same as specified in 2.02 E of this Section.

PART 3 - EXECUTION

3.01 INSTALLATION OF CHAIN LINK FENCE

A. Install chain link mesh enclosures and gates in the configuration shown on the Drawings. Chain link fabric and barbed wire shall be stretched with mechanical equipment.

B. The area to be enclosed shall be uniformly and smoothly finish graded before beginning the fence installation. Fence shall be installed after final grading has been completed.

C. All posts shall be embedded into the ground in concrete footings to the depths shown. Concrete shall have a minimum compressive strength of 3500 psi. Allow concrete footings to cure for 7 days before installing fence.

D. After installing posts and the concrete has cured 7 days, dig a narrow trench so the chain link fabric can be extended below grade as shown.

E. Install all top, bottom, intermediate, and bracing rails and cross-truss rods. Install horizontal truss bars spanning over the top of the enclosure.

F. Weld flat bars or tubes in place to close all openings between gates and gate posts and between chain link fabric and posts and all other openings or slots wider than 1/2-inch.

G. Fence fabric shall be securely fastened to the outward side of the posts with the lower edge below ground level as shown. Fencing and gates shall be properly braced to prevent sagging.

H. Demonstrate that all gates swing smoothly and freely without binding or dragging, that all gates are lockable, and that all gate hardware operates properly.

END OF SECTION
PART 1 - GENERAL
1.01 SECTION INCLUDES
A. Provide all:
   1. Landscape irrigation
   2. Soil preparation
   3. Landscape planting
   4. Decorative loose stone and bark surfacing
B. Related Work Specified Elsewhere:
   1. Section 03315: Concrete Work
   2. Section 15400: Plumbing
1.02 QUALITY ASSURANCE
A. Comply with all applicable requirements in the adopted editions of the [Uniform Building Code (UBC)], [Uniform Plumbing Code (UPC)], [California Building Code (CBC)] [and the California Plumbing Code (CPC)].
B. Comply with applicable local amendments to the above referenced codes.

PART 2 - PRODUCTS
2.01 TOPSOIL MIX
A. Fertile, friable topsoil free of refuse, roots, heavy or stiff clay, stones larger than 1 inch, weeds, weed seeds, sticks, brush, litter and other deleterious substances. Topsoil shall be free of toxic amounts of acid alkaline elements and shall be capable of sustaining healthy plant life.

2.02 SOIL AMENDMENTS
A. Redwood sawdust, or shredded fir bark, clean and free of large chips. Size: Fine 0 to 1/8-inch.
B. Commercial fertilizer, clean, uniform composition, in labeled bag containers showing the following analysis: 11% nitrogen; 9% phosphoric acid; 6% potash.

2.03 PLANT MATERIALS
A. Plants shall be first class representatives of their normal species or variety. They shall have normal or average branch systems and vigorous root systems. Plants shall be free from pests and diseases, disfiguring knots, scalds, abrasions of the bark, or other disfiguring injury. Plants not conforming to these requirements shall be rejected and must be removed immediately from the site. All plants shall be of the size, age and condition [required to match existing plants to be replaced]. Plants delivered to the site shall be adequately protected from sun and wind shock until planted.
B. Names of Plants and Standards: All plant materials shall conform to the standards as outlined by the Association of Nurserymen.
C. Inspections: The Contractor shall be responsible for all inspection of plant materials required by the state, federal and county authorities and shall provide the necessary certificates.
D. Container Stock: Container stock shall have been well established in the container in which delivered. The roots shall not have grown beyond the limits of the container.
E. Quantities: Quantities necessary to restore or replace existing landscaping and provide full coverage [to complete the work shown on the drawings] shall be furnished.

2.04 LANDSCAPE IRRIGATION MATERIALS
A. Pipe, fittings and related material matching existing.
2.05  GRASS SOD
   A.  Blue/rye grass  [or other grass mixture matching the existing lawn]  nursery grown, 
       harvested as a sod and delivered in rolls.

2.06  DECORATIVE LOOSE SURFACING
   A.  Stone Aggregate:  Clean, dry natural stone aggregate matching existing material in 
       type, size and color.
   B.  Tan Bark:  Clean, dry fir bark matching existing material in type and size.

PART 3 - EXECUTION

3.01  SOIL PREPARATION
   A.  Scarify existing soil to a depth of 6 inches and incorporate soil amendments and 
       fertilizer.  Bring soil to grade or slightly above grade by adding topsoil.
   B.  Compact soil surface with a lawn roller or tamper.

3.02  INSTALLING SOD
   A.  Cut existing soil surface down so that when sod is placed the finished surface will be 
       flush with existing grass lawn and flush with or slightly above adjacent pavement.

3.03  INSTALL PLANT MATERIALS
   A.  Dig holes for plants at least 6 inches larger all around than the plant’s rootball.
   B.  Scarify sides of hole.
   C.  Place plant on a 2-inch layer of new topsoil, place plant in hole, and backfill with 
       topsoil.
   D.  Place plants high enough so that when they settle in place the crown of the rootball 
       will be slightly above surrounding grade.
   E.  Place a mulch of 3/4-inch fir bark all around new plant materials.
   F.  Stake all 5-gallon and larger plants.

3.04  WATERING AND MAINTENANCE
   A.  Water and sod and plant material immediately after planting.
   B.  Maintain and guarantee all plant material and sod for 30 days after planting.  Keep 
       material watered and in good growing condition.  Replace sickly or dying plant 
       material.

3.05  ADJUSTMENT OF FINISHED SURFACE LEVELS
   A.  In planted or sodded areas make a final adjustment of finished levels after 30 days. 
       It is essential that finished grades are flush with adjoining paving within 1/4-inch as 
       required by Accessibility Standards in Federal ADA and the  [California Building 
       Code].

3.06  ADJUSTING THE HEIGHT OF EXISTING SPRINKLER HEADS
   A.  Raise existing sprinkler heads to be flush with the new soil levels.  Cut the existing 
       pipe and install new pipe fittings where required.
   B.  Replace existing damaged sprinkler heads with new sprinkler heads matching the 
       replaced heads in quality and function.

END OF SECTION
SECTION 05560
METAL FABRICATIONS

PART 1 - GENERAL
1.01 SUMMARY
A. Section Includes:
   1. All metal fabrications and other miscellaneous metal items together with related
      accessory items and fasteners, including:
      a. Steel ladders.
      b. Floor plate support angles.
      c. Floor plates.
      d. Structural steel columns, beams and other miscellaneous steel framing.
      e. All other metal fabrications and miscellaneous metal not covered under
         other sections.
B. Related Sections:
   1. Section 06100: Rough Carpentry - manufactured framing hardware for wood
      framing

1.02 REFERENCES
A. Publications:
   1. American Institute of Steel Construction: “Specifications for the Design,
      Fabrication and Erection of Structural Steel for Buildings” (AISC), latest edition.
   2. Publications of the National Association of Architectural Metal Manufacturers
      (NAAMM): “Metal Product Outline; Division 5 Metal.”

1.03 SUBMITTALS
A. Submit the in accordance with Section 01300.
B. Product Data: Fully describe every product proposed for use.
C. Shop Drawings:
   1. Show dimensions, finishes, joining, attachments, inserts, and relationship of
      work to adjoining construction.
   2. Indicate all shop and erection details including cuts, copes, connections, holes,
      threaded fasteners and welds. Indicate welds using AWS "Welding Symbols."
   3. Show field measured dimensions of this and adjacent work and location of
      inserts on fabrication drawings.

1.04 QUALITY ASSURANCE
A. Contractor: Qualifications: Welding procedures, welders, and welding operations
   shall be qualified for the type of work required in accordance with AWS Standard
   Qualification Procedures.
B. Regulatory Requirements: Comply with the following codes and reference
   standards unless higher standards are specified, shown or required by applicable
   codes:
   1. "Specification for the Design, Fabrication and Erection of Structural Steel for
   2. Structural Welding Code of the American Welding Society, AWS D1.1, latest
      edition.
   4. Ladder design requirements in UBC, CCR Title 24, OSHA and Cal-OSHA.
C. Testing: Provide expansive anchor bolt and epoxy anchor bolt pull out testing as
   required under Part 3 of this Section.

1.05 DELIVERY, STORAGE AND HANDLING
A. Deliver anchorage devices, which are to be embedded in the work of other trades to the project site in sufficient time to permit their timely installation. Provide proper setting drawings, templates and directions for installation of these items.

B. Store materials above ground on platforms, skids or other supports. Store all fasteners and welding electrodes in a weathertight and dry place until ready for use. Store packaged materials in their original containers.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

A. Standard Structural Steel Shapes, Bars and Plates: ASTM A36.

B. Architectural and Miscellaneous Steel Items: ASTM A283, Grade A.

C. Steel Tubing: ASTM A500, (cold formed) Grade A, or ASTM A501 (hot formed), welded or seamless.

D. Aluminum: Alloy 6016-T6 or 6063-T5, T6 or T832.

E. Bolts and Nuts: ASTM A307, Grade A.

F. Plain Washers: ANSI B27.2, Type A.

G. Beveled Washers: ANSI B27.4.

H. Expansion Shield Anchor Bolts and Drive Pins for Attaching Items to Concrete or Masonry:
   1. Expansion anchor bolts shall be machine bolts inserted in separate double metal wedge lead expansion shields. Minimum bolt size 1/2-inch-diameter. Minimum embedment in concrete or masonry 3 inches. Do not load in excess of 1/4 of certified test value. RAWL Doubles; Keystone Double Wedge; or equal. Use where noted and for:
      a. Loads of 1,000 pounds or over.
      b. To attach all machines and devices with moving parts.
      c. For all loads in Tension or Withdrawal.
   2. Wedge anchor bolts, special machine bolts with built-in expanding wedge. Minimum size: 3/8-inch-diameter by 3-inch embedment in concrete or masonry. Do not load in excess of 1/4 of certified test value. Phillips Red Head Wedge Anchors WS series; Wej-it expansion bolts; or equal. Use where noted and for:
      a. Loads less than 1,000 pounds.
      b. Loads in shear only.
      c. Do not use for loads in Tension or Withdrawal or for loads subject to vibration.
   3. Drive-anchors: One-piece deformed spring steel anchor: RAWL- Drives; Buildex; or equal. 1/4-inch-minimum diameter. Drive shall be long enough so that all of the deformed portion plus 1/2-inch will be embedded in the concrete or masonry. Use for loads less than 200 pounds.

I. Grout: Hydraulic cement, non-shrinking, quick-setting, unaffected by water after setting and conforming to ASTM C595. Burk Plug, Super Por-Rock; or equal.

2.02 GALVANIZING

A. Hot-dip galvanize all exterior ferrous metal work and all interior ferrous metal work so noted.

B. Hot-dip galvanize all sheet steel, plain or shaped in accordance with ASTM A525, Commercial Class 1.25 ounces per square foot.

C. Hot-dip galvanize all products fabricated from rolled, pressed and forged steel shapes, plates, bars and strip 1/8-inch thick or heavier, in accordance with ASTM A123.
D. Hot-dip galvanize all steel hardware, nuts, bolts, washers, anchors, and threaded rods in accordance with ASTM A153. Size thread clearance to allow for galvanized coating; rerun threads after galvanizing, if required, to assure a smooth fit.

2.03 GALVANIZING REPAIR
A. Repair damaged galvanizing by heated repair method. Repair materials shall be Galvalloy as manufactured by Metalloy Products Company, 1341 Sussex Lane, Newport Beach, CA, telephone (714) 642-3435, Distributor: Victor California, 766 Harrison Street, San Francisco, CA 94107, telephone (415) 421-9231; or Gal-Viz as manufactured by Thermacote Welco, Pasadena, CA, telephone (213) 681-6627.
1. Heat substrate to 600°F, or apply hot process touch-up material right after welding before metal has cooled below 600°F.
2. Rub bar of specified galvanize repair material over surface of hot substrate to apply a uniform coating of zinc. Wire brush hot coating with a clean wire brush to smooth out and bond zinc coating to substrate.

2.04 SHOP PRIMING
A. Refer to Section 09900 for surface preparation, pretreatment, primers, and application techniques.
B. Apply one shop coat of [rust inhibiting primer] [aromatic urethane zinc-rich primer] in accordance with the requirements of Section 09900 to all steel fabrications not scheduled to be galvanized.
1. Apply two coats of primer to surfaces not in contact but inaccessible after assembly.

2.06 FABRICATIONS
A. Ladders, Steel:
1. Rails: 2-1/2-inch x 3/8-inch flat bar drilled or punched for insertion of rungs.
2. Rungs: 1-inch-diameter solid bar inserted into holes drilled in rails and welded on the outside. Space rungs equal distance apart.
3. Provide brackets, welded to rails, spaced 8 feet on centers maximum for attachment to concrete or masonry with two 3/4-inch-diameter drilled anchor bolts at each connection.
4. Hot dip galvanize after fabrication.
5. Coat rungs with an epoxy base paint containing aluminum oxide grit; Wooster “Safe-Stride” Anti-slip paint; or equal.
6. Provide a retractable ladder extension where ladder does not extend above the highest surface served: Bilco “Ladder Up,” equivalent by Saf-T-Climb; or equal.
B. Ladders, Aluminum:
1. Material: Aluminum alloy 6063-T5 or T6.
2. Rails: 1/2-inch x 3-inch flat bar.
4. Brackets: 1/2-inch x 3-inch bent brackets.
5. Fabrication:
a. Weld all joints using a gas shielded arc. Size weld to develop full strength of member. Grind welds smooth.
b. Drill rails; insert end of rung in hole and weld on outside of rail.
c. Shop weld brackets to rail; one bracket within 1 foot of each end and intermediate brackets at 5-foot maximum centers.
d. Round all exposed edges. Grind all corners to 1/4-inch radius.
e. Space rungs so that all steps including the lowest and the highest are an equal distance apart and do not exceed 12 inches.
f. Anodize all parts after fabrication, 0.7 mils, Architectural Class I, \[clear AA-C22-A41\] \[dark bronze AA-C22-A42\].
g. Provide retractable ladder extension where ladder does not extend above the highest surface served. Manufacturer: Bilco Ladder-Up; Saf-T-Climb; or equal.
h. Provide alloy 304 stainless steel chain, eye bolts and chrome-plated brass snap fasteners to close ladder access openings in guardrails. Use chain that has 13 welded links of 3/16-inch-diameter stainless wire.
i. Isolate aluminum from concrete, galvanized steel and other dissimilar metal with plastic tape or bituminous paint.

C. Floor Plate Support Angles:
1. Floor plate frames shall be of the same material as the gratings they support unless noted otherwise.
2. Install floor plate support angles where shown on the Drawings. They shall be fabricated in complete, closed frames in such a manner that they lie completely flat and in a true plane. When installed they shall support the floor plates with even, uniform, non-rattling bearing.
3. In fabricating the closed frames, the Contractor shall take precautionary measures to prevent twisting of the frame due to any large ratio of length to width. Long, narrow frames shall be designed and fabricated to retain the grating in closed frames not exceeding 10 feet in length, or as shown on the Drawings.
4. Coat surfaces of aluminum floor plate support frames with bituminous mastic.

D. Floor Plates: Aluminum 1/4-inch-thick checker plate with stiffeners as required to support required loads. Support on a welded angle iron frame as detailed and set 1/4-inch below the floor so that the surface of the floor plate will be flush with the floor.

2.07 ATTACHMENTS
A. Metal Anchors: Metal anchors of sizes and material noted on the Drawings shall be detailed for installation when concrete is being placed. All anchors or anchor bolts shall be full diameter dimension. All frames shall be rigidly anchored in place with anchors of detail required for each specific location. All metal anchors or anchor bolts shall be galvanized, unless otherwise shown or specified. Welding studs (Nelson studs) shall not be used to anchor members to concrete.

PART 3 - EXECUTION
3.01 ERECTION TOLERANCES
A. Finished work shall conform to a straight line or flat plane to within 1/8-inch in 8 feet and to within 1/4-inch total deviation.
B. Curved surfaces shall conform to a true arc of a circle to within 1/16-inch in 6 inches.

3.02 INSTALLATION GENERAL
A. Fabricate and pre-fit metal work in the shop, in transportable components ready for field erection.
B. Make proper allowance for expansion and contraction of the metals and of the materials to which they are fastened.
C. Where metal is fastened to concrete, make the connection by means of sleeves and fastenings embedded in concrete or by expansion shield anchor bolts or wedge anchor bolts. Wood plugs, plastic plugs or powder driven studs are not acceptable.
D. Construct steel work in accordance with AISC Standard practices to withstand the forces normally applied and in compliance with \[UBC and\] OSHA requirements.
E. Furnish anchor bolts and other connectors required for connection to concrete or other materials. Test 25% of anchor bolts for withdrawal.

F. Set structural members to lines and elevations shown. Align and adjust members before making permanent connections.

G. All metal work exposed to view shall have all welds ground smooth. Exposed work shall:
   1. Have finished surfaces that are flat, straight, square, plumb and level.
   2. Curves shall be smooth, free of flat spots, and of uniform radius or if intended to be of changing radius, shall be a flowing fair curve.
   3. Transitions between curved and straight portions of work shall be made at tangent points and shall be smooth and free flowing without flat spots or abrupt changes in direction.

H. All metal work subjected to contact by personnel shall have all corners rounded or chamfered, all edges ground smooth.

I. Perform all welding in accordance with AWS Code D1.1. Employ methods and techniques to achieve strength and good appearance.

J. Field assembly: Set members to lines and elevations indicated. Align and adjust members before making permanent connections.

K. Galvanized metal repair: Repair damaged galvanized metal by the heated substrate method as specified in paragraph 2.03.

L. Touch-up painting (ferrous metals): After field assembly, clean all bare metal and all abrasions to shop coat, and spot paint with same primer used in the shop.

3.03 LADDERS
A. Install ladders with stainless steel expansion anchor bolts.
B. Locate first rung same distance above surface below it as space between other rungs.

3.04 MISCELLANEOUS
A. Furnish the following for field installation:
   1. Custom fabricated steel connectors for wood beams and other rough carpentry work.
   2. Miscellaneous metal work not specified in other sections.

3.05 REPAIRS
A. Repair or replace all defective work including:
   1. Unsightly welds.
   2. Discontinuous welds.
   3. Uneven connections.
   4. Variations exceeding specified tolerances.
   5. Kinks, bends.
   6. Other defects affecting the quality, strength, utility and appearance of the work.

3.06 CLEANING
A. Wash thoroughly using clean water and detergent.
B. Do not use acid solutions, steel wool or other abrasives.
C. Remove stubborn grease stains with mineral spirits.

END OF SECTION
SECTION 05500
METAL FABRICATIONS (MISCELLANEOUS METAL)

PART 1 - GENERAL
1.01 SUMMARY
A. Section Includes:
   1. All metal fabrications and other miscellaneous metal items together with related
      accessory items and fasteners, including:

1.02 REFERENCES
A. American National Standards Institute:
   1. B18.23.1 Beveled Washers

1.03 SUBMITTALS
A. Submit in accordance with Section 01300.
B. Product Data: Fully describe every product proposed for use.
C. Shop Drawings:
   1. Show dimensions, finishes, joining, attachments, inserts, and relationship of
      work to adjoining construction.
   2. Indicate all shop and erection details including cuts, copes, connections, holes,
      threaded fasteners and welds. Indicate welds using AWS "Welding Symbols."
   3. Show field measured dimensions of this and adjacent work and location of
      inserts on fabrication drawings.
   4. Submit a full floor plan layout and details for all gratings and grating frames.

1.04 QUALITY ASSURANCE
A. Contractor’s Qualifications: Welding procedures, welders, and welding operations
   shall be qualified for the type of work required in accordance with AWS Standard
   Qualification Procedures.
B. Regulatory Requirements: Comply with the following codes and reference
   standards unless higher standards are specified, shown or required by applicable
   codes:
   1. "Specification for the Design, Fabrication and Erection of Structural Steel for
   2. Structural Welding Code of the American Welding Society, AWS D1.1, latest
      edition.
   3. Uniform Building Code (UBC), adopted edition, especially paragraphs 509,
      Guardrails and 1006.9, [CBC 1006.9a] Handrails.
   4. Stair, guardrail and accessibility design requirements in [UBC],
      [CCR Title 24], OSHA and [CCR Title 8 Cal-OSHA] and the Federal
      Americans with Disabilities Act (ADA).
C. Testing:
   1. Test materials in accordance with Section 05100.
   2. Test welding in accordance with Section 05100.

1.05 DELIVERY, STORAGE AND HANDLING
A. Deliver anchorage devices that will be embedded in the work of other trades in
   sufficient time to permit their timely installation. Provide proper setting drawings,
   templates and directions for installation.
B. Store materials above ground on platforms, skids or other supports. Store all
   fasteners and welding electrodes in a weathertight and dry location until ready for
   use. Store packaged materials in their original labeled containers.

PART 2 - PRODUCTS
2.01 MATERIALS, GENERAL
A. Standard Structural Steel Shapes, Bars and Plates: ASTM A36.
B. Architectural and Miscellaneous Steel Items: ASTM A283, Grade A.
C. Steel Tubing: ASTM A500, (cold formed) Grade A, or ASTM A501 (hot formed), welded or seamless.
D. Steel Pipe: Seamless, conforming to ASTM A53, Type E or S, Grade B.
E. Aluminum: ASTM B483, Alloy 6061-T6 or 6063-T5 or T6.
F. Bolts and Nuts: ASTM A307, Grade A.
G. Plain Washers: ASTM F844.
I. Weld Type Bends and Fittings for Pipe Guardrails, Handrails and Stair Rails: R&B Wagner, Inc.; J.G. Braun; or equal.
   1. Provide manufactured preformed side outlet (3-way) elbows, radius elbows, bends, tees, crosses and other fittings of flush design for welded assembly.
   2. Provide elbows with a 1-inch inside radius.
   3. Provide three-way elbows with a 1/8-inch inside radius.
   4. Provide inside alignment sleeves.
J. Concrete Inserts for Guardrail Posts: 16-gauge galvanized steel sleeves, or foam polystyrene inserts 1/2-inch larger than post diameter x 6 inches (150 mm) deep with removable slip-on plastic covers.
K. Anchorages to Concrete and Masonry:
   1. Refer to Section 05100 for anchors carrying shear or tension loads 400 lbs. or more.
   2. Provide cast-in-place, expansion or bonded anchorages with minimum size 3/8-inch-diameter, 3-inch embedment.
   3. Provide a satisfactory evaluation report by ICBO.
   4. Do not load the anchorage in excess of half the ICBO values without inspection by Engineer.
   5. Material: Galvanized steel, [stainless steel] as noted.
   6. Do not use for loads in tension or withdrawal or for loads subject to vibration.
L. Drive-Anchors: One-piece deformed spring steel anchor: RAWL-Drives, Buildex, or equal. 1/4-inch minimum diameter. Drive anchors shall be long enough so that all of the deformed portion plus 1/2-inch will be embedded in the concrete or masonry. Use for loads less than 200 pounds.
M. Non-Shrink Grout: ASTM C1107, Grade B (construction) [Grade C (precision)] with no shrinkage as measured by ASTM C827. Furnish a pre-mixed product consisting of properly proportioned amounts of non-metallic dimensionally stable material to which water is added.
N. Handrail Wall Brackets for Steel Railing: 1/4-inch formed steel drilled for screw attachment to pipe rail and expansion bolt anchor to wall, Wagner H-B-1 type 1-H; Blumcraft wall bracket; or equal.
O. Safety Stair Nosings: Nosing base to be extruded aluminum type 6063-T5 filled with resilient epoxy binder (13%) combined with a filler that contains at least 60% aluminum oxide abrasive. Provide a minimum coefficient of friction of 0.50. Furnish in two contrasting colors having a difference in light reflectivity of at least 70% to meet [CCR Title 24 and] ADA requirements for the visually impaired. Top surface 3 inches wide; 1/4-inch thick. American Safety Tred #9511 for concrete filled pan stairs and #3511 for poured concrete stairs; equivalent products by Wooster; or equal.
P. Fusion Epoxy Coating:
   1. Fusion epoxy coating material shall be 100% dry powder epoxy resin as manufactured by Minnesota Mining and Manufacturing Company “Scotchkote
No. 203," Michigan Chrome and Chemical Company "Micron No. 650," or equal.
2. Field touchup of the epoxy coating with Scotchkote No. 306, equivalent Micron
system, or equal, as recommended by the manufacturer.

2.08 ATTACHMENTS
A. Metal Anchors: Provide metal anchors required to secure all frames and other items
rigidly in place and detailed for installation into concrete forms prior to placing
concrete.
B. Anchor Bolts: Full diameter hot-dip galv
anize steel unless otherwise shown.
DO NOT USE welding studs (Nelson studs) to anchor members to concrete.

PART 3 - EXECUTION
3.01 ERECTION TOLERANCES
A. Conform to straight plumb and horizontal lines which also form a true flat plane to
within 1/8-inch in 2 feet and 1/4-inch in 10 feet and 1/2 maximum overall.
B. Curved surfaces shall conform to a true arc of a circle to within 1/8-inch in 12 inches
and 1/4-inch maximum overall.

3.02 INSTALLATION GENERAL
A. Fabricate and pre-fit metal work in the shop, in transportable components ready for
field erection.
B. Make proper allowance for expansion and contraction of the metals and of the
materials to which they are fastened.
C. Where metal is fastened to concrete, make the connection by means of sleeves and
fastenings embedded in concrete or by expansion shield anchor bolts or wedge
anchor bolts. Wood plugs, plastic plugs or powder driven studs are not acceptable.
D. Construct steel work in accordance with AISC Standard practices to withstand the
forces normally applied and in compliance with [UBC and] OSHA requirements.
E. Grind welds smooth on all metal work exposed to view. Provide work that has:
1. Surfaces that are flat, straight, square, plumb and level.
2. Smooth curves, free of flat spots, and of uniform radius or, if intended to be of
changing radius, follow a flowing fair curve.
3. Make transitions between curved and straight portions of work at tangent points
to achieve smooth and free flowing lines and surfaces without flat spots or
abrupt changes in direction.
F. Provide 1/8-inch radius corners and edges on all exposed work.
G. Perform all welding in accordance with AWS Code D1.1. Employ methods and
techniques to achieve strength and good appearance.
H. Field Assembly: Set members to lines and elevations indicated. Align and adjust
members before making permanent connections.
I. Galvanized Metal Repair: Repair damaged galvanized metal by the heated
substrate method as specified in paragraph 2.03.
J. Touchup Painting (Ferrous Metals): After field assembly, clean all bare metal and
all abrasions to shop coat, and spot paint with same primer used in the shop.

3.03 GUARDRAILS AND HANDRAILS
A. Provide workmanship of the highest quality performed by mechanics skilled in
executing high quality architectural metal work.
B. Set shop fabricated guardrail sections into position and align the top rail so that it is
ture to specified tolerances. Do field joining neatly and inconspicuously.
C. Install horizontal sections of guardrail with the top rail exactly horizontal. Vary the
height of the rail as required to accommodate sloping deck surfaces. Maintain code
required minimum and maximum rail heights.
D. Support guardrails with temporary braces and shoring to maintain true alignment until all final connections and grouting are completed.

3.04 STAIRS AND PLATFORMS
A. Furnish anchor bolts and other connectors required for connection to concrete or other materials.
B. Set structural members to lines and elevations shown. Align and adjust members before making permanent connections.
C. Where stairs land on sloping floors, the height of the first riser at the center of the stair shall be equal to the height of all other risers.

3.05 METAL STAIR NOSINGS
A. Provide safety stair nosings in accordance with paragraph 2.01 of this Section at all concrete stairs and landings. Make nosings the full length of each tread less 2 inches at each end. Protect exposed surfaces of safety nosings during construction and leave the surfaces clean and free of concrete and staining.
B. For interior stairs, provide a top and bottom nosing that contrast with adjoining surfaces and nosings on intermediate treads. For exterior stairs, provide nosings on all treads that contrast with surrounding surfaces. Adequate contrast is defined as a 70% difference in light reflectivity.

3.06 STEEL LADDERS
A. Install ladders with stainless steel expansion anchor bolts.
B. Locate first rung same distance above surface below it as space between other rungs.

3.07 GRATINGS AND FLOOR PLATES
A. Install support frames so that gratings and floor plates have continuous support and so gratings and floor plates will sit in their frames without rattling or rocking in any direction including across diagonal corners.

3.08 MISCELLANEOUS
A. Furnish the following for field installation:
   1. Custom fabricated steel connectors for wood beams and other rough carpentry work.
   2. Door frames made of structural steel shapes for installation in the concrete pour. Provide all anchors and connectors.
   3. Miscellaneous metal work not specified in other sections.

3.09 REPAIRS
A. Repair or replace all defective work including:
   1. Unsightly welds.
   2. Discontinuous welds.
   3. Uneven connections.
   4. Variations exceeding specified tolerances.
   5. Kinks, bends.
   6. Other defects affecting the quality, strength, utility and appearance of the work.

3.10 CLEANING
A. Wash thoroughly using clean water and detergent.
B. Do not use acid solutions, steel wool or other abrasives.
C. Remove stubborn grease stains with mineral spirits.

END OF SECTION
SECTION 09900
PAINTING

PART 1 - GENERAL

1.01 SUMMARY
A. Section Includes:
   1. A painter’s finish on all exterior and interior surfaces, except:
      a. Integrally finished materials such as ceramic tile, brick, glass, concrete masonry units, concrete floors, laminated plastic, resilient flooring, carpet, etc.
      b. Factory finished items such as acoustic panels, acoustic tile, exposed T-grid suspension systems, toilet partitions, anodized aluminum, light fixtures, etc.
   2. Painter’s top coat or refinishing coat in a color to match adjacent surfaces on:
      a. Miscellaneous mechanical and electrical items that are furnished with a factory finish that does not match the color of surrounding surfaces such as panelboards, air supply or return registers, fire extinguisher cabinets, hose reel cabinets, access doors and similar items that are located in finished walls or ceilings.
   3. Back prime woodwork prior to installation. See Section 06100 [and 06200].
   4. Prime coat paint all exposed and concealed surfaces of sheetmetal flashings prior to installation including the inside of galvanized steel rainwater gutters and downspouts. See Section 07600.

1.02 REFERENCES
A. Where standards of surface preparation are described by citing SSPC specification numbers reference is made to the “Steel Structures Painting Manual” Volume 2 published by the Steel Structures Painting Council.

1.03 SUBMITTALS
A. Submit in accordance with Section 01300.
B. Contractor Qualifications: Submit a list of at least five projects completed in the past five years where High Performance Coatings similar to those required for this project were applied by the Specialty Painting Contractor proposed for this project.
C. Product Data:
   1. Submit complete technical data on all materials to be used on the project for review prior to ordering material. Include manufacturer’s brand name and type of material for each coat of each system to be used.
   2. If products manufactured by makers other than the first named product by the first named maker listed in Part 2 of this Section are submitted, submit supporting performance test results prepared by an independent paint testing laboratory for comparison with the performance of the first named product by the first named maker.
   3. If the Contractor’s second submittal of a proposed equivalent material is not favorably reviewed the Contractor will be back-charged by the Owner for the cost of subsequent reviews.
D. Manufacturer’s Certification: That products furnished meet applicable Air Quality Management District regulations as to allowable VOC content for the place of application and use intended.
E. Samples: For paints submit two 8-1/2 by 11-inch brush-outs of each paint system and each color on cardboard. For stains and transparent finishes submit two complete sample finishes on 8-1/2 by 11-inch pieces of the wood that will be used on the project.
1.04 QUALITY ASSURANCE
   A. Contractor Qualifications: The Contractor is cautioned that the application of High Performance Architectural Coatings (HPAC) specified under this Section requires special skill, knowledge and equipment. In submitting his bid, the Contractor represents that he is skilled and experienced applying these coatings, has studied the material manufacturer’s application requirements for the materials specified, agrees that the materials is suitable for intended use, and has included in his bid the coat of all labor and material required to achieve a successful coating system meeting the performance requirements of the contract documents.
   B. Regulatory Requirements: All work, material, procedures and practices under this Section shall conform with requirements of the Federal Standard 40 CFR on air quality control, and the requirements of the local Air Resources Board or Air Quality Management District having jurisdiction. Coatings or primers applied at locations other than the project site shall be done in accordance with local air quality regulations in effect at the place the coating is applied.

1.05 WARNING
   A. The Contractor is advised that application of paint and finishing material may be hazardous. The Contractor shall take all necessary precautions to ensure the safety of workers and property.

1.06 DELIVERY, STORAGE AND HANDLING
   A. Deliver all materials in unopened containers with manufacturer’s label. Label shall state VOC content.
   B. Store in assigned area. Maintain storage area clean and fire safe. Dispose of used rags and clean buckets daily. Store solvents in closed approved storage containers.
   C. Submerge solvent soaked rags in water.

1.07 PROJECT CONDITIONS
   A. Environmental Requirements:
      1. Provide ambient temperatures recommended by manufacturer of material to be applied.
      2. Provide adequate ventilation.
      3. Provide 40- to 50-foot candles of illumination on all surfaces in areas to be painted including floors, walls and ceiling even though they do not require painting.
      4. Use temporary dust barriers to close off areas being painted from areas where other work is being performed.

1.08 COLORS AND COLOR SAMPLES
   A. Before starting work, obtain color schedule and samples of colors selected for this project by the Architect. The colors selected may not be standard colors for the manufacturer whose materials are being used in which case custom colors shall be mixed to match the samples provided by the Architect. “Deep tone” highly pigmented accent colors may be selected for up to 10% of the area painted.
   B. Colors are to be factory or machine mixed, using light-fast colorants proportioned by accurate measurement into a proper tinting base. The color formula for each color shall be submitted to facilitate future color matching.
   C. Exterior deep tone colors are to be factory ground into the pigment for maximum color fastness.

PART 2 - PRODUCTS
2.01 MATERIALS
   A. Coatings used shall be “top of the line” and of the type recommended by the manufacturer for the intended use and substrate.
B. Applicable Air Quality Management District regulations prohibit the manufacture, sale or application of Architectural Coatings and Specialty Coatings having greater than stipulated levels of volatile organic compounds.

C. The Contractor shall base his bid on using the products specified. If the products specified are not available in formulations that meet applicable Air Quality Management District regulations on maximum VOC levels, the Contractor shall submit products of equivalent quality and function that comply with regulations in effect at that time.

D. If the Contractor applies any coatings for which it has not submitted certificates indicating the VOC content and that the product complies with applicable Air Quality Management District regulations, or if it applies coatings that have been modified or thinned other than as recommended by the manufacturer, the Contractor shall be responsible for any fines, costs, remedies, or legal actions that may result.

E. The Contractor shall not submit or use any material containing Trichlorethylene III because of its potential cancer causing properties. If any of the materials specified in this Section contain trichlorethylene, they shall be considered deleted from this Specification.

2.02 SPECIALTY COATINGS: PRIMERS, STAINS, SEALERS AND CLEARS

A. Products and makers listed establish type of material and level of quality. Equivalent products manufactured by ICI Dulux Paint Stores, Sherwin-Williams, or equal may be submitted for review.

B. Specialty Coatings: Coatings listed under this category include primers, sealers, stains and clear coatings. All products provided shall comply with the maximum allowable VOC limit assigned to that category of product by the Air Quality Management District having jurisdiction.

3.03 APPLICATION

A. Apply all material in strict accordance with manufacturer’s instructions. Apply first coat immediately after surface preparation.

B. Do not apply coatings when temperature is below 55°F. Do not apply exterior coatings in damp or rainy weather. Do not apply exterior coatings on damp wood.

C. Brush out each coat to a uniform, even coating; lay material on in one direction and brush out at right angles. Special application techniques may be required for new coatings with low VOC content. Apply such coatings in strict accordance with manufacturer’s detailed instructions. Allow material to dry 48 hours between coats unless longer period specified by manufacturer.

D. Sand between coats for enamel and varnish finishes.

E. Do necessary puttying or filling of nail holes, cracks and other blemishes after first coat has been applied. Finish putty or fill flush with adjoining surface in neat, workmanlike manner. Putty or fill nail holes in wood to be stained, with colored putty to match finish.

F. Back prime all interior and exterior wood trim before installation. Prime all exposed and concealed surfaces of sheetmetal flashing prior to installation.

G. Paint items and surfaces before installation that will be difficult or impossible to paint after installation.

H. Coat all six surfaces of wood doors with the specified coats. Seal mortises and cutouts for locks, hinges and other hardware with varnish.

I. Apply not less than the number of coats specified. Apply additional coats if required for uniform coverage and full hiding. Apply finishes in their factory original consistencies. Do not thin unless specifically recommended by the manufacturer.
J. Finish work shall be uniform in color, full coverage, smooth and free of sags and brush marks. Varnish work shall be done so that an entire surface is coated while maintaining a wet edge so that there are no lap marks or areas of uneven color.

K. Do all cutting in to a sharp, true line. Repaint if necessary to correct over runs.

L. Do not paint over Underwriters' labels, fusible links, sprinkler heads, or fire alarm devices.

M. Paint access panels, electrical panels, air registers and similar items prior to installation to prevent edges from peeling or chipping when panels are removed.

N. Repaint factory finished electrical panels, air registers, and other items to match adjacent painted surfaces.

END OF SECTION
SECTION 09960
PROTECTIVE COATINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Coat or paint all facilities and equipment which are part of this Contract, except:
      a. Metal completely embedded in concrete (except aluminum).
      b. Piping buried in ground or encased in concrete.
      c. Galvanized grating, galvanized bolts, and galvanized grating frames.
      d. Chain link fence and galvanized fence gates.
      e. Rubber.
      f. Plastic pipe, including: polyvinyl chloride, polyethylene, and polypropylene piping, except as noted.
      g. Stainless steel.
      h. Bronze, brass.
      i. Nameplates and grease fittings.
      j. Factory finished electrical panels.
      k. Factory fusion epoxy coated items (except for field touchup).
      l. Aluminum or galvanized ductwork enclosed inside furred ceiling spaces.
      m. Aluminum handrail and aluminum guardrail.
      n. Concrete, except as defined herein, as specified elsewhere, or as shown on the Drawings.

B. Related Sections:
   1. Section 10400: Identifying Devices

C. The Contractor is to base this bid on using the products specified. If the products specified are not available in formulations that meet applicable regulations on volatile organic compounds (VOC) levels at time of application, the Contractor is to submit for review products of equivalent quality and function that comply with regulations in effect at that time. A reasonable difference in cost of material between the first named items specified and the products that are required to meet regulations that change after the bid date and are in effect at the time of application may be approved for payment by Change Order.

1.02 REFERENCES

A. Where standards of surface preparation are described by citing SSPC specification numbers reference is made to the “Steel Structures Painting Manual” Volume 2 published by the Steel Structures Painting Council.

B. American Society of Testing and Materials (ASTM):
   1. ASTM D4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
   3. ASTM D4541 Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
   4. ASTM F1249 Test Method for Water Vapor Transmission Rate Through plastic Film and Sheeting Using a Modulated Infrared Sensor

1.03 DEFINITIONS

A. Dry Film Thickness (DFT) - The prime coat and the sum of all fully cured applied coats for the paint system.
B. Exterior Surface - Surface that is not inside a building or structure and is exposed to the weather. Epoxy surfaces that are affected by the ultraviolet rays from the sun shall be considered an exterior surface if the sun can shine on the surface.

C. Stripe Coat - Coating applied to the edge, corner, welds or bolts, which is applied prior to application of additional system coats.

D. Submerged - Surfaces that are under water or the vertical extension of those walls that are partly under water during normal operating conditions.

1.04 SUBMITTALS
A. Submit in accordance with Section 01300.
B. Prior to ordering material, submit a complete schedule of materials to be used. Include manufacturer's brand name, product name, and designation number for each coat of each system to be used.
C. Prior to commencing work, submit a detailed list of all surfaces and equipment items upon which the Contractor intends to apply protective coatings.
D. Provide the following information on each paint product:
   1. Abrasion resistance, ASTM D4060, 1 kg load at 1000 cycles, CS-17 wheel.
   2. Impact resistance, ASTM D2794, direct and reverse.
E. If materials other than those listed are submitted, submit additional information to fully define the proposed substitution. The Engineer may further require the Contractor to furnish additional test results from an independent paint laboratory comparing the proposed substitution with one of the named products, at no additional cost to the [Owner]. For substituted materials, provide a list of references, including contact person and phone number, where proposed substitute paint system has been used in similar exposures. Provide a minimum of [five] references (no duplicate owners or agencies).
F. Provide Material Safety Data Sheets (MSDSs) for all products.
G. Manufacturer's Certification: That products furnished meet applicable Air Quality Management District regulations as to allowable volatile organic compound (VOC) content for the place of application and use intended.
H. Submit a full range of the manufacturer's standard and let down finish colors for review and selection by the Engineer. After final colors have been selected, submit two 8-1/2- x 11-inch samples on cardboard of each color indexed as to manufacturer and color designation. Color chips 3/4-inch x 1-1/2-inch may be used for pipe color codes. [Colors may require special blending to meet [Owner's] requirements to match existing color systems.]
I. Submit four pipe and equipment color code charts, 11 x 14 inches in size, with typed labels and using color chips. Upon favorable review, frame charts and mount under glass, suitable for hanging in work areas.

1.05 QUALITY ASSURANCE
A. Environmental Regulatory Requirements:
   1. All work, material, procedures, and practices under this Section shall conform with requirements of the local Air Resources Board or Air Quality Management District having jurisdiction. Prime or finish coat painting done in locations other than the project site shall be in accordance with air quality regulations in effect at the place the coating is applied. Products specified herein are, to the best of the Design Engineer's knowledge, in compliance with the applicable volatile
organic compounds (VOC)\(^1\) levels allowable at the date these Specifications were issued for bid.

2. The Air Resources Board or Air Quality Management District having jurisdiction may prohibit the sale or application of paints and enamels containing more than the stipulated percentages of volatile organic solvents manufactured after a stated date. Provide material meeting applicable regulations effective at the date of manufacture, or if not available, provide top of the line materials developed as replacements for specified materials and meeting applicable regulations as to VOC solvents content.

3. If the Contractor applies coatings that have been modified or thinned other than as recommended by manufacturer, he will be responsible for any fines, costs, remedies or legal actions that may result.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

A. Perform surface preparation in accordance with Paragraph 3.02 below and the latest revision of the following requirements or manufacturer’s requirements, whichever is more stringent:


2. Brush Clean: Remove dirt, dust, loose rust and foreign matter in accordance with specification SSPC-SP 2, "Hand Tool Cleaning."

3. Solvent Clean: Solvent clean metallic surfaces to be painted to remove all oils or grease in accordance with specification SSPC-SP 1, "Solvent Cleaning." Use solvents recommended by manufacturer of paint to be used in each area. In addition, lightly hand sand copper piping.

4. Abrasive Blast: Conform to the requirements of SSPC-SP 10, "Near White Blast Cleaning." Paint all blasted surfaces within 8 hours of blasting unless the Engineer gives specific permission to do otherwise. Remove all weld spatter by grinding or chipping prior to sandblasting.

5. Commercial Blast Cleaning: Conform to the requirements of SSPC-SP 6 Paint all blasted surfaces within 8 hours of blasting unless the Engineer gives specific permission to do otherwise. Remove all weld spatter by grinding or chipping prior to cleaning.

3.02 APPLICATION

A. All steel coating application to be done in accordance with the latest revision of SSPC-PA: When successive coats of paint of the same colors are specified, tint alternate coats sufficiently to produce enough contrast to indicate complete coverage of the surface.

B. Apply all material in strict accordance with manufacturer’s instructions. Apply first coat immediately after surface preparation. Keep all paints at a consistency and applied in accordance with the printed directions of the manufacturer. The painting shall be done by hand, spray or roller as approved by the Engineer in conformance to individual paint manufacturer’s recommendations. The Engineer and paint supplier will review all surfaces to be painted on the job prior to application of any coatings. Once the Contractor begins undercoating or priming, this will be his guarantee that the surface is acceptable to paint. All painted surfaces are to be free from drips, ridges and brush marks. The following stipulations also apply:

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\(^1\) Measured in grams per liter by weight of coating as applied, excluding water and color added to be base tint.
1. Thinning permitted only when recommended by the manufacturer and only with thinner recommended for use with the particular product.
2. The use of additives to improve working characteristics or to lengthen or shorten set time is prohibited.
3. Items difficult or impossible to paint after installation are to be painted before installation and touched up after installation.
4. Apply each coat to a uniform, even coating; lay material on in one direction and finish at right angles. Allow material to thoroughly dry between coats. Scuff, sand and remove all runs, sags, overspray, surface roughness and other defects between each coat. Dust and wipe surface clean before applying next coat.
5. Cutting in is to be sharp and straight, free from overlaps or fuzzy edges. Redo any imperfect work.
6. Apply not less than the number of coats or dry film thickness specified. Apply additional coats if required for uniform coverage, full hiding, and to achieve film continuity. Finished work to be uniform in color, full coverage, smooth and free of sags and brush marks.
7. Do not apply coating when temperature is below 55°F or when the temperature of the surface to be painted is less than 4°F over the dew point temperature. Perform coating operations only under favorable environmental conditions. Take all steps necessary to protect and completely cure the work. Correct defective work to the full satisfaction of the Engineer.
8. Apply the last finish coat on all work after all major construction is complete and the work areas have been cleaned up and are dust free.

END OF SECTION
SECTION 15050
PIPING, VALVES AND ACCESSORIES

PART 1 - GENERAL
1.01 SUMMARY
A. Section includes: Provide all piping, including fittings, valves, supports, and accessories as shown on the Drawings, described in the Specifications and as required to completely interconnect all equipment with piping for complete and operable systems, including equipment drains.

1.02 REFERENCES
A. Air-Conditioning and Refrigeration Institute (ARI)
B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
C. American Society of Testing and Materials (ASTM)
D. American Society of Mechanical Engineers (ASME)
E. American National Standards Institute (ANSI)
F. American Water Works Association (AWWA)
G. American Welding Society (AWS)
H. Cast Iron Soil Pipe Institute (CISPI)
I. U.S. Department of Transportation (DOT)
J. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)
K. National Fire Protection Association (NFPA)

1.03 SUBMITTALS
A. Shop Drawings:
   1. Verify by excavation, inspection and measurement all installation conditions, including existing utilities and structures, for [buried] [all] pipe before preparation of Shop Drawings. Submit field measurements and photos with Shop Drawings where exposed conditions are significantly different than indicated on the Drawings. See also paragraph 3.02, Existing Utilities, of Section [02301] [02302].
   2. Layouts and Schematics: Submit detailed installation drawings of all piping. Schematics may be submitted for piping 4 inches and smaller. The Drawings and schematics shall include: pipe support locations and types, fittings, valves, other appurtenances. (Product Review)
   3. Submit data to show that the following items conform to the Specification requirements:
      b. Fabricated pipe supports and other pipe supports (Product Review).
      c. Pipe couplings and flexible pipe pieces (Product Review).
      d. Valves and Accessories (Product Review).
      e. Thermal insulation (Product Review).
   5. Submit reinforcement calculations for T.M-2P to demonstrate compliance with AWWA M11.
   7. Submit samples of gaskets and other materials where required by the detailed specifications.

END OF SECTION