

TECHNICAL SPECIFICATIONS
FOR
CONSTRUCTION OF
CONNECTOR ROAD WATERLINES
FOR
CITY OF PENDLETON
JUNE 2023



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 FOR
 CONNECTOR ROAD WATERLINES
 FOR
 CITY OF PENDLETON

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END OF SECTION

SECTION 01 10 00 - SPECIAL PROVISIONS

PART 1 GENERAL

These Special Provisions supplement and amplify certain sections of the General Conditions and Supplementary General Conditions. The General Conditions and Supplementary General Conditions shall apply except as modified herein. These Special Provisions and additional technical specifications may contain occasional requirements not pertinent to the project. However, these specifications shall apply in all particulars insofar as they are applicable to this project.

1.1 APPLICABLE STANDARD SPECIFICATIONS AND PLANS

City of Pendleton, Oregon, Public Works Standards and American Public Works Association (APWA) Standard Specifications and Drawings (including all revisions through the date of bid opening), apply except as may be modified herein. In the case of discrepancy, unless noted otherwise herein, the more restrictive provisions shall apply.

1.2 SCOPE OF WORK

The work to be performed under these specifications and drawings consists of furnishing all labor, materials, and equipment necessary for the construction of approximately 6,200 lineal feet (LF) of 18-inch diameter transmission main, 4,900 LF of 30-inch diameter transmission main, a flow meter vault, and associated mobilization, site work, and appurtenances. The work also includes water connections into existing systems. In addition to water system work, the project includes the mass excavation and rough grading required to bring the finished grading to the subgrade of the future roadways.

The above general outline of principal features of the work does not in any way limit the responsibility of the CONTRACTOR(s) to perform all work and furnish all equipment, labor, and materials required by the specifications and drawings. The drawings and specifications shall be considered and used together. Anything appearing as a requirement of either shall be accepted as applicable to both even though not so stated therein or shown.

No attempt has been made in these specifications or drawings to segregate work covered by any trade or subcontract under one specification. Such segregation and establishment of subcontract limits will be solely a matter of specific agreement between the CONTRACTOR and its subcontractors and shall not be based upon any inclusion, segregation, or arrangement in or of these specifications.

1.3 COORDINATION OF DRAWINGS AND SPECIFICATIONS

The drawings and specifications are intended to describe and provide for a complete work. Any requirement in one is as binding as if stated in all. The CONTRACTOR shall provide any work or materials clearly implied in the Contract Documents even if the Contract Documents

do not mention it specifically. If there is a conflict within the Contract Documents, it will be resolved by the following order of precedence:

- A. Permits for outside agencies required by law
- B. OWNER-CONTRACTOR Agreement
- C. Addenda to Contract Documents
- D. CONTRACTOR's Proposal
- E. City of Pendleton Special Provisions
- F. Contract Drawings
- G. Technical Specifications
- H. General Conditions of the Contract
- I. Standard Specifications for the City of Pendleton, Oregon
- J. APWA Standard Specifications
- K. APWA Standard Drawings
- L. AWWA/ANSI Standards

Dimensions shown on the drawings or that can be computed shall take precedence over scaled dimensions. Notes on drawings are part of the drawings and govern in the order described above. Notes on drawings shall take precedence over drawing details.

The intent of the drawings and specifications is to prescribe the details for the construction and completion of the work which the CONTRACTOR undertakes to perform according to the terms of the Contract. Where the drawings or specifications describe portions of the work in general terms, but details are incomplete or silent, it is understood that only the best general practice is to prevail and that only materials and workmanship of the best quality are to be used. Unless otherwise specified, the CONTRACTOR shall furnish all labor, materials, tools, equipment, and incidentals, and do all the work involved in executing the Contract in a manner satisfactory to the OWNER'S REPRESENTATIVE.

The contract drawings are designated by general title, sheet number, and sheet title. When reference is made to the drawings, the "Sheet Number" of the drawing will be used. Each drawing bears the OWNER'S REPRESENTATIVE's File No. 22-3530 and the general title:

CITY OF PENDLETON, OREGON
TASK ORDER NO. 23: CONNECTOR ROAD WATERLINES

The specific titles of each sheet are contained on G-1 of the Drawings.

1.4 CODE REQUIREMENTS

All work shall be done in strict compliance with the requirements of the most current publications of the follow:

- A. International Building Code
- B. Oregon Structural Specialty Code

- C. Uniform Mechanical Code
- D. Uniform Plumbing Code
- E. National Electric Code
- F. National Electric Safety Code
- G. Oregon State Department of Labor and Industries
- H. Umatilla County
- I. City of Pendleton

In case of disagreement between codes or these specifications, the more restrictive shall prevail.

1.5 NOT USED

1.6 COORDINATION WITH OTHER CONTRACTORS AND WITH OWNER

Certain work within this contract may require connection to and coordination with the work of other contractors and OWNER. The CONTRACTOR under these specifications shall cooperate fully with all other contractors and OWNER and carefully fit its own work to such other work as may be directed by the OWNER'S REPRESENTATIVE. The CONTRACTOR shall not commit or permit any act to be committed which will interfere with the performance of work by any other contractor or the OWNER.

1.7 ACCESS TO WORK

Access to the work shall be provided as may be required by the OWNER or its representatives, and all authorized representatives of the state and federal governments and any other agencies having jurisdiction over any phase of the work, for inspection of the progress of the work, the methods of construction or any other required purposes.

1.8 PERMITS AND LICENSES

Unless provided for otherwise in these Contract Documents, all permits, licenses, and fees shall be obtained by the CONTRACTOR and all costs shall be borne by the CONTRACTOR. CONTRACTOR shall pay all plan check fees and other fees necessary to obtain permits and shall accommodate special inspections required thereof. CONTRACTOR shall be responsible for compliance with all permit provisions and shall accommodate all special inspections required thereof, all at no additional expense to the OWNER beyond prices as bid.

The following permits are to be obtained by the OWNER:

- A. Department of Environmental Quality (DEQ), 1200-C
 - 1. To be transferred to Contractor prior to initiation of construction activities.
- B. City of Pendleton, ENGINEERING Department, Right-of-Way Use Permit

1.9 SITE INVESTIGATION AND PHYSICAL DATA

The CONTRACTOR acknowledges that it is satisfied as to the nature and location of the work and the general and local conditions, including but not limited to those bearing upon transportation, disposal, handling and storage of materials, availability of water, roads, groundwater, access to the sites, coordination with other contractors, and conflicts with pipelines, structures, and other contractors. Information and data furnished or referred to herein is furnished for information only. Any failure by the CONTRACTOR to become acquainted with the available information and existing conditions will not be a basis for relief from successfully performing the work and will not constitute justification for additional compensation.

The CONTRACTOR shall verify the locations and elevations of existing pipelines, structures, grades, and utilities, prior to construction. The OWNER assumes no responsibility for any conclusions or interpretations made by the CONTRACTOR on the basis of the information made available.

1.10 TEMPORARY UTILITIES FOR CONSTRUCTION PURPOSES

- A. The CONTRACTOR shall make all arrangements necessary to provide all temporary utilities for construction purposes and shall pay all costs associated those temporary utilities.
- B. Water for construction purposes (dust control, hydrostatic testing of water mains, etc.) will be furnished by the OWNER at no cost, unless otherwise noted.
 - 1. The CONTRACTOR shall have access to a fire hydrant located near the intersection of Highway 11 & SE Kirk Street.
 - 2. The CONTRACTOR shall furnish all valves, hoses, connections, backflow prevention devices, and other devices as necessary to obtain sufficient water for construction and for filling and testing of water lines as required.
 - 3. The OWNER shall provide a fire hydrant flow meter to track total water used. The CONTRACTOR shall apply for this service at City Hall and provide a refundable deposit for the meter.
 - 4. Backflow protection is required on all connections to potable water systems.

1.11 FIELD SERVICE BY MANUFACTURER'S REPRESENTATIVE

The CONTRACTOR shall furnish the services of a manufacturer's or material supplier's representative for all major equipment and materials furnished by the CONTRACTOR or OWNER under this contract, to check, place in operation and test the installation, and train operating personnel. The manufacturer's representative shall be qualified and authorized to perform repairs and maintenance on the equipment. The above gives a general scope of the

services desired from the manufacturer's representative. It will be the responsibility of the CONTRACTOR and the equipment manufacturer to determine detailed requirements. Costs for services of the manufacturer's representative shall be included in the proposal of the CONTRACTOR. The operator training mentioned above shall include sufficient time during the CONTRACTOR's operation and testing period to fully explain to the operating personnel the features of the equipment and maintenance thereof.

1.12 CONSTRUCTION WITHIN PUBLIC RIGHTS-OF-WAY

When the work contemplated is wholly or partly within the right-of-way of a public agency such as a city, county, or state, the OWNER will obtain from these agencies any right-of-way and street opening permits and all other necessary permit(s) required for the work. The CONTRACTOR shall abide by all regulations and conditions stipulated in the permit(s). Such conditions and requirements are hereby made a part of these specifications, as fully and completely as though the same were fully set forth herein. The CONTRACTOR shall examine the permit(s) granted to the OWNER by any city, county, state, and federal agencies. Failure to do so will not relieve the CONTRACTOR from compliance with the requirements stated therein.

See Subsection 1.8, PERMITS & LICENSES, for information on permits obtained by OWNER for project.

The CONTRACTOR shall obtain all construction permits and pay all fees or charges and furnish any bonds and insurance coverages as necessary to ensure that all requirements of the city, county, state, or federal agencies will be observed, and the roadway and ditches are restored to their original condition or one equally satisfactory. A copy of all permits shall be kept on the work site for use of the OWNER'S REPRESENTATIVE.

1.13 CONSTRUCTION WITHIN PRIVATE EASEMENTS

When portions of the work contemplated are within easements held by the OWNER on private property, the CONTRACTOR shall ascertain for itself to what extent the width, status, and special conditions attached to easements may have on its operations and all costs resulting therefrom shall be included and absorbed in the unit prices of the CONTRACTOR's bid. CONTRACTOR shall coordinate with private property owners and businesses if required. Landscaping, surface restoration, and fence restoration shall be completed within 24 hours following piping and conduit installation and other construction work. Temporary fencing shall be provided continuously until such private fencing is properly restored.

The CONTRACTOR's attention is directed to Paragraph 6.20 of the General Conditions regarding safety and the protection of property. Certain portions of this project require working in close proximity to existing structures and property within private easements. It is the CONTRACTOR'S responsibility to conduct its operations and limit the size of equipment used in such a manner so as to prevent damage to existing property from excessive vibration or from other direct or indirect CONTRACTOR operations. The cost associated with repairing

or replacing property that is damaged by the CONTRACTOR's operations shall be the responsibility of the CONTRACTOR, in accordance with the General Conditions.

1.14 NOT USED

1.15 PRIVATE ROADS AND DRIVEWAYS

Bridges at entrances to business properties where vehicular traffic is necessary shall be provided and maintained. Bridges shall be adequate in width and strength for the service required. No private road or driveway may be closed without approval of the OWNER'S REPRESENTATIVE unless written authority has been given by the owner whose property has been affected. Driveways shall be left open and ready for use at the end of the work shift. All expenses involved in providing for construction, maintenance, and use of private roads or driveways, shall be borne by the CONTRACTOR and the amount thereof absorbed in the unit prices of the CONTRACTOR's bid.

1.16 TRAFFIC CONTROL AND PROTECTION

The CONTRACTOR shall maintain traffic control and protection in the work areas 24 hours per day. Traffic control shall conform to the standards set forth in the "Oregon Manual on Uniform Traffic Control Devices" issued by the Oregon Department of Transportation.

The CONTRACTOR shall conduct its operations to keep one lane of traffic open for public and private access at all times on city, county, and public streets, roads, and highways. If required by the State, the CONTRACTOR shall conduct its operations so as to keep both directions of traffic open on State Highways. Permits obtained for the project may have more stringent requirements than noted in this section.

Prior to beginning construction, the CONTRACTOR shall submit a detailed street closure and traffic control plan to the OWNER'S REPRESENTATIVE for review and to all local permitting jurisdictions for approval. As construction proceeds, the CONTRACTOR shall notify the OWNER'S REPRESENTATIVE as to the status of street closures and detours.

On streets where traffic is heavy, the OWNER'S REPRESENTATIVE or jurisdictional permitting agencies may require the construction of two-way bridges of adequate design. These bridges shall be provided with guard rails and shall be well lighted at all times. Detours as required by the OWNER'S REPRESENTATIVE shall be surfaced with gravel or crushed rock and maintained in good condition. Detours for pedestrians shall not exceed one block in length, and foot bridges over the trenches shall be provided with adequate handrails.

All work shall be carried on with due regard for safety to the public. Open trenches shall be provided with barricades of a type that can be seen at a reasonable distance, and at night they shall be distinctly indicated by adequately placed lights.

1.17 NOT USED

1.18 NOT USED

1.19 LIMITS OF THE WORK AND STORAGE OF SPOILS

The limits of the site which may be used for construction, storage, materials handling, parking of vehicles, and other operations related to the project include the project site as shown on the drawings and adjacent public rights-of-way subject to permission of the public owner of that right-of-way. The limits of work also include rights of access obtained by the CONTRACTOR, subject to all public laws and regulations and rights of access by utility companies and other holders of easement rights.

The CONTRACTOR may contact adjoining property owner representatives and negotiate storage and/or disposal of spoils and grubbed materials for locations outside of the right-of-way. The OWNER will provide information on identified landowners with property near the site who may be willing to accept excess earthwork materials, topsoil, and clearing and grubbing materials. Should the CONTRACTOR negotiate such an arrangement, a copy of the written agreement between the CONTRACTOR and property owner shall be provided to the OWNER prior to initiation of these activities.

When disposing of excess, spoil, or other construction materials on public or private property, the ultimate recipient shall not fill in or otherwise convert wetlands or 100-year floodplain areas delineated on the latest Federal Emergency Management Agency floodplain maps.

1.20 EXISTING WATER SYSTEM SHUTDOWN

If the project involves the need to shut down an existing water system, the CONTRACTOR shall coordinate the work to ensure minimal shutdown time. The CONTRACTOR shall submit a written shutdown schedule to the OWNER for approval. The CONTRACTOR shall provide 72-hour notice preceding each shutdown.

1.21 NOT USED

1.22 TESTING AND OPERATION OF FACILITIES

It is the intent of the OWNER to have a complete and operable facility. All of the work under this contract will be fully tested and inspected in accordance with the specifications. Upon completion of the work, the CONTRACTOR shall operate the completed facilities as required to test the equipment under the direction of the OWNER'S REPRESENTATIVE. During this period of operation by the CONTRACTOR, the new facilities will be tested thoroughly to determine their acceptance.

1.23 NOT USED

1.24 SALVAGE AND DEBRIS

Unless otherwise indicated on the drawings or in the specifications, all castings, pipe, equipment, demolition debris, spoil, or any other discarded material or equipment shall become the property of the CONTRACTOR and shall be disposed of in a manner compliant with applicable federal, state, and local laws and regulations governing disposal of such waste products. No burning of debris or any other discarded material will be permitted.

1.25 SAFETY STANDARDS AND ACCIDENT PREVENTION

The CONTRACTOR shall be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the work. This requirement shall apply continuously and not be limited to normal working hours. The required and/or implied duty of the OWNER'S REPRESENTATIVE to conduct construction review of the CONTRACTOR's performance does not, and is not intended to, include review of the adequacy of the CONTRACTOR's safety measures in, on, or near the construction site.

The CONTRACTOR shall comply with the safety standards provisions of applicable laws and building and construction codes. The CONTRACTOR shall exercise every precaution at all times for the prevention of accidents and protection of persons, including employees, and property. During the execution of the work the CONTRACTOR shall provide and maintain all guards, railing, lights, warnings, and other protective devices which are required by law or which are reasonably necessary for the protection of persons and property from injury or damage.

1.26 PUBLIC SAFETY AND CONVENIENCE

General Rule: The CONTRACTOR shall ensure the safety of the public during its performance of the Work and shall minimize any public inconvenience in addition to any other requirement imposed by law. These duties include, but are not limited to, the matters listed below.

Access: The CONTRACTOR shall not unreasonably restrict access to public facilities, commercial property, fire hydrants, residential property, and other areas where the public can be expected to be present, such as sidewalks and streets without first obtaining approval of the OWNER. Driveways shall be closed only with the approval of the OWNER or after obtaining specific permission from the property owner or owners. In addition, the CONTRACTOR shall not obstruct or interfere with travel over any public street or sidewalk without approval of the OWNER.

Public Transit: The CONTRACTOR shall not interfere with the normal operation of any public transit vehicles unless otherwise authorized.

Work Site: The CONTRACTOR shall keep the Project site safe in compliance with applicable law. Safety includes, but is not limited to: 1) providing an approved type of secured and

adequate barricades or fences that are easily visible from a reasonable distance around open excavations; 2) closing up or covering with steel plates all open excavations at the end of each Working Day in all street areas and in all other areas when it is reasonably required for public safety; 3) marking all open work and obstructions by lights at night; 4) installing and maintaining all necessary signs, lights, flares, barricades, railings, runways, stairs, bridges, and facilities; 5) observing any and all safety instructions received from the OWNER; and 6) following all laws and regulations concerning worker and public safety. In the event that the law requires greater safety obligations than that imposed by the OWNER, the CONTRACTOR shall comply with the law.

Emergency: Emergency vehicles, including but not limited to police, fire, and disaster units shall be provided access to the work site at all times.

Cleanliness: The CONTRACTOR shall, on a continuing basis, keep the surfaces of all public and private roadways, sidewalks, and other pathways free of dirt, mud, cold plane grindings, and other matters that the CONTRACTOR may place upon the road. The cost of performing such work shall be included in the CONTRACTOR's Bid and no additional payment will be made for performing this task.

Parking: The CONTRACTOR shall make any necessary contacts with all applicable governmental bodies to arrange for the removal of parked automobiles, vehicles and other obstructions if they would interfere with the performance of the CONTRACTOR'S work.

Accidents: The CONTRACTOR'S Project Manager or superintendent shall be in charge of accident prevention. CONTRACTOR shall take all actions necessary to prevent damage, injury and loss to persons and property as a result of accidents.

Project Health and Safety Plan: CONTRACTOR shall develop, publish, and implement an overall Project Health and Safety Program for the Project. This Program shall conform to all applicable codes. Contractor shall submit the written Safety Program to the OWNER'S REPRESENTATIVE within 30 days after the receipt of the written Notice to Proceed and prior to mobilizing to the project site. The Plan shall be assembled to address project specific health and safety issues to both the public and on-site personnel. The plan shall include the following items when they apply:

- Employee orientation
- Safety inspections
- Instruction and training
- Accident reporting
- Signs and barricades
- Fire prevention and protection
- Welding, cutting, and burning
- Painting and surface treatment
- Electricity
- Machinery and mechanized equipment
- Excavations
- Sanitation
- Chlorine safety
- Hazardous materials
- Hazardous communications program
- Job hazard analysis

- First aid/medical facilities
- Personal protective equipment
- Confined space entry plan
- Shoring plan
- Fall protection plan
- Emergency Action Plan
- Housekeeping
- Safety training requirements and certification
- Pedestrian access around work site during construction and after hours

If the project requires other health and safety issues to be addressed, they too shall be included in the Project Health and Safety Plan. The Program shall subsequently be distributed to and implemented by the CONTRACTOR's personnel as well as its subcontractors and suppliers. CONTRACTOR shall fully implement and comply with the Safety Program and submit to the OWNER a letter signed by CONTRACTOR'S owner/president affirming such implementation and compliance within 15 days after on-site work has started. CONTRACTOR shall notify the OWNER when safety meeting will be held so that OWNER's personnel may attend. A copy of the approved Health and Safety Plan must be maintained on-site at all times during the life of the Project.

The OWNER has no responsibility for Work site safety. Work site safety is the responsibility of the CONTRACTOR. The CONTRACTOR is required to have a competent person on site at all times during construction activities.

The CONTRACTOR shall provide signs on work zone fencing that provide information regarding access to businesses and stating that such businesses are open and in operation. The CONTRACTOR shall furnish and install the signs and provide sign attachments for the various business names.

1.27 WARRANTY PERIOD

The CONTRACTOR shall warrant all furnished materials and equipment for a period of one year from date of final acceptance of the Work by the OWNER. This warranty shall mean prompt attention to the correction and/or complete replacement of the faulty material or equipment. The expiration of the one-year warranty period shall not affect any other claims or remedy available to the OWNER. There may be other warranty provisions in these contract documents in addition to those noted above.

1.28 UTILITY PROPERTIES AND SERVICE

In areas where the CONTRACTOR's operations are adjacent to or near a utility and such operations may cause damage which might result in significant expense, loss and inconvenience, the operations shall be suspended until all arrangements necessary for the protection thereof have been made by the CONTRACTOR.

The CONTRACTOR shall notify all utility offices which may be affected by the construction operation at least 48 hours in advance. Before exposing any utility, the utility having jurisdiction shall grant permission and may oversee the operation. Should service of any

utility be interrupted due to the CONTRACTOR's operation, the proper authority shall be notified immediately. It is of the utmost importance that the CONTRACTOR cooperates with the said authority in restoring the service as promptly as possible. Any costs shall be borne by the CONTRACTOR.

Utilities which may be impacted include the following:

Cascade Natural Gas Corporation	Natural Gas
Pacific Power	Electrical
Century Link	Telephone
City of Pendleton	Water, Sanitary Sewer, Storm Drain
Various entities	Telecom / Fiber Optic

1.29 SANITARY FACILITIES

The CONTRACTOR shall provide and maintain sanitary facilities for its employees and its subcontractors' employees that will comply with the regulations of the local and state Departments of Health and as directed by the OWNER'S REPRESENTATIVE.

1.30 STREET CLEANUP

The CONTRACTOR shall clean daily all dirt, gravel, construction debris, and other foreign material resulting from its operations from all streets and roads to a condition satisfactory to the OWNER'S REPRESENTATIVE.

1.31 VEHICLE PARKING

The vehicles of the CONTRACTOR's and subcontractors' employees shall be parked in accordance with local parking ordinances and in designated as shown in the Drawings.

1.32 PROTECTION OF QUALITY OF WATER

The work to be performed involves connections to an existing potable water system. The CONTRACTOR shall take such precautions as are necessary or as may be required to prevent the contamination of the water. Such contamination may include but shall not be limited to deleterious chemicals such as fuel, cleaning agents, paint, demolition and construction debris, sandblasting residue, etc. In the event contamination does occur, the CONTRACTOR shall, at its own expense, perform such work as may be necessary to repair any damage or to clean the affected areas of the water mains to a condition satisfactory to the OWNER'S REPRESENTATIVE.

1.33 RECORD DRAWINGS

CONTRACTOR shall maintain at the site one set of specifications, full size drawings, shop drawings, equipment drawings and supplemental drawings which shall be corrected as the work progresses to show all changes made. Drawings shall be available for inspection by the

OWNER'S REPRESENTATIVE. Upon completion of the contract and prior to final payment, specifications and drawings shall be turned over to the OWNER'S REPRESENTATIVE.

1.34 NOT USED

1.35 SURVEYS

Based upon the information provided by the Contract Documents, the CONTRACTOR shall develop and make all detail surveys necessary for layout and construction, including exact component location, working points, lines, and elevations. Prior to construction, the field layout shall be approved by the OWNER'S REPRESENTATIVE. The CONTRACTOR shall have the responsibility to carefully preserve benchmarks, reference points, and stakes, and in the case of destruction thereof by the CONTRACTOR or resulting from its negligence, the CONTRACTOR shall be charged with the expense and damage resulting therefore and shall be responsible for any mistakes that may be caused by the unnecessary loss or disturbance of such benchmarks, reference points and stakes.

When automated machine guidance (AMG) or machine control techniques are incorporated into the construction phase of a project, the ENGINEER will provide the following: construction staking control, site calibration data, digital terrain models (DTMs), a survey datum statement, design alignments, and electronic design files to the CONTRACTOR. The CONTRACTOR is ultimately responsible for verifying all the digital data provided by the ENGINEER prior to commencement of AMG work.

The electronic files are provided solely as a convenience for informational purposes. The electronic files are not to be considered Record Drawings, Contract Documents, drawings for construction purposes, or any other signed documents. Actual hard copies of the drawings, specifications, or other items that contain a professional ENGINEER or surveyor stamp and signature are the only source to be considered as Record Drawings, Contract Documents, drawings for construction purposes, or any other signed documents. In all cases where discrepancies occur between the electronic files and hard copies, the hard copies shall govern. Alteration or reuse of the electronic files, including transmittal to others, for purposes other than those for which the material was intended, is prohibited without the written consent of the ENGINEER.

The accuracy or completeness of the electronic files is not guaranteed by the ENGINEER and the ENGINEER assumes no liability for errors or omissions in the electronic files. The recipient agrees to indemnify and hold harmless the ENGINEER, their respective officers, employees, agents, and representatives from and against liability for all claims, losses, damages, and expenses, including reasonable attorney's fees, involving the completeness and accuracy or unauthorized use of the information contained in the electronic files. The recipient's use of the electronic files shall be considered evidence of the recipient's agreement with and acceptance of the terms outlined herein.

A. Project Survey Control Network and Site Calibration

The ENGINEER shall provide an array of semi-permanent control stations around the project site to serve as the project survey control network. An ASCII text file of the control stations in Point number, Northing, Easting, Elevation, and Description (P,N,E,Z,D) format will be provided, including a survey sketch of the control station locations, in PDF format. A Survey Datum Statement, in PDF format, will also be provided to document the horizontal and vertical datum required to be used for the project site calibration.

The CONTRACTOR is responsible for verifying the project survey control network utilizing Global Navigation Satellite Systems technology. The CONTRACTOR shall provide a written site calibration report documenting the results of a site calibration using the project survey control network provided by the ENGINEER. If the site calibration report is rejected by the ENGINEER, the ENGINEER and the CONTRACTOR shall confer, as soon as practical, and endeavor to resolve the site calibration deficiencies. No AMG work shall take place until the site calibration report is accepted by the ENGINEER.

B. Digital Terrain Models, Design Alignments, and Electronic Design Files

The ENGINEER shall provide DTMs, design alignments, and electronic design files developed for the project. The electronic design files are intended to assist the Contractor's AMG techniques and workflow. The CONTRACTOR is responsible for verifying the DTMs, design alignments, and electronic design files by collecting a series of confidence points taken to verify the DTMs provided. The Contractor shall provide an ASCII text file of the confidence points to the ENGINEER. If the confidence points determined by the ENGINEER to be out of tolerance with the project requirements, the ENGINEER and the Contractor shall confer, as soon as practical, and endeavor to resolve any deficiencies in the DTMs, design alignments, and electronic design files. No AMG work shall take place until the confidence points are accepted by the ENGINEER.

1.36 WORK HOUR LIMITATIONS

All work shall be conducted between the hours of 7:00 a.m. and 6:00 p.m. on non-holiday weekdays only. No weekend work will be allowed. Requests for variations in work hours shall be made in writing for consideration by the OWNER'S REPRESENTATIVE. No work shall be conducted outside of the above-described days and hours without prior approval of the OWNER'S REPRESENTATIVE.

1.37 DUST PREVENTION

All unpaved streets, roads, detours, haul roads, or other areas where dust may be generated shall receive an approved dust-preventive treatment or be routinely watered to prevent dust. Applicable environmental regulations for dust prevention shall be strictly enforced.

1.38 EROSION AND SEDIMENTATION CONTROL

The OWNER has obtained a National Pollutant Discharge Elimination system (NPDES) 1200-C Permit for this project. The CONTRACTOR shall take the necessary steps and pay the required fees to transfer the Permit from the OWNER to the CONTRACTOR (DEQ Form 08-WQ-013). The CONTRACTOR shall be responsible for compliance with all 1200-C permit provisions.

Temporary construction site erosion control measures shall be designed and constructed in accordance with the 1200-C and permit obtained by the OWNER and drawings provided within the Contract Documents.

Erosion control measures shall be maintained throughout the project site until approved permanent cover such as a healthy stand of grass, other permanent vegetation, or other ground covering is established. When approved permanent ground cover is established, all temporary erosion control measures shall be removed from the construction site. Erosion control measures shall be installed as approved, per the erosion control drawing(s) in the above referenced document. Erosion control measures including stabilized construction entrances and sediment barriers must be established in conjunction with site clearing and grading.

During construction, and until permanent vegetation or other ground covering is established, the erosion control facilities shall be upgraded as needed for unexpected storm events or site conditions and with the purpose of retaining sediment and sediment-laden water on the construction site.

Any violations or fines assessed due to the CONTRACTOR's activities shall be borne solely by the CONTRACTOR at no cost to the OWNER or ENGINEER.

1.39 INTERFERENCES, OBSTRUCTIONS, AND SEWER CROSSINGS

At certain places, power, light, and telephone poles may interfere with excavation and the operation of the CONTRACTOR's equipment. Necessary arrangements shall be made by the CONTRACTOR with utility companies for moving or maintaining such poles. The utility company affected by any such interferences shall be notified thereof so that the necessary moving or proper care of poles and appurtenances may have appropriate attention.

All costs resulting from any other interferences and obstructions, or the replacement of such, whether or not herein specifically mentioned, shall be included and absorbed in the unit prices of the CONTRACTOR's bid.

1.40 NOISE LIMITATIONS

The project areas are located within an agricultural and residential zoned area. All applicable city and county ordinances and state and federal regulations shall be complied with.

1.41 STORAGE AND PROTECTION OF EQUIPMENT AND MATERIALS

- A. Materials and equipment stored overnight shall be placed neatly on the job site. Unusable materials (i.e., rejected or damaged liner material, old concrete chunks, metal scraps, etc.) shall be expeditiously removed from the job site.

Provide appropriate barricades, signs, and traffic control devices in like-new condition where necessary to protect the public from any hazards associated with the storage of materials and equipment used for this project.

- B. No equipment and/or materials shall be stored outside the immediate work area on public rights-of-way, in the following locations, or in the following manner:
1. In any maintained landscaped or lawn area.
 2. In a manner that would totally eliminate an individual residents' street parking.
 3. In front of any business.

The "immediate work area" is the area where work is taking place or will be taking place within one calendar day. The CONTRACTOR shall immediately move stored material or equipment which causes a nuisance or creates complaints.

- C. Equipment and/or materials may be stored outside of the immediate work area on public rights-of-way if the CONTRACTOR secures an agreement with the adjoining property owner. Should the CONTRACTOR negotiate such an arrangement, a copy of the written agreement between the CONTRACTOR and property owner shall be provided to the OWNER prior to initiation of these activities.

1.42 COMPETENT PERSON DESIGNATION

CONTRACTOR shall designate a qualified and experienced "competent person" at the site whose duties and responsibilities shall include enforcement of Oregon – OSHA regulations regarding excavations, the prevention of accidents, and the maintenance and supervision of construction site safety precautions and programs.

1.43 EMERGENCY MAINTENANCE SUPERVISOR

The CONTRACTOR shall submit to the OWNER'S REPRESENTATIVE the names, addresses, and telephone numbers of at least two employees responsible for performing emergency maintenance and repairs when the CONTRACTOR is not working. These employees shall be designated, in writing by the CONTRACTOR, to act as its representatives and shall have full authority to act on its behalf. At least one of the designated employees shall be available for a telephone call any time an emergency arises.

1.44 NOT USED

1.45 NOT USED

1.46 USE OF EXPLOSIVES

The use of explosives shall not be allowed on this project. Alternative methods of excavation shall be utilized.

1.47 CONTAMINATED MATERIAL

A. General

It is possible that the CONTRACTOR may encounter contaminated material (soil and/or water) during excavation activities. This specification identifies requirements for handling and disposing contaminated media.

B. Definitions

1. "Contaminated material" is defined as soil, water, free product, Underground Storage Tanks (UST), buried abandoned utility lines containing residual or free product, solid waste, treated wood waste, chemical containers, or other solid, liquid, or gas substances with contamination levels above background levels.
2. "Hazardous substances" shall mean those substances or materials defined in the Oregon Revised Statutes (ORS) 465.200, as amended.
3. "Release" shall have the meaning as defined in ORS 465.200, as amended.
4. "Environmental laws" shall mean any applicable statute, law, ordinance, order, consent decree, judgment, permit, license, code, covenant, deed, common law, treaty, convention, or other requirement pertaining to protection of the environment, health or safety, natural resources, conservation, wildlife, waste management or disposal, hazardous substances, or pollution, including but not limited to regulation of releases to air, land, water, and groundwater.

C. Execution

1. Discovery of Contaminated Material

In the event that the CONTRACTOR, during the course of construction or during any other activities authorized under this contract, should encounter suspected contaminated material or any other materials suspected of posing a threat to human health and the environment, the CONTRACTOR shall notify the OWNER'S REPRESENTATIVE immediately and manage according to requirements identified below.

2. Discovery of Contaminated Soil

CONTRACTOR shall note evidence of contamination (odor, visual staining of soil, free liquid product seeping from soil, sheen on groundwater etc.) and note location of evidence on a sketch of the excavation and provide to the OWNER'S REPRESENTATIVE.

CONTRACTOR shall report the discovery to the OWNER'S REPRESENTATIVE immediately. CONTRACTOR shall stop all excavation activities, and secure the site to prevent entry by the public. The excavation shall not be backfilled. Protect all open excavations with berms, plates, and fencing. CONTRACTOR may continue with work in other non-contaminated areas.

CONTRACTOR shall assist OWNER'S REPRESENTATIVE in collecting sample(s) of suspected contaminated media for testing and characterization. CONTRACTOR shall allow 21 days, at no cost to OWNER, for testing, results, and instructions as to how to proceed with contaminated materials.

The CONTRACTOR shall obtain a copy of an approved soil disposal/acceptance permit (Disposal/Treatment Facility requires transporter to have a copy of the permit).

CONTRACTOR will transport and dispose of contaminated material at an approved disposal/treatment facility.

CONTRACTOR shall provide the OWNER'S REPRESENTATIVE with a copy of the contaminated soil disposal receipt.

3. Handling of Contaminated Soil

After approval from the OWNER'S REPRESENTATIVE, excavate the soil in a manner that prevents commingling of contaminated and non-contaminated soil. OWNER'S REPRESENTATIVE will make determination (based on soil saturation) if contaminated soil can be directly transported to a treatment or disposal facility, or if soil needs to be stockpiled to reduce water content. OWNER'S REPRESENTATIVE will determine when stockpiled soil can be transported off-site.

CONTRACTOR will be responsible for stockpiling contaminated soil in containers or on impervious surface to prevent the spread of contamination. Any water runoff from the contaminated soil stockpile area(s) must be contained by CONTRACTOR and handled as contaminated water.

Minimize movement of excavation equipment over or through contaminated soil to prevent movement of contaminated soil into areas where no contaminated soil exists.

Stockpiles will be created on an approved site and shall be surrounded by a fence to limit access. The stockpiles must be covered and bermed during periods of rainfall to prevent run-on and run-off. The stockpiles shall be covered with a minimum 10 mil high density polyethylene (HDPE) plastic during periods of strong winds, nightfall, over the weekends, or during extended work stoppages. If dust is observed coming from the stockpiles, the stockpiles shall be either covered or the dust controlled with water.

Maintain excavation equipment in good working order. Prevent spillage of oil, fuel, or hazardous substances from equipment. In particular, promptly repair oil leaks from equipment and clean up any contaminated soil.

4. Transport of Contaminated Materials

CONTRACTOR shall comply with all applicable federal, state, or local laws, codes, and ordinances that govern or regulate contaminated substance transportation. Contaminated soils placed in stockpiles shall be loaded into trucks in a manner that prevents the spilling or tracking of contaminated soil into areas of the site with uncontaminated soil. Loose material falling onto the exterior of the truck during loading shall be removed before the truck leaves the loading area. Any material collected in the loading area shall either be placed back into the truck or back into the stockpile. If loading areas are unpaved, the surface soil shall be sampled at the conclusion of the loading activities to confirm that contaminated soil is not present. If loading areas are paved, any loose soil shall be cleaned from the pavement at the conclusion of the loading activities.

Specific truck haul routes shall be established before beginning off-site contaminated media transport. On-site truck routes shall be established to minimize or prevent movement of trucks over contaminated soils. Off-site truck routes shall be established to reduce the risk of releases of contaminated soils and impact on local traffic. The CONTRACTOR shall be responsible for ensuring that loaded truck weights are within acceptable limits. All trucks shall be covered before they leave the loading area.

The CONTRACTOR shall ensure that all drivers of vehicles transporting contaminated substances have in their possession during transport all applicable Oregon State and local vehicle insurance requirements, valid driver's license, and vehicle registration and license. The CONTRACTOR shall be responsible for informing all drivers of transport vehicle about:

- a. The nature of the material transported.
- b. Required routes to and from the off-site thermal treatment or disposal facility.

- c. Applicable county street regulations and requirements and State of Oregon Department of Transportation codes, regulations, and requirements.
- d. The County's requirement for proper handling and transportation of the substances.

The CONTRACTOR shall not allow contaminated substances to be spilled or tracked off-site at any time during the project. Trucks used for the transportation of contaminated substances off-site shall be watertight, substance compatible, licensed, insured, and permitted pursuant to federal, state, and local statutes, rules, regulations, and ordinances.

If contaminated media is discarded prior to removal of contaminated material, the price per cubic yard of soil materials and price per 100 gallons of contaminated water will be negotiated with OWNER.

1.48 NOT USED

1.49 NOT USED

1.50 NOT USED

1.51 NOT USED

1.52 NOT USED

1.53 PROJECT INFORMATION SIGNS

The CONTRACTOR shall furnish and install project information signs in accordance with the following requirements:

- A. A project information sign shall be installed facing each direction of traffic at each location where traffic is entering the work area. A minimum of two signs will be required for pipeline projects.
- B. A submittal for the project information sign(s) shall be prepared for the OWNER'S REPRESENTATIVE review prior to fabrication.
- C. The CONTRACTOR shall install the project information sign(s) at location(s) as directed by the OWNER'S REPRESENTATIVE.
- D. No construction work shall commence on the project site until the project information signs are installed.
- E. The CONTRACTOR shall maintain the signs through the duration of the project.

- F. Specific requirements on the sign's project information will be provided to the CONTRACTOR when developing the sign. OWNER'S REPRESENTATIVE will provide the sign for the CONTRACTOR to install.

The project information sign(s) shall be constructed of ¾-inch thick plywood with a finish grade of veneer on the sign face. The sign(s) shall be 48-inches high by 60-inches wide. The sign(s) shall be securely attached to two 4-inch square treated wood posts. The sign(s) shall be installed such that the top of the sign is approximately 10 feet above grade or as necessary to permit proper public viewing. The wood posts shall be buried at least 3 feet below grade. Provide adequate supports for the sign(s) as site conditions dictate. The sign(s) shall have black letters on a white background and they shall be the product of a commercial sign manufacturer or supplier. Logos shall be color. The letters shall be at least 4-inches in height.

The sign(s) will contain basic project information including: Project name, estimated project duration, project construction cost, project OWNER's name and OWNER's contact and phone number, OWNER'S REPRESENTATIVE's name, CONTRACTOR's name, OWNER's and OWNER'S REPRESENTATIVE's company logos, the CONTRACTOR's logo if the CONTRACTOR so desires, any funding agency logo(s) along with any required wording from those agencies. The logos shall be sized such that they are visible from a distance approved by the OWNER'S REPRESENTATIVE. The OWNER, OWNER'S REPRESENTATIVE, and funding agencies will provide electronic images of their logos for the CONTRACTOR's use in developing the signs. In addition, the sign(s) at a minimum shall contain the following project information:

1.54 TRANSMISSION MAIN CONTRACTOR QUALIFICATION PRIOR TO BIDDING

The Transmission Main Contractor must be qualified by the OWNER'S REPRESENTATIVE prior to bidding. A Statement of Qualifications Form shall be submitted to the OWNER'S REPRESENTATIVE for review and approval by all prospective transmission main contractors. Refer Section 00 20 50, Transmission Main Contractor Statement of Qualifications Form for prequalification information.

END OF SECTION

SECTION 01 22 20 - MEASUREMENT AND PAYMENT

PART 1 GENERAL

The work is divided into schedules as described below. Measurement and payment will be on a lump sum and unit price basis for work associated with the construction of the project in accordance with the prices set forth in the proposal for the individual work items. Where work is required but does not appear as a separate item in the proposal, the cost for that work shall be included and absorbed in the unit prices named in the proposal. Basis of measurement and payment for individual bid items will be as follows:

Schedule A – 30-inch Diameter Transfer Water Line

- A-1. Mobilization, bonds, insurance, and demobilization: Payment for mobilization, bonds, insurance, and demobilization will be on a lump sum basis. The amounts paid for this bid item in the contract progress payment will be based on the percent of the original contract amount that is earned from other contract items, as follows:
- a. When 5 percent of the original contract amount is earned, 50% of the amount for the bid item will be paid.
 - b. When 95 percent work of the original contract amount is earned, 50% of the amount for the bid item will be paid.

This schedule of mobilization progress payments will not limit or preclude progress payments otherwise provided by the contract.

- A-2. Traffic control: Payment for traffic maintenance and protection, flagging, temporary fencing, and safety barricades, including all coordination, materials, and equipment, as required, will be on a lump sum basis.
- A-3. Erosion control: Payment for installation of approved erosion control devices (silt fencing, straw bales, and other items), as required, including all labor, materials, and equipment, as required, will be on a lump sum basis.
- A-4. Construction survey and staking: Payment for construction survey and staking, including all coordination, materials, labor, and equipment, as required, will be on a lump sum basis, complete.
- A-5. Furnish and install Class 52 ductile iron pipe / C900 PVC pipe with Class B (imported granular material) trench backfill: Payment for furnishing and installing Class 52 ductile iron pipe or C900 PVC pipe with Class B (imported granular material) trench backfill, including all work and materials; Contractor quality assurance testing and acceptance; storage and transport of pipe; excavation to depths up to 8 feet below finished roadway subgrade as shown in the Drawings; all required joint restraint systems for pipe, fittings, valves, and appurtenances; standard concrete thrust blocks (including concrete, excavation, and thrust plates) where shown in the Drawings; dewatering; Class B pipe bedding, pipe zone

backfill, and trench backfill materials; and general surface restoration will be on a per linear foot basis for the pipe diameters shown. Pipe bedding, pipe zone, and trench backfill is understood to be imported granular material, compacted in place as shown in the Drawings. Class B fill material shall be as specified within Section 31 23 17, Trenching.

The pay quantities for pipe, trench excavation, and backfill will be on the basis of the horizontal length of pipe laid without deductions for valves or fittings which may be included in the end-to-end measurement of a continuous section of pipe. Where pipe is laid on a continuous slope greater than 10 percent for a distance greater than 100 feet, payment will be made upon the average slope distance between 100-foot stations. When water mains intersect, the measurement of each main shall be to the intersection of the center lines of the connecting fittings.

- A-6. Furnish and install ductile iron fittings: Payment for furnishing and installing ductile iron fittings will be made on a per each basis for the type and diameter of fittings shown. Fitting installation will be considered a separate pay item from work performed under other pay items. Fitting accessories including glands, bolts, and gaskets shall be considered incidental in the fitting weights for payment. Payment for joint restraint systems is included under the payment for restrained joint pipe.
- A-7. Furnish and install buried valves: Payment for furnishing and installing buried valves not included in other pay items, including valve boxes, covers, risers, extensions, and concrete collars, if required, complete, will be on a per each valve basis for the diameters shown in the Drawings.
- A-8. Furnish and install 4-inch diameter combination air release vacuum (CARV) valve assemblies: Payment for furnishing and installing combination air release vacuum (CARV) valve assemblies complete will be on a per each basis for the valve sizes as indicated on the drawings. Payment shall include piping and fittings for the sizes as indicated in the bid schedule; special coating for pipe; combination air valve; elbows; nipples; unions; isolation joints; valve box; excavation; pipe bedding and backfill; drain rock and geotextile fabric; stand vent pipe and cover; precast vault or box with cover; appurtenances; and removal and replacement of concrete curbs and sidewalks, as may be required. Excavation, sheeting, shoring, and dewatering shall be considered incidental to payment.
- A-9. Furnish and install 4-inch diameter blow-off assemblies: Payment for furnishing and installing permanent blow-off assemblies, complete, will be on a per each basis. Payment shall include furnishing and installing materials included in the blow-off detail in the Drawings and other appurtenances within the pay limits shown on the drawings, including the mainline tee. Excavation, sheeting, shoring, and dewatering shall be considered incidental to payment.
- A-10. Furnish and install Flow Meter Vault, complete: Payment for Flow Meter Vault shall include all work required to construct and test all items for the meter vault and will be made on a lump sum basis. The unit price shall be full compensation for the precast concrete vault at the depth and size as shown in the Drawings, including excavation and backfill, drainage

pipng, water piping, and fittings inside and immediately outside vault, piping specials and accessories, hatch, ladder, and any other work shown on the Drawings, complete, unless specified under other bid items.

- A-11. Connections to existing water system piping: Payment for connecting to existing water system piping, including exploratory excavation as may be required to confirm piping locations and type; any additional excavation and backfill; cutting existing piping; removal and abandonment of existing utilities, fittings, valves, and appurtenances; and all other miscellaneous tie-in related work not included in other Bid Items, will be on a lump sum basis for the sizes and types as shown in the Drawings.
- A-12. Additional cost for overexcavation and select backfill material for unsuitable trench conditions: Payment for overexcavation and select backfill material for unsuitable trench conditions will only be considered as approved by the Owner's Representative. When such pre-approval is obtained, payment will be made on a per cubic yard basis.
- A-13. Additional cost for utility trench excavation, hauling, disposal, and backfill, STA A11+80 to A12+05, STA A43+00 to A54+00, and STA A59+00 to A59+90: Payment for additional excavation, hauling, disposal, and backfill for pipe installed at depths beyond 8 feet below finished roadway subgrade as shown in the Drawings from STA A11+80 to A12+05, STA A43+00 to A54+00, and STA A59+00 to A59+90, including all work and materials; excavation to depths beyond 8 feet below finished roadway subgrade as shown in the Drawings; hauling and disposal of materials excavated to a designated off-site location; and Class B pipe bedding, pipe zone backfill, and trench backfill materials will be made at the unit price per cubic yard. The additional cost for utility trench excavation at depths beyond 8 feet and hauling will be paid for in addition to the linear foot price for pipe installation, trench excavation, and backfill in Pay Item A-5 for trench depths up to 8 feet. Pipe bedding, pipe zone, and trench backfill is understood to be imported granular material, compacted in place as shown in the Drawings. Class B fill material shall be as specified within Section 31 23 17, Trenching.
- A-14. Hydrostatic testing, flushing, and disinfection of water mains: Payment for hydrostatic testing, flushing, and disinfection of water mains will be on a lump sum basis per Alignment and shall include furnishing, installing, and removing temporary blow-off piping, including miscellaneous piping, valves, fittings, and thrust restraint. The Owner shall provide off-site laboratory analysis. Payment for any retesting shall be paid by the Contractor.
- A-15. Abandon-in-place existing 24-inch and 30-inch diameter asphaltic concrete pipe waterline, cut and plug with grout: Payment for abandoning pipe in place shall be on a per cubic yard basis for flowable fill material installed. Final measurement of flowable fill installed shall be based on concrete supplier batch tickets received on site, noting quantities delivered and placed. Work considered incidental to this item shall include plugging the ends of abandoned pipe with grout; disconnecting and capping new/live mains; excavation; pipe

hole cutting; backfill; and restoring excavations, as required per Section 33 11 50, Existing Pipe Abandonment, will be on a per cubic yard basis.

- A-16. Abandon and remove existing ductile iron pipe waterline at High Level Pump Station site: Payment for removing abandoned piping; disconnecting and capping new/live mains; capping abandoned pipe ends; removal/demolition of associated valves, valve boxes and vaults, test stations, meters and meter boxes, hydrants, abandoned services, and other appurtenances; excavation; pipe hole cutting; backfill; and restoring excavations, as required per Section 33 11 50, Existing Pipe Abandonment, will be on a per linear foot basis.

Schedule B – 18-inch Diameter Domestic Water Line

- B-1. Mobilization, bonds, insurance, and demobilization: Payment for mobilization, bonds, insurance, and demobilization will be on a lump sum basis. The amounts paid for this bid item in the contract progress payment will be based on the percent of the original contract amount that is earned from other contract items, as follows:
- a. When 5 percent of the original contract amount is earned, 50% of the amount for the bid item will be paid.
 - b. When 95 percent work of the original contract amount is earned, 50% of the amount for the bid item will be paid.

This schedule of mobilization progress payments will not limit or preclude progress payments otherwise provided by the contract.

- B-2. Traffic control: Payment for traffic maintenance and protection, flagging, temporary fencing and safety barricades, including all coordination, materials, and equipment, as required, will be on a lump sum basis.
- B-3. Erosion control: Payment for installation of approved erosion control devices (silt fencing, straw bales, and other items), as required, including all labor, materials, and equipment, as required, will be on a lump sum basis.
- B-4. Construction survey and staking: Payment for construction survey and staking, including all coordination, materials, labor, and equipment, as required, will be on a lump sum basis, complete.
- B-5. Furnish and install Class 52 ductile iron pipe / C900 PVC pipe with Class B (imported granular material) trench backfill: Payment for furnishing and installing Class 52 ductile iron pipe or C900 PVC pipe with Class B (imported granular material) trench backfill, including all work and materials; Contractor quality assurance testing and acceptance; storage and transport of pipe; excavation to depths up to 8 feet below finished roadway subgrade as shown in the Drawings; all required joint restraint systems for pipe, fittings, valves, and appurtenances; standard concrete thrust blocks (including concrete, excavation, and thrust plates) where shown in the Drawings; dewatering; Class B pipe bedding, pipe zone

backfill, and trench backfill materials; and general surface restoration will be on a per linear foot basis for the pipe diameters shown. Pipe bedding, pipe zone, and trench backfill is understood to be imported granular material, compacted in place as shown in the Drawings. Class B fill material shall be as specified within Section 31 23 17, Trenching.

The pay quantities for pipe, trench excavation, and backfill will be on the basis of the horizontal length of pipe laid without deductions for valves or fittings which may be included in the end-to-end measurement of a continuous section of pipe. Where pipe is laid on a continuous slope greater than 10 percent for a distance greater than 100 feet, payment will be made upon the average slope distance between 100-foot stations. When water mains intersect, the measurement of each main shall be to the intersection of the center lines of the connecting fittings.

- B-6. Furnish and install ductile iron fittings: Payment for furnishing and installing ductile iron fittings will be made on a per each basis for the type and diameter of fittings shown. Fitting installation will be considered a separate pay item from work performed under other pay items. Fitting accessories including glands, bolts, and gaskets shall be considered incidental in the fitting weights for payment. Payment for joint restraint systems is included under the payment for restrained joint pipe.
- B-7. Furnish and install buried valves: Payment for furnishing and installing buried valves not included in other pay items, including valve boxes, covers, risers, extensions, and concrete collars, if required, complete, will be on a per each valve basis for the diameters shown in the Drawings.
- B-8. Furnish and install 3/4-inch diameter air release valve (ARV) assemblies: Payment for furnishing and installing 3/4-inch diameter air release valve (ARV) assemblies, including piping and fittings; special coating for pipe; combination air valve; elbows; nipples; unions; isolation joints; valve box; excavation; pipe bedding and backfill; stand pipe; meter box; precast manhole; appurtenances; and removal and replacement of concrete curbs and sidewalks, as may be required, complete, within the pay limits as shown in the Drawings, will be on a per each basis. Excavation, sheeting, shoring, and dewatering shall be considered incidental to payment.
- B-9. Furnish and install 4-inch diameter blow-off assemblies: Payment for furnishing and installing permanent blow-off assemblies, complete, will be on a per each basis. Payment shall include furnishing and installing materials included in the blow-off detail in the Drawings and other appurtenances within the pay limits shown on the drawings, including the mainline tee. Excavation, sheeting, shoring, and dewatering shall be considered incidental to payment.
- B-10. Furnish and install fire hydrant assemblies: Payment for furnishing and installing fire hydrant assemblies will be on a per each basis. The unit price for hydrants shall include all costs for shackles, tie rods, pier blocks, gravel, painting, elbows, thrust blocks, and all other items for the complete installation of the hydrant. Hydrant isolation valves and tees will be paid for at the unit contract price each under the appropriate bid items.

- B-11. Connections to existing water system piping: Payment for connecting to existing water system piping, including exploratory excavation as may be required to confirm piping locations and type; any additional excavation and backfill; cutting existing piping; removal and abandonment of existing utilities, fittings, valves, and appurtenances; and all other miscellaneous tie-in related work not included in other Bid Items, will be on a lump sum basis for the sizes and types as shown in the Drawings.
- B-12. Additional cost for utility trench rock excavation, hauling, and disposal, STA A1+00 to STA A11+60: Payment for rock excavation and hauling will be made at the unit price per cubic yard of rock excavated and hauled to a designated off-site location. The additional cost for utility trench rock excavation and hauling will be paid for in addition to the linear foot price for pipe, trench excavation, and backfill in Pay Items B-6a and B-6b. The pay limits for pipe trench shall be 12 inches below the pipe invert and the width shall be the nominal pipe diameter plus 18 inches on each side of the pipe. No payment will be made for utility trench rock excavation beyond these limits. Bidders shall provide a unit cost for all work associated with the hauling and disposal of rock materials developed during trench excavation.

Rock excavation is defined in Section 31 23 18, Rock Removal, and as determined by the Owner's Representative. Rock excavation will be measured by surveying coordinates and elevations of the solid rock surface prior to and following excavation of the rock; the total quantity of rock excavated will be calculated from these measurements. Rock measurement will be subject to approval by the Owner's Representative. Cost of surveying rock measurement shall be the responsibility of the Contractor. No additional payment will be made for common excavation beyond these limits to remove solid rock and/or boulders, nor will payment be made for select backfill beyond these limits placed to fill voids left by removing solid rock and/or boulders.

Contractor's attention is directed to Section 31 23 17, Trenching, which disallows the use of explosives and controlled blasting in the excavation and removal of rock for utility trench construction.

- B-13. Additional cost for overexcavation and select backfill material for unsuitable trench conditions: Payment for overexcavation and select backfill material for unsuitable trench conditions will only be considered as approved by the Owner's Representative. When such pre-approval is obtained, payment will be made on a per cubic yard basis.
- B-14. Additional cost for utility trench excavation, hauling, disposal, and backfill, STA A52+20 to A53+80 and STA A59+00 to A60+40: Payment for additional excavation, hauling, disposal, and backfill for pipe installed at depths beyond 8 feet below finished roadway subgrade as shown in the Drawings from STA A52+20 to A53+80 and STA A59+00 to A60+40, including all work and materials; excavation to depths beyond 8 feet below finished roadway subgrade as shown in the Drawings; hauling and disposal of materials excavated to a designated off-site location; and Class B pipe bedding, pipe zone backfill, and trench backfill materials will be made at the unit price per cubic yard. The additional cost for utility trench excavation at depths beyond 8 feet and hauling will be paid for in addition to the linear

foot price for pipe installation, trench excavation, and backfill in Pay Item A-5 for trench depths up to 8 feet. Pipe bedding, pipe zone, and trench backfill is understood to be imported granular material, compacted in place as shown in the Drawings. Class B fill material shall be as specified within Section 31 23 17, Trenching.

- B-15. Hydrostatic testing, flushing, and disinfection of water mains: Payment for hydrostatic testing, flushing, and disinfection of water mains will be on a lump sum basis per Alignment and shall include furnishing, installing, and removing temporary blow-off piping, including miscellaneous piping, valves, fittings, and thrust restraint. The Owner shall provide off-site laboratory analysis. Payment for any retesting shall be paid by the Contractor.
- B-16. Abandon and remove existing 8-inch diameter cast iron waterline in Kirk Avenue: Payment for removing abandoned piping; disconnecting and capping new/live mains; capping abandoned pipe ends; removal/demolition of associated valves, valve boxes and vaults, test stations, meters and meter boxes, hydrants, abandoned services, and other appurtenances; excavation; pipe hole cutting; backfill; and restoring excavations, as required per Section 33 11 50, Existing Pipe Abandonment, will be on a per linear foot basis.
- B-17. Saw-cut existing asphaltic concrete (AC) pavement and concrete surfacing, STA A1+00 to A1+65: Measurement and payment for saw-cutting existing AC pavement and concrete surfacing shall include trench width limits plus 6 inches on each side of trench for tee-cut excavation. Payment for saw-cutting existing surfacing for cuts up to 4 inches in depth and for each 1-inch depth beyond the first 4-inch thickness shall be on a per linear foot of cutting basis.
- B-18. Hot mix asphaltic concrete (HMAC) trench resurfacing, STA A1+00 to A1+65: Measurement and payment for trench resurfacing shall be on a per ton basis. Payment for HMAC) trench resurfacing shall include furnishing and installing of the asphaltic concrete and aggregate base materials, compaction, process control, acceptance testing, and other incidental work required to provide permanent HMAC pavement at thicknesses as shown on the Drawings and specified in Section 32 12 16, Asphaltic Concrete Pavement.

Schedule C – Earthwork

- C-1. Mobilization, bonds, insurance, and demobilization: Payment for mobilization, bonds, insurance, and demobilization will be on a lump sum basis. The amounts paid for this bid item in the contract progress payment will be based on the percent of the original contract amount that is earned from other contract items, as follows:
- a. When 5 percent of the original contract amount is earned, 50% of the amount for the bid item will be paid.
 - b. When 95 percent of the original contract amount is earned, 50% of the amount for the bid item will be paid.

This schedule of mobilization progress payments will not limit or preclude progress payments otherwise provided by the contract.

- C-2. Temporary protection and direction of traffic/project safety: Measurement for payment for temporary protection and direction of traffic/project safety shall be on a lump sum all required basis. Payment shall include all supervision, planning, training, signs, barricades, barriers, lights, cones, flag persons, and such devices and work, etc., as may be required during execution of the Work. Payment shall be made on in-progress payment requests in proportion to the percentage of Work completed to date. Payment shall be made at the lump sum price stated in the Bid Schedule for "Temporary Protection and Direction of Traffic/Project Safety."
- C-3. Erosion and sediment control: Measurement for payment for erosion and sediment control shall be on a lump sum all required basis. There shall be no measurement for payment purposes. This item shall include furnishing all labor and materials necessary to comply with all environmental requirements related to construction activities, silt fence, straw wattles, etc. Payment shall be made at the lump sum price stated in the Bid Schedule for "Erosion and Sediment Control."
- C-4. Earthwork: This is a lump sum all required bid item. There shall be no measurement of the Work for payment purposes. Earthwork shall include all clearing, grubbing, structure removal, excavation, embankment, borrow material, waste disposal, watering, scarifying, soft spot removal, compacting, all grade control other than that performed by the Engineer, etc., as required to completely construct the cross section of the road up to the subgrade level, including shoulders and ditches, as shown on the Drawings and called for in the Technical Specifications. Payment shall be made at the lump sum price stated in the Bid Schedule for "Earthwork."
- C-5. Surface restoration: This is a lump sum all required bid item. There shall be no measurement of the Work for payment purposes. Surface restoration shall include all labor and materials necessary to comply with the project requirements. Payment shall be made at the lump sum price stated in the Bid Schedule for "Surface Restoration."
- C-6. Construction survey and staking: Payment for construction survey and staking, including all coordination, materials, labor, and equipment, as required, will be on a lump sum basis, complete.

END OF SECTION

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section contains administrative and procedural requirements for submittals for review, information, and for Project closeout.
- B. Section includes:
 - 1. Schedule of Submittals.
 - 2. Submittal requirements.
 - 3. Submittal procedures.
 - 4. Owner's Representative review.
 - 5. Resubmittal procedures.
 - 6. Product data.
 - 7. Shop Drawings.
 - 8. Samples.
 - 9. Design data.
 - 10. Test reports.
 - 11. Certificates.
 - 12. Manufacturer's instructions.
 - 13. Manufacturer's field reports.
 - 14. Erection Drawings.
 - 15. Construction progress schedules.
 - 16. Breakdown of contract price.
 - 17. Operation and maintenance (O&M) instructions.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Owner's Representative's responsive action.
- B. Informational Submittals: Written and graphic information and physical Samples that do not require Owner's Representative's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SCHEDULE OF SUBMITTALS

- A. Within 10 days after the Effective Date of the Contract, Contractor shall submit to Owner's Representative a preliminary Schedule of Submittals, including proposed list of major products proposed for use, with specification section reference, name of Manufacturer, supplier, trade name, subcontractor, and model number of each

product. Provide a schedule of specific target dates for the submission and return of submittals and shop drawings required by the Contract Documents.

- B. For products specified only by reference standards, indicate Manufacturer, trade name, model or catalog designation, and reference standards.
- C. The list and schedule shall be updated and resubmitted when requested by the Owner's Representative.
- D. Contractor's Schedule of Submittals will be acceptable to the Owner's Representative if it provides a workable arrangement for reviewing and processing the required submittals.

1.4 SHOP DRAWING AND SAMPLE SUBMITTAL REQUIREMENTS

- A. Before submitting a Shop Drawing or Sample, Contractor shall have:
 - 1. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - 2. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
 - 3. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - 4. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
- B. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.
- C. With each submittal, Contractor shall give Owner's Representative specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Owner's Representative for review of each such variation.

1.5 SUBMITTAL PROCEDURES

- A. Contractor shall submit Shop Drawings and Samples to Owner's Representative for review in accordance with the accepted Schedule of Submittals.
- B. Transmit each submittal with Owner's Representative-accepted transmittal form certifying compliance with requirements of Contract Documents.
- C. Sequentially number transmittal forms. Mark transmittal forms for resubmittals with original number and sequential alphabetic suffix.
- D. Show each Submittal with the following numbering and tracking system:
 - 1. Submittals shall be numbered according to specification section. For example, the first product submittal for Section 05 50 00 would be "05 50 00-1". Resubmittals of that submittal would be "05 50 00-1.1", followed by "05 50 00-1.2", and so on. The second product submittal for that Section would be "05 50 00-2".
 - 2. Submittals containing product information from multiple sections of the specifications will not be reviewed. Contractor and/or their supplier shall divide submittals in a manner that meets the numbering and tracking system requirements stated herein.
 - 3. Alternative method of numbering may be used if acceptable to Owner's Representative.
- E. Identify: Project, Contractor, subcontractor and supplier, pertinent drawing and detail number, and specification Section number appropriate to submittal.
- F. Apply Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is according to requirements of the Work and Contract Documents.
- G. Coordinate submission of related items.
 - 1. All shop drawings for interrelated items shall be scheduled for submission at the same time.
 - 2. The Owner's Representative may hold shop drawings in cases where partial submission cannot be reviewed until the complete submission has been received or where shop drawings cannot be reviewed until correlated items affected by them have been received. When such shop drawings are held, the Owner's Representative will advise the Contractor in writing that the shop drawing submitted will not be reviewed until shop drawings for all related items have been received.

- H. When hard copies of submittals are provided by the Contractor, six copies of all materials shall be provided to the Owner's Representative. Two copies of reviewed submittals will be kept by the Owner's Representative, two copies of reviewed submittals will be transmitted to the Owner, and two copies of reviewed submittals will be returned to the Contractor. If the Contractor requests that more than two copies of the reviewed submittal be returned, then the Contractor shall submit the appropriate quantity of submittals.
- I. When electronic transmittals of submittals are provided by the Contractor under established protocols described elsewhere in the Contract Documents or as jointly developed by the Owner, Owner's Representative and Contractor, provide electronic submittals in portable document format (PDF) in addition to the source document format (Word, Excel, AutoCAD, etc.). Reviewed submittals will be returned to the Contractor as PDF electronic files.
- J. For each submittal for review, allow not less than 14 days for Owner's Representative review, excluding delivery time to and from Contractor.
- K. Identify variations in Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.
- L. Allow space on submittals for Contractor and Owner's Representative review stamps or comments.
- M. When revised for resubmission, the Contractor shall identify changes made since previous submission. A narrative of changes shall be provided, and shop drawings or calculations shall indicate that a revision was made.
- N. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with review comments.
- O. Submittals not requested will not be recognized nor processed.
- P. Incomplete Submittals: Owner's Representative will not review. Complete submittals for each item are required. Delays resulting from incomplete submittals are not the responsibility of Owner's Representative.

1.6 OWNER'S REPRESENTATIVE REVIEW

- A. Informational submittals and other similar data are for Owner's Representative's information, do not require Owner's Representative's responsive action, and will not be reviewed or returned with comment.
- B. The Owner's Representative's review of submittals and shop drawings is not a check of any dimension or quantity and will not relieve the Contractor from responsibility for errors of any sort in the submittals and shop drawings.

- C. Submittals made by Contractor that are not required by Contract Documents may be returned without action.
- D. The Owner's Representative will review the submitted data and shop drawings and return to the Contractor with notations thereon indicating "No Exception Taken", "Make Corrections Noted", "Rejected", "Revise and Resubmit", or "Submit Specified Item".
- E. If more than two submissions of an item are required to meet the Project specifications, Contractor shall be responsible for Owner's Representative's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.
- F. Owner's Representative will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Owner's Representative. Owner's Representative's review will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
- G. Owner's Representative's review will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.
- H. Owner's Representative's review of a separate item as such will not indicate approval of the assembly in which the item functions.
- I. Owner's Representative's review of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 1.4.C and Owner's Representative has given written acceptance of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Owner's Representative will document any such accepted variation from the requirements of the Contract Documents in a Field Order.
- J. Owner's Representative's review of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 1.4 A. and B.
- K. Owner's Representative's review of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

- L. Neither Owner's Representative's receipt, review, return of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.
- M. Contractor shall perform the Work in compliance with the requirements and commitments set forth in returned Shop Drawings and Samples, subject to the provisions of Paragraph 1.6.I.

1.7 RESUBMITTAL PROCEDURES

- A. Contractor shall make corrections required by Owner's Representative and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Owner's Representative on previous submittals.
- B. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required review of an item with no more than two submittals. Owner's Representative will record Owner's Representative's time for reviewing a third or subsequent submittal of a Shop Drawings, sample, or other item requiring review, and Contractor shall be responsible for Owner's Representative's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.
- C. If Contractor requests a change of a previously reviewed submittal item, Contractor shall be responsible for Owner's Representative's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

PART 2 PRODUCTS

2.1 CONSTRUCTION PROGRESS SCHEDULES

- A. Within 10 days after the Effective Date of the Contract, prepare and submit to the Engineer a practicable schedule showing the order in which the Contractor proposes to carry out the Work, the dates on which the important features of the work will start, and the contemplated dates for completing same. A time-scaled bar chart schedule shall include the following:
 - Construction activities
 - Submittal and review of critical material samples and shop drawings
 - Procurement and delivery of critical materials
 - Duration of work, including completion times of all stages and their sub-phases

- B. Attention is drawn to typical local climatic weather patterns and Work shall be coordinated accordingly.
- C. Complete Project schedule shall be revised and resubmitted to the Owner's Representative at a minimum occurrence of every three weeks for review.
- D. Three Week Lookahead Schedules: Provide each week at the weekly construction meeting. The previous week's completed work shall be shown on the schedule for a total of 4 weeks shown.

2.2 BREAKDOWN OF CONTRACT PRICE

- A. Within 10 days after the Effective Date of the Contract, submit a complete breakdown of all lump sum bid items showing the value assigned to each part of the work, including an allowance for profit and overhead adding up to the total lump sum contract price.
- B. Breakdown of lump sum bids shall be coordinated with the items in the schedule and shall be in sufficient detail to serve as the basis for progress payments during construction.
- C. Owner's Representative will review the contract price breakdown and may request items to be further broken down or for more items be added in order to facilitate tracking of work progress for payment.
- D. Preparatory work, bonds, and insurance required in setting up the job will be allowed as a separate entry on the cost breakdown but shall not exceed 5 percent of the total base bid.
- E. Upon acceptance of the breakdown of the contract price by the Owner's Representative, it shall be used as the basis for all requests for payment.

2.3 PRODUCT DATA

- A. Product Data: Action Submittal: Submit to Owner's Representative for review for assessing conformance with information given and design concept expressed in Contract Documents. Submitted data shall be sufficient in detail for determination of compliance with the Contract Documents.
- B. Mark each copy to identify applicable products, models, options, and other data. Supplement Manufacturers' standard data to provide information specific to this Project.
 - 1. Note submittal will be returned to Contractor without review of submittal if products, models, options, and other data are not clearly marked or identified.

- C. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- D. After review, produce copies and distribute according to Paragraph 1.5.M and for record documents.

2.4 SHOP DRAWINGS

- A. Shop Drawings: Action Submittal: Submit to Owner's Representative for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional Owner's Representative licensed in the state of Project, responsible for designing components shown on Shop Drawings.
 - 1. Include signed and sealed calculations to support design.
 - 2. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
 - 3. Make revisions and provide additional information when required by authorities having jurisdiction.
- D. All dimensioned shop drawings shall be scalable and provided as full-sized (22-inch x 34-inch) sheets. PDF electronic files shall print as scalable full-sized sheets.
- E. After review, produce copies and distribute according to Paragraph 1.5.M and for record documents.

2.5 SAMPLES

- A. Samples: Action Submittal: Submit to Owner's Representative for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Samples for Selection as Specified in Product Sections:
 - 1. Submit to Owner's Representative for aesthetic, color, and finish selection.
 - 2. Submit Samples of finishes, textures, and patterns for Owner selection.

- C. Submit Samples to illustrate functional and aesthetic characteristics of products, with integral parts and attachment devices. Coordinate Sample submittals for interfacing work.
- D. Include identification on each Sample, with full Project information.
- E. Submit number of Samples specified in individual Specification Sections; Owner's Representative will retain one Sample.
- F. Reviewed Samples that may be used in the Work are indicated in individual Specification Sections.
- G. After review, produce copies and distribute according to Paragraph 1.5.M and for record documents.

2.6 DESIGN DATA

- A. Informational Submittal: Submit data for Owner's Representative's knowledge as Contract administrator or for Owner.
- B. Submit information for assessing conformance with information given and design concept expressed in Contract Documents.

2.7 TEST REPORTS

- A. Informational Submittal: Submit reports for Owner's Representative's knowledge and records as Contract administrator or for Owner.
- B. Submit test reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

2.8 CERTIFICATES

- A. Informational Submittal: Submit certification by Manufacturer, installation/application Subcontractor, or Contractor to Owner's Representative, in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product but must be acceptable to Owner's Representative.

2.9 MANUFACTURER'S INSTRUCTIONS

- A. Informational Submittal: Submit Manufacturer's installation instructions for Owner's Representative's knowledge as Contract administrator or for Owner.

- B. Submit printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, to Owner's Representative in quantities specified for Product Data.
- C. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

2.10 MANUFACTURER'S FIELD REPORTS

- A. Informational Submittal: Submit reports for Owner's Representative's knowledge and records as Contract administrator or for Owner.
- B. Submit report within 48 hours of observation to Owner's Representative for information.
- C. Submit reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

2.11 ERECTION DRAWINGS

- A. Informational Submittal: Submit Drawings for Owner's Representative's knowledge and records as Contract administrator or for Owner.
- B. Submit Drawings for information assessing conformance with information given and design concept expressed in Contract Documents.
- C. Data indicating inappropriate or unacceptable Work may be subject to action by Owner's Representative or Owner.

2.12 NOT USED

2.13 NOT USED

2.14 OPERATION AND MAINTENANCE (O&M) INSTRUCTIONS

- A. Submit preliminary O&M materials for review by Owner's Representative. The Equipment Manufacturer may furnish instruction manuals prepared specifically for the equipment furnished or standard manuals may be used if statements like "if your equipment has this accessory..." or listings of equipment not furnished are eliminated. O&M materials will be returned to the Contractor for resubmittal if the O&M materials do not clearly indicate what specific equipment was furnished and all items not provided being clearly crossed out. Poorly reproduced copies are not acceptable. Operation and maintenance instructions shall contain the following as a minimum:
 - 1. Reviewed shop drawings and submittal data;

2. Model, type, size, and serial numbers of equipment furnished;
 3. Equipment and driver nameplate data;
 4. List of parts showing replacement numbers;
 5. Recommended list of spare parts;
 6. Complete operating instructions including start-up, shutdown, adjustments, cleaning, etc.;
 7. Maintenance and repair requirements including frequency and detailed instructions; and
 8. Name, address and phone numbers of local representative and authorized repair service.
- B. Following review of the preliminary O&M materials by the Owner's Representative and before acceptance of the Work, submit:
1. Four copies of complete final operation and maintenance instructions for all equipment supplied. Submit items in 8-1/2 x 11-inch heavy-duty three-ring binders when appropriate, or in 8-1/2 x 11-inch file folders. All binders and folders shall have clear plastic pockets on the front of the cover and the spine to allow for insertion of identifying information.
 2. Two searchable electronic PDF copies of full O&M materials. Provide each electronic copy on its own individual thumb drive or disc.

2.15 OTHER REQUIRED SUBMITTALS

- A. Other required submittals include the items listed below. This list is provided for Contractor's convenience only and may not be complete in all respects. Contractor shall provide all submittals specified or required, whether or not listed here.
1. Contractor Emergency Contact List.
 2. Erosion and Sediment Control Plan.
 3. Traffic Control and Protection Plan.

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 45 00 - QUALITY CONTROL

PART 1 GENERAL

1.1 DESCRIPTION

- A. This Section covers quality control requirements supplementary to those of the General Conditions and Technical Specifications.

1.2 PROVISIONS

- A. Contractor's Responsibility for Testing

The Contractor shall be responsible for the cost of all testing as specified in this section. Additional information has been provided regarding the payment responsibility for the Owner with regards to the Project.

- B. Owner's Right to Perform Additional Tests

The Owner or Owner's Representative reserves the right to complete additional testing. In such cases, the Contractor shall provide safe access for the Owner or Owner's Representative and their inspectors to adequately inspect the quality of work and the conformance with Project specifications.

1.3 QUALITY ASSURANCE

- A. Testing Requirements

An independently owned and operated laboratory approved by the Owner's Representative shall perform all testing as specified herein.

- B. Testing

1. General

- a. All required testing of work and/or materials shall be conducted in the presence of the Owner's Representative. The Contractor shall provide 48-hour notification to the Owner and Owner's representative prior to conducting any and all quality assurance testing. Where applicable, work and materials shall only be buried with the consent of the Owner's Representative.
- b. Where such inspection and testing are to be conducted by an independent laboratory or agency, the sample, or samples of material to be tested shall be selected by such laboratory or agency or by the Owner's Representative. The Contractor shall furnish such samples of all materials without charge to Owner.

- c. The results from any and all tests are made for the information of the Owner. Regardless of any test results, the Contractor is solely responsible for the quality of workmanship and materials and for compliance with the requirements of the Drawings and Specifications.

2. Costs of Testing

- a. The Contractor shall be responsible for and shall pay for all tests as specified in Part 3 of this Section. Additional information has been provided regarding the payment responsibility for the Owner with regards to the Project.
- b. With regards to all materials to be tested, where test results demonstrate that the material or workmanship does not meet the minimum requirements of the Contract Documents, additional testing shall be completed and shall be paid for by the Contractor with no reimbursement by the Owner.

1.4 SPECIAL INSPECTIONS

Special inspections and testing as required by Chapter 17 of the IBC shall be conducted by Owner-retained Special Inspectors and Testing Agencies as required and as indicated in the Contract Documents.

A. Special Inspectors and Testing Agencies Responsibilities

- 1. Verify that manufacturers maintain detailed fabrication and quality control procedures and review the completeness and adequacy of those procedures to perform the Work.
- 2. Promptly notify Owner and Contractor of irregularities and deficiencies observed in the Work during performance of their services.
- 3. Submit certified written report of each test, inspection and similar quality control service to Owner, Contractor, and jurisdictional authorities. Interpret test results and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- 4. Submit final report of special inspections at Substantial Completion, including a list of unresolved deficiencies.
- 5. Re-test and re-inspect corrected work.

B. Contractor's Responsibilities

- 1. Provide quality requirements to all subcontractors and enforce all requirements.

2. Notify Owner, Owner's Representative, Special Inspectors and Testing Agencies at least 48 hours in advance of time when Work that requires testing or special inspecting will be performed, unless otherwise indicated in the Contract Documents.
3. Pay for any Contractor requested testing and inspecting not required by the Contract Documents.
4. Pay for any re-testing or re-inspections by Special Inspectors and Testing Agencies for replacement work resulting from work that failed to comply with the Contract Documents. Owner will deduct such costs from the Contract Price.
5. Submit copies of licenses, certifications, correspondence, records, and similar documents used to establish compliance with standards and regulations that pertain to performance of the Work to the Owner, Owner's Representative, and Special Inspectors.
6. Where Special Inspection requires pre-construction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - a. Provide test specimens representative of proposed products and construction in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - b. Provide information on configurations of test assemblies, testing procedures and laboratory test records to adequately demonstrate capability of products to comply with performance requirements.
7. Cooperate with Agencies performing required tests, special inspections, and similar quality control services. Notify Agencies in advance of operations to permit assignment of personnel. Provide the following:
 - a. Access to the Work.
 - b. Incidental labor, equipment, and materials necessary to facilitate tests and special inspections.
 - c. Adequate quantities of representative samples of materials that require testing and inspecting. Assist Agencies in obtaining samples.
 - d. Provide facilities for storage and field curing of test samples.
 - e. Deliver samples to Testing Agencies.

8. Coordinate sequence of activities to accommodate required quality-assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and special inspecting.
9. Schedule times for tests, special inspections, obtaining samples, and similar activities. Distribute schedule to Owner, Owner's Representative, Special Inspectors, Testing Agencies, and each party involved in portions of the work where tests and special inspections are required.

1.5 SUBMITTALS

A. Laboratory Test or Inspection Reports

Each report shall be signed and certified by the independently owned and operated testing laboratory. Unless otherwise specified, submit three copies of each report to the Owner or Owner's Representative.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 FIELD TESTING SCHEDULE

- A. The Contractor shall complete field testing in accordance with the following schedule. Additional source material testing shall be completed as necessary to establish the basis of field tests. The frequency of testing listed in this schedule lists the minimum number of tests per quantity of work completed by the Contractor. Testing locations to be determined by the Owner's Representative.

Material to be Tested	Payment Responsibility for Initial Testing	Minimum Testing Frequency
Trench Backfill	Contractor	In-place compaction testing (w/ nuclear compaction gauge) performed at 2-foot elevation increments, one test per 200 lineal feet of pipeline trench as measured along pipe centerline. Owner's Representative may reduce frequency to one test per lift for every 1,500 lineal feet of pipeline trench when satisfied with Contractor's method of compaction. See Article 3.16, Field Quality Control of Section 31 23 17, Trenching for further details.
Asphalt Concrete	Contractor	As required when placed. See detailed requirements in Subsections 1.5, Quality Assurance, and 3.3, Field Quality Control of Section 32 12 16, Asphalt Paving.
Earthwork / Embankment Material	Contractor	A minimum of one ASTM D1557 laboratory density test will be performed for each testable material used as embankment material, providing the maximum theoretical density and optimum moisture content of the material can be determined. A minimum of one nuclear gauge density test (ASTM D6938) will be performed every 800 square yards on each lift of material to show required density is being achieved. Once an acceptable compaction method is established and verified with field density tests, the testing interval can be reduced to one test each 1,600 square yards on each lift. If backfill material or compaction equipment changes, compaction testing shall immediately be performed to verify that density is being achieved and shall continue at 800 square yard intervals until a new compaction method is verified.
Waterline – Hydrostatic testing and disinfection	Contractor	As required. See Section 33 13 00, Testing & Disinfection of Water Utility Piping.

END OF SECTION

SECTION 01 75 00 - TESTING, TRAINING, AND COMMISSIONING

PART 1 GENERAL

1.1 SCOPE

This section specifies equipment and system testing and start-up, services of Manufacturer's representatives, training of Owner's personnel, and final testing requirements for the complete facility.

1.2 CONTRACT REQUIREMENTS

- A. Testing, training, and start-up are requisite to the satisfactory completion of the Contract.
- B. Complete all testing, training, and start-up within the Contract Time(s).
- C. Furnish all necessary labor, power, chemicals, tools, equipment, instruments, and services required for and incidental to completing functional testing, performance testing, and operational testing.
- D. Provide competent, experienced technical representatives of Equipment Manufacturers for assembly, installation, testing, and operator training.

1.3 START-UP PLAN

- A. Submit start-up plan for each piece of equipment and each system not less than 2 weeks prior to planned initial equipment or system start-up.
- B. Provide detailed Start-up Progress Schedule with the following activities identified:
 - 1. Manufacturer's services
 - 2. Installation certifications
 - 3. Operator training
 - 4. Submission of operation and maintenance manual
 - 5. Functional testing
 - 6. Performance testing
 - 7. Operational testing
- C. Provide testing plan with test logs for each item of equipment and/or system. Include testing of alarms, control circuits, capacities, speeds, flows, pressures, vibrations, sound levels, and other parameters.
- D. Provide summary of shutdown requirements for existing systems if required, which are necessary to complete start-up of new equipment and systems.

- E. Revise and update start-up plan based upon review comments, actual progress, or to accommodate changes in the sequence of activities.

1.4 GENERAL START-UP AND TESTING PROCEDURES

A. Mechanical Systems:

1. Remove rust preventatives and oils applied to protect equipment during construction.
2. Flush lubrication systems and dispose of flushing oils. Recharge lubrication system with lubricant recommended by Manufacturer.
3. Flush fuel system and provide fuel for testing and start-up.
4. Install and adjust packing, mechanical seals, O-rings, and other seals. Replace defective seals.
5. Remove temporary supports, bracing, or other foreign objects installed to prevent damage during shipment, storage, and erection.
6. Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver.
7. Perform cold alignment and hot alignment to Manufacturer's tolerances.
8. Adjust V-belt tension and variable pitch sheaves.
9. Inspect hand and motorized valves for proper adjustment. Tighten packing glands to ensure no leakage but permit valve stems to rotate without galling. Verify valve seats are positioned for proper flow direction.
10. Tighten leaking flanges or replace flange gasket. Inspect screwed joints for leakage.
11. Install gratings, safety chains, handrails, shaft guards, and sidewalks prior to operational testing.

B. Electrical Systems

1. Perform insulation resistance tests on wiring except 120-volt lighting, wiring, and control wiring inside electrical panels.
2. Perform continuity tests on grounding systems.
3. Test and set switchgear and circuit breaker relays for proper operation.

4. Perform direct current high potential tests on all cables that will operate at more than 2,000 volts. Obtain services of independent testing lab to perform tests.
 5. Check motors for actual full load amperage draw. Compare to nameplate value.
- C. Instrumentation Systems
1. Bench or field calibrate instruments and make required adjustments and control point settings.
 2. Leak test pneumatic controls and instrument air piping.
 3. Energize transmitting and control signal systems, verify proper operation, ranges, and settings.

1.5 FUNCTIONAL TESTING

- A. Functionally test mechanical and electrical equipment for proper operation after general start-up and testing tasks have been completed.
- B. Demonstrate proper rotation, alignment, speed, flow, pressure, vibration, sound level, adjustments, and calibration. Perform initial checks in the presence of and with the assistance of the Manufacturer's representative.
- C. Demonstrate proper operation of each instrument loop function including alarms, local and remote controls, instrumentation, and other equipment functions. Generate signals with test equipment to simulate operating conditions in each control mode.
- D. Conduct continuous 8-hour test under full load conditions. Replace parts which operate improperly.

1.6 CERTIFICATE OF PROPER INSTALLATION

- A. At completion of functional testing, furnish written report prepared and signed by Manufacturer's authorized representative, certifying equipment:
 1. Has been properly installed, aligned, adjusted, and lubricated.
 2. Is free of any stresses imposed by connecting piping or anchor bolts.
 3. Is suitable for satisfactory full-time operation under full load conditions.
 4. Operates within the allowable limits for vibration.
 5. Controls, protective devices, instrumentation, and control panels furnished as part of the equipment package are properly installed, calibrated, and functioning.

- 6. Control logic for start-up, shutdown, sequencing, interlocks, and emergency shutdown has been tested and is properly functioning.
- B. Furnish written report prepared and signed by the electrical and/or instrumentation subcontractor certifying:
 - 1. Motor control logic that resides in motor control centers, control panels, and circuit boards furnished by the electrical and/or instrumentation subcontractor has been calibrated and tested and is properly operating.
 - 2. Control logic for equipment start-up, shutdown, sequencing, interlocks, and emergency shutdown has been tested and is properly operating.
- C. Co-sign the reports along with the Manufacturer's representative and subcontractors.

1.7 TRAINING OF OWNER’S PERSONNEL

- A. Provide operations and maintenance training for items of mechanical, electrical, and instrumentation equipment. Utilize Manufacturer's representatives to conduct training sessions.
- B. Coordinate training schedule with City staff. Coordinate training sessions to prevent overlapping sessions. Arrange sessions so that individual operators and maintenance technicians do not attend more than two sessions per week.
- C. Provide Operation and Maintenance Manual for specific pieces of equipment or systems 2 weeks prior to training session for that piece of equipment or system.
- D. Satisfactorily complete functional testing before beginning operator training.
- E. The Owner may videotape the training for later use with the Owner’s personnel.

1.8 MINIMUM SERVICE SCHEDULE

Minimum services as specified shall be provided in accordance with the following schedule:

Specification Section	Equipment	Minimum On-Site Time Requirements		
		1) Equipment Installation	2) Equipment Testing	3) Operator Training
40 71 13	Electromagnetic Flow Meters	1 CWD	0.5 CWD	0.25 CWD

NOTE: CWD is defined as a consecutive working day consisting of 8 hours each from 8:00 a.m. to 5:00 p.m.

1.9 OPERATIONAL TESTING

- A. Conduct operational test of the entire facility after completion of operator training. Demonstrate satisfactory operation of equipment and systems in actual operation.
- B. Conduct operational test for continuous 7-day period.
- C. Owner will provide operations personnel, power, fuel, and other consumables for duration of test.
- D. Immediately correct defects in material, workmanship, or equipment which became evident during operational test.
- E. Repeat operational test when malfunctions or deficiencies cause shutdown or partial operation of the facility or results in performance that is less than specified.

1.10 RECORD KEEPING

- A. Maintain and submit to Owner's Representative the following records generated during start-up and testing phase of Project:
 - 1. Daily logs of equipment testing identifying all tests conducted and outcome.
 - 2. Logs of time spent by Manufacturer's representatives performing services on the job site.
 - 3. Equipment lubrication records.
 - 4. Electrical phase, voltage, and amperage measurements.
 - 5. Insulation resistance measurements.
 - 6. Pump torsional and lateral vibration analysis report.
 - 7. Data sheets of control loop testing including testing and calibration of instrumentation devices and set points.

END OF SECTION

SECTION 02 30 00 - SUBSURFACE INVESTIGATION

PART 1 GENERAL

1.1 SUMMARY

- A. Subsurface investigations and reporting have been performed for the purpose of obtaining data for the planning and design of this Project. Copies of such reporting are attached to the Contract Documents as Supplementary Information.

1.2 LIMITATIONS

- A. The subsurface investigations and reporting are being made available solely for the convenience of the Bidder and shall not relieve the Bidder or the Contractor of any risk, duty to make examinations and investigations as required by Article 4 of the Instructions to Bidders, or any other responsibility under the Contract Documents.
- B. It is mutually agreed to by all parties:
 - 1. Written reports are reference documents and are not part of the Contract Documents.
 - 2. Subsurface investigations are for the purpose of obtaining data for planning and design of the Project.
 - 3. Data concerning borings and test pits is intended to represent with reasonable accuracy conditions and material found in specific borings and test pits at the time the borings and test pits were made.
- C. It is expressly understood and agreed the Owner and Owner's Representative assume no responsibility whatsoever in respect to the sufficiency or accuracy of the investigation thus made, the records thereof, or of the interpretations set forth therein, or made by the Owner in the Owner's use thereof; and there is no warranty or guarantee, either expressed or implied, that the conditions indicated by such investigations, or records thereof, are representative of those existing throughout such areas, or any part, or that unforeseen developments may not occur.
- D. The Owner's subsurface investigations and reporting are made available to Bidder or Contractor only on the basis of the understandings and agreement herein stated.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 02 41 00 - DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of existing facilities.
2. Abandoning and removing utilities.

B. Related Sections:

1. Section 31 05 16 - Aggregates for Earthwork
2. Section 31 10 00 - Site Clearing
3. Section 31 22 13 - Rough Grading
4. Section 31 23 16 - Excavation
5. Section 33 05 50 - Existing Pipe Abandonment

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Submit to Owner's Representative a copy of written permission of private property owners, with copy of fill permit for said private property, as may be required for disposal of materials.

1.3 QUALITY ASSURANCE

A. Existing Conditions: Determine the extent of work required and limitations before proceeding with Work.

B. Conform to applicable local, state, and federal codes for environmental requirements in relation to disposal of debris.

1. Burning at the Site for the disposal of refuse, debris, and waste materials resulting from demolition and site clearing operations shall not be permitted.

C. Permits: The Contractor is responsible for obtaining all necessary permits required for completion of the Work described in this Section.

D. Protection of Persons and Property: Meet all federal, state, and local safety requirements for the protection of workmen, other persons, and property in the vicinity of the Work and requirements of the General Provisions.

- E. If the existing material to be demolished and removed contains any hazardous materials which will require special handling upon removal, such as asbestos or lead, it is the responsibility of the Contractor to remove and dispose of the material in accordance with all applicable federal, state, and local regulations.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Existing Materials: All materials, equipment, miscellaneous items, and debris involved, occurring, or resulting from demolition, clearing, and grubbing work shall become the property of the Contractor at the place of origin, except as otherwise indicated in the Drawings or Specifications.
- B. Crushed Rock: As specified in Section 31 05 16-2.1, Aggregates for Earthwork. Of the size shown in the Drawings or specified herein.
- C. Sand: As specified in Section 31 05 16-2.2, Aggregates for Earthwork.

PART 3 EXECUTION

3.1 EXAMINATION

- A. The Owner assumes no responsibility for the actual condition of the facilities to be demolished. The Contractor shall visit the site, inspect all facilities and be familiar with all existing conditions and utilities.
- B. Demolition drawings identify major equipment and structures to be demolished only. Auxiliary utilities such as water, air, chemicals, drainage, lubrication oil, hydraulic power fluid, electrical wiring, controls, and instrumentation are not necessarily shown shall be considered incidental to all demolition work.
- C. Identify waste and salvage areas for placing removed materials.

3.2 PREPARATION

- A. Carefully coordinate the work of this Section with all other work and construction.
- B. Call Local Utility Line Information service at 1-800-332-2344, not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.

2. Disconnect or arrange for disconnection of utilities (if any) affected by required work.
3. Keep all active utilities intact and in continuous operations.

3.3 PROTECTION

- A. Utilities: Locate, identify, and protect utilities located by utilities and indicated in the Drawings to remain from damage.
- B. Survey control: Protect benchmarks, survey control points, and existing structures from damage or displacement.
- C. Preservation and Trimming of Trees, Shrubs and Other Vegetation: As specified in Section 31 10 00-3.4.C, Site Clearing.
- D. Landscaped Areas: Protect existing landscaped areas as specified in Section 31 10 00-3.4.D, Site Clearing.
- E. Miscellaneous Site Features: Protect all existing miscellaneous site features from damage by excavating equipment and vehicular traffic, including but not limited to existing structures, fences, mailboxes, sidewalks, paving, guy wires, utility poles, and curbs.
- F. Repair and Replacement:
 1. Damaged items, including but not restricted to those noted above, shall be repaired, or replaced with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of Work of this contract.
 2. Any damage to existing facilities or utilities to remain as caused by the Contractor's operations shall be repaired at the Contractor's expense.

3.4 DEMOLITIONS

- A. Areas which are to be excavated for the purpose of demolition shall be cleared and stripped in accordance with Section 31 10 00-3.6, Site Clearing.
- B. Carefully consider all bearing loads and capacities for placement of equipment and material on site. In the event of any questions as to whether an area to be loaded has adequate bearing capacity, consult with Owner's Representative prior to the placement of such equipment or material.

C. Demolition of Existing Structures:

1. Excavate around existing structures as required to perform demolition operations and to plug associated existing pipelines where shown in the Drawings.
2. Provide shoring, bracing, and supports, as required, to ensure adjacent structures are not damaged and structural elements of existing structure are not overloaded during demolition activities.
 - a. Increase structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under any part of this Contract.
 - b. Remove all temporary protection when the Work is complete or when so authorized by the Owner's Representative.
3. Any floors that are to remain in place shall be completely cracked through to allow for drainage. Cracking shall be accomplished by dropping a demolition ball or by other methods approved by the Owner's Representative.
4. Remove and dispose of all exposed and/or protruding metalwork, piping, plumbing, and conduits resulting from demolition activities, and all woodwork, roofing, and electrical and mechanical equipment removed from demolished structures.
 - a. Reinforcing bars shall be cut flush with final wall elevations as shown in the Drawings.
 - b. No detached metalwork, excluding concrete reinforcing bars, shall be buried with the concrete and masonry rubble.

D. Backfill at Demolished Structures:

1. For structures designated to be abandoned and/or demolished in place, concrete and/or masonry rubble and excavated soils resulting from demolition activities shall be used for backfill or placed in the bottoms of said structures only as directed by the Owner's Representative.
2. Concrete and masonry rubble used for backfilling shall be broken into pieces no larger than 12 inches on any one side.
3. Materials resulting from abandonment/demolition activities approved for backfill shall be combined with imported filler sand to create a dense, compacted backfill.

4. Backfilling or placement of the excavated material in the structures shall meet the following requirements.
 - a. Furnish, place and compact filler sand along with the concrete and masonry rubble so that all voids are filled and a dense, compacted backfill is obtained.
 - b. Filler sand shall be placed in horizontal layers completely filling all voids between pieces of rubble and not exceeding 12 inches in thickness.
 - c. Each layer of filler sand shall be compacted to obtain at least 90 percent of maximum density as determined by ASTM Method D-698-78 (AASHTO T-99).
 - d. Water shall be furnished by the Contractor and added to each layer as required to maintain optimum moisture content.
 - e. The amount of filler sand used shall only be the amount needed to fill all voids created by placement of the concrete and asphalt rubble, as directed by the Owner's Representative.
 - f. At locations where concrete and masonry rubble are used for backfill, they shall be placed such that a minimum of 3 feet of compacted non-rubble backfill material (crushed rock) exists between any rubble and finished grade. Protruding reinforcing bars shall be cut to lengths that allow granular backfill to be placed and compacted to required levels in and above the rubble.
 5. Disposal of all materials not used for backfill shall be performed off-site and in compliance with applicable local, state, and federal codes and requirements.
 6. In areas where new construction will take place, no trace of these structures shall remain prior to placing of backfill.
- E. Backfilling within the footprint of new structures with rubble material resulting from demolition activities will not be allowed.
- F. All existing improvements designated in the Drawings or specified to be removed, including but not limited to structures, pipelines, walls, footings, foundations, slabs, pavements, curbs, fencing, and similar structures occurring above, at, or below existing ground surface shall be included in the demolition work.
- G. Unless otherwise specified, any resulting voids shall be backfilled with suitable excavated or imported material compacted to the density of the adjacent soil.

3.5 EXISTING WATER UTILITY PIPING ABANDONMENT

- A. As specified in Section 33 05 50, Existing Pipe Abandonment.

3.6 ELECTRICAL AND CONTROL SYSTEM DEMOLITION

- A. All electrical and control system demolition work shall at all times be conducted in a safe and proper manner to avoid injury from electrical shock to all personnel.
 - 1. Electrical equipment to be shut off for a period of time shall be tagged, locked out, and sealed with a crimped wire and lead seal and made inoperable.
 - 2. At no time shall live electrical wiring or connections or those which can become energized be accessible to any persons without suitable protection or warning signs.

3.7 ASPHALTIC CONCRETE DEMOLITION

- A. Asphalt pavement shall be removed to the limits shown in the Drawings.
- B. The limits of the removal shall be saw cut.
- C. Asphalt pavement may not be used as rubble fill.

3.8 REMOVAL

- A. Remove debris, rock, excavated materials, rubble, abandoned piping, and extracted plant life resulting from abandonment and/or demolition activities from site.
- B. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- C. Removal: All material resulting from demolition, clearing, and grubbing, and trimming operations shall be removed from the Project Site and disposed of in a lawful manner. Materials placed on property of private property owners shall be by written permission only.

3.9 GRADING

- A. All grading work shall be completed in accordance with Section 31 22 13, Rough Grading.

3.10 CLEANUP

- A. During and upon completion of work, promptly remove all unused tools and equipment, surplus materials, debris, and dust and shall leave all areas affected by the work in a clean, condition, as may be subject to Owner's Representative approval.
- B. Adjacent structures shall be cleaned of dust, dirt, and debris resulting from demolition.
- C. Adjacent areas shall be returned to their existing condition prior to the start of work.

END OF SECTION

SECTION 03 60 00 - GROUTING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes all work necessary to form, mix, place, cure, repair, finish, and perform all other work as required to produce finished grout, in accordance with the requirements of the Contract Documents.
- B. Work covered in this Section includes:
 - 1. Patching, grouting, and sealing.
 - 2. Grout for support of mechanical, electrical, and communications equipment
 - 3. Removal of loose and spalling grout and concrete
 - 4. Anchoring cement for metal fabrications

1.2 RELATED SECTIONS

- A. Section 05 50 00 - Miscellaneous Metals
- B. Section 33 05 50 - Existing Pipe Abandonment

1.3 SUBMITTALS

- A. Certified Test Results: Verifying the compressive strength, shrinkage, and expansion requirements specified herein for grout used around ground supported steel reservoir bases or for grouts as required by the Owner's Representative.
- B. Manufacturer Technical Data and Strength Test Results: For sack-mix grouts used on minor-structure/systems provide datasheet information verifying the compressive strength, shrinkage, and expansion requirements specified herein for grout used.
- C. Manufacturer's Literature: Containing instructions and recommendations on the mixing, handling, placement, and appropriate uses for each type of non-shrink and epoxy grout used in the work.

1.4 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Specifications, codes, and standards shall be as referred to herein.

Comply with the provisions of the following codes, specifications, and standards, except as otherwise shown or specified.

B. Codes and Standards

1. American Society for Testing and Materials (ASTM)

- a. C1084, "Standard Test Method for Portland-Cement Content of Hardened Hydraulic-Cement Concrete"
- b. C109, "Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch or 50-mm Cube Specimens)"
- c. C191, "Standard Test Method for Setting Time of Hydraulic Cement"
- d. C131, "Standard Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine"
- e. C136, "Standard Test Method for Sieve Analysis to Fine and Coarse Aggregate"
- f. C143, "Standard Test Method for Slump of Hydraulic Cement Concrete"
- g. C150, "Standard Specification for Portland Cement"
- h. C488, "Standard Test Method for Pull-Out Strength"
- i. C531, "Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes"
- j. C579, "Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes"
- k. C827, "Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures"
- l. C827, "Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures"
- m. C882, "Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear"
- n. C939, "Standard Test Method for Flow of Grout for Preplaced – Aggregate Concrete (Flow Cone Method)"
- o. C942, Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory ""
- p. C1090, "Standard Test Method for Measuring Changes in Height of Cylindrical Specimens from Hydraulic Cement Grout"

- q. C1107, "Standard Test Method for Packaged Dry, Hydraulic Cement Grout (Non-Shrink)"
 - r. C1437, "Standard Test Method for Flow of Hydraulic Cement Mortar"
 - s. E488, "Standard Test Method for Strength of Anchors in Concrete and Masonry Elements"
- 2. American Concrete Institute (ACI)
 - a. "Guide to Hot Weather Concreting", ACI 305R.
 - b. "Guide to Cold Weather Concreting", ACI 306R.
 - c. "Guide for Selecting and Specifying Materials for Repair of Concrete Surfaces", ACI 320.2R, as supplemented and modified herein.
 - 3. CRD-C 621, Corps of Engineers Specification for Non-Shrink Grout

1.5 DELIVERY HANDLING AND STORAGE

- A. Deliver products in original packaging, labeled with product identification, manufacturer, batch number and shelf life.
- B. Handle products in accordance with manufacturer's printed recommendations. Do not place grout when temperature or humidity will affect the performance or appearance of the grout.
- C. Store products in a dry area. Protect from direct sunlight.
- D. Do not place grout on dirty, wet, or frozen substrates.

PART 2 PRODUCTS

2.1 PREPACKAGED GROUTS

- A. High Strength Non-shrink grout: This type of grout is to be used wherever grout is required in the Contract Documents unless another type is specifically referenced.
 - 1. High Strength Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation of each type of non-shrink grout specified herein shall be that recommended by the manufacturer for the particular application.

Early Height Change, ASTM C827	0.0 to +0.3%		
Hardened Height Change, ASTM C1090	+0.2 to +0.4%		
Effective Bearing Area	95%		
Compressive Strength, ASTM C942	Plastic	Flowable	Fluid
1 Day (min.)	1,000 psi	1,000 psi	1,000 psi
28 Days (min.)	5,000psi	5,000psi	5,000psi
Bond Strength, ASTM C882			
28 Days	2000psi		
Application Temperature	40°F to 90°F		
Material Temperature	40°F to 90°F		

- B. General Purpose Non-Shrink Grout shall have minimum 28-day compressive strength of 2500 psi when tested and meet the shrinkage and expansion requirements listed for high strength non-shrink grout.
- C. Application
 - 1. High Strength Non-shrink grout shall be used for the repair of all holes and defects in concrete members which are water bearing or in contact with soil or other fill material, grouting under the exterior rim of the steel tank and all equipment base plates, and at all locations where grout is specified in the contract documents.
 - 2. General Purpose Non-Shrink Grout shall be used for non-structural, non-repair interior or exterior grout applications.

2.2 CONSISTENCY

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where “dry pack” is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as specified herein for the particular application.
- B. The slump for topping grout and concrete fill shall be adjusted to match placement and finishing conditions but shall not exceed four (4) inches.

2.3 MEASUREMENT OF INGREDIENTS

- A. Measurements for cement grout shall be made accurately by volume using containers approved by the Owner’s Representative. Shovel measurement shall not be allowed.
- B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 EXECUTION

3.1 GENERAL

- A. All surface preparation, curing, and protection of cement grout shall be as specified by the manufacturer. The finish of the grout surface shall match that of the adjacent concrete.
- B. Base concrete or masonry must have attained its design strength before grout is placed, unless authorized by the Owner's Representative.

3.2 GROUTING PROCEDURES

Prepackage Grouts: All mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution of prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

3.3 INSTALLATION

A. Examination

1. Examine substrates and conditions under which materials will be installed. Do not proceed with Installation until unsatisfactory conditions are corrected.
2. Coordinate installation with adjacent work to ensure proper sequence of construction. Protect adjacent areas landscaping from contact due to mixing and handling of materials.

B. Surface Preparation

Comply with manufacturer's printed instructions and the following:

1. Mechanically remove all unsound concrete to the limits indicated on the drawings. Remove cement paste and laitance to expose sound aggregate.
2. Clean surface to receive grout of all materials including dust, oil, dirt, and grease or Efflorescence.
3. Dampen with clean water before patching and remove standing water.

C. Specialized Installation Requirements

1. Grout Below Bearing Plates:
 - a. Support bearing plates above cleaned bearing surfaces with double-nutted anchor bolts or wedges.

- b. Fill space below bearing plates supporting structural members and stationary equipment with non-metallic non shrink grout.
 - c. Fill space below bearing plates supporting vibrating equipment with metallic non shrink grout.
 - 2. Grout in Steel Bollards:
 - a. Fill steel bollards with non-metallic non shrink grout.
 - b. Smooth trowel grout to 1-inch-high convex curve at top of bollards.
 - 3. Grout in Steel Door Frames: Install non-metallic non shrink grout between masonry rough opening and door frames in masonry walls, fully filling frames with grout.
- D. Formwork:
 - 1. Comply with manufacturer's printed instructions and the following:
 - a. Forms must be watertight, strong, properly braced, and properly coated.
 - b. Allow a minimum clearance of 2 inches between forms and baseplate for grout entry.
 - c. Allow a minimum grout head of 6 inches.
 - d. Slope form on placing side to assist in grout movement and to prevent trapping air.
 - e. Allow 1-inch horizontal clearance and 1-inch vertical clearance for height above bottom of baseplate.
 - f. Provide venting of forms to avoid entrapment of air.
- E. Mixing Requirements:
 - 1. Comply with manufacturer's printed instructions and the following:
 - a. Do not re-temper with additional water.
- F. Placement of Grout Materials:
 - 1. Comply with manufacturer's printed instructions and the following:
 - a. The area to be grouted should be thoroughly flushed and soaked with clean water prior to grouting. Leave no standing water.

- b. Place the grout quickly and continuously use light rodding or strapping to eliminate air bubbles.
- c. Place grout mixture into prepared areas from one side or the other, rapidly and continuously, to reduce air entrapment. Avoid placing grout from opposite sides.
- d. Grout temperature should be maintained from 50°F to 90°F to achieve specified results. Use cold water in hot weather or hot water in cold weather to achieve desired grout temperature. Do not use if temperature is expected to go below 32°F within a 12-hour period.

G. Curing Requirements:

- 1. Utilizing a damp cure of at least 3 days is necessary to control the non-shrink characteristics and maintain strength levels.
- 2. Cover fresh grout and anchoring cement with plywood where exposed to construction traffic for 24 hours minimum.

H. Cleaning After Grout Placement

- 1. Remove excess material before material cures. If material has cured, remove using mechanical methods that will not damage substrate.

3.4 COMPLETION

- A. Adjusting Defective Work: Replace or patch grout and anchoring cement as directed by Owner's Representative.

END OF SECTION

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

- A. The extent of metal fabrications work is shown on the Drawings and includes items fabricated from iron, steel, stainless steel and aluminum shapes, plates, bars, sheets, strips, tubes, pipes, and castings which are not a part of structural steel or other metal systems in other sections of these specifications.
- B. Section Includes:
 - 1. Shop-fabricated metal items
 - 2. Bollards
 - 3. Ladders
 - 4. Anchors
 - 5. Access hatches
 - 6. Fasteners
 - 7. Miscellaneous fabricated architectural details
- C. Related Sections:
 - 1. Section 03 60 00 - Grouting
 - 2. Section 09 90 00 - Painting and Coating
 - 3. Section 33 05 64 - Precast Concrete Valve Vaults and Meter Boxes

1.2 REFERENCE STANDARDS

- A. Aluminum Association (AA):
 - 1. AA DAF-45 - Designation System for Aluminum Finishes
- B. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum
 - 2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels
 - 3. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels

4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels
- C. American National Standards Institute (ANSI):
1. ANSI A14.3 - American National Standard (ASC) for Ladders - Fixed - Safety Requirements
- D. American Welding Society (AWS):
1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination
 2. AWS D1.1 - Structural Welding Code - Steel
 3. AWS D1.6 - Structural Welding Code - Stainless Steel
- E. ASTM International (ASTM):
1. ASTM A6 - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
 2. ASTM A36 - Standard Specification for Carbon Structural Steel
 3. ASTM A47, grade as selected - Malleable Iron Castings
 4. ASTM A48, Class 30 - Gray Iron Castings
 5. ASTM A53- Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 6. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
 7. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 8. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 9. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High-Pressure Service and Other Special Purpose Applications
 10. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

11. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
12. ASTM A283, Grade C - Steel Plates to be Bent or Cold Formed
13. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes
14. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
15. ASTM A312 - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
16. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
17. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
18. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
19. ASTM A513 - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
20. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing
21. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts
22. ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
23. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
24. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
25. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
26. ASTM A992 - Standard Specification for Structural Steel Shapes
27. ASTM B26 - Standard Specification for Aluminum-Alloy Sand Castings
28. ASTM B85 - Standard Specification for Aluminum-Alloy Die Castings

29. ASTM B177 - Standard Guide for Engineering Chromium Electroplating
 30. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 31. ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes
 32. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire
 33. ASTM B 308, Alloy 6061-T6, Anodic Coating Class I, AA-C22-A41, anodized after fabrication - Structural Aluminum Shapes and Plates
 34. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
 35. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
 36. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings
 37. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings
 38. ASTM F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength
 39. ASTM F436 - Standard Specification for Hardened Steel Washers
 40. ASTM F844 - Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use
 41. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength
- F. Builders Hardware Manufacturers Association (BHMA):
1. ANSI/BHMA A156.20 - American National Standard for Strap and Tee Hinges and Hasps
- G. National Ornamental & Miscellaneous Metals Association (NOMMA):
1. NOMMA Guideline 1 - Joint Finishes

- H. SSPC: The Society for Protective Coatings:
 - 1. SSPC - Steel Structures Painting Manual
 - 2. SSPC Paint 15 - Steel Joist Shop Primer/Metal Building Primer
 - 3. SSPC Paint 20 - Zinc-Rich Coating (Type I - Inorganic and Type II - Organic)
 - 4. SSPC SP 1 - Solvent Cleaning
 - 5. SSPC SP-7 Brush-off Blast Cleaning
 - 6. SSPC SP 10 - Near-White Blast Cleaning

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for Submittals.
- B. Manufacturer's Data: For information only, submit copies of Manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions for products to be used in miscellaneous metal work, including paint products.
- C. Shop Drawings:
 - 1. General: Submit copies of shop drawings for the fabrication and erection of all assemblies of miscellaneous metal work which are not completely shown by the Manufacturer's data sheets.
 - a. Include plans, elevations, and details of sections and connections and fabricators proposed shop coat paint or galvanizing specifications.
 - b. Show anchorage and accessory items.
 - c. Furnish setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors, which are to be embedded in concrete construction.
 - d. Indicate welded connections using standard AWS A2.4 welding symbols.
 - e. Indicate net weld lengths.
 - 2. Stairs, Handrails, and Railings:
 - a. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.

3. Gratings:

- a. Indicate details of gratings, plates, component supports, anchorages, openings, perimeter construction details, and tolerances.

D. Samples:

1. Submit two sets of representative samples of materials, illustrating factory finishes as may be requested by the Owner's Representative.
2. Owner's Representative's review will be for color, texture, style and finish only.

E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.4 NOT USED

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Transporting, handling, storing, and protecting products shall be in accordance with Manufacturer's requirements.
- B. Inspection: Accept metal fabrications on-site in labeled shipments. Inspect for damage.
- C. Protect metal fabrications from damage by exposure to weather or by ground contact.

1.6 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to preparation of Shop Drawings and fabrication. Indicate field measurements on Shop Drawings.
 1. Do not delay job progress; allow for trimming and fitting where taking field measurements before fabrication.

PART 2 PRODUCTS

2.1 GENERAL

- A. For the fabrication of miscellaneous metal work items which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names, roughness and defects which impair strength, durability, and appearance. Remove such blemishes by grinding or by welding and grinding prior to cleaning, treating and application of surface finishes including zinc coatings.

2.2 NOT USED

2.3 NOT USED

2.4 BOLLARDS

A. Description:

1. Steel pipe, concrete filled
2. Crowned cap
3. Size: 6-inch diameter, length as indicated on Drawings.
4. Shop Finish: Prime-paint, one-coat.

B. Concrete Fill:

1. Minimum Compressive Strength: 3,000 pounds per square inch (psi).
2. As specified on the Drawings.

C. Anchors: Concealed type as indicated on Drawings.

2.5 LADDERS

A. Vault Ladders:

1. ANSI A14.3.
2. Aluminum or galvanized steel construction.
3. Siderails:
 - a. Size: 1/2 by 2 inches
 - b. Spacing: 20 inches on center
4. Rungs:
 - a. Solid rod. Hex rod or gnarled rebar
 - b. Size: 1-inch diameter
 - c. Spacing: 12 inches on center
5. Mounting:
 - a. Space rungs as shown on Drawings, a minimum of 7 inches from wall surface.
 - b. Provide steel mounting brackets and attachments per Drawings.
6. Shop Finish: Mill finish.

2.6 NOT USED

2.7 NOT USED

2.8 ANCHORS

- A. All anchors shall be epoxy anchors or expansion anchors as shown in the Drawings.
- B. Materials:
 - 1. As shown in the Drawings.
 - 2. For direct bury:
 - a. Malleable iron complying with ASTM A47
 - b. Cast steel complying with ASTM A27
 - c. Iron and steel galvanized in compliance with ASTM A153
 - 3. For wetted atmospheric conditions
 - a. Type 316 stainless steel
 - 4. Threaded rod, nuts, bolts, and washers:
 - a. Material matching anchor insert type
- C. Types:
 - 1. Threaded-type Concrete Inserts:
 - a. Internally threaded to receive machine bolts
 - b. Malleable iron, ASTM A47
 - c. Cast steel, ASTM A27
 - d. Stainless steel, type 304, ASTM A320
 - 2. Wedge-type Concrete Inserts:
 - a. Box-type ferrous castings designed to accept bolts having special wedge-shaped heads.
 - 3. Slotted-type Concrete Inserts:
 - a. Box-type welded construction with slot designed to receive square head bolt and with knockout cover.
- D. Manufacturers:
 - 1. Hilti, Inc.
 - 2. Simpson Strong-Tie Co., Inc.
 - 3. Proprietary products as named in the Drawings.

2.9 NOT USED

2.10 NOT USED

2.11 NOT USED

2.12 ACCESS HATCHES

- A. Use materials of the size and thickness shown in Drawings or, if not shown in the Drawings, of the size recommended by Product Manufacturer.
- B. Work to the dimension shown in the Drawings or accepted on final shop drawings, using proven details of fabrication and support.
- C. Use the type of materials shown or specified for the various components of the Work.
- D. Vault Access Hatch:
 - 1. Frame opening length x width shall be as specified in the Drawings.
 - 2. Flush grip handle.
 - 3. Comp. spring lifting mechanism assembly.
 - 4. Heavy duty forged brass hinges with stainless steel pins.
 - 5. Heavy duty automatic lock open arm with red vinyl release grip.
 - 6. Heavy duty check chain.
 - 7. Plate cover reinforced for 300 psf live load.
 - 8. 1-1/2-inch drain coupling.
 - 9. Channel frame with anchor flange.
 - 10. Stainless steel slam-lock with brass spoon handle.
 - 11. All steel plates, sheeting, and hardware shall be galvanized or cadmium plated except as noted above.
 - 12. Shop finish of cover and frame: Mill finish.
 - 13. Recessed hasp for pad lock.
 - 14. Aluminum in contact with concrete or grout shall be coated with epoxy as specified herein.

2.13 ROUGH HARDWARE

- A. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing and supporting systems. Acceptable manufacturers are Simpson or equal.
- B. Manufacture or fabricate items of sizes, shapes, and dimensions required. Furnish malleable iron washers for heads and nuts which bear on wood structural connections; elsewhere furnish galvanized steel washers.

2.14 MISCELLANEOUS FABRICATIONS, FRAMING, AND SUPPORTS

- A. Provide miscellaneous steel framing and supports required to complete the Work.
- B. Fabricate miscellaneous units to the sizes, shapes and profiles shown in the Drawings or, if not shown, of the required dimensions to receive adjacent grating, plates doors, or other work to be retained by the framing.
- C. Except as otherwise shown, fabricate from structural steel shapes and plate and steel bars, all welded construction using mitered corners, welded brackets and splice plates and a minimum number of joints for field connection.
- D. Cut, drill, and tap units to receive hardware and similar items to be anchored to the work.
- E. Equip units with integrally welded anchors for casting into concrete, bolting to structural steel or building into masonry. Furnish inserts if units must be installed after concrete is placed.
- F. Galvanize all miscellaneous fabrications unless otherwise noted.

2.15 NON-SHRINK GROUT

- A. Where required for anchoring, patching, or sealing, grouting, and sealing compounds shall conform to the requirements of Section 03 60 00, Grouting.

2.16 MATERIALS

- A. Materials listed below shall be provided unless otherwise noted in the Drawings or other sections of these specification.
- B. Steel:
 - 1. Structural W Shapes: ASTM A992
 - 2. Structural Shapes: ASTM A36

3. Channels and Angles: ASTM A36
 4. Steel Plate: ASTM A36
 - a. Steel Plate to be Bent or Cold Formed: ASTM A283, Grade C
 5. Hollow Structural Sections: ASTM A500, Grade B
 6. Structural Pipe: ASTM A53, Grade B, Schedule 40 unless shown otherwise in Drawings
 7. Bar: ASTM A36
 - a. Cold-Finished Steel Bar: ASTM A108, grade as selected by fabricator
 8. Sheet Steel: ASTM A653, Grade 33 Structural Quality
 9. Tubing: ASTM A513, Type 5, minimum 50 kilopounds per square inch (ksi) yield strength
 10. Standard Bolts: ASTM A307; Grade A
 - a. Washers: ASTM F844
 11. High Strength Bolts: ASTM A325
 - a. Washers: ASTM F436; Type 1
 12. Nuts: ASTM A563; heavy-hex type
 13. Welding Materials: AWS D1.1; type required for materials being welded
- C. Stainless Steel:
1. Bars and Shapes: ASTM A276; Type 316
 2. Tubing: ASTM A269; Type 316
 3. Pipe: ASTM A312, seamless; Type 316
 4. Plate, Sheet, and Strip: ASTM A666; Type 316
 5. Bolts, Nuts, and Washers: ASTM A354; Type 316
 6. Welding Materials: AWS D1.6; type required for materials being welded
- D. Aluminum:
1. Structural Aluminum Shapes and Plates: ASTM B308, Alloy 6061, Temper T66, Anodic Coating Class I, anodized after fabrication
 2. Aluminum-Alloy-Drawn Seamless Tubes: ASTM B210 Alloy 6063, Temper T6

3. Aluminum-Alloy Bars: ASTM B211 Alloy 6063, Temper T6
 4. Bolts, Nuts, and Washers: Stainless steel or Steel, galvanized
 5. Welding Materials: AWS D1.1; type required for materials being welded
- E. Bolts, Nuts, and Washers for Equipment and Piping:
1. Select fasteners for the type, grade, and class required for the installation of miscellaneous metal items.
 2. Carbon Steel:
 - a. General: Zinc-coated, ASTM A153
 - b. Structural Connections: ASTM A307, Grade 2 (60 ksi), hot-dip galvanized
 - c. Anchor Bolts: ASTM A307, Grade 2 (60 ksi), hot-dip galvanized
 - d. Pipe and Equipment Flange Bolts: ASTM A193, Grade B-7
 - e. High Strength Bolts: ASTM F3125, Heavy Hex Head
 3. Stainless Steel: Type 316 stainless steel, Class 2; ASTM A193 for bolts; ASTM A194 for nuts
 - a. Where stainless steel bolts are in contact with dissimilar metals, glass epoxy insulating sleeves and washers shall be used to electrically isolate the bolts.

2.17 FABRICATION

- A. Workmanship:
1. Use materials of the size and thicknesses shown in the Drawings or, if not shown, of the required size and thickness to produce adequate strength and durability in the finished product for the intended use as approved by the Owner's Representative.
 2. Work to the dimensions shown in the Drawings or accepted on Shop Drawings, using proven details of fabrication and support.
 3. Use the type of materials shown in the Drawings or specified for the various components of work.
 4. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
 5. Ease exposed edges to a radius of approximately 1/32-inch, unless otherwise shown in the Drawings.

6. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing the Work.
- B. Fit and shop-assemble items in largest practical sections for delivery to Site.
 - C. Fabricate items with joints tightly fitted and secured.
 - D. Continuously seal joint members by means of continuous welds in accordance with the recommendations of AWS, unless otherwise noted or approved.
 - E. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small, uniform radius.
 - F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
 - G. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
 - H. Loose Bearing and Leveling Plates:
 1. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of required thickness and bearing area.
 2. Drill plates to receive anchor bolts and for grouting as required.
 3. Galvanize after fabrication.
 - I. Miscellaneous Steel Trim:
 1. Provide shapes and sizes for profiles shown in the Drawings.
 2. Except as otherwise indicated, fabricate units from structural steel shapes and plates and steel bars, with continuously welded joints and smooth exposed edges.
 3. Use concealed field splices wherever possible.
 4. Provide cutouts, fittings, and anchorages as required for coordination of assembly and installation with other work.
 - J. Fabrication Tolerances:
 1. Squareness: 1/16-inch maximum difference in diagonal measurements.
 2. Maximum Offset between Faces: 1/16-inch.

3. Maximum Misalignment of Adjacent Members: 1/16-inch.
4. Maximum Bow: 1/16-inch in 48 inches.
5. Maximum Deviation from Plane: 1/16-inch in 48 inches.

2.18 FINISHES

A. Steel:

1. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
2. Do not prime surfaces in direct contact with concrete or where field welding is required.
3. Prime-paint items with one coat, except where galvanizing is specified.
4. Coatings as specified per Section 09 90 00, Painting and Coating.
 - a. Primer paint selected must be compatible with the required finish coats of paint.
 - b. At locations in contact with potable water, use only primer approved for potable water use.
5. Galvanizing for Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strips: ASTM A123; hot-dip galvanize after fabrication
6. Galvanizing for Fasteners, Connectors, and Anchors:
 - a. Hot-Dip Galvanizing: ASTM A153
 - b. Mechanical Galvanizing: ASTM B695; Class 50 minimum
7. Chrome Plating: ASTM B177, nickel-chromium alloy, polished finish
8. Sheet Steel: Galvanized
9. Bolts: Hot-dip galvanized
10. Nuts: Hot-dip galvanized
11. Washers: Hot-dip galvanized
12. Touchup Primer for Galvanized Surfaces: ASTM A780 (A780M), A1. Repair Using Zinc-Based Alloys (Heat and Stick Method)

B. Stainless Steel:

1. Satin-Polished Finish: Number 4, satin directional polish parallel with long dimension of finished face.
2. Mirror-Polished Finish: Number 8, mirror polish with preliminary directional polish lines removed.

C. Aluminum:

1. Protection of All Aluminum:

- a. Aluminum surfaces in contact with cementitious, masonry or dissimilar materials, apply the following coating system:
 - 1) One (1) coat of epoxy primer, 1 to 2 mils dry film (D.F.).
 - 2) Followed by two (2) coats of Bitumastic, 6 to 8 mils D.F.
 - 3) Followed by two (2) coats of tarset material, 6 to 8 mils D.F.

D. Shop Painting

1. Shop painting of metal fabrications shall be allowed only at the sole discretion of the Owner's Representative.
2. Shop paint miscellaneous metal work in accordance with Section 09 90 00, Painting and Coating, with the following exceptions:
 - a. Those members or portions of members to be embedded in concrete or masonry.
 - b. Surfaces and edges to be field welded.
 - c. Galvanized surfaces.
3. Remove scale, rust, and other deleterious materials before the shop coat of paint is applied.
 - a. Clean off heavy rust and loose mill scale in accordance with SSPC SP-7, Brush-off Blast Cleaning.
 - b. Remove oil, grease, and similar contaminates in accordance with SSPC SP-1, Solvent Cleaning.
4. Immediately following surface preparation, brush or spray on metal primer paint, applied in accordance with the Manufacturer's instructions or as specified below.

5. Apply one shop coat of metal primer paint to fabricated metal items, except apply two coats of paint to surfaces which will be inaccessible after assembly or erection. Change color of second coat to distinguish it from the first.
- E. Touch-up Painting, Pre-painted Items:
1. Immediately after erection, clean field welds, bolted connections, and abraded areas of the shop paint, and paint all exposed areas with the same material as used for shop painting.
 2. Apply touch-up coatings by brush or spray to provide a minimum dry film thickness of the original coating thickness.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive Work.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal and aluminum where Site welding is required.
- B. Furnish setting drawings, diagrams, templates, instructions, and directions for the installation of anchorages, such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors. Supply steel items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections. Coordinate delivery of such items to the Project Site.

3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, and free from distortion or defects.
- B. Make provisions for erection stresses. Install temporary bracing to maintain alignment until permanent bracing and attachments are installed.
- C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal items to in-place construction, including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.
- D. Fit exposed connections accurately together to form tight hairline joints.
- E. Grind joints smooth and touch-up shop paint coat.

- F. Do not weld, cut, or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication and are intended for bolted or screwed field connections.
- G. Field-weld components indicated on Drawings and Shop Drawings.
- H. Perform field welding according to AWS D1.1 with regards to procedures of manual shielded metal-arc welding, the appearance and quality of welds made, and the methods used in correcting welding work.
- I. Obtain approval from Owner's Representative prior to site cutting or making adjustments not scheduled.

3.4 TOLERANCES

- A. Maximum Variation from Plumb: 1/4-inch per story or for every 12 feet in height, whichever is greater, non-cumulative.
- B. Maximum Variation from Level: 1/16-inch in 3 feet and 1/4-inch in 10 feet.
- C. Maximum Offset from Alignment: 1/4-inch.
- D. Maximum Out-of-Position: 1/4-inch.

3.5 FIELD QUALITY CONTROL

- A. Welding: Inspect welds according to AWS D1.1.
- B. Replace damaged or improperly functioning hardware.
- C. After erection, touch up welds, abrasions, and damaged finishes with prime paint or galvanizing repair paint to match shop finishes.
- D. Touch up factory-applied finishes according to Manufacturer-recommended procedures.

3.6 ADJUSTING

- A. Adjust operating hardware and lubricate as necessary for smooth operation.

END OF SECTION

SECTION 09 90 00 - PAINTING AND COATINGS

PART 1 GENERAL

1.1 THE REQUIREMENT

- A. Work under this Section shall include the protective coating of all specified surfaces including all surface preparation, pretreatment, coating application, touch-up of factory coated surfaces, protection of surfaces not to be coated, cleanup, and appurtenant work, all in accordance with the requirements of the Contract Documents.
- B. This specification is applicable to coated pipe, steel, concrete and other surfaces listed in the coating schedule at the end of this section.
- C. The Coating System Schedules summarize the surfaces to be coated, the required surface preparation and the coating systems to be applied. Coating notes on the drawings are used to show exceptions to the schedules, to show or extend the limits of coating systems, or to clarify or show details for application of the coating systems.
- D. Related Work Specified in Other Sections -- Shop coatings and/or factory finishes on fabricated or manufactured equipment may be specified in other divisions. Some items with factory finishes, or corrosion resistant finishes may be scheduled or directed to be painted by the Owner's Representative to unify a wall finish or color scheme, at the Owner's Representative's discretion.
- E. Exclusions -- Do not coat the following surfaces unless specified or directed elsewhere: Stainless steel, aluminum, copper, brass, bronze and other corrosion-resistant material (except for valve bodies and piping); Electrical switch-gear and motor control centers having factory finish; Fencing; Multiple coated factory finished baked enamel or porcelain products; Concealed areas such as ducts, piping, conduits and items specified elsewhere for special linings and coatings.
- F. Damaged Factory Finish -- If directed by the Owner's Representative, refinish the entire exposed surfaces of equipment chipped, scratched or otherwise damaged in shipment or installation.
- G. All coating in contact with potable water shall be NSF approved.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Comply with the provisions of the following codes, specifications and standards, except as otherwise shown or specified.
1. "Architectural Specification Manual" by the Painting and Decorating Contractors of America (PDCA), 333 Taylor Avenue North, Seattle, Washington 98109.
 2. "Systems and Specifications" - Volume 2 of Steel Structures Painting Council (SSPC).
 3. National Sanitation Foundation (NSF) Standard No. 61.
- B. References herein to "NACE" shall mean the published standards of the National Association of Corrosion Owner's Representatives, P.O. Box 986, Katy, TX 77450.
- C. Pipe Coating Commercial Standards
- | | |
|----------------|---|
| ANSI/AWWA C105 | Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids. |
| ANSI/AWWA C203 | Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied. |
| ANSI/AWWA C205 | Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4-inch and Larger - Shop Applied |
| ANSI/AWWA C209 | Cold Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Pipelines. |
| ANSI/AWWA C210 | Liquid Epoxy Coating for Exterior and Interior of Steel Pipe. |
| ANSI/AWWA C213 | Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines. |
| ANSI/AWWA C214 | Tape Coating systems for the Exterior of Steel Water Pipelines. |
- D. Federal Specifications
- | | |
|------------------|--|
| DOD-P-23236A(SH) | Military Specification, Paint Coating Systems, Steel Ship Tank, Fuel and Salt Water Ballast. |
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1.3 CONTRACTOR SUBMITTALS

- A. Coating Materials List -- The Contractor shall provide a coating materials list which indicates the manufacturer and the coating number, keyed to the coating systems herein.

- B. Coating Manufacturer's and Applicator Information -- For each coating system to be used the Contractor shall submit, the following listed data.
1. Manufacturer's data sheet for each product used, including statements on the suitability of the material for the intended use.
 2. Manufacturer's instructions and recommendations on surface preparation and application.
 3. Colors available for each product and each coat.
 4. Compatibility of shop and field applied coatings (where applicable).
 5. Material safety data sheet (MSDS) for each product used.
 6. The manufacturer's recommended products and procedures for field coating repairs and field preparation of field cut pipe ends.
 7. The name of the proposed coating applicator shop along with certification that the applicator shop is qualified and equipped to apply the coatings systems as specified.
 8. Certificate -- Submit manufacturer's certificate of compliance with the specifications and standards signed by a representative in the manufacturer's employ.
 9. Samples -- Provide painted surface areas at the job for approval of main color selections or submit sample on 12-inch sample of substrate using required finish system at Owner's Representative's discretion.

1.4 QUALITY ASSURANCE

- A. Painter Qualifications -- The Painting/Coating Contractor must be capable of performing the various items of work as specified. The Painting/Coating Contractor shall furnish a statement covering experience on similar work, a list of machinery, plant and other equipment available for the proposed work, and a financial statement, including a complete statement of the Painter/Coating Contractor's financial ability and experience in performing similar painting and coating work. The Painting/Coating Contractor shall have a minimum of five (5) years practical experience and a successful history in the application of the specified products to concrete/steel surfaces. Upon request, the Painting/Coating Contractor shall substantiate this requirement by furnishing a list of references, which shall include jobs of similar nature.
- B. The Contractor shall give the Owner's Representative a minimum of 3 days advance notice of the start of any field surface preparation work of coating application work, and a minimum of 7 days advance notice of the start of any shop surface preparation work.

- C. All such work shall be performed only in the presence of the Owner's Representative, unless the Owner's Representative has granted prior approval to perform such work in its absence.
- D. Inspection by the Owner's Representative, or the waiver of inspection of any particular portion of the work, shall not relieve the Contractor of its responsibility to perform the work in accordance with these Specifications.
- E. Surface Preparation -- Evaluation of blast cleaned surface preparation work will be based upon comparison of the blasted surfaces with the standard samples available from the NACE, using NACE standard TM-01-70.
- F. Scaffolding shall be erected and moved to locations where requested by the Owner's Representative to facilitate inspection. Additional illumination shall be provided by the Contractor to cover all areas to be inspected.
- G. Paint Products -- No request for substitution shall be approved which decreases the film thickness designated or the number of coats to be applied, or which offers a change from the generic type of coating specified. Painting shall be done at such times as the Contractor and Owner's Representative may agree upon in order that dust-free and neat work be obtained. All painting shall be in strict accordance with the manufacturer's instructions and shall be performed in a manner satisfactory to the Owner's Representative.
- H. Manufacturer's Representative -- Require coating manufacturer's representative to be at job site when the first day's coating application is in progress and periodically during progress of the work.
- I. Labels -- Deliver to the job site in the original sealed containers with manufacturer's name, product name, type of product, manufacturer's specification or catalog number or federal specification number, and instructions for reducing where applicable.
- J. Colors -- Colors will be selected from manufacturer's standard colors as reviewed by Owner's Representative and approved by the Owner. Colors for special coatings that are limited in their availability and color selection will be chosen on the basis of manufacturer's standard colors, provided that the manufacturer's product line represents a color range comparable to similar products of other manufacturers.
- K. Flame Spread -- Provide paint materials which will result in a Class II finish for all coated surfaces in exit corridors, and a Class III finish for all other interior rooms or areas.
- L. Film Thickness Testing -- On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC "Paint Application Specification No. 2" using a magnetic-type dry film thickness gage such as Mikrotest model FM, Elcometer model 111/1EZ, or approved equal. Each coat shall be tested for the correct thickness. No

measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using wet film gage readings and destructive film thickness tests.

- M. Inspection Device -- The Contractor shall furnish, until final acceptance of such coatings, inspection devices in good working condition for the detection of holidays and measurement of dry-film thicknesses of protective coatings. Dry-film thickness gages shall be made available for the Owner's Representative's use at all times while coating is being done, until final acceptance of such coatings. The Contractor shall provide the services of a trained operator of the holiday detection devices until the final acceptance of such coatings.
- N. Holiday Testing -- The Contractor shall holiday test all coated ferrous surfaces. Areas which contain holidays shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then retested.
 - 1. Coatings with Thickness Exceeding 20 Mils -- For surfaces having a total dry film coating thickness exceeding 20 mils: pulse-type holiday detector such as Tinker & Razor Model AP-W, D.E. Stearns Co. Model 14/20, or approved equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.
 - 2. Coatings with Thickness of 20 Mils or Less -- For surfaces having a total dry film coating thickness of 20 mils or less: Tinker & Razor Model M1 nondestructive type holiday detector, K-D Bird Dog, or approved equal shall be used. The unit shall operate at less than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flo, or equal, shall be added to the water prior to wetting the detector sponge.

1.5 DELIVERY, HANDLING, AND STORAGE

- A. Deliver in labeled containers as specified above and store in a locked room accessible for inspection. Comply with fire and health regulations.
- B. Provide adequate heat and forced mechanical ventilation for health, safety and drying requirements. Use explosion proof equipment. Provide face masks.
- C. Protect adjacent surfaces with suitable masking and drop cloths as required. Remove cloths or waste from the project daily.
- D. Apply to surfaces under recommended environmental conditions and within the limitations established by the material manufacturer. Do not apply coating in snow, rain, fog or mist; or when the relative humidity exceeds 85 percent; or to damp or wet surfaces, unless otherwise permitted by the coating manufacturer's printed

instructions. Coating application may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the paint manufacturer during application and drying periods.

1.6 PROTECTION

- A. Follow all safety recommendations of manufacturer regarding ventilation and danger from explosion or breathing paint fumes or skin exposure, and all applicable O.S.H.A. and other regulations.
- B. Protect surface adjacent to work being coated from overspray, drips or other damage.

1.7 EXTRA STOCK

Provide one gallon of each type and color, fully labeled, at completion of job.

PART 2 PRODUCTS

2.1 GENERAL

- A. Definitions -- The terms "paint," "coatings" or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, tape and all other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat. The term "DFT" means minimum dry film thickness.
- B. General -- Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's directions, and name of manufacturer, all of which shall be plainly legible at the time of use.
- C. Use coating materials suitable for the intended use and recommended by their manufacturer for the intended service.
- D. Compatibility -- In any coating system only compatible materials from a single manufacturer shall be used in the work. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, subject to the approval of the Owner's Representative, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.
- E. Colors -- All colors and shades of colors of all coatings shall be as selected or specified by the Owner's Representative. Each coat shall be of a slightly different shade, to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples by the Owner's Representative. Color pigments shall be lead free.

- F. Protective Coating Materials -- Products shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. Where requested, the Contractor shall provide the Owner's Representative with the names of not less than 10 successful applications of the proposed manufacturer's products demonstrating compliance with this specification requirement.
- G. Substitute or "Or-Equal" Submittals -- Unless otherwise specified, materials are from the catalogs of the companies listed herein. Materials by other manufacturers are acceptable provided that they are established as being compatible with and of equal quality to the coatings of the companies listed. The Contractor shall provide satisfactory documentation from the firm manufacturing the proposed substitute or "or equal" material that said material meets the specified requirements and is equivalent or better than the listed materials.
- H. The cost of all testing and analyzing of the proposed substitute materials that may be required by the Owner's Representative shall be paid by the Contractor. If the proposed substitution requires changes in the contract work, the Contractor shall bear all such costs involved and the costs of allied trades affected by the substitution.

2.2 INDUSTRIAL COATING SYSTEMS

A. General

Provide and apply the industrial coatings systems which follow as listed in the coating schedule, as required by these specifications and as directed by the Owner's Representative. Coat all existing and new exposed interior or exterior surfaces and submerged and intermittently submerged surfaces as indicated, except as specifically excluded in Part 1 of this section or on the drawings or finish schedules. Coating System Numbers listed below shall be used as the Coating System code letter, and shall be used on any coating submittals or correspondence.

B. Industrial coating systems shall be as follows

1. Coating System 100

- a. Location -- Exposed, unprimed, non-galvanized, non-submerged metal surfaces, both interior and exterior including piping and structural steel.
- b. Surface Preparation -- As specified herein.
- c. Coating System -- Apply prime coat and topcoat, 4.0-6.0 mils each coat of Tnemec Series 66-2 Hi-Build Epoxoline, or approved equal. Color as selected by Owner.

2. Coating System 101

- a. Location -- Exposed metal surfaces, shop primed, both interior and exterior including piping, railings, ladders, steel doors, and any other metal items not otherwise specified.
- b. Surface Preparation -- As specified herein.
- c. Coating System -- Apply shop prime coat 3.0 mils DFT Tnemec Series 90-97 Tneme-Zinc, one coat 4.0 - 6.0 mils DFT Tnemec Series 66 Hi-Build Epoxoline, and 3.0 - 4.0 mils DFT of Tnemec Series 175 Endura Shield, or approved equal. Color as selected by Owner.

3. Coating System 102

- a. Location -- Unprimed or non-galvanized, continuously or intermittently submerged metal items, exterior surfaces, including piping, structural steel and all other metal items not otherwise specified.
- b. Surface Preparation -- As specified herein.
- c. Coating System -- Prime, intermediate and topcoat, 4.0-6.0 mils each coat of Tnemec Series 20 Pota-Pox, or approved equal. Color as selected by Owner.

4. Coating System 103

- a. Location -- Vertical concrete walls, exterior, below finish grade, not exposed to view.
- b. Surface Preparation -- As specified herein.
- c. Paint System -- Apply two coats 9.0-10.0 mils each, Carboline Bitumastic 50, or approved equal.

5. Coating System 104

- a. Location - Nonsubmerged, exposed to view, PVC piping.
- b. Surface Preparation -- As specified herein.
- c. Coating System -- Apply one coat, 4.0-6.0 mils Tnemec Series 66-2 Hi-Build Epoxoline, or approved equal. Color as selected by Owner.

2.3 SPECIAL PIPE AND SEVERE SERVICE COATING SYSTEMS

A. General

The following coatings are for buried pipe and surfaces used in severe service conditions. The manufacturers' products listed in this paragraph are materials which satisfy the material descriptions of this paragraph and have a documented successful record for long term submerged or severe service conditions. Proposed substitute products will be considered as indicated within the paragraph entitled " 'Or-Equal' Clause" in Section 01 33 00, Submittal Procedures.

B. Special pipe and severe service coating systems shall be as follows

1. Coating System 200 -- Cement Mortar Coating
 - a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.
 - b. Surface Preparation - As specified herein.
 - c. Coating System -- A 1-1/2-inch minimum thickness mortar coating reinforced with 3/4-inch galvanized welded wire fabric shall be provided. The cement mortar shall contain no less than one part Type V cement to 3 parts sand. The cement mortar shall be cured by a curing compound meeting the requirements of "Liquid Membrane-Forming Compounds for Curing Concrete" ASTM C 309-81, Type II, white pigmented, or by enclosure in an 8-mil thick polyethylene sheet with all joints and edges lapped by at least 6 inches. At the Owner's Representative's discretion, the hot applied coal tar epoxy coating may be used as the curing membrane for the mortar coating.
2. Coating System 201 -- Hot Applied Coal Tar Epoxy Coating
 - a. Location -- Exterior surface of concrete pipe and cement-mortar coated pipe and fittings.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- The hot applied coal tar epoxy shall be a solvent free 100 percent solids coal tar epoxy chemically compatible with hydrating cement and suitable for application on moist surfaces of freshly placed cement mortar or concrete and properly prepared cured surfaces. The coal tar epoxy coating material shall be Amercoat 1972B or approved equal. The finish coal tar epoxy coating shall have a minimum DFT of 26 mils.
3. Coating System 202 -- Coal-Tar Epoxy Coating System
 - a. Location -- Exterior surface of buried steel pipe, fittings and other ferrous surfaces.

- b. Surface Preparation -- As specified herein.
 - c. Coating System -- High build, 2-component amine or polyamide cured coal-tar epoxy shall have a solids content of at least 68 percent by volume, suitable as a long term coating of buried surfaces, and conforming to AWWA C210. Prime coats are for use as a shop primer only. Prime coat shall be omitted when both surface preparation and coating are to be performed in the field. The coal-tar epoxy coating system shall include:
 - 1) Prime coat (DFT = 1.5 mils), Amercoat 83HS, Tnemec P66, or equal.
 - 2) Finish coats (2 or more, DFT = 18 mils), Amercoat 78 HB, Tnemec 46 H-413, or equal.
 - 3) Total system DFT = 19.5 mils.
4. Coating System 203 -- Fusion Bonded Epoxy
- a. Location -- Ferrous surfaces of sleeve couplings, steel pipe and fittings.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- The coating material shall be a 100 percent powder epoxy applied in accordance with the ANSI/AWWA C213 "AWWA Standard for Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines". The coating shall be applied using the fluidized bed process.
 - 1) Liquid Epoxy -- For field repairs, the use of a liquid epoxy will be permitted, applied in not less than 3 coats to provide a DFT 16 mils. The liquid epoxy shall be a 100 percent solids epoxy recommended by the powder epoxy manufacturer.
 - 2) Coating (DFT = 16 mils), Scotchkote 203, or equal.
 - 3) Total system DFT = 16 mils.
5. Coating System 204 -- Hot, Coal-Tar Enamel
- a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.
 - b. Surface Preparation - As specified herein
 - c. Coating System -- Coal-Tar Enamel materials and procedures shall be in accordance with ANSI/AWWA C203. This system shall consist of a primer layer, coal-tar enamel layer, coal-tar saturated nonasbestos felt outerwrap and a finish coat. Total system DFT = 188 mils.

6. Coating System 205 -- Hot Applied Tape
 - a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Tape coating materials and procedures shall be in accordance with ANSI/AWWA C203. This system shall consist of a cold-applied liquid primer and heated coal-tar base tape. Total system DFT = 50 mils.
7. Coating System 206 -- Cold Applied Tape
 - a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Tape coating materials and procedures shall be in accordance with ANSI/AWWA C209. Prefabricated tape shall be Type II. The system shall consist of a primer layer, inner layer tape of 35 mils, and an outer layer tape of 35 mils. Total system DFT = 70 mils.
8. Coating System 207 -- PVC Tape
 - a. Location -- Small galvanized steel pipe and fittings.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Prior to wrapping pipe with PVC tape, the pipe and fittings shall be primed using a primer recommended by the PVC tape manufacturer. After being primed, the pipe shall be wrapped with a 20-mil adhesive PVC tape, half lapped for a total thickness of 40 mils.
9. Coating System 208 -- Mastic
 - a. Location -- Pipe and fitting joints, and general buried surface coating repair and touch up.
 - b. Surface Preparation - As specified herein.
 - c. Coating System -- Mastic shall be a one-part solvent drying heavy bodied thixotropic synthetic elastomeric coating with chemically inert resins and fillers and an average viscosity of 650,000 CPS at 77 degrees Fahrenheit, thereby requiring generous applications by hand or trowel. Total coat thickness shall be 30 mils, minimum. Mastic shall be Protecto Wrap 160 H or approved equal and be fully compatible with pipeline coating systems.

10. Coating System 209 -- Polyethylene Encasement

- a. Location -- Ductile iron, steel and concrete cylinder pipe and fittings
- b. Surface Preparation -- None required.
- c. Coating System -- Except as otherwise specified, application of polyethylene encasement shall be in accordance with ANSI/AWWA C105 using Method C.

11. Coating System 210 – Wax Tape

- a. Location – Buried ductile iron and steel pipe fittings and couplings where specified.
- b. Surface Preparation – As specified herein
- c. Coating System -- Except as otherwise specified, application of wax tape installation shall be in accordance with ANSI/AWWA C217.

12. Coating System 211 – Zinc coating and polyethylene encasement

- a. Location – Buried ductile iron pipe and fittings
- b. Surface Preparation – As specified herein.
- c. Coating System – The exterior of the pipe shall be coated with a layer of arc-sprayed zinc per ISO 8179. The mass of zinc applied shall be 200 grams per square meter (0.6554 ounces per square foot) of pipe surface. A finishing layer topcoat shall be applied to the zinc. Zinc coated pipe shall be use in conjunction with V-Bio polywrap installed per ANSI/AWWA C105 method C.

2.4 ARCHITECTURAL COATING SYSTEMS

A. General

"Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or topcoat.

Fungus Control: Submit evidence for all paints attesting the passing of Federal Test Method Standard No. 141, Method 6271.1 showing no fungus growth or other approved test results.

Apply to surfaces under recommended environmental conditions and within the limitations established by the material manufacturer. Acrylics require 60 degrees Fahrenheit (°F) and above temperature and below 50 percent relative humidity. Apply water-based paints only when the temperature of surfaces to be painted and the

surrounding air temperatures are between 50°F and 90°F unless otherwise permitted by the paint manufacturer's printed instructions.

B. Architectural coating systems shall be as follows

1. Coating System 300

- a. Location -- Vertical, exterior concrete masonry unit walls exposed to view.
- b. Surface Preparation -- As specified herein.
- c. Coating System -- Apply prime, intermediate and top coat, 75 ft²/gal, 100 ft²/gal and 100 ft²/gal respectively for each coat of Tnemec Series 156 Envirocrete or approved equal. Color as selected by Owner.

2. Paint System 301

- a. Location -- Vertical concrete exterior walls and flat concrete exterior roofs and slabs exposed to view.
- b. Surface Preparation -- As specified herein.
- c. Coating System -- Apply two coats 6.0-9.0 mils (100 ft²/gal) each coat, Tnemec Series 156 Envirocrete, or approved equal. Color as selected by Owner.

3. Paint System 302

- a. Location -- Interior concrete masonry unit walls and interior and exterior wood walls, ceilings and other wood surfaces not otherwise specified, exposed to view.
- b. Surface Preparation -- As specified herein.
- c. Coating System -- Prime as specified by coating manufacturer. Apply two coats 6.0 - 9.0 mils (100 ft²/gal) each coat, Tnemec Series 156 Envirocrete, or approved equal. Color as selected by Owner.

4. Paint System 303

- a. Location -- Wood surfaces not otherwise specified, exposed to view.
- b. Surface Preparation -- As specified herein.
- c. Coating System -- Apply an alkyd primer as recommended by the manufacturer, 2 mils. Apply finish coats (two or more coats 6 mils total) of single component, water based acrylic latex coating, Tnemec Series 6, Carboline 3350 or equal. Total DFT = 8 mils. Color as selected by Owner.

5. Paint System 304
 - a. Location -- Interior drywall surfaces not otherwise specified, exposed to view.
 - b. Surface Preparation - As specified herein.
 - c. Coating System -- Apply two coats 2.0 - 3.0 mils each coat of single component, water based acrylic latex coating, Themec Series 6, Carboline 3350 or equal. Color as selected by Owner.
6. Paint System 305
 - a. Location -- Exterior brick surfaces not otherwise specified, exposed to view.
 - b. Surface Preparation -- Surfaces shall be cleaned with a manufacturers approved chemical cleaner and power washed. Surfaces shall be completely dry, free from efflorescence, oils, paint and other contaminants before the coating system is applied. Coating system shall be applied according to the manufacturers published recommendations. A manufacturer's representative shall be present during application of the coating system, if required by the manufacturer's warranty.
 - c. Coating System -- Apply two coats of masonry water retardant material. The system shall be clear, non-staining, silane-modified-siloxane, Fabrishield 161, Rainstopper 1500, or equal. The selected coating system shall provide a minimum of a five-year manufacturer's warranty.

PART 3 EXECUTION

3.1 STORAGE, MIXING AND THINNING OF MATERIALS

- A. Manufacturer's Recommendations -- Unless otherwise specified herein, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating shall be strictly observed.
- B. All protective coating materials shall be used within the manufacturer's recommended shelf life.
- C. Storage and Mixing -- Coating materials shall be protected from exposure to cold weather, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings of different manufacturers shall not be mixed together.

3.2 SURFACE PREPARATION STANDARDS

- A. The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this specification.
1. Solvent Cleaning (SSPC-SP1) -- Removal of oil, grease, soil, salts and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion or steam.
 2. Hand Tool Cleaning (SSPC-SP2) -- Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.
 3. Power Tool Cleaning (SSPC-SP3) -- Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing and grinding.
 4. White Metal Blast Cleaning (SSPC-SP5) -- Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.
 5. Commercial Blast Cleaning (SSPC-SP6) -- Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.
 6. Brush-Off Blast Cleaning (SSPC-SP7) -- Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust and loose paint.
 7. Near-White Blast Cleaning (SSPC-SP10) -- Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.
 8. High- and Ultra High- Pressure Water Jetting (SSPC-SP12): Water jetting at high- or ultra high-pressure to prepare a surface for recoating using pressure above 10,000 psi.
 9. Surface Preparation of Concrete (SSPC-SP-13) - Surface preparation of concrete by mechanical, chemical, or thermal methods prior to the application of bonded protective coating or lining systems.
 10. Industrial Blast Cleaning (SSPC-SP14): Blast cleaning to remove all visible oil, grease, dust and dirt, when viewed without magnification.

3.3 CORRECTIONS AND CLEANUP

At completion any damaged, de-laminated or defaced coated surfaces shall be touched up, restored and left in first class condition. Any coated or finished surfaces damaged in fitting or erection shall be restored. If necessary, an entire wall shall be refinished rather than spot finished. Upon completion and prior to final acceptance, all equipment and unused materials accumulated in the coating process shall be removed from the site and any spillage, spatter spots or other misplaced coating material shall be removed in a manner which will not damage surfaces. Perform required patching, repair and cleaning to the satisfaction of the Owner's Representative. Cooperate and coordinate work with the work of other trades in the removal and replacement of hardware, fixtures, covers, switch plates, etc., as required for coating.

3.4 SURFACE PREPARATION

A. General

Prepare all surfaces scheduled to receive new coating systems, as required to provide for adequate bonding of the specified coating system to the substrate material. Request review of prepared surfaces by the Owner's Representative prior to proceeding. For existing coated surfaces, hand wash with cleaner or product recommended by coating manufacturer to properly prepare existing surface and provide for bonding of coating specified to follow. Remove any loose, peeling or flaking coating, or mildewed areas. Surface preparation minimums shall be as follows:

1. Exposed metal items, nonsubmerged, unprimed, non-galvanized both interior and exterior, including: piping, structural steel and all other metal items not otherwise specified, shall undergo surface preparation in accordance with SSPC-SP6, "Commercial Blast Cleaning".
2. Exposed metal items, shop primed, both interior and exterior including: piping, steel doors, steel ladders to be painted, and railings, and all other metal items not otherwise specified, shall undergo surface preparation in accordance with SSPC-SP1, "Solvent Cleaning"; SSPC-SP2, "Hand Tool Cleaning"; and SSPC-SP3, "Power Tool Cleaning" as may be required to remove grease and loose, peeling, or chipped paint.
3. Metal items, unprimed or non-galvanized, continuously or intermittently submerged, both interior and exterior including: piping, structural steel and all other metal items not otherwise specified, shall undergo surface preparation in conformance with SSPC-SP10, "Near-White Blast Cleaning".
4. Stainless Steel - Nonsubmerged and submerged, exposed piping and fittings, both interior and exterior shall undergo surface preparation in accordance with SSPC-SP1, "Solvent Cleaning".

5. Polyvinyl Chloride (PVC) - Nonsubmerged, both interior and exterior, process piping and plumbing, shall be lightly sanded prior to application of the specified coating system to follow.
6. Nonsubmerged Concrete - Clean all concrete surfaces of dust, form oil, curing compounds or other incompatible matter. Etch and prime if required by manufacturer for specified coating products to follow. Allow minimum 28-day cure of concrete prior to application of coating systems.
7. Concrete Masonry Units -- Repair all breaks, cracks and holes with concrete grout. The surface must be free of dirt, dust, loose sand and other foreign matter. Brush clean. Allow minimum 28-day cure of concrete joint mortar and repair grout prior to application of coatings system.
8. Wood -- Wood surfaces shall be thoroughly cleaned and free of all foreign matter with cracks, nail holes and other defects properly filled, smoothed and sandpapered to fine finish. Wipe clean of dust.
9. Preparation of All Existing Coated Surfaces -- Removed rough and defective coating film from material surfaces to be painted. Touch up with approved primer. Clean all greasy or oily surfaces, to be painted, with benzine or mineral spirits or Rodda's Gresof before coating, or as recommended by manufacturer. For walls, patch existing nicks and gouges, sand to match wall finish.

3.5 PRIME COATING

- A. Exposed Steel -- Prime coat all exposed steel in accordance with SSPC PS 13.01 for epoxy-polyamide coating systems. Prime coats shall be applied following completion of surface preparation requirements as specified in paragraph 3.4.A.1 above.
- B. Galvanized Metal -- After surface preparation specified above, prime galvanized metal items receiving paints as specified with Tnemec Series 66 Hi-Build Epoxaline or equal, verifying with manufacturer before application the compatibility with coatings specified to follow.
- C. Shop Primed Metal -- Where indicated on the plans or coating schedule and following the surface preparation procedures specified in paragraph 3.4.A.2 above, the Contractor shall apply intermediate and topcoats of the specified paint system to shop primed metal. The Contractor shall verify with the manufacturer(s) representative of the item(s) to be painted, before application, the compatibility of shop primers with the specified intermediate and topcoat coating systems.
- D. Non-Shop Primed Metal and Piping -- Prime coat all exposed metal and piping, except stainless steel, received at job site following completion of surface preparation requirements as specified in paragraph 3.4.A.1 above. Prime paint in accordance with

SSPC PS No. 13.01 for epoxy-polyamide primers. Epoxy-polyamide primers shall conform to the standards set forth in SSPC Paint Specification No. 22.

- E. Cast-In-Place Reinforced Concrete -- After surface preparation specified above, prime coat concrete as specified in the coating schedule found elsewhere in the specifications.
- F. Concrete Masonry Units -- After surface preparation specified above, prime coat as specified in the coating schedule found elsewhere in the specifications.
- G. Wood Surfaces -- Following surface preparation specified above, prime coat exterior exposed wood surfaces with appropriate coating system as specified in the painting schedule.

3.6 FIELD PRIME

Wherever shop priming has been damaged in transit or during construction, the damaged area shall be cleaned and touched up with field primer specified herein or returned to the shop for resurfacing and repriming, at the Owner's Representative's discretion. Metal items delivered to the job site unprimed shall be cleaned and primed as specified herein.

3.7 APPLICATION

- A. Thickness -- Apply coatings in strict conformance with the manufacturer's application instructions. Apply each coat at the rate specified by the manufacturer to achieve the dry mil thickness specified. If material must be diluted for application by spray gun, build up more coating to achieve the same thickness as undiluted material. Correct apparent deficiency of film thickness by the application of an additional coat.
- B. Porous Surfaces -- Apply paint to porous surfaces as required by increasing the number of coats or decreasing the coverage as may be necessary to achieve a durable protective and decorative finish.
- C. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same working day.
- D. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations, and this Section, whichever has the most stringent requirements.
- E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. Use stripe coating for these areas.

- F. Special attention shall be given to materials which will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.
- G. Ventilation -- Adequately ventilate enclosed rooms and spaces during painting and drying periods.
- H. Drying Time -- Do not apply next coat of coat until each coat is dry. Test non-metallic surfaces with moisture meter. The manufacturer's recommended drying time shall mean an interval under normal condition to be increased to allow for adverse weather or drying conditions. Coating manufacturer's representative shall verify by cure testing, complete cure of coatings systems used for immersion service.

3.8 COATING SCHEDULE

Coating Schedule

<u>Item</u>	<u>Location</u>	<u>Material</u>	<u>Coating System</u>
Piping Coatings (exterior surface of pipe)	Vaults	Ductile Iron	Coating System 102
Concrete (below grade)	Vaults	Concrete	Coating System 103
Miscellaneous Metals (exterior surfaces)	Vaults	Steel	Coating System 101

Notes:

1. Where handrails are to be field welded, taper paint layers back from welded end. Leave each layer approximately 6 inches back from previous layer. Provide sufficient exposed length of railing as to not cause damage from field welding to shop prime/paint.
2. Fusion bonded epoxy can be substituted for coal tar epoxy. Potable water epoxy, NSF approved, shall be used for all surfaces in contact with potable water.
3. If a location and material are not specifically identified in the table, the coating systems specified in Section 2, Products, shall apply to the entire project as noted in the specifications for each coating system.

END OF SECTION

SECTION 31 05 13 - SOILS FOR EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes range of soil and subsoil materials intended to be referenced by other sections, generally for fill and grading purposes. Materials are indicated by "Type" to assist in referencing from other sections and on Drawing notes.
- B. Section includes:
 - 1. Subsoil materials
 - 2. Topsoil materials
- C. Related Sections
 - 1. Section 31 05 16 - Aggregates for Earthwork
 - 2. Section 31 10 00 - Site Clearing
 - 3. Section 31 22 13 - Rough Grading
 - 4. Section 31 23 16 - Excavation
 - 5. Section 31 23 17 - Trenching
 - 6. Section 31 23 18 - Rock Removal
 - 7. Section 31 23 23 - Fill

1.2 -REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- B. ASTM International (ASTM):
 - 1. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
 - 2. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
 - 3. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

- B. Materials Source: Submit name of imported materials source.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Furnish materials of each type from same source throughout the Work.
- B. Soil Testing:
 - 1. Soil sampling and testing to be completed by an independent laboratory approved by the Owner's Representative.
 - 2. Frequency of testing shall be determined by the Owner's Representative.
 - 3. All soil testing shall be paid for by the Contractor.
- C. Compaction Tests:
 - 1. Maximum density at optimum moisture content determined by ASTM D698 (AASHTO T99).
 - 2. In-place density in accordance with Nuclear Testing Method, ASTM D6938.
- D. Soil Classification: All imported materials shall be classified in accordance with ASTM D2487.

PART 2 PRODUCTS

2.1 SUBSOIL MATERIALS

- A. Subsoil Type S1, Select Native Material:
 - 1. Select earth obtained from on-site excavations approved for use by Owner's Representative.
 - 2. Graded.
 - 3. Free of peat, humus, vegetative matter, organic matter, and rocks larger than 6 inches in diameter.
 - 4. Processed as required to be placed in thickness as prescribed and at the optimum moisture content to obtain level of compaction required by these specifications.
- B. Subsoil Type S2, Imported Fill Material:
 - 1. Imported earth approved for use by Owner's Representative.

2. Meeting the requirements of Subsoil Type S1.

2.2 TOPSOIL MATERIALS

A. Topsoil Type TS1, Select Native Topsoil Material:

1. Top 6 - 12 inches of existing soil containing organic matter.
2. Owner's Representative decision shall be final as to determination of what material is topsoil quality.
3. Graded.
4. Free of roots, rocks larger than 1/2-inch diameter, subsoil, debris, large weeds, and foreign matter.
 - a. Screening: Single screened.

B. Topsoil Type TS2, Imported Topsoil Material:

1. Imported borrow.
2. Friable loam.
3. Reasonably free of roots, rocks larger than 1/2-inch, subsoil, debris, large weeds, and foreign matter.
 - a. Screening: Single screened.
4. Acidity range (pH) of 5-1/2 to 7-1/2.
5. Containing minimum of 4 percent and maximum of 25 percent inorganic matter.

2.3 SPOILS

- A. All excess material not suitable or not required for backfill and grading shall be hauled off site and disposed of at a location provided by the [Contractor/City] and approved by the Owner's Representative.
- B. Make arrangements for disposal of the material at no additional cost to the Owner.
- C. Landfill permit to be obtained by the Contractor and provided to Owner's Representative prior to commencement of disposal.

2.4 SOURCE QUALITY CONTROL

- A. Testing and Analysis of Subsoil Material: Perform in accordance with ASTM D1557 (AASHTO T180).
- B. When tests indicate materials do not meet specified requirements, change material, or vary compaction methods and retest. Additional testing shall be completed and paid for by the Contractor with no reimbursement by the Owner.
- C. Furnish materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.1 EXCAVATION

- A. Excavate material of every nature and description to the lines and grades as indicated on the Drawings and/or as required for construction of facilities.
- B. Site within clearing limits shall be stripped of topsoil as required to obtain additional topsoil necessary to complete Work indicated in the Drawings or as specified.
- C. When practical, do not excavate wet topsoil.
- D. Stockpile excavated material meeting requirements for subsoil materials and topsoil materials.
- E. Remove excess excavated subsoil and topsoil not intended for reuse from Site.
- F. Remove excavated materials not meeting requirements for subsoil materials and topsoil materials from Site.

3.2 STOCKPILING

- A. Stockpile soils at locations approved by Owner for redistribution as specified.
 - 1. Site may not have sufficient area to stockpile excavated material that will be required for fill later in the Project. If additional stockpile area is required to complete the Project on schedule, arrange off-site stockpile areas.
 - 2. No additional payments will be made for stockpiling excavated materials off-site.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Prevent intermixing of soil types or contamination.

- E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
 - 1. Grade surface of stockpiles to prevent ponding of water.
 - 2. Cover stockpiles to minimize the infiltration of water.
- F. Stockpile unsuitable and/or hazardous materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.3 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.
- B. When borrow area is indicated, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

SECTION 31 05 16 - AGGREGATES FOR EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes a range of coarse and fine aggregate materials intended to be referenced by other Sections, generally for fill and grading purposes. Materials are indicated by "Type" to assist in referencing from other Sections and in Drawing notes.
- B. Section Includes:
 - 1. Coarse aggregate materials
 - 2. Fine aggregate materials
- C. Related Sections
 - 1. Section 31 05 13 - Soils for Earthwork
 - 2. Section 31 22 13 - Rough Grading
 - 3. Section 31 23 17 - Trenching
 - 4. Section 31 23 19 - Dewatering
 - 5. Section 31 23 23 - Fill
 - 6. Section 32 11 23 - Aggregate Base Courses
 - 7. Section 33 05 50 - Existing Pipe Abandonment
 - 8. Section 33 11 10 - Water Utility Distribution and Transmission Piping
 - 9. Section 33 12 16 - Water Utility Distribution and Transmission Valves

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO M147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses
 - 2. AASHTO T27 - Sieve Analysis of Fine and Coarse Aggregates
 - 3. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
 - 4. AASHTO TP61 - Standard Method of Test for Determining the Percentage of Fracture in Coarse Aggregate
- B. ASTM International (ASTM):
 - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
3. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
4. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
5. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Materials Source: Submit name of imported materials suppliers.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- D. Results of aggregate sieve analysis and standard proctor tests for all granular material.

1.4 QUALITY ASSURANCE

- A. Furnish each aggregate material from a single source throughout the Work.
- B. Aggregate Testing:
 1. Aggregate sampling and testing to be completed by an independent laboratory approved by the Owner's Representative.
 2. The frequency of testing shall be determined by the Owner's Representative.
 3. All aggregate testing shall be paid for by the Contractor.
- C. Compaction Tests:
 1. Maximum density at optimum moisture content determined by ASTM D1557 (AASHTO T180).
 2. In-place density in accordance with Nuclear Testing Method, ASTM D6938.
- D. Aggregate Classification: All imported materials shall be classified in accordance with ASTM D2487.

PART 2 PRODUCTS

2.1 COARSE AGGREGATE MATERIALS

A. Coarse Aggregate Type A1, Dense-Graded Aggregate: Crushed rock with ¾-inch-0, 1-inch-0, 1-1/2-inch-0, 2-inch-0 and 2-1/2-inch-0 gradation as shown in the Drawings and meeting the requirements provided below.

1. Grading - Dense-graded base aggregate shall be crushed rock, including sand. Uniformly grade the aggregates from coarse to fine.
2. Sieve analysis shall be determined according to AASHTO T27.
3. The aggregates shall conform to one of the grading requirements Table 31 05 16-A below.

**Table 31 05 16-A
Grading Requirements for Dense-Graded Aggregate
Separated Sizes
Percent Passing (by weight)**

Sieve Size	2-1/2" - 0	2" - 0	1-1/2" - 0	1" - 0	3/4" - 0
3"	100				
2-1/2"	95 - 100	100			
2"	-	95 - 100	100		
1-1/2"	-	-	95 - 100	100	
1-1/4"	55 - 75	-	-	-	
1"	-	55 - 75	-	90 - 100	100
3/4"	-	-	55 - 75	-	90 - 100
1/2"	-	-	-	55 - 75	-
3/8"	-	-	-	-	55 - 75
1/4"	30 - 45	30 - 45	35 - 50	40 - 55	40 - 60
No. 4*	-	-	-	-	-
No. 10	1	1	1	1	1

¹ Of the fraction passing the 1/4-inch sieve, 40 percent to 60 percent shall pass the No. 10 sieve.

* Report percent passing sieve when no grading requirements are listed.

4. Fracture of Rounded Rock:
 - a. Determined according to AASHTO TP61.
 - b. Provide at least one fractured face based on the following percentage of particles retained on the 1/4-inch sieve for the designated size:

Minimum Percent of Fractured Particles
by Weight of Material

<u>Designated Size</u>	<u>Retained on 1/4-Inch Sieve</u>
1-1/2-inch – 0 and larger	50
Smaller than 1-1/2-inch – 0	70

5. Durability:

a. Crushed rock aggregate shall meet the following durability requirements:

<u>Test</u>	<u>Test Method</u>	<u>Requirements</u>
Abrasion	AASHTO T 96	35.0 percent maximum
Degradation (Coarse Aggregate)	ODOT TM 208	30.0 percent maximum
Passing No. 20 Sieve, Sediment Height	ODOT TM 208	3.0-inch maximum

6. Sand Equivalent - Crushed rock aggregate will be tested according to AASHTO T 176 and shall have a sand equivalent of not less than 50.

B. Coarse Aggregate Type A2, Granular Drain Backfill Material: Crushed or uncrushed rock or gravel as shown in the Drawings.

1. Material shall be clean and free draining.
2. Sieve analysis shall be according to AASHTO T27.
3. Grading: Meeting the gradation requirements provided in Table 31 05 16-B below.

Table 31 05 16-B
Grading Requirements for Granular Drain Backfill Material
Separated Sizes
Percent Passing (by weight)

Sieve Size	Separated Sizes 1-1/2-inch – 3/4-inch	Separated Sizes 3/4-inch – 1/2-inch
2-inch	100	
1-1/2-inch	90 - 100	
1-inch	20 - 55	100
3/4-inch	0 - 15	85 - 100
1/2-inch	-	0 - 15
3/8-inch	0 - 5	-

- C. Coarse Aggregate Type A3, Select Native Granular Material:
 1. Select aggregate and rock obtained from on-site excavations and controlled blasting approved for use by Owner’s Representative.
 2. Graded.
 3. Free of peat, humus, vegetative matter, and organic matter.
 4. Sorted as required to be placed in thickness as prescribed and at the optimum moisture content to obtain level of compaction required by these specifications.

2.2 SAND

- A. Sand: Sand material shall consist of granular material, naturally produced, or produced from crushed gravel, or dredge sand that is reasonably free of organic material, mica, clay, fly ash, and other deleterious material, meeting the gradations of Table 31 05 16-C below.

**Table 31 05 16-C
Grading Requirements for Sand
Separated Sizes
Percent Passing (by weight)**

Sieve Size	Coarse Sand	Medium Sand	Fine Sand
1-inch	100	100	100
3/8-inch	95 - 100	95 - 100	-
#4	80 - 100	70 - 95	90 - 100
#30	10 - 30	10 - 45	-
#100	-	2 - 10	2 - 10
#200	0 - 8	0 - 7	0 - 4
Sand Equivalent	50 min.	50 min.	50 in.

2.3 SOURCE QUALITY CONTROL

- A. Coarse Aggregate Material – Testing and Analysis: Perform in accordance with ASTM C136 and ASTM D 1557 (AASHTO T180).
- B. Sand – Testing and Analysis: Perform in accordance with ASTM C136 and ASTM D1557 (AASHTO T180).

- C. When tests indicate materials do not meet specified requirements, change material and retest. Additional testing shall be completed and paid for by the Contractor with no reimbursement by the Owner.

PART 3 EXECUTION

3.1 STOCKPILING

- A. Stockpile materials imported to site at locations as approved by Owner's Representative for redistribution as specified.
- B. Separate different aggregate materials with dividers or stockpile individually to prevent mixing.
- C. Prevent intermixing of aggregate types or contamination.
- D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
 - 1. Grade surface of stockpiles to prevent ponding of water.
 - 2. Cover stockpiles to minimize the infiltration of water.

3.2 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.
- B. When borrow area is indicated, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

SECTION 31 10 00 - SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes clearing site of incidental paving and curbs, debris, grass, trees, and other plant life in preparation for site or building excavation work.
- B. Related Sections:
 - 1. Section 02 41 00 - Demolition
 - 2. Section 31 22 13 - Rough Grading
 - 3. Section 31 23 18 - Rock Removal

1.2 DEFINITIONS

- A. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.
- B. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2-inch caliper to a depth of 12 inches below subgrade.
- C. Interfering or Objectionable Material: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying; topsoil.
- D. Limits of Disturbance: Work area boundary as shown on the Drawings.
- E. Root Wad: Tree stump and root mass including all roots greater than 1-inch diameter.
- F. Stripping: Removal of topsoil remaining after applicable scalping is completed.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Clearing, Grubbing, and Stripping Plan: Drawings clearly showing proposed limits to clearing, grubbing, and stripping activities at Site.
- C. Certification or disposal permit for landfill and/or waste disposal site.
- D. A copy of written permission of private property owners, with copy of fill permit for said private property, as may be required for disposal of materials.

1.4 QUALITY ASSURANCE

- A. Existing Conditions: Determine the extent of Work required and limitations before proceeding with Work.
- B. Obtain Owner's Representative's approval of staked clearing, grubbing, and stripping limits prior to commencing clearing, grubbing, and stripping.
- C. Conform to applicable local, state, and federal codes for environmental requirements and disposal of debris,
 - 1. Burning on Project Site will not be permitted.
 - 2. Use of herbicides will not be permitted.
- D. Permits: The Contractor is responsible for obtaining all necessary permits required for completion of the Work described in this Section.
- E. Protection of Persons and Property: Meet all federal, state, and local safety requirements for the protection of laborers, other persons, and property in the vicinity of the work and requirements of the General Provisions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Existing Materials: All materials, equipment, miscellaneous items, and debris involved, occurring or resulting from demolition, clearing, and grubbing work shall become the property of the Contractor at the place of origin, except as otherwise indicated in the Drawings or specifications.
- B. Wound Paint: Emulsified asphalt formulated for use on damaged plant tissues.

PART 3 EXECUTION

3.1 GENERAL

- A. Clear, grub, and strip areas needed for waste disposal, borrow, or Site improvements within limits shown in approved Clearing, Grubbing, and Stripping Plan.
- B. Remain within the right-of-way and property lines at all times.
- C. Do not injure or deface vegetation or structures that are not designated for removal.

3.2 EXAMINATION

- A. Verify existing plant life designated to remain is tagged or identified.
- B. Identify waste and salvage areas for placing removed materials.

3.3 PREPARATION

- A. Carefully coordinate the work of this Section with all other work and construction.
- B. Call Local Utility Line Information service at 1-800-332-2344, not less than three working days before performing Work.
- C. Request underground utilities to be located and marked within and surrounding construction areas.
 - 1. Disconnect or arrange for disconnection of utilities (if any) affected by required work.
 - 2. Keep all active utilities intact and in continuous operations.
- D. Prepare Site only after:
 - 1. Erosion and sediment controls are in place.
 - a. Limit areas exposed uncontrolled to erosion during installation of temporary erosion and sediment controls and in compliance with COP Erosion and Sediment Control Manual and ESC Permits.
 - 2. Tree and vegetation protection is installed.
 - a. Protect existing site improvements, trees, and shrubs to remain to preclude damage during construction.
 - 3. Temporary fencing is installed along the Limits of Disturbance as shown on the Drawings.
 - 4. Notification of utility agencies; disconnect or arrange for disconnection of utilities (if any) affected by required work. Keep all active utilities intact and in continuous operation.

3.4 PROTECTION

- A. Utilities: Locate, identify, and protect utilities located by utilities and indicated in the Drawings to remain from damage.
- B. Survey control: Protect benchmarks, survey control points, and existing structures from damage or displacement.

C. Preservation and Trimming of Trees, Shrubs, and Other Vegetation:

1. Avoid injury to trees, shrubs, vines, plants, grasses, and other vegetation growing outside of the areas to be cleared and grubbed and those trees and shrubs designated to be preserved.
2. Protect existing trees and shrubs against cutting, breaking, or skinning of roots, skinning and bruising of bark, smothering of roots by stockpiling construction materials, excavated materials, excess foot or vehicular traffic, and parking of vehicles within drip line.
3. Provide temporary guards, as necessary, to protect trees and vegetation to be left standing.
4. Temporarily cover exposed roots with wet burlap to prevent roots from drying out, cover with earth as soon as possible.
5. Provide protection for roots and limbs over 1-1/2-inch diameter cut during construction operations. Coat cut faces with emulsified asphalt.
6. Repairable damage to trees and shrubs designated to remain shall be made by a professional tree surgeon approved by the Owner's Representative. Cost shall be borne by the Contractor.

D. Landscaped Areas:

1. When any portion of the Work crosses private property or landscaped areas, excavate topsoil separately and pile it on the opposite side of the trench from the subsoil.
2. Conduct Work in a manner that will restore original conditions as nearly as practicable.
3. Remove and replace any trees, shrubs, plants, sod, or other vegetative material as needed to complete Work.
4. All shrubs or plants shall be balled by experienced workers, carefully handled and watered, and replaced in their original positions without damage. Sod shall be handled in a similar manner.
5. Wherever sod cannot be saved and restored, the ground must be reseeded and cared for until a stand of grass is reestablished.
6. Plants or shrubs killed or destroyed shall be replaced and paid for by the Contractor.

7. It is the intent of this paragraph that the Contractor shall leave the surface and plantings in substantially the same conditions as before the Work is undertaken.
- E. Miscellaneous Site Features: Protect all existing miscellaneous site features from damage by excavating equipment and vehicular traffic, including but not limited to existing structures, fences, mailboxes, sidewalks, paving, and curbs.
- F. Repair and Replacement:
1. Damaged items, including but not restricted to those noted above, shall be repaired or replaced with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of work of this contract.
 2. Any damage to existing facilities or utilities to remain as caused by the Contractor's operations shall be repaired at the Contractor's expense.

3.5 LIMITS

- A. As follows, but not to extend beyond Limits of Disturbance as shown on the Drawings:
1. Excavation: 5 feet beyond top of cut slopes.
 2. Trench Excavation: 6 feet from trench centerline, regardless of actual trench width.
 3. Fill:
 - a. Clearing and Grubbing: 5 feet beyond toe of permanent fill.
 - b. Stripping: 2 feet beyond toe of permanent fill.
 4. Roadways: Clearing, grubbing, scalping, and stripping 5 feet from roadway shoulders.
 5. Other Areas: As shown.
- B. Remove rubbish, trash, and junk from entire area within the Limits of Disturbance as material is generated. Stockpiling shall be permitted in area(s) as provided or approved by the Owner.

3.6 CLEARING AND GRUBBING

- A. Clear and grub areas within limits shown in approved Clearing, Grubbing, and Stripping Plan.
- B. Except in areas to be excavated, all holes resulting from the clearing and grubbing operations shall be backfilled and compacted in accordance with the applicable sections of these Specifications.

- C. Clearing:
 1. Remove trees, saplings, snags, stumps, shrubs, brush, vines, grasses, weeds, and other vegetative growth within the clearing limits shown in the Drawings, except those trees and shrubs noted to remain in the Drawings or as directed by the Owner's Representative.
 2. Clearing shall be performed in such a manner as to remove all evidence of the presence of vegetative growth from the surface of the Project Site and shall be inclusive of sticks and branches of thickness or diameter greater than 3/8-inch and of grasses, weeds, exceeding 12 inches in height except as otherwise indicated.
 3. Clear undergrowth and deadwood, without disturbing subsoil.
- D. Grubbing: Clear areas required for access to site and execution of Work and remove all stumps, root wads, and roots over 1-inch diameter to the following depths:
 1. Future Structures and Building Areas 24 Inches
 2. Roads and Parking Areas 18 Inches
 3. All other Areas 12 Inches

3.7 TREE REMOVAL

- A. Exercise care in cutting, felling, trimming, and handling of those trees shown for removal to prevent damage to neighboring trees and structures to remain.
- B. Tree Salvage: As shown on the Drawings.
- C. No trees may be removed unless approved and permitted by the Owner's Representative.
- D. Do not top trees unless otherwise specified or approved by Owner in writing.

3.8 REMOVAL AND DISPOSAL

- A. Native vegetation may be mulched and used on Site.
- B. Asphalt and Gravel Surfaces:
 1. Asphalt, concrete, and gravel surfaces designated for removal shall be done to full depth.
 2. Asphalt, concrete, and gravel removed at Site may be reused at Site where shown in the Drawings or following approval of the Owner's Representative.

3. Haul removed asphalt, concrete, and gravel which is unsuitable for reuse or that exceeds quantity required.
- C. Remove debris, rock, abandoned piping, and extracted plant life from Site.
 - D. Remove from the Site all debris, materials, equipment, and items found thereon and materials and debris resulting from the Work, except as otherwise indicated.
 1. All existing improvements designated on the Drawings or specified to be removed including but not limited to structures, pipelines, walls, footings, foundations, slabs, pavements, curbs, fencing, and similar structures occurring above, at, or below existing ground surface shall be included in the Work.
 2. Unless otherwise specified, any resulting voids shall be thoroughly cracked out for drainage and backfilled with suitable excavated or imported material compacted to the density of the adjacent soil.
 - E. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
 - F. Do not burn or bury materials on site. Leave site in clean condition.
 - G. Removal: All material resulting from demolition, clearing, and grubbing, and trimming operations shall be removed from the Site and disposed of in a lawful manner. Materials placed on property of private property owners shall be by written permission only.
 - H. Cleanup: During and upon completion of work, promptly remove all unused tools and equipment, surplus materials, and debris.
 - I. Adjacent areas shall be returned to their existing condition prior to the start of Work.

3.9 CLEANUP

- A. During the time Work is in progress, make every effort to maintain the Site in a neat and orderly condition.
- B. All refuse, broken pipe, excess fill material, cribbing, and debris shall be removed as soon as practicable.
- C. Should the Work not be maintained in a satisfactory condition, the Owner may cause the work to stop until the cleanup of the Work has been done to the satisfaction of the Owner's Representative.

- D. The Work will not be considered complete, or the final payment certificate issued until all rubbish, unused material, or equipment shall have been removed and the premises left in a condition satisfactory to the Owner and the Owner's Representative.

END OF SECTION

SECTION 31 22 13 - ROUGH GRADING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes rough grading and filling associated with contouring of Site in preparation for building excavation and subsequent site work.
- B. Section Includes:
 - 1. Excavating topsoil
 - 2. Excavating subsoil
 - 3. Cutting, grading, filling, and rough contouring of Site
- C. Related Sections:
 - 1. Section 01 45 00 - Quality Control
 - 2. Section 31 05 13 - Soils for Earthwork
 - 3. Section 31 05 16 - Aggregates for Earthwork
 - 4. Section 31 10 00 - Site Clearing
 - 5. Section 31 23 16 - Excavation
 - 6. Section 31 23 17 - Trenching
 - 7. Section 31 23 18 - Rock Removal
 - 8. Section 31 23 23 - Fill

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- B. ASTM International (ASTM):
 - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 - 2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
 - 3. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
 - 4. ASTM D2434 - Standard Test Method for Permeability of Granular Soils (Constant Head)

5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Soils for Earthwork: As specified in Section 31 05 13, Soils for Earthwork.
- C. Aggregates for Earthwork: As specified in Section 31 05 16, Aggregates for Earthwork.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ASTM C136, ASTM D2419, and ASTM D2434.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Subsoil Fill: Type S1 and S2 as specified in Section 31 05 13, Soils for Earthwork.
- B. Topsoil: As specified in Section 31 05 13, Soils for Earthwork.
 1. Type TS1, Select Native Topsoil Material, as may be available.
 2. TS2, Imported Topsoil Material, as may be required.
- C. Structural Fill: Type A1, Dense-Graded Aggregate as specified in Section 31 05 16, Aggregates for Earthwork. Size of aggregate as shown in the Drawings.
- D. Granular Fill: Coarse Aggregate Type A1, Dense-Graded Aggregate as specified in Section 31 05 16, Aggregates for Earthwork. Size of aggregate as shown in the Drawings.
- E. Soil Sterilant: Pramitol 5SP as manufactured by CIBA-GEIGY, Spike 80W as manufactured by Elanco Products Company, or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify survey benchmark and intended elevations for the Work are as indicated on Drawings.

3.2 PREPARATION

- A. Call Local Utility Line Information service at 1-800-332-2344 not less than 3 working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
 - 2. Notify Owner's Representative of any potential conflicts resulting from utility locations and the Drawings.
 - 3. Notify utility company to remove and relocate utilities, as may be necessary.
- B. Identify required lines, levels, contours, and datum.
- C. See Section 31 10 00, Site Clearing for additional requirements in protection of existing utilities, survey control, plant life, and landscaped areas in coordination with the Work of this Section.

3.3 TOPSOIL EXCAVATION

- A. Excavate and stockpile topsoil as specified in Section 31 05 13, Soils for Earthwork.

3.4 SUBSOIL EXCAVATION

- A. Excavate subsoil from areas to be further excavated, re-landscaped, or re-graded as shown in the Drawings.
- B. When practical, do not excavate wet subsoil. When wet subsoil must be excavated and is to be reused on site for the Work, process wet material to obtain optimum moisture content.
- C. Stockpile excavated material in area designated onsite in accordance with Section 31 05 13, Soils for Earthwork.
- D. When excavating through roots, perform Work by hand and cut roots with sharp axe.
- E. Benching Slopes: Horizontally bench existing slopes greater than 3H:1V to key placed fill material to slope to provide firm bearing.

- F. Stability: Replace damaged or displaced subsoil as specified for fill.
- G. In roadbed cuts, the subgrade material shall be compacted to 90 percent of maximum density as determined by ASTM D1557 for a minimum of 6 inches below the top of the subgrade.
- H. Depending on the type of material encountered, the Contractor may have to scarify, aerate or water, over-excavate, or take other actions as necessary to bring soils to proper moisture in order to achieve the required compaction.

3.5 FILLING

A. General:

1. Grading and filling operations shall not take place when weather conditions and moisture content of fill materials prevent the attainment of specified density.
2. Vertical curves or roundings at abrupt changes in slope shall be established as approved by Owner's Representative.
3. Bring all graded areas to a relatively smooth, even grade and slope by blading or dragging. Remove high spots and fill depressions.

B. Fill areas to contours and elevations shown in the Drawings with unfrozen materials.

C. Subsoil Fill for Embankments:

1. Prior to construction of any embankment, the area beneath the embankment and the areas from which embankment material will be obtained shall be cleared and grubbed. The existing soil beneath the embankment shall then be compacted to 90 percent of maximum density as determined by ASTM D1557 for a minimum of 6 inches below ground surface. Any unsuitable material shall be removed prior to placement of any embankment.
2. Upon completion of the embankment foundation, embankment material shall be placed in horizontal lifts and compacted to 90 percent of ASTM D1557. Embankment lift depth shall not exceed the capability of compaction equipment being used to achieve the required compaction for the full depth of each lift. The embankment material shall be native or import free of vegetative or organic matter, boulders 6 inches or larger in diameter, or frozen material and shall be at or below optimum moisture content at the time of placement. Depending on the type of embankment material, the Contractor may have to scarify, aerate, water, or take other actions as necessary to bring soils to proper moisture to achieve the required compaction.

3. The embankment shall be brought to the lines and grade required on the Drawings and as established by the Engineer. Any unsuitable material which may have been used in constructing the embankment shall be removed and replaced with suitable material and compacted at no cost to the Owner.

D. Topsoil Fill:

1. Scarify prepared subgrade to depth of 4 inches immediately prior to placing topsoil.
2. Place topsoil in areas to be seeded to depths indicated in the Drawings, minimum depth of 6 inches.
3. Place topsoil material loose; do not compact, do not place in wet or muddy conditions.

E. Place material in continuous layers as follows:

1. Subsoil Fill: Maximum 8 inches compacted depth.
2. Structural Fill: Maximum 12 inches compacted depth.
3. Granular Fill: Maximum 12 inches compacted depth.

F. Maintain optimum moisture content of fill materials to attain required compaction density.

G. Slope grade away from building minimum 2 percent slope for minimum distance of 10 feet, unless noted otherwise.

H. Make grade changes gradual. Blend slope into level areas.

I. Repair or replace items indicated in the Drawings to remain which are damaged by excavation or filling. All costs shall be borne by the Contractor.

3.6 BALANCING EARTHWORK

A. It shall be the Contractor's responsibility to make their own determination of quantities required to complete the Work. Any imbalance in the actual earthwork which may occur shall be adjusted by either of the following methods.

1. When sufficient material is not available from the excavation areas to construct the embankments, the Contractor shall arrange for and obtain borrow material to complete the Work. Borrow material shall be equal to or better than the on-site embankment material.
2. When excess material exists beyond that required to complete the embankments, the Contractor shall dispose of the excess material at a location selected by the Contractor outside of the Project boundaries.

3.7 FINISHING OF SUBGRADE

- A. All roadbeds, ditches, and other excavations and embankments shall be trimmed accurately to the lines, grades, and cross sections as shown on the Drawings and established by the Engineer and shall be finished in a thoroughly workmanlike manner to within plus or minus 0.05 foot of the required grade.
- B. Upon completion of the subgrade, the Contractor shall load test the finished subgrade surface. The load test shall consist of slowly driving a loaded dump truck over the road surface. The dump truck shall have a minimum capacity of 10 cubic yards. The Owner's Representative and Contractor shall note and mark any soft areas. The Contractor shall excavate out and either replace unsuitable material or properly compact all soft areas in order to provide a firm base that conforms to the Specifications. Any soft areas that occur as part of the Project because of over-watering, improper compaction, weather, etc., shall be replaced at no cost to the Owner.

3.8 FIELD QUALITY CONTROL

- A. Perform laboratory material tests in accordance with ASTM D1557 (AASHTO T180).
- B. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D2922
 - 2. Moisture Tests: ASTM D3017
- C. Frequency and location of testing is dependent upon type of material placed. See Section 01 45 00, Quality Control for testing requirements.
- D. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest at the sole expense of the Contractor.

3.9 SOIL STERILANT

- A. Upon completion of the subgrade, the Contractor shall apply a soil sterilant to the surface of the subgrade in accordance with the manufacturer's or supplier's recommendations to adequately sterilize the subgrade.
- B. The Applicator shall be licensed by the State of Oregon for the class of herbicide utilized. Any damage to adjacent areas caused by the sterilant shall be repaired by the Contractor at no expense to the Owner.

END OF SECTION

SECTION 31 23 16 - EXCAVATION

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes excavation required for site structures or under slabs-on-grade or paving. Excavating for utilities outside building is included in Section 31 23 17, Trenching.
- B. Section Includes:
 - 1. Excavating for building foundations
 - 2. Excavating for paving, roads, and parking areas
 - 3. Excavating for slabs-on-grade
 - 4. Excavating for site structures
 - 5. Excavating for landscaping
- C. Related Sections:
 - 1. Section 01 45 00 - Quality Control
 - 2. Section 02 41 00 - Demolition
 - 3. Section 31 05 13 - Soils for Earthwork
 - 4. Section 31 05 16 - Aggregates for Earthwork
 - 5. Section 31 10 00 - Site Clearing
 - 6. Section 31 22 13 - Rough Grading
 - 7. Section 31 23 17 - Trenching
 - 8. Section 31 23 18 - Rock Removal
 - 9. Section 31 23 19 - Dewatering
 - 10. Section 31 23 23 - Fill
 - 11. Section 33 05 50 - Existing Pipe Abandonment
 - 12. Section 33 11 10 - Water Utility Distribution and Transmission Piping.

1.2 DEFINITIONS

- A. Common Excavation: All excavation required for Work, regardless of the type, character, composition, or condition of the material encountered. Common Excavation shall further include all debris, junk, broken concrete, and all other material. All excavation shall be classified as Common Excavation, unless provided as Rock for under Section 31 23 18, Rock Removal below.
- B. Common Material: All soils, aggregate, debris, junk, broken concrete, and miscellaneous material encountered in Common Excavation, excluding rock as defined below.

- C. Concrete Excavation: The removal of pieces of concrete larger than 1 cubic yard in volume that requires drilling, splitting and breaking methods, or a necessitating a trench width increase of 18 inches or more than the width of the preceding 10 feet of trench. Concrete excavation includes materials composed of Portland cement that are not identified other than manholes, structures, sewer pipe, or other appurtenances.
- D. Exploratory Excavation: The removal and replacement of material from locations shown on the Drawings, or as directed for the purpose of investigating underground conditions and identifying potential utility conflict between existing and proposed utilities.
- E. Overbreak: Material beyond and outside of the slope limits established by the Owner's Representative, which becomes displaced or loosened during excavation and is excavated.
- F. Pothole Excavation: Pothole excavation is the removal and replacement of all materials via coring, vacuum extraction, or similar method, not classified as exploratory excavation, for the purposes of locating an underground utility and to investigate underground conditions.
- G. Rock Removal: As defined in Section 31 23 18, Rock Removal.
- H. Spoils: Excavated materials from Site unsuitable for use as fill or not required for backfill and grading.
- I. Unsuitable Materials: See Spoils.

1.3 REFERENCES

- A. Local utility standards when working within 24 inches of utility lines.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Excavation Protection Plan: At a minimum, to include the following:
 - 1. Methods and sequencing of mass excavation.
 - 2. Proposed onsite and off-site spoil disposal locations.
 - 3. Anticipated difficulties and proposed resolutions.
 - 4. Proposed routes for Owner's access to Owner's facilities impacted by excavation Work.
 - 5. Proposed haul routes.

1.5 QUALITY ASSURANCE

- A. Allowable Tolerances: Final grades shall be plus or minus 0.1-foot.
- B. Provide adequate survey control to avoid unauthorized over-excavation.
- C. Weather Limitations:
 - 1. Material excavated when frozen or when air temperature is less than 32 degrees Fahrenheit (F) shall not be used as fill or backfill until material completely thaws.
 - 2. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

1.6 NOT USED

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 PREPARATION

- A. Prior to commencing work in this Section, become familiar with site conditions. In the event discrepancies are found, notify the Owner's Representative as to the nature and extent of the differing conditions.
- B. Call Local Utility Line Information service at 1-800-332-2344 not less than 3 working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
 - 2. Coordinate with and notify utility companies should it be necessary to remove or relocate facilities.
- C. Identify required lines, levels, contours, and datum.
- D. See Section 31 10 00, Site Clearing for additional requirements in protection of existing utilities, survey control, plant life, and landscaped areas in coordination with Work in this Section.

3.2 SITE CONDITIONS

- A. Quantity Survey: The Contractor shall be responsible for calculations for quantities and volume of cut and fill from existing site grades to finish grades established under this

contract as indicated in the Drawings or specified and shall include the cost for all earthwork in the total basic bid.

- B. Dust Control: Must meet all federal, state, and local requirements. Protect persons and property from damage and discomfort caused by dust. Water surfaces as necessary and when directed by Owner's Representative to quell dust.
- C. Soil Control: Soil shall not be permitted to accumulate on surrounding streets or sidewalks nor to be washed into sewers.

3.3 EXISTING UNDERGROUND UTILITIES

- A. Protect active utilities encountered, located or otherwise, and notify persons or agencies owning same.
- B. Remove inactive or abandoned utilities from within the project grading limits in accordance with Section 33 11 50, Existing Pipe Abandonment.
- C. For sewer and other miscellaneous drainage facilities, fill and plug pipes as follows:
 - 1. General:
 - a. Remove all structures to a minimum of 3 feet below subgrade, unless otherwise noted.
 - b. Cover top surface of all abandoned structures with two sheets of nonwoven geotextile, extended at least 1-foot beyond the outside walls of the abandoned manhole, sump, or basin.
 - c. Plug all abandoned pipes with permanent plugs as specified in Section 33 05 50, Existing Pipe Abandonment.
 - 2. Sumps:
 - a. Remove existing sediment, soil, and water. Properly dispose of these materials in accordance with the requirements of these specifications.
 - b. Remove top cone and first solid concrete section to a depth of approximately 8 to 10 feet below ground.
 - c. Fill sump with CLSM.
 - d. Backfill remaining voids for facilities within existing or proposed roadways with approved materials meeting the requirements of Section 32 11 23, Aggregate Base Courses.

3. Salvaging Manhole Frames, Covers, and Grates:
 - a. Remove manhole frames, covers, and grates scheduled for salvage and store in approved location.
 - b. Frames, grates, and covers meeting Specifications may be salvaged from structures to be adjusted and may be reused in the Work if of suitable size and condition.
 - c. Replace, at no additional cost to the Owner, all items damaged or lost by the Contractor with similar items that are comparable in all respects with those they are to replace, and which are adequate for the intended purpose.
 - d. Clean salvaged components to be reused of foreign material by methods that will not harm the components.
4. Existing Manhole Frames and Covers: Manhole frames and covers removed by the Contractor are the property of the Owner. Notify the Owner's Representative a minimum of 48 hours before removal to arrange for pickup of the removed frames and covers, if not reused.

3.4 PRESERVATION OF EXISTING IMPROVEMENT

- A. Protect adjacent existing structures which may be damaged by excavation work.
 1. Conduct operations in such a manner that existing street facilities, utilities, railroad tracks, structures, and other improvements, which are to remain in place, will not be damaged. Furnish and install cribbing and shoring or whatever means necessary to support material around existing facilities, or to support the facilities themselves, and maintain such supports until no longer needed.
 2. Open slopes shall not be cut within 5 feet of any existing spread footings unless approved by the Owner's Representative.
 3. Do not interfere with 45 degree bearing splay of foundations unless approved by the Owner's Representative.
 4. Excavated material shall not be placed adjacent to existing or proposed structures.

3.5 EXCAVATION

- A. General:
 1. Method of excavation shall be the Contractor's option, but care shall be exercised as final grade is approached to leave it in undisturbed condition.

2. If the final grade for supporting structures is disturbed, it shall be restored to requirements of these Specifications and satisfaction of the Owner's Representative at no additional cost to Owner.
 3. The Contractor is advised that footings should be poured as soon as possible to minimize unfavorable final grade conditions from developing.
 4. Provide all measures to ensure public safety.
- B. Control of Water:
1. Provide and maintain equipment to remove and dispose of water during the course of the work of this Section and keep excavations dry and free of frost or ice.
 2. Bearing surfaces that become softened by water or frost must be re-excavated to solid bearing at Contractor's expense and backfilled with compacted crushed rock at Contractor's expense.
 3. Grade top perimeter of excavation to prevent surface water from draining into excavation.
 4. See additional requirements in Section 31 23 19, Dewatering.
- C. Frozen Ground: Frost protection shall be provided for all structural excavation work. Foundation work shall not be placed on frozen ground.
- D. Excavate material of every nature and description to the lines and grades as indicated in the Drawings and/or as required for construction of the facility.
1. Allow for forms, shoring, working space, granular base, topsoil, and similar items, wherever applicable.
 2. Trim excavations to neat lines. Remove loose matter and lumped subsoil.
- E. Excavated Materials: Soils excavated at Site will be treated and used as one of two general categories of material as provided below.
1. Fill:
 - a. Subsoil Type S1, Select Native Fill, as approved for use by Owner's Representative.
 - b. Excavated materials are not to be used as trench backfill. Trench backfill shall be as specified in Section 31 23 107, Trenching.

2. Spoils:

- a. Ensure there is sufficient suitable material available to complete embankments and other required fillings prior to disposing of any excavated materials.
- b. Make arrangements for disposal of spoils and include as part of contract work in preparing of project bids. The CONTRACTOR may make arrangements with adjoining property owners for disposal of spoils in preparation of bids.
- c. Landfill permit or written permission from private property owner to be obtained by the CONTRACTOR and provided to the OWNER'S REPRESENTATIVE.

F. Shoring:

1. The Contractor shall be solely responsible for excavation protection and worker safety and shall provide sheeting and shoring wherever required, all in accordance with current local, state, and federal laws, codes, and ordinances.
2. Where shoring, sheet piling, sheeting, bracing, lagging, or other supports are necessary to prevent cave-ins or damage to existing structures, it shall be the responsibility of the Contractor to design, furnish, place, maintain, and remove such supports in accordance with applicable ordinances and safety requirements.
3. The design, planning, installation, and removal of all sheeting accomplished in such a manner as to maintain the undisturbed state of the soil below and adjacent to the excavation.

G. Slope existing banks with machine to angle of repose or less until shored.

1. Shape, trim, and finish cut slopes to conform to lines, grades, and cross-sections shown, with proper allowance for topsoil or slope protection, where shown.
2. Protection of excavation side slopes:
 - a. Use excavation methods that will not shatter or loosen excavation slopes.
 - b. Where practical, excavate materials without previous loosening and in limited layers or thickness to avoid breaking the material back of the established slope line.
 - c. Avoid overbreaks. Overbreak is incidental to the Work, except in cases where the Owner's Representative determines that such overbreak was unavoidable.

- d. Excavation in rock or rocky cuts:
 - 1) Once completed, thoroughly test the slopes with bars or other approved means to remove all loose, detached, broken, or otherwise unstable material.
 - 2) Remove jutting points. Scale slopes using mine scaling rods or other approved methods to remove loose or overhanging materials and provide a safe, trim, neat, and stable condition.
 - 3) Dispose of the materials removed under this subparagraph in the same manner as other excavated material.
- e. Remove all exposed roots, debris, and all stones more than 3 inches in size which are loose or could become loosened.
- 3. Construct slopes free of all exposed roots.
- 4. Construct slopes free of unstable rock and loose stones exceeding 3 inches in diameter.
- 5. Round tops of cut slopes in soil to not less than a 6-foot radius, provided such rounding does not extend off-site, outside of easements, outside of rights-of-way, or adversely impacts existing facilities, adjacent property, or completed Work.
- 6. Trim all surfaces neatly and smoothly.
- H. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity; perform compaction in accordance with Section 31 23 17, Trenching and Section 31 23 23, Fill.
- I. Notify Owner's Representative of unexpected subsurface conditions.
- J. Over-excavation for Unsuitable Foundation Conditions:
 - 1. Cross-sectional dimensions and depths of excavations shown in the Drawings shall be subject to such changes as may be found necessary by the Owner's Representative to secure foundations free from soft, weathered, shattered, and loose material or other objectionable materials.
 - 2. Unsuitable materials encountered shall be removed and replaced with Coarse Aggregate Type A1, 2-1/2-inch – 0 gradation, as specified in Table 31 05 16-A of Section 31 05 16, Aggregates for Earthwork. All material placed shall be compacted to 95 percent of maximum dry density.

3. Unsuitable materials shall be removed and replaced only as directed in writing by Owner's Representative.

K. Rock Removal:

1. Remove boulders and rock up to 1/2 cubic yard measured by volume per the requirements of this Section.
2. Remove larger boulders and rock material as specified in Section 31 23 18, Rock Removal.
3. Concrete removal, as defined herein, shall be treated as Rock Removal.

- L. Stockpile excavated material in area(s) designated on or off site in accordance with Section 31 05 13, Soils for Earthwork.

3.6 FIELD QUALITY CONTROL

- A. Perform excavation and controlled fill operations in accordance with the requirements of this Section.
- B. Coordinate the visual inspection and approval of all bearing surfaces by Owner's Representative before installing subsequent work.

3.7 PROTECTION

- A. Prevent displacement or loose soil from falling into excavation; maintain soil stability and store excavated materials at a distance from top of excavation.
- B. Protect structures, utilities, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

END OF SECTION

SECTION 31 23 17 - TRENCHING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the requirements for excavation and backfill of all utilities, including installation of pipe bedding, pipe zone backfill, trench backfill, and related Work as shown on the Drawings and as specified.
- B. Section includes:
 - 1. Excavating trenches for pipe, utility vaults, and other utilities.
 - 2. Compacted fill from top of utility bedding to final grades.
 - 3. Trench and utility vault backfilling and compaction.
- C. Related Sections:
 - 1. Section 01 45 00 - Quality Control
 - 2. Section 31 05 13 - Soils for Earthwork
 - 3. Section 31 05 16 - Aggregates for Earthwork
 - 4. Section 31 10 00 - Site Clearing
 - 5. Section 31 22 13 - Rough Grading
 - 6. Section 31 23 16 - Excavation
 - 7. Section 31 23 18 - Rock Removal
 - 8. Section 31 23 23 - Fill
 - 9. Section 31 23 24 - Flowable Fill
 - 10. Section 33 11 10 - Water Utility Distribution and Transmission Piping

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- B. ASTM International (ASTM):
 - 1. ASTM C403 - Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
 - 2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))

3. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
4. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
5. D4832, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

1.3 DEFINITIONS

- A. Controlled Low Strength Material (CLSM): Also referred to as Flowable Fill. Lean cement concrete fill. A self-compacting, cementitious material.
- B. Flexible Pipe: For the purposes of these Specifications, tubing between 1/2-inch and 4-inch diameter constructed of polyvinyl chloride (PVC) and high-density polyethylene (HDPE) are considered flexible pipes. HDPE piping 4 inches in diameter and larger is also considered flexible pipe.
- C. Geosynthetics: Geotextiles, geogrids, geomembranes, and drainage composite materials.
- D. Imported Material: Materials obtained from sources offsite, suitable for specified use.
- E. Lift: Loose (uncompacted) layer of material.
- F. Obstructions: Items which may be encountered during utility and vault trenching which do not require replacement.
- G. Optimum Moisture Content:
 1. Determined in accordance with ASTM Standard specified to determine maximum dry density for relative compaction.
 2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.
- H. Pipe Bedding: Trench backfill zone for full trench width which extends from the bottom outside surface of the pipe to a minimum of 6 inches below the bottom outside surface of pipe, conduit, cable, or duct bank to the trench foundation so as to uniformly support the barrel of the pipe.
- I. Pipe Zone: Trench backfill zone for full trench width which extends from the bottom outside surface of the pipe to a minimum of 12 inches above the top outside surface of pipe, conduit, cable, or duct bank.

- J. Pipe Bedding, Pipe Zone, and Trench Backfill Classifications:
1. Class A: Backfill with suitable native or imported material that is approved to meet the characteristics required for the specific surface loading or other criteria of the backfill zone.
 2. Class B: Backfill with imported granular material consisting of gravel or crushed rock meeting the requirements of this Section and Coarse Aggregate Type A1 as specified in Section 31 05 16, Aggregates for Earthwork; typical designated size shall be 1-inch-0 or 3/4-inch-0.
 3. Class C: Backfill with Fine Sand, as specified in Section 31 05 16, Aggregates for Earthwork.
 4. Class D: Backfill with approved pit run or bar run material, well-graded from coarse to fine; maximum dimension shall be 3 inches.
 5. Class E: Backfill with CLSM. See Section 31 23 24, Flowable Fill.
- K. Pothole Excavations: Removal and replacement of all materials via coring, vacuum extraction, or similar method for the purposes of locating an underground utility and to investigate underground conditions.
- L. Prepared Trench Bottom: The bottom of the trench on which the pipe bedding is to lie, and which provides support for the pipe.
- M. Relative Compaction: Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM Standards.
- N. Rigid Pipe: For the purposes of these Specifications, pipe constructed of PVC, ductile iron, steel, concrete, and clay pipes are considered rigid pipes.
- O. Sewer, Pipes, and Mains: Conduits of circular or other geometric shapes, used to convey liquids or gases, or other material.
- P. Trench Backfill: Trench backfill zone for full trench width extending from the top of the pipe zone to pavement base rock, ground surface, or other surface material.
- Q. Trench Stabilization: Removal of unsuitable material in the bottom of a trench and replacement with specified material for support of a pipe, main, conduit, structure, or appurtenances.
- R. Utility: Any buried pipe, duct, conduit, or cable.

- S. Well-Graded: A mixture of particle sizes with no specific concentration or lack thereof of one or more sizes that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

1.4 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Excavation Protection Plan: At a minimum, to include the following:
 - 1. Methods and sequencing of mass excavation.
 - 2. Proposed on-site and off-site spoil disposal locations.
 - 3. Anticipated difficulties and proposed resolutions.
 - 4. Proposed routes for Owner's access to Owner's facilities impacted by excavation Work.
 - 5. Proposed haul routes.
- C. Product Data:
 - 1. Geotextile fabric, indicating fabric and construction
 - 2. Tracer wire
 - 3. Connectors for tracer wire and/or marking tapes
 - 4. Tracer wire locate boxes
- D. Imported Materials:
 - 1. Materials Source: Submit name and location of imported fill materials suppliers.
 - 2. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
 - 3. Submit results of aggregate sieve analysis and standard proctor test for granular material.
- E. CLSM: Mix designs in accordance with Submittal requirements of Section 31 23 24, Flowable Fill.

1.5 QUALITY ASSURANCE

- A. Subsoil and topsoil fill materials: In accordance with Quality Assurance requirements stated in Section 31 05 13, Soils for Earthwork.

- B. Aggregate fill materials: In accordance with Quality Assurance requirements stated in Section 31 05 16, Aggregates for Earthwork.
- C. CLSM:
 - 1. In-place testing: In accordance with ASTM C403.
 - 2. Compressive testing: In accordance with ASTM D4832.
- D. Allowable Tolerances: Final grades shall be plus or minus 0.1-foot.

1.6 NOT USED

1.7 COORDINATION

- A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.
- B. Coordinate trenching and utility installation work with other work at utility construction location occurring near or adjacent to specified herein.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Subsoil Fill: Excavated Native Material, Subsoil Type S1, and Imported Fill Material, Subsoil Type S2, are not suitable for use as trench backfill.
- B. Imported Granular Fill: Coarse Aggregate Type A1, Dense-Graded Aggregate with gradation as shown in the Drawings and specified in Section 31 05 16, Aggregates for Earthwork.
- C. Concrete:
 - 1. Lean concrete as specified in Section 31 23 24, Flowable Fill, with compressive strength of 100 pounds per square inch (psi).
 - 2. Structural concrete as shown on the Drawings with compressive strength of 3,000 psi.
- D. Drain Rock: Coarse Aggregate Type A2, Granular Drain Backfill Material with gradation as shown in the Drawings and specified in Section 31 05 16, Aggregates for Earthwork.
- E. Sand: As specified in Section 31 05 16, Aggregates for Earthwork.
- F. Trench Stabilization Material: Coarse Aggregate Type A1, Dense-Graded Aggregate, 2-1/2-inch – 0 gradation as specified in Section 31 05 16, Aggregates for Earthwork.

2.2 NOT USED.

2.3 ELECTRONIC LOCATING MATERIALS

A. Tracer Wire:

1. Direct burial No. 12 AWG solid, annealed copper-clad steel (CCS) high strength tracer wire.
2. Tensile Breaking Load: 380-pound average.
3. Jacket:
 - a. High molecular weight high-density polyethylene complying with ASTM D1248, 30-volt rating.
 - b. Color: Provide in colors per Article 2.03.B above.
4. Manufacturer and Product: Copperhead Industries; LLC, 12 CCS high strength reinforced tracer wire, or equal.

B. Tracer Wire Connectors:

1. Waterproof, corrosion proof and suitable for No. 12 AWG solid core wire.
2. Prefilled with silicone and suitable for use with low-voltage tracer lines of less than 50 volts.
3. Lug Connectors:
 - a. Waterproof plastic housing that encases the silicone prefilled lug terminals.
 - b. Manufacturer and Product: King Innovations; DryConn™ Direct Bury Lug or equal.
4. Twist Connectors:
 - a. Waterproof epoxy-filled packaging that encases the silicone prefilled twist connectors.
 - b. Manufacturer and Product: 3M Division; DBY Direct Bury Splice Kit 09053 connectors or equal.

C. Ground Wire: No. 12 AWG bare solid copper wire.

D. NOT USED.

2.4 NOT USED.

PART 3 EXECUTION

3.1 PREPARATION

- A. Call Local Utility Line Information service at 1-800-332-2344 not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
 - 2. Coordinate with and notify utility companies should it be necessary to remove or relocate facilities.
 - 3. Maintain and protect above and below grade utilities indicated to remain.
- B. Identify required lines, levels, contours, and datum locations.
- C. Drawings and/or specifications cover and govern replacement and restoration of foreseeable damage.
- D. The site of an open cut excavation shall be first cleared of all obstructions preparatory to excavation in accordance with Section 31 10 00, Site Clearing.
- E. See Section 31 10 00, Site Clearing for additional requirements in protection of existing utilities, survey control, plant life, and landscaped areas in coordination with Work in this Section.
 - 1. Intent of Drawings and Specifications is that all streets, structures, and utilities be left in condition equal to or better than original condition.
 - 2. Where damage occurs, and cannot be repaired or replaced, the Contractor shall purchase and install new material which is satisfactory to Owner.
- F. Potholing / Exploratory Test Pits: Dig such exploratory test pits and perform potholing as may be necessary in advance of trenching to determine the exact location and elevation of subsurface structures, pipelines, duct banks, conduits, and other obstructions which are likely to be encountered or need to be connected to and shall make acceptable provision for their protection, support, and maintenance of their continued operation.
- G. Paved or Surfaced Streets:
 - 1. Wherever paved or surfaced streets are cut, saw wheel, or approved cutting devices shall be used.

2. Width of pavement cut shall be as shown in the Drawings.
 3. Any cut or broken pavement shall be removed from site during excavation.
- H. Traffic:
1. Maintain street traffic at all times as required by the Drawings and as specified herein.
 2. Erect and maintain barricades, warning signs, traffic cones, and other safety devices during construction in accordance with the latest edition of Manual of Uniform Traffic Control Devices (MUTCD), Part 6, to protect the traveling public in any area applicable.
 3. Provide flaggers as required during active work in roadway areas.
- I. Operations shall be confined to rights-of-way and easements provided. Avoid encroachment on, or damage to, private property or existing utilities unless prior arrangements have been made with copy of said arrangement submitted to Owner's Representative.

3.2 EASEMENTS

- A. Where portions of the Work are located on private property, easements and permits will be obtained by the Owner. Easements shall provide for the use of property for construction purposes to the extent indicated on the easements.
- B. Copies of these easements and permits will be available from the Owner for inspection by the Contractor. It shall be the Contractor's responsibility to determine the adequacy of the easement obtained in every case.
- C. Confine construction operations to within the easement limits or street right-of-way limits or make special arrangements with the property owners for the additional area required and notify the Owner's Representative with a copy of the written approval from property owners of any such conditions.
- D. Any damage to private property, either inside or outside the limits of right-of-way or easements provided by the Owner, resulting from Work shall be the responsibility of the Contractor. Before the Owner's Representative will authorize final payment, the Contractor will be required to furnish the Owner with written releases from property owners where the Contractor has obtained special agreements or easements or where the Contractor's operations, for any reason, have not been kept within the construction right-of-way obtained by the Owner.

3.3 PROTECTION

A. Existing Facilities:

1. It is the intent of these specifications that all streets, structure, and utilities be left in a condition equal to or better than original condition at the completion of the Project.
2. Where damage occurs, and cannot be repaired or replaced, the Contractor shall purchase and install new material to the satisfaction to the Owner's Representative.
3. Drawings and/or specifications cover and govern replacement and restoration of foreseeable damage.

B. Removal of Water:

1. As specified in Section 31 23 19, Dewatering.
2. At all times during construction provide and maintain ample means and devices with which to remove promptly and dispose of properly all water entering the excavations or other parts of the Work.
3. Keep all excavations dry until the utilities or vaults to be placed therein are completed. In water bearing sand, well points and/or sheeting shall be supplied, together with pumps and other appurtenances of ample capacity to keep the excavation dry as specified.
4. Dispose of water from the Work in a suitable legal manner without damage to adjacent property or structures.

C. Trench Protection:

1. Provide the materials, labor, and equipment necessary to protect trenches at all times.
2. Trench protection shall provide safe working conditions in the trench and protect the Work, existing property, utilities, pavement, etc.
3. The method of protection shall be according to the Contractor's design.
4. The Contractor may elect to use a combination of shoring, overbreak, tunneling, boring, sliding trench shields, or other methods of accomplishing the work provided the method meets the approval of all applicable local, state, and federal safety codes.

5. Damages resulting from improper shoring, improper removal of shoring, or from failure to shore shall be the sole responsibility of the Contractor.

3.4 LINES AND GRADES

- A. Trench excavation for piping, utility vaults, and other utilities shall be performed to the alignment and grade as indicated in the Drawings.
- B. Where grades are not shown in the Drawings, utilities shall be laid to grade between control elevations shown.
- C. Water mains shall be installed with a minimum cover as specified in Section 33 11 10, Water Utility Distribution and Transmission Piping.
- D. The Owner's Representative reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.
- E. Changes in the grade and horizontal alignment of the pipeline as shown in the Drawings or as provided elsewhere in the Specifications may be necessary due to unanticipated interferences or other reasons.
 1. No additional compensation will be allowed the Contractor for changes in horizontal alignment.
 2. No additional compensation will be allowed for changes in grade which require additional depth of trench excavation and backfill up to 2 feet from those shown in the Drawings.
- F. Use laser-beam instrument with qualified operator to establish lines and grades.

3.5 OBSTRUCTIONS

- A. Obstructions to the construction of the trench, such as tree roots, stumps, abandoned pilings, abandoned buildings and concrete structures, logs, rubbish, and debris of all types shall be removed without additional compensation from the Owner.
- B. The Owner's Representative may, if requested by the Contractor or Owner, make changes in the trench alignment to avoid major obstructions if such alignment changes can be made within the perpetual easement and right-of-way and without adversely affecting the intended function of the facility or increasing costs to the Owner.

3.6 INTERFERING ROADWAYS AND STRUCTURES

- A. Remove, replace and/or repair any damage done during trenching activities to fences, buildings, cultivated fields, drainage crossings, and any other properties without additional compensation from the Owner.
 - 1. Replace or repair these structures to a condition as good as or better than their pre-construction condition prior to commencing work in the area.
- B. Paved Roadways:
 - 1. Where paved roadways are cut as part of trenching activities, Class D trench backfill will be required to the bottom of pavement base.
 - 2. New pavement shall be equal to or better than the existing paved surface.
 - 3. New surface shall not deviate by more than 1/4-inch from the existing finish elevation.
- C. Existing Structures:
 - 1. If existing structures are encountered as part of trenching activities which will prevent construction and are not adequately shown in the Drawings, the Contractor shall notify the Owner's Representative before continuing with the Work.
 - 2. The Owner's Representative may make such field revisions to the utility alignment as necessary to avoid conflict with the existing conditions.
 - 3. The cost of waiting or "down time" during such field revisions shall be borne by the Contractor without additional cost to the Owner or liability to the Owner's Representative.
 - 4. If the Contractor fails to so notify the Owner's Representative when a conflict of this nature is encountered, but proceeds with construction despite this interference, the Contractor shall do so at the Contractor's own risk with no additional payment.

3.7 TRENCHING

- A. Excavate subsoil as required for construction of utilities to elevations shown in the Drawings.
- B. Remove boulders and rock up to 1/2 cubic yard measured by volume per the requirements of this Section. Remove larger boulders and rock material as specified in Section 31 23 18, Rock Removal.

C. Open Trench Limit:

1. Do not advance open trench beyond the distance which will be backfilled and compacted the same day.
2. A maximum length of open trench shall not exceed 100feet at any one time.
3. Temporary resurfacing shall be completed within 300 feet of the associated open trench limit for each main pipe laying operation.
4. Cover or backfill excavations at the end of each day.
5. If the trench is not backfilled at the end of each working day:
 - a. Provide means to prevent caving of excavation sides, as necessary, during non-working hours.
 - b. Cover the excavation with a system as needed to provide public safety and prevention of entry during non-working hours.
 - c. Provide signed and stamped submittal of caving prevention system and cover system.
6. New trenching shall not be started when earlier trenches need backfilling, or the surfaces of streets or other areas need to be restored to a safe and proper condition.

D. Utility Crossings: Avoid horizontal and vertical conflicts with existing utilities.

1. Perform excavation within 24 inches of existing utility service in accordance with utility's requirements.
2. Vertical clearance between the new pipe and existing utilities shall be 12 inches minimum, unless otherwise noted on the Drawings.
3. Where existing utility lines are damaged or broken during trenching activities, the utility shall be repaired or replaced. For water or sewer bearing lines, care being taken to insure a smooth flow line and absolutely no leakage at the new joints.
4. All expenses involved in the repair or replacement of leaking or broken utility lines that have occurred due to the Contractor's operations shall be borne by the Contractor, and the amount thereof shall be absorbed in the unit prices of its bid.

- E. Water Lines Crossing Sewer Lines: Whenever water lines cross sewer lines, the Contractor shall comply with local Health Department requirements.
 - 1. Wherever possible, the bottom of the water line shall be 18 inches or more above the top of sewer pipe. One full length of the water line pipe shall be centered at the crossing.
 - 2. For clearances less than 1-1/2 feet, the Contractor shall replace the existing sewer pipe with ductile iron or PVC of equal size, centered at the utility crossing, or shall encase existing sewer pipe with concrete for a minimum of 10 feet on both sides of crossing, as directed by the Owner's Representative, at no additional cost to the Owner.

- F. Excavate trenches to width and depth as indicated on Drawings. No additional payment will be provided for trenching activities beyond dimensions shown in the Drawings.
 - 1. Excavation for trenches in which pipelines are to be installed shall provide adequate space for workers to place and joint the pipe properly and safely, but in every case the trench shall be kept to a minimum width.
 - 2. The width of the pipe trench at and below the top of the pipe shall be such that the clear space between the barrel of the pipe and the trench shall not exceed 12 inches on either side of the pipe.
 - 3. Excavation for utility vaults and other structures shall be wide enough to provide 18 inches between the structure surface and the sides of the excavation.
 - 4. For pipe or utility vaults to have bedding material, excavate to a depth of 6 inches below the bottom of the pipe or utility vault. Care shall be taken not to excavate below depths required.
 - 5. If over digging occurs, the trench bottom shall be filled to grade with compacted bedding material.

- G. Remove water or materials that interfere with Work.
 - 1. The trench at all times shall be kept free from water to facilitate fine grading, the proper laying and joining of pipe, and prevention of damage to completed joints.
 - 2. Adequate pumping equipment shall be provided to handle and dispose of the water without damage to adjacent property.
 - 3. Water in the trench shall not be allowed to flow through the pipe while construction work is in progress unless special permission to do so has been given by the Owner's Representative.

4. An adequate screen shall be provided to prevent the entrance of objectionable material into the pipe.
 5. Remove and dispose of existing abandoned sewer pipe, structures, and other facilities as necessary to construct the improvements.
 - a. Where the excavation activities require the removal of portions of an abandoned pipeline, masonry plugs shall be installed in the open ends of the pipe, unless otherwise noted in the Drawings or by the Owner's Representative.
 - b. Coordinate with Owner's Representative prior to plugging.
 - c. For plugs less than 36 inches in diameter, 8-inch-deep masonry units shall be used. For plugs in larger pipelines, 12-inch-deep masonry units shall be used.
 6. The costs associated with the removal of water and materials noted above will be considered incidental to trench excavation and backfill.
- H. Do not interfere with 45 degree bearing splay of foundations.
- I. Over-excavation for Unsuitable Trench Foundation Conditions:
1. Cross-sectional dimensions and depths of excavations shown in the Drawings shall be subject to such changes as may be found necessary by the Owner's Representative to secure foundations free from soft, weathered, shattered, and loose material or other objectionable materials.
 2. Unsuitable materials shall be removed and replaced only as directed in writing by Owner's Representative.
 3. Unsuitable materials encountered shall be removed and replaced with Coarse Aggregate Type A1, 2-1/2-inch – 0 gradation, as specified in Table 31 05 16-A of Section 31 05 16, Aggregates for Earthwork. All material placed shall be compacted to 95 percent of maximum dry density.
 4. Install nonwoven geotextile under trench stabilization material, over the soft or yielding excavated surface.
 - a. Install the nonwoven geotextile ahead of placement of the trench stabilization material, continuously along the excavation bottom and centered on the pipe centerline.
 - b. Use nonwoven geotextile width equal to the pipe diameter plus 2 feet.
 - c. Place laps or splices in the geotextile in the direction of the pipe laying.

- J. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
- K. Excavated material shall be placed at locations and in such a manner that it does not create a hazard to pedestrian or vehicular traffic or interfere with the function of existing drainage facilities or system operation.
- L. Remove excess subsoil not intended for reuse from site.
- M. Stockpile excavated material in area designated on site in accordance with Section 31 05 13, Soils for Earthwork.

3.8 TUNNELING

- A. In lieu of open cut trenching as specified above, the Contractor may utilize tunnel methods for installation of pipe where ground conditions are favorable and such methods will not disturb foundations under curbs, sidewalks, and other structures.
 - 1. The Owner's Representative must approve tunneling methods prior to utility installation.
 - 2. Where tunneling is used, payment for the pipe installation will be made for the equivalent trench excavation and backfill as if the open cut method was used. Payment will not be made for surface restoration including pavement, curbs, sidewalks, and other surface improvements whose replacement is avoided by the tunneling method.

3.9 SHEETING AND SHORING

- A. Sheet, shore, and brace excavations to prevent danger to persons, new and existing structures, and adjacent and neighboring properties and to prevent caving, erosion, settlement, and loss of surrounding subsoil.
- B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
- C. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- D. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.
- E. Design sheeting and shoring to be removed at completion of excavation work, unless shown otherwise in the Drawings.

F. Construction Sheeting Left in Place:

1. Furnish, install, and leave in place construction sheeting and bracing when specified or when indicated or shown on the Drawings.
2. Construction sheeting and bracing originally intended for temporary installation, placed by the Contractor to protect adjacent and neighboring structures, may be left in place if desired by the Contractor and approved by the Owner's Representative. All such sheeting and bracing left in place shall be included in the cost for excavation.
3. Any construction sheeting and bracing which the Contractor has placed to facilitate its work may be ordered in writing by the Owner's Representative to be left in place. The right of the Owner's Representative to order sheeting and bracing left in place shall not be construed as creating an obligation on its part to issue such orders. Failure of the Owner's Representative to order sheeting and bracing left in place shall not relieve the Contractor of its responsibility under the contract.
4. For sheeting and shoring to be left in place as part of the completed Work, cut off minimum 18 inches below finished grade.

3.10 COMPACTION

- A. Testing will be required to show specified densities of compacted backfill are being achieved by the Contractor's compaction methods.
- B. Moisture Control:
 1. Moisture condition backfill material to within 2 percent of optimum moisture content required for compaction throughout each lift of the fill.
 2. Add moisture to granular backfill by sprinkling during compaction operation.
 3. Compaction by ponding or jetting is not permitted.
- C. Compact all materials and areas that are not accessible for in-place density testing, as determined by the Owner's Representative, in place by whatever equipment and method is practicable or specified, and as approved by the Owner's Representative.
 1. Perform compaction at such moisture content as is required to produce well-filled, dense, and firm material in place that will show no appreciable deflection or reaction under the compacting equipment.

3.11 BEDDING

- A. All utility vaults, potable water pipe 4-inch nominal diameter and over, all steel pipe, all concrete sewer pipe, all plastic pipe, all pipe under existing or future structures or roadways, and any and all utilities at a depth greater than 6 feet shall be laid in pipe bedding material.
- B. Unless otherwise noted in the Drawings, pipe, or conduit of less than 4-inch diameter, outside structure lines and at a depth of less than 6 feet shall be bedded in native material properly shaped as specified below, all as detailed on the Drawings.
- C. Compacted bedding material shall be placed the full width of the excavated trench to a depth as shown on the trench detail included in the Drawings.
 - 1. In lieu of a detail, the depth shall be 6 inches.
- D. Spread the bedding smoothly over entire width of trench to the proper grade so that the pipe is uniformly supported along the barrel.
- E. Hand grade and compact each lift to provide a firm, unyielding surface along the entire pipe length. For rigid pipe, compact to at least 90 percent relative compaction.
- F. Excavate bell holes at each joint to permit proper assembly and inspection of the joint.
- G. Check grade and correct irregularities in bedding material.
- H. Center pipes horizontally in trench width.

3.12 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen fill materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Maintain optimum moisture content of fill materials to attain required compaction density.
- D. Place fill material, with the exception of CLSM, in continuous layers and compact in 6- to 8-inch lifts.
 - 1. Prevent pipe from moving either horizontally or vertically during placement and compaction of pipe zone material.
 - 2. Where trenches are under existing or future structures, paved areas, road shoulders, driveways, or sidewalks, or where designated on the Drawings or specified elsewhere in these specifications, the trench backfill shall be Class B or

Class E and pipe zone backfill shall be Class B or Class E. Class B backfill shall be compacted to 95 percent of maximum density at optimum moisture content.

3. Where trenches are outside existing or future structures, paved areas, road shoulders, driveways, or sidewalks, or where designated on plans or specified elsewhere, the trench backfill shall be Class A and pipe zone backfill in these areas shall be Class B. For these locations, compaction of Class B backfill shall be to not less than 90 percent of maximum density at optimum moisture content. Class B backfill shall be compacted to not less than 95 percent of maximum density at optimum moisture content.
- E. Employ placement method that does not disturb or damage nearby or adjacent foundation perimeter drainage or utilities in trench.
 - F. Do not use power-driven impact compactors to compact pipe zone material.
 - G. Backfill Immediately: All trenches and excavations shall be backfilled immediately after pipe or conduit is in approved condition to receive it and shall be carried to completion as rapidly as possible, unless otherwise directed by the Owner's Representative.
 - H. Under no circumstances shall water be permitted to rise in open trenches after pipe has been placed.
 - I. Do not allow backfill material to free fall into the trench or allow heavy, sharp pieces of material to be placed as backfill until after at least 2 feet of backfill has been provided over the top of pipe.
 - J. Use hand compactors for compaction until at least 2 feet of backfill is placed over top of pipe. Thoroughly tamp each lift, including area under haunches, with handheld tamping bars supplemented by "walking in" and slicing material under haunches with a shovel to ensure that voids are completely filled before placing each succeeding lift.
 - K. Placement of Sand:
 1. Place medium sand in lifts not exceeding 8 inches in uncompacted thickness.
 2. Compact each lift to a minimum of 95 percent relative compaction prior to placing succeeding lifts.
 - L. Placement of CLSM:
 1. Discharge from truck-mounted drum-type mixer into trench.
 2. Place in lifts not exceeding 2 feet in thickness.
 3. No compaction of CLSM is allowed.

4. Use steel plates to protect the CLSM from traffic a minimum of 24 hours. After 24 hours, the CLSM may be paved, or opened to traffic until permanent surface restoration is completed if it has hardened sufficiently to prevent rutting.
- M. New trenching shall not be started when earlier trenches need backfilling, or the surfaces of streets or other areas need to be restored to a safe and proper condition.
- N. Do not leave trench open at end of working day.

3.13 NOT USED.

3.14 ELECTRONIC LOCATING FACILITY INSTALLATION

A. Tracer Wire and Terminal Appurtenances:

1. Tracer Wire:

- a. Install as shown or directed directly over the pipe centerline and on top of the pipe zone in all sewer trenches, including mainline sewers, service laterals and storm sewer inlet leads.
- b. Connect mainline and service lateral tracer wires using either an approved direct-bury lug connector or direct-bury twist connector.
- c. Extend tracer wire to locator stations in manholes, locator boxes, storm inlets, or other visually identifiable terminal appurtenances, allowing for access with electronic locating equipment, as shown or directed and according to the following requirements:

2. Locator Stations:

- a. Install locator stations as shown within manholes.
- b. Mount locator station to manhole wall within 18 inches of manhole rim with two stainless steel expansion anchors.
- c. Drill a minimum 3/8-inch diameter hole through the manhole wall within 18 inches of the finish grade of the manhole rim.
- d. Extend the tracer wire from the pipe trench in one continuous piece up the outside of the manhole and through the hole and into a locator station and attach to one of the lugs in the locator station.
- e. When multiple tracer wires are terminated in manhole install a multi-lead locator station.

- f. Extend a ground wire from the locator station through a minimum 3/8-inch diameter hole in the manhole wall.
 - g. Install ground wire approximately 3 feet deep and extend from the outside manhole wall a minimum of 3 feet horizontally in any direction.
 - h. Seal all holes drilled in manhole walls with silicone sealant.
3. Storm Inlet Tracer Wire Termination: Terminate tracer wire inside inlet and directly over storm outlet pipe by placing tracer wire as follows:
- a. Drill a minimum 3/8-inch diameter hole through inlet wall to pass tracer wire through to inside inlet wall.
 - b. Seal hole with silicon sealer or material approved by Owner's Representative.
 - c. Leave 6 inches of coiled tracer wire along inside of inlet wall approximately 3 inches below the inlet frame and grate or as directed by Owner's Representative.
4. Service Lateral Tracer Wire Termination: Terminate tracer wire at ends of service laterals as shown or directed, as follows:
- a. Termination in Tracer Wire Locate Boxes: Extend the tracer wire in one continuous piece up vertically from the pipe trench and into the bottom of the locate box. Leave 18 inches of coiled tracer wire inside locate box.
 - b. Termination at 2-inch by 4-inch Markers: Extend tracer wire in one continuous piece directly up service lateral 2-inch by 4-inch markers and leave 18 inches of tracer wire wrapped around the exposed top end of 2-inch by 4-inch marker.

3.15 VISUAL IDENTIFICATION FACILITIES

- A. Tracer Wire Locate Boxes: Install tracer wire locate boxes directly over service laterals at property line, service boundary, or other location as shown or directed by the Owner's Representative.

3.16 FIELD QUALITY CONTROL

- A. All testing and reporting shall be conducted and completed by an independent laboratory provided by the Owner. Initial testing will be paid for by the Owner. Subsequent testing after failure of initial acceptance testing shall be paid by the Contractor.
- B. Perform laboratory material tests in accordance with ASTM D1557 (AASHTO T180).

- C. In-place compaction testing of pipeline backfill materials shall be performed at 2-foot elevation increments, one test per 200 lineal feet of pipeline trench as measured along pipe centerline.
 - 1. The Owner's Representative may reduce the frequency when satisfied with method of compaction.
 - 2. The Owner's Representative may direct testing at a higher frequency at no additional cost to the Owner upon failure to obtain specified densities or if the Contractor changes compaction equipment or methods of compaction.
 - 3. The Owner's Representative shall determine all test locations.
- D. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D2922
 - 2. Moisture Tests: ASTM D3017
- E. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest at the sole expense of the Contractor.

3.17 SURFACE RESTORATION AND CLEANUP

- A. Open Trenches: At the end of each workday, all open trenches shall be backfilled and all trenches within streets shall be temporarily paved or covered to the satisfaction of the Owner's Representative and the local permitting agency.
 - 1. Temporary paving shall be replaced with permanent street paving at the completion of construction within street rights-of-way, or sooner, if deemed necessary by the Owner's Representative.
 - 2. No gravel-filled trenches shall be left open within the street right-of-way at the end of the workday.
- B. Topsoil:
 - 1. Where trenches cross lawns, garden areas, pastures, cultivated fields, or other areas on which reasonable topsoil conditions exist, remove the topsoil to the specified depth and place the material in a stockpile.
 - 2. Topsoil shall not be mixed with other excavated material.
 - 3. After the trench has been backfilled, the topsoil shall be replaced.
- C. Clean up and remove all excess materials, construction materials, debris from construction, etc. Replace or repair any fences, mailboxes, signs, landscaping, or other

facilities removed or damaged during construction. Replace all lawns, topsoil, shrubbery, flowers, etc., damaged or removed during construction. The Contractor shall be responsible for seeing that lawns, shrubs, etc. remain alive and leave premises in condition equal to original condition before construction.

3.18 NOT USED

END OF SECTION

SECTION 31 23 18 - ROCK REMOVAL

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes removal of subsurface rock during excavation by mechanical method. **The use of explosives for rock removal is not permitted for this Project.**
- B. Section Includes:
 - 1. Removing identified and discovered rock during excavation.
 - 2. Suitable machinery and tools to assist rock removal.
- C. Related Sections:
 - 1. Section 31 22 13 - Rough Grading
 - 2. Section 31 23 16 - Excavation
 - 3. Section 31 23 17 - Trenching
 - 4. Section 31 23 23 - Fill

1.2 NOT USED

1.3 DEFINITIONS

- A. Common Excavation: All excavation required for Work, regardless of the type, character, composition, or condition of the material encountered. All excavation shall be classified as Common Excavation, unless provided for under Rock Removal below.
- B. Common Material: All soils, aggregate, debris, junk, broken concrete, and miscellaneous material encountered in Common Excavation, excluding rock as defined below.
- C. Rock: Solid mineral material, including boulders, solid bedrock, or ledge rock, with volume in excess of 1/2 cubic yard or solid material which, by actual demonstration, cannot be reasonably excavated with suitable machinery as defined herein. The Owner's Representative may waive the requirements for actual demonstration if the material encountered is well-defined rock.
- D. Rock Removal: Removal of rock as defined herein by systematic and continuous drilling, hammering, breaking, splitting, or other methods approved by the Owner's Representative.

E. Suitable Machinery:

1. A track-mounted hydraulic excavator of the 52,800- to 72,500-pound class equipped with a single shank ripper.
2. A track-mounted rocksaw trencher capable of a minimum trenching depth of 4 feet.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Equipment: Manufacturer information regarding pound class of machinery proposed for rock removal.
- C. Survey Report: Submit survey report mapping extent and locations of rock encountered, to be used in calculating total volume of rock removal.

1.5 NOT USED

1.6 PROJECT CONDITIONS

- A. Conduct survey of rock uncovered in excavation for structures or trenching for utilities prior to removal of material.
- B. Conduct survey and document conditions of buildings near locations of rock removal, prior to blasting, and photograph existing conditions identifying existing irregularities.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify site conditions and note subsurface irregularities affecting Work of this section.

3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Owner's Representative Approval for Rock Removal:
 1. Prior to commencement of rock removal, expose all material anticipated to be rock by removing the common material above it and then notify the Owner's Representative.

2. The Owner's Representative, in association with the Contractor or the Contractor's representative, will measure the amount of material to be removed in an effort to reach a mutually agreeable volume for anticipated rock removal.
3. Prior to commencing the proposed rock removal, the Contractor must receive written approval by the Owner's Representative stating the approximate volume of excepted rock removal to receive payment.
4. During rock removal activities, should it become apparent the previously agreed upon volume of rock removal will be exceeded, notify the Owner's Representative immediately. Should the Contractor proceed with rock removal in excess of the previously agreed upon volume, the Contractor will do so at their own risk and expense.

3.3 ROCK REMOVAL BY MECHANICAL METHOD

- A. Excavate and remove rock by mechanical method.
 1. Use a single shank ripper to fracture rock.
 2. Use rocksaw along utility trench limits.
 3. Drill holes and use expansive tools and wedges to fracture rock.
- B. Cut away rock at bottom of excavation to form level bearing.
- C. Remove shaled layers to provide sound and unshattered base for footings and foundations.
- D. In utility trenches, excavate to 6 inches below invert elevation of pipe and 24 inches wider than pipe diameter.
- E. For vaults and other structures, excavate to the depth necessary to install the structure and to a maximum of 18 inches beyond the outside walls of the vault or structure.
- F. Remove excavated materials from site.
- G. Correct unauthorized rock removal associated with structural excavations in accordance with backfilling and compacting requirements of Section 31 23 16, Excavation and as directed by Owner's Representative.
- H. Correct unauthorized rock removal associated with utility work in accordance with backfilling and compacting requirements of Section 31 23 17, Trenching and as directed by Owner's Representative.
- I. If material which would be classified as rock as defined herein is mechanically removed with equipment of a larger size than specified as Suitable Machinery herein, it shall be understood that any added costs for the removal of rock by this method shall be

included in the unit price for common excavation and not paid for under this pay item. If material which would be classified as rock as defined herein is mechanically removed without [blasting,] hammering, breaking, or splitting, it will be considered common excavation and not paid for under this pay item. If equipment larger than the suitable machinery as defined herein is brought on the Project Site for the sole purpose of rock removal without hammering, breaking, or splitting, then such excavation will be considered rock removal.

3.4 NOT USED

3.5 FIELD QUALITY CONTROL

- A. Request visual inspection of foundation bearing surfaces by Owner's Representative before installing subsequent work.

END OF SECTION

SECTION 31 23 19 - DEWATERING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes temporary dewatering and surface water control systems for open excavations and utility trenches.
- B. Section includes:
 - 1. Dewatering systems.
 - 2. Surface water control systems.
 - 3. System operation and maintenance.
 - 4. Water disposal.
- C. Related Sections:
 - 1. Section 02 30 00 - Subsurface Investigations
 - 2. Section 31 05 16 - Aggregates for Earthwork
 - 3. Section 31 23 16 - Excavation
 - 4. Section 31 23 17 - Trenching

1.2 SUBMITTALS

- A. Dewatering Plan:
 - 1. Descriptions of proposed groundwater and surface water control facilities including, but not limited to, equipment; methods; standby equipment and power supply; pollution control facilities; discharge locations to be utilized; and provisions for immediate temporary water supply as required by this Section.
 - 2. Plan to be reviewed by the Owner's Representative prior to the beginning of construction activities requiring dewatering. Review by the Owner's Representative of the design shall not be construed as a detailed analysis of the adequacy of the dewatering system, nor shall any provisions of the above requirements be construed as relieving the Contractor of its overall responsibility and liability for the work.

1.3 DEFINITIONS

- A. Dewatering includes the following:
 - 1. Lowering of ground water table and intercepting horizontal water seepage to prevent ground water from entering excavations, trenches, tunnels, and /or shafts.

2. Reducing piezometric pressure within strata to prevent failure or heaving of excavations, trenches, tunnels, and /or shafts.
3. Disposing of removed water.

B. Surface Water Control: Removal of surface water within open excavations.

1.4 QUALITY CONTROL

- A. All dewatering operations shall be adequate to assure the integrity of the finished project and shall be the responsibility of the Contractor.
- B. Provide all labor, materials, and equipment necessary to dewater trench and structure excavations, in accordance with the requirements of the Contract Documents.
- C. Secure all necessary permits to complete the requirements of this Section.
- D. Control the rate and effect of the dewatering in such a manner as to avoid all objectionable settlement and subsidence.
- E. Where the critical structures or facilities exist immediately adjacent to areas of proposed dewatering, reference points shall be established and observed at frequent intervals to detect any settlement which may develop.
 1. The responsibility for conducting the dewatering operation in a manner which will protect adjacent structures and facilities rests solely with the Contractor.
 2. The cost of repairing any damage to adjacent structures and restoration of facilities shall be the responsibility of the Contractor.

PART 2 PRODUCTS

2.1 EQUIPMENT

Dewatering, where required, may include the use of well points, sump pumps, temporary pipelines for water disposal, rock or gravel placement, and other means. Standby pumping equipment shall be maintained on the jobsite.

PART 3 EXECUTION

3.1 DEWATERING

- A. Provide all equipment necessary for dewatering.
 - 1. Have on hand, at all times, sufficient pumping equipment and machinery in good working condition.
 - 2. Have available, at all times, competent workers for the operation of the pumping equipment.
 - 3. Adequate standby equipment shall be kept available at all times to insure efficient dewatering and maintenance of dewatering operation during power failure.
- B. Dewatering for structures and pipelines shall commence when groundwater is first encountered and shall be continuous until such times as water can be allowed to rise in accordance with the provisions of this Section or other requirements.
- C. Site Grading:
 - 1. At all times, site grading shall promote drainage.
 - 2. Surface runoff shall be diverted from excavations.
 - 3. Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and be pumped or drained by gravity from the excavation to maintain a bottom free from standing water.
- D. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation.
- E. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, the affected areas shall be excavated and replaced with drain rock.
- F. Maintain the water level below the bottom of excavation in all work areas where groundwater occurs during excavation construction, backfilling, and up to acceptance.
- G. Flotation shall be prevented by maintaining a positive and continuous removal of water. The Contractor shall be fully responsible and liable for all damages which may result from failure to adequately keep excavations dewatered.
- H. If well points or wells are used, they shall be adequately spaced to provide the necessary dewatering and shall be sandpacked and/or other means used to prevent

pumping of fine sands or silts from the subsurface. A continual check shall be maintained to ensure that the subsurface soil is not being removed by the dewatering operation.

- I. Dispose of water from the work in a suitable manner without damage to the environment or adjacent property. No water shall be drained into work built or under construction without prior consent of the Owner's Representative. Water shall be filtered using an approved method to remove sand and fine sized soil particles before disposal into any drainage system.
- J. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted backfill and prevent flotation or movement of structures, pipelines, and sewers.
- K. Dewatering of trenches and other excavations shall be considered as incidental to the construction of the work and all costs thereof shall be included in the various contract prices in the bid forms.

END OF SECTION

SECTION 31 23 23 - FILL

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes backfilling required at building perimeter and site structures to subgrade elevations, fill under interior and exterior slabs-on-grade or pavement, and fill under landscaped areas. Backfilling for utilities within building proper is included within this section; backfilling for utilities outside building is included in Section 31 23 17, Trenching.
- B. Section includes:
 - 1. Backfilling site structures to subgrade elevations.
 - 2. Fill under paving.
 - 3. Fill for over-excavation.
- C. Related Sections:
 - 1. Section 31 05 13 - Soils for Earthwork
 - 2. Section 31 05 16 - Aggregates for Earthwork
 - 3. Section 31 22 13 - Rough Grading
 - 4. Section 31 23 16 - Excavation
 - 5. Section 31 23 17 - Trenching
 - 6. Section 31 23 24 - Flowable Fill
 - 7. Section 33 11 10 - Water Utility Distribution and Transmission Piping

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International (ASTM):
 - 1. ASTM C403 - Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
 - 2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 3. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

4. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
5. ASTM D4832 - Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.

1.3 DEFINITIONS

- A. Controlled Low Strength Material (CLSM): Also referred to as Flowable Fill elsewhere in these Specifications. A self-compacted, cementitious material.
- B. Imported Material: Materials obtained from sources offsite, suitable for specified use.
- C. Lift: Loose (uncompacted) layer of material.
- D. Optimum Moisture Content:
 1. Determined in accordance with ASTM Standard specified to determine maximum dry density for relative compaction.
 2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Imported Materials:
 1. Materials Source: Submit name and location of imported fill materials suppliers.
 2. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
 3. Submit results of aggregate sieve analysis and standard proctor test for granular material.
- C. CLSM: Mix designs in accordance with Submittal requirements of Section 31 23 24, Flowable Fill.

1.5 QUALITY ASSURANCE

- A. Subsoil and topsoil fill materials: In accordance with Quality Assurance requirements stated in Section 31 05 13, Soils for Earthwork.
- B. Aggregate fill materials: In accordance with Quality Assurance requirements stated in Section 31 05 16, Aggregates for Earthwork.

- C. CLSM:
 - 1. In-place testing: In accordance with ASTM C403.
 - 2. Compressive testing: In accordance with ASTM D4832.
- D. Allowable Tolerances: Final grades shall be plus or minus 0.1-foot.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Subsoil Fill: Type S2, Imported Fill Material, as specified in Section 31 05 13, Soils for Earthwork. Not for use in roadway limits.
- B. Imported Granular Fill: Coarse Aggregate Type A1, Dense-Graded Aggregate with gradation as shown in the Drawings and specified in Section 31 05 16, Aggregates for Earthwork.
- C. Concrete:
 - 1. Lean concrete as specified in Section 31 23 24, Flowable Fill, with compressive strength of 100 pounds per square inch (psi).
 - 2. Structural concrete as noted in the Drawings.
- D. Drain Rock: Coarse Aggregate Type A2, Granular Drain Backfill Material with gradation as shown in the Drawings and specified in Section 31 05 16, Aggregates for Earthwork.
- E. Foundation Stabilization Material: Coarse Aggregate Type A1, Dense-Graded Aggregate, 2-1/2-inch - 0 gradation as specified in Section 31 05 16, Aggregates for Earthwork.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Prior to Work in this Section, become familiar with Site conditions. In the event discrepancies are found, notify Owner's Representative as to the nature and extent of the differing conditions.
- B. Verify sub-drainage, damp-proofing, or waterproofing installation has been inspected.
- C. Verify underground tanks are anchored to their own foundations to avoid flotation after backfilling.

- D. Verify structural ability of unsupported walls to support loads imposed by fill.

3.2 SITE CONDITIONS

- A. Quantity Survey: The Contractor shall be responsible for calculations for quantities and volume of cut and fill from existing site grades to finish grades established under this contract as indicated in the Drawings or specified and shall include the cost for all earthwork in the total basic bid.
- B. Dust Control: Must meet all federal, state, and local requirements. Protect persons and property from damage and discomfort caused by dust. Water surfaces as necessary and when directed by Owner's Representative to quell dust.
- C. Soil Control: Soil shall not be permitted to accumulate on surrounding streets or sidewalks nor to be washed into sewers.

3.3 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Control of Water:
 - 1. Excavated areas shall be kept free of water and frost.
 - 2. Bearing surfaces which become softened by water or frost shall be re-excavated to solid bearing at Contractor's expense and backfilled with compacted crushed rock at Contractor's expense.
 - 3. See Section 31 23 19, Dewatering for additional details.
- C. Compact subgrade to density requirements for subsequent backfill materials.
- D. Cut out soft areas of subgrade not capable of compaction in place and replace with specified granular fill material. See Article 3.5, Over-excavation for Unsuitable Foundation Conditions in Section 31 23 16, Excavation for additional details.
- E. Proof roll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.
- F. Subgrade to be approved by Owner's Representative prior to placement of structures and commencement of backfill activities.
- G. Do not allow or cause any work performed or installed to be covered up or enclosed prior to required tests and approvals. Should any Work be enclosed or covered up, uncover at Contractor's expense.

3.4 BACKFILLING

- A. Backfill areas to contours and elevations shown in the Drawings with unfrozen materials.
- B. Do not place materials when weather conditions and/or moisture content prevent attainment of specified density.
- C. Maintain optimum moisture content of backfill materials to attain required compaction density.
- D. Employ placement method that does not disturb or damage other work.
- E. Mechanical tampers permitted in confined areas.
- F. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- G. Foundation Base for Structures:
 - 1. Bring excavation to required subgrade elevation shown in the Drawings.
 - 2. Place foundation base material to required grade shown in the Drawings.
 - 3. Place foundation base material in 6-inch lifts and compact to 95 percent maximum dry density.
 - 4. Foundations established near finished site grades:
 - a. Place a 3-inch-thick layer of Coarse Aggregate Type A1, Dense-Graded Aggregate, 3/4-inch-0 gradation in the bottom of footing excavations to minimize disturbance of silty foundation soils during wet weather.
 - b. Lightly compact material with a light-weight hand-operated vibratory plate compactor.
 - c. To provide uniform support, slabs should be underlain by a minimum 8-inch-thick granular base course consisting of 1-1/2 or 3/4-inch - 0 gradation.
 - d. The base course material should be installed in a single lift and compacted to at least 95 percent of the maximum dry density. See Drawings for details.
- H. Backfill for Structures:
 - 1. Prior to placing backfill, remove forms, temporary construction, and debris below grade.

2. Backfill shall not be placed against poured concrete until 28 days have passed from completion of original concrete pour, unless otherwise approved by Owner's Representative.
3. Heavy compactors and large pieces of construction equipment shall be kept away from any embedded wall a distance of at least 5 feet in order to avoid the build-up of excessive lateral pressures.
 - a. Over-compaction of fill near walls should be avoided.
4. Compaction within 5 feet of the walls shall be accomplished using hand-operated vibratory plate compactors or tamping units.
5. The maximum particle size of granular material placed against buried structures shall be limited to no greater than 1-1/2-inch diameter.
6. Structural fill backfill material shall be brought up on all sides of the walls and footings in such a manner as to avoid adverse differential lateral earth pressures on the vertical surfaces.
7. Appropriate lift thickness will depend on the type of compaction equipment used and the type of material being placed. All material shall be compacted to at least 95 percent of the standard maximum dry density.
 - a. For moderate- to heavy-weight compactors, a maximum loose lift thickness of 12 inches shall be used.
 - b. For hand-operated or small compactors, a maximum loose lift thickness of 8 inches shall be used.
8. Particular care must be taken to avoid damage to the pipe connections to the structure.
9. Utility trench backfill within 10 feet of all structural perimeters shall meet the requirements for structural fill.
- I. For areas receiving surface structures or existing paved areas to be constructed or replaced, such as roadways, driveways, [and sidewalks:
 1. Place Coarse Aggregate Type A1, Dense-Graded Aggregate, 3/4-inch-0 gradation in 6-inch lifts.
 2. Compact with vibratory equipment to 95 percent maximum density, unless otherwise specified or shown in the Drawings.

- J. Permanent Embankment Fill:
 - 1. On the sloping ground around the roadway, the new embankment fill shall be placed in horizontal lifts on a continuous series of minimum 6- to 8-foot-wide horizontal benches excavated into the surface of the existing slope.
 - 2. Fill slopes shall be slightly overbuilt and then trimmed back to final grade using a track hoe with a smooth-edged bucket.
 - 3. The Engineer shall review the proposed placement of any fill and evaluate the subgrade prior to fill placement.
 - 4. The proposed compaction equipment shall be approved by the Engineer prior to fill placement to evaluate loads on embedded walls.
 - 5. Permanent embankment fill placed beyond 5 feet of pavement and roadways should be compacted to at least 95 percent of the maximum dry density.
 - 6. Landscape fill shall be compacted to at least 90 percent of the maximum dry density as determined by ASTM D1557. Landscape fill should be no steeper than 3H:1V, unless shown otherwise.
- K. Slope grade away from building minimum 2 percent slope for minimum distance of 10 feet, unless noted otherwise in the Drawings.
- L. Make gradual grade changes. Blend slope into level areas.
- M. Remove surplus backfill materials from Site in accordance with Section 31 23 16, Excavation.

3.5 FIELD QUALITY CONTROL

- A. All testing and reporting shall be conducted and completed by an independent laboratory provided by the Owner. Initial testing will be paid for by the Owner. Subsequent testing after failure of initial acceptance testing shall be paid by the Contractor.
- B. Perform laboratory material tests in accordance with ASTM D1557 (AASHTO T180).
- C. Per requirements of Section 01 45 00, Quality Control.
- D. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D2922.
 - 2. Moisture Tests: ASTM D3017.

- E. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest at the sole expense of the Contractor.
- F. When testing of subgrade is not possible or feasible as detailed above, proof roll compacted fill surfaces under slabs-on-grade, pavers, paving, and as may be otherwise required by the Owner's Representative.

3.6 PROTECTION OF FINISHED WORK

- A. Reshape and re-compact fills subjected to vehicular traffic.

3.7 NOT USED

END OF SECTION

SECTION 31 23 24 - FLOWABLE FILL

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes flowable lean concrete mix used for structure backfill, utility bedding and backfill and other subgrade Site Work. Applications also include filling abandoned structures and utilities that remain in place.
- B. Section Includes:
 - 1. Structure backfill
 - 2. Utility bedding
 - 3. Utility backfill
 - 4. Filling abandoned utilities
- C. Related Sections:
 - 1. Section 33 05 50 - Existing Pipe Abandonment
 - 2. Section 31 23 16 - Excavation
 - 3. Section 31 23 17 - Trenching
 - 4. Section 31 23 23 - Fill
 - 5. Section 33 11 10 - Water Utility Distribution and Transmission Piping

1.2 DEFINITIONS

- A. Flowable Fill: Also referred to as Controlled Low Strength Material (CLSM) elsewhere in the Specifications. Lean cement concrete fill.
- B. Utility: Any buried pipe, duct, conduit, manhole, tank, or cable.

1.3 REFERENCE STANDARDS

- A. ASTM International (ASTM):
 - 1. ASTM C33 - Standard Specification for Concrete Aggregates
 - 2. ASTM C94 - Standard Specification for Ready-Mixed Concrete
 - 3. ASTM C150 - Standard Specification for Portland Cement
 - 4. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete
 - 5. ASTM C403 - Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance

6. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete
7. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
8. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
9. ASTM C1040 - Standard Test Methods for Density of Unhardened and Hardened Concrete in Place by Nuclear Methods
10. ASTM D4832 - Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Field Quality-Control Submittals:
 1. Mix Design:
 - a. Furnish flowable fill mix design for each specified strength.
 - b. Furnish separate mix designs when admixtures are required for the following:
 - 1) Flowable fill Work during hot and cold weather.
 - 2) Air entrained flowable fill Work.
 - c. Identify design mix ingredients, proportions, properties, admixtures, and tests.
 2. Furnish test results to certify flowable fill mix design properties meet or exceed specified requirements.
- D. Delivery Tickets:
 1. Furnish duplicate delivery tickets indicating actual materials delivered to Project Site.

1.5 QUALITY ASSURANCE

- A. In-place testing of Flowable Fill: In accordance with ASTM C403.
- B. Compressive testing of Flowable Fill: In accordance with ASTM D4832.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Minimum Conditions: The following minimum conditions shall be met at time of flowable fill placement.
 - 1. Do not install flowable fill during inclement weather.
 - 2. Ambient temperature must be at least 34 degrees Fahrenheit (F) (4 degrees Celsius (C)) and rising.
 - 3. Flowable fill shall be at 40 degrees F (4 degrees C).
 - 4. Subgrade on which flowable fill is to be placed shall be free of disturbed or soft material, debris, and water.

1.7 FIELD MEASUREMENTS

- A. Verify field measurements before installing flowable fill to establish quantities required to complete the Work.

PART 2 PRODUCTS

2.1 FLOWABLE FILL

- A. Flowable Fill:
 - 1. Composed of cement, pozzolans, fine aggregate, water, and admixtures.
 - 2. Low cement content.
 - 3. Non-segregating, self-consolidating, free-flowing, and excavatable material which will result in a hardened, dense, non-settling fill.
 - 4. Compressive strength at 28 days of 100 to 200 pounds per square inch (psi), if not otherwise shown in Drawings or specified.

2.2 MATERIALS

- A. Portland Cement: ASTM C150, Type 1 – Normal.
- B. Fine Aggregates: ASTM C33.
- C. Water: Clean and not detrimental to concrete.

2.3 ADMIXTURES

- A. Air Entrainment: ASTM C260.

- B. Chemical Admixture: ASTM C494.
- C. Fly Ash: ASTM C618 Class C or F, obtained from residue of electric generating plant using ground or powdered coal.
- D. Plasticizing: ASTM C1017 Type 1, plasticizing.

2.4 MIXES

- A. Mix and deliver flowable fill according to ASTM C94, Option C.
- B. Flowable Fill Design Mix:

ITEM	PROPERTIES
Cement Content	75 to 100 lb/cu yd
Fly Ash Content	[None]
Water Content	As specified
Air Entrainment	5 to 35 percent
28-Day Compressive Strength	Maximum 200 psi.
Unit Mass (Wet)	80 [100] to 110 [125] pcf
Temperature, Minimum at Point of Delivery	50 degrees F (10 degrees C)

- C. Provide water content in design mix to produce self-leveling, flowable fill material at time of placement.
- D. Design mix air entrainment and unit mass are for laboratory design mix and source quality control only.

2.5 SOURCE QUALITY CONTROL

- A. Test and analyze properties of flowable fill design mix and certify results for the following:
 1. Design mix proportions by weight of each material.
 2. Aggregate: ASTM C33 for material properties and gradation.
 3. Properties of plastic flowable fill design mix including:
 - a. Temperature
 - b. Slump
 - c. Air entrainment
 - d. Wet unit mass
 - e. Yield
 - f. Cement factor

4. Properties of hardened flowable fill design mix including:
 - a. Compressive strength at 1-day, 7 days, and 28 days. Report compressive strength of each specimen and average specimen compressive strength.
 - b. Unit mass for each specimen and average specimen unit mass at time of compressive strength testing.
- B. Prepare delivery tickets containing the following information:
 1. Project designation
 2. Date
 3. Time
 4. Class and quantity of flowable fill
 5. Actual batch proportions
 6. Free moisture content of aggregate
 7. Quantity of water withheld

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify excavation specified in Section 31 23 16, Excavation and trenching specified in Section 31 23 17, Trenching is complete.
- B. Verify utility installation as specified in elsewhere in the specifications is complete and tested before placing flowable fill.
- C. Verify excavation is dry and dewatering system is operating, as may be required, prior to placement of flowable fill.

3.2 PREPARATION

- A. Support and restrain utilities to prevent movement and flotation during installation of flowable fill.
- B. Protect structures and utilities from damage caused by hydraulic pressure of flowable fill before fill hardens.
- C. Protect utilities and foundation drains to prevent intrusion of flowable fill.

3.3 INSTALLATION – FILL, BEDDING, AND BACKFILL

- A. Place flowable fill by chute, pumping, or other methods as approved by Owner's Representative.

- B. Place flowable fill in lifts to prevent lateral pressures from exceeding structural capacity of structures and utilities.
- C. Place flowable fill evenly on both sides of utilities to maintain alignment.
- D. Place flowable fill to elevations indicated on Drawings without vibration or other means of compaction.

3.4 INSTALLATION – FILLING ABANDONED UTILITIES

- A. As specified in Section 33 11 50, Existing Pipe Abandonment.

3.5 FIELD QUALITY CONTROL

- A. Perform inspection and testing according to ASTM C94.
 - 1. Take samples for tests for every 100 cubic yards of flowable fill, or fraction thereof, installed each day.
 - 2. Sample, prepare, and test four compressive strength test cylinders according to ASTM D4832. Test one specimen at 3 days, one at 7 days, and two at 28 days.
 - 3. Measure temperature at point of delivery when samples are prepared.
- B. Further construction proceeding upon placed flowable fill will be permitted only after initial set is attained, as measured by ASTM C 403.
 - 1. Perform in place penetration (density) tests using handheld penetrometer to measure penetration resistance of hardened flowable fill.
 - 2. Perform tests at locations as directed by Owner's Representative.
- C. Defective Flowable Fill: The Owner's Representative reserves the right to reject all flowable fill failing to meet the following test requirements or flowable fill delivered without the following documentation.
 - 1. Test Requirements:
 - a. Minimum temperature at point of delivery.
 - b. Compressive strength requirements for each type of fill.
 - 2. Documentation: Duplicate delivery tickets.
- D. No traffic or construction equipment shall be allowed on flowable fill for a least 24 hours after placement.

3.6 CLEANING

- A. Remove spilled and excess flowable fill from Project Site.
- B. Restore facilities and Site areas damaged or contaminated by flowable fill installation to existing condition before installation.

END OF SECTION

SECTION 32 11 23 - AGGREGATE BASE COURSES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes construction of an aggregate subbase and base course for placement under asphalt or concrete paving, unit paving, or placed and left exposed.
- B. Section Includes:
 - 1. Aggregate subbase
 - 2. Aggregate base course
- C. Related Sections:
 - 1. Section 31 22 13 - Rough Grading
 - 2. Section 31 23 17 - Trenching
 - 3. Section 31 23 23 - Fill
 - 4. Section 31 05 16 - Aggregates for Earthwork

1.2 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications
 - 2. T11, Standard Method of Test for Materials Finer Than 75 μ m (No. 200) Sieve in Mineral Aggregates by Washing
 - 3. T27, Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
 - 4. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- B. ASTM International (ASTM):
 - 1. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
 - 2. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
 - 3. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

4. ASTM D2940 - Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports
5. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.3 DEFINITIONS

- A. Completed Course: Compacted, unyielding, free from irregularities and standing water, with smooth, tight, even surface, true to grade, line, and cross-section.
- B. Completed Lift: Compacted with uniform cross-section thickness.
- C. Keystone: Fine aggregate used to aid in binding of loose surface stone.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 1. Submit data for geotextile fabric and herbicide.
- C. Materials Source: Submit name of aggregate materials suppliers.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Furnish each aggregate material from single source throughout the Work.

PART 2 PRODUCTS

2.1 SHOULDER AGGREGATE

- A. Of the size shown on the Drawings.
- B. Coarse Aggregate: Type A1, Dense-Graded Aggregate as specified in Section 32 05 16, Aggregates for Earthwork.

2.2 DENSE-GRADED BASE AGGREGATES

- A. Of the size shown on the Drawings.
- B. Coarse Aggregate: Type A1, Dense-Graded Aggregate as specified in Section 32 05 16, Aggregates for Earthwork.

2.3 OPEN-GRADED BASE AGGREGATES

- A. Of the size shown on the Drawings.
- B. Coarse Aggregate: Type A2, Granular Drain Backfill Material as specified in Section 32 05 16, Aggregates for Earthwork.

2.4 SOURCE QUALITY CONTROL

- A. Perform tests necessary to locate acceptable source of materials meeting specified requirements.
- B. Final approval of aggregate material will be based on test results of installed materials.
- C. Should separation of coarse from fine materials occur during processing or stockpiling, immediately change methods of handling materials to correct uniformity in grading.

2.5 EQUIPMENT

- A. Compaction Equipment: Adequate in design and number to provide compaction and to obtain specified density for each layer.

2.6 ACCESSORIES

- A. Geotextile Fabric: AASHTO M288; non-woven, polypropylene.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

- A. Obtain Engineer's acceptance of subgrade before placing base course or surfacing material.
- B. Verify compacted substrate is dry and ready to support paving and imposed loads.
 - 1. Proof roll substrate with equipment approved by the Engineer in minimum two perpendicular passes to identify soft spots.
 - 2. Remove soft substrate and replace with compacted fill as specified in Section 31 23 23, Fill.

3.2 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.

- B. Do not place base course or surfacing materials in snow or on soft, muddy, or frozen subgrade.

3.3 HAULING AND SPREADING

A. Hauling Materials:

1. Do not haul over surfacing in process of construction.
2. Loads: Of uniform capacity.
3. Maintain consistent gradation of material delivered; loads of widely varying gradations will be cause for rejection.

B. Spreading Materials:

1. Distribute material to provide required density, depth, grade, and dimensions with allowance for subsequent lifts.
2. Produce even distribution of material on prepared surface without segregation.
3. Should segregation of coarse from fine materials occur during placing, immediately change methods of handling materials to correct uniformity in grading.
4. Maintain consistent gradation of material. Widely varying gradation will be cause for rejection.

3.4 CONSTRUCTION OF COURSES

A. Untreated Aggregate Base Course:

1. If the required compacted depth of the base course exceeds 6 inches, construct it in two or more layers of nearly equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches.
2. Completed Course Total Thickness: As shown on the Drawings.
3. Spread lift on preceding course to required cross-section. Place each layer in spreads as wide as practical and to the full width of the course before a succeeding layer is placed.
4. Lightly blade and roll surface until thoroughly compacted.
5. Add keystone to achieve compaction and as required when aggregate does not compact readily due to lack of fines or natural cementing properties, as follows:
 - a. Use 3/4-inch leveling course or surfacing material as keystone.

- b. Spread evenly on top of base course, using spreader boxes or chip spreaders.
 - c. Roll surface until keystone is worked into interstices of base course without excessive displacement.
 - d. Continue operation until course has become thoroughly keyed, compacted, and will not creep or move under roller.
6. Blade or broom surface to maintain true line, grade, and cross-section.
- B. Gravel Surfacing and Leveling Course:
1. Place shoulder aggregates in a single layer, or two or more layers of nearly equal thickness. The maximum compacted thickness of any one layer shall not exceed 9 inches.
 2. Spread on preceding course in accordance with cross-section shown.
 3. Blade lightly and roll surface until material is thoroughly compacted.
 4. Complete Total Thickness: As shown on the Plans, 8-inch minimum.

3.5 ROLLING AND COMPACTION

- A. Commence compaction of each layer of base immediately after spreading operations and continue until density of 95 percent of maximum density has been achieved as determined by AASHTO T180.
- B. Roll each layer of material until there is no appreciable reaction or yielding under the compactor before succeeding layer is applied.
- C. Shape and maintain the surface of each layer during compaction operations. Commence rolling at outer edges and continue toward center; do not roll center of road first.
- D. Apply water as needed to obtain specified densities.
- E. Place and compact each lift to the required density before succeeding lift is placed.
- F. Surface Defects: Remedy by loosening and rerolling. Reroll entire area, including surrounding surface, until thoroughly compacted.
- G. Finished surface shall be true to grade and crown before proceeding with surfacing.

3.6 SURFACE TOLERANCES

- A. Blade or otherwise work surfacing as necessary to maintain grade and cross-section at all times, and to keep surface smooth and thoroughly compacted.
- B. Finished Surface of Untreated Aggregate: Within plus or minus 0.04-foot of grade shown at any individual point.
- C. Overall Average: Within plus or minus 0.04-foot from crown and grade specified.

3.7 FIELD QUALITY CONTROL

- A. Quality control testing shall be performed by an independent testing laboratory provided by the Owner.
- B. Refer to table below for minimum sampling and testing requirements for aggregate base course and surfacing. The Owner reserves the right to complete additional testing.

Property	Test Method	Frequency	Sampling Point
Gradation	AASHTO T11 and AASHTO T27	One sample every 500 tons but at least every 4 hours of production	Roadbed after processing
Moisture Density (Maximum Density)	AASHTO T180	One test for every aggregate grading produced	Production output or stockpile
In-Place Density and Moisture Content	AASHTO T180	One for each 500 ton but at least every 5,000 square feet of area	In-place completed, compacted area

3.8 CLEANING

- A. Remove excess material from the Work area. Clean stockpile and staging areas of all excess aggregate. Restore per Specifications as applicable.

END OF SECTION

SECTION 32 12 16 - ASPHALT CONCRETE PAVEMENT

PART 1 GENERAL

1.1 SCOPE

This section includes the construction of asphalt concrete pavement for patching of utility trenches within roadways.

1.2 REFERENCE STANDARDS

- A. References herein to "AASHTO" shall mean Association of American State Highway Transportation Officials.
- B. Standard Specifications: Where the term "Standard Specifications" is used, such reference shall mean the current edition of the Oregon Department of Transportation (ODOT) Standard Specifications for Highway Construction. Where reference is made to a specific part of the Standard Specifications, such applicable part shall be considered as part of this section of the Specifications. In case of a conflict in the requirements of the Standard Specifications and the requirements stated herein, the requirements herein shall prevail.

1.3 DEFINITIONS

- A. Maximum Density Test (MDT): Theoretical maximum density of the bituminous mixture determined by multiplying the theoretical maximum specific gravity, determined by ASTM D2041 (Rice), by 62.4 pounds per cubic foot.

1.4 SUBMITTALS

- A. Aggregate Qualification Tests: In accordance with Standard Specifications Section 00640 for aggregate used in aggregate base.
- B. Aggregate Qualification Tests: In accordance with Standard Specifications Section 00745 for aggregate used in asphalt concrete.
- C. Job mix formula shall be an approved job mix formula. Submit formula, supplier, and product identification to the Owner's Representative 30 days prior to start.
 - 1. Definite percentage for:
 - a. Each sieve fraction.
 - b. New asphalt cement.
 - c. Recycled asphalt pavement.
 - 2. Temperature of completed mix when discharged from mixer.

3. Character and quantity of anti-strip and recycling agents.

1.5 QUALITY ASSURANCE

- A. All testing to determine compliance with the specifications shall be performed by an independent testing laboratory contracted by the Contractor and approved by the Owner's Representative. All testing costs shall be borne by the Contractor.
- B. A minimum of five (5) nuclear densometer readings shall be taken in random locations within every test area. Each test area shall not exceed 200 tons of asphalt; however, smaller areas may be designated by the Owner's Representative.
- C. The surface smoothness of the new asphalt concrete pavement shall be such that when a 10-foot straightedge is laid longitudinally across the paved area in any direction, the new pavement shall not deviate from the straightedge more than 1/8 inch. Surface drainage shall be maintained. Additionally, paving must conform to the design grade and crown and contain no abrupt edges, low or high areas or any other imperfections as determined by the Owner's Representative. Pavement construction not meeting these requirements will be repaired by grinding the existing pavement to a 1 1/2-inch depth and replacing with Level 3, 1/2-inch dense graded Asphaltic Concrete the full width at no cost to Owner.

1.6 PRE-PAVING CONFERENCE

- A. Any supervisory personnel of the Contractor and any subcontractors who are to be involved in the paving work shall meet with the Owner's Representative, at a time mutually agreed upon, to discuss methods of accomplishing all phases of the paving work.
- B. The Contractor shall be prepared to review the size and type of equipment to be used and the anticipated rate of placement to determine equipment needs.

PART 2 PRODUCTS

2.1 AGGREGATE MATERIAL

- A. Aggregate Base for Dense Graded Asphalt Concrete: The aggregate material shall be a clean, well-graded crushed base aggregate conforming to the Standard Specifications. Base course and leveling course shall be 3/4-inch minus aggregate.

2.2 ASPHALT CONCRETE PAVEMENT

A. Dense Graded Hot Mix Asphalt Concrete

1. Use Level 3, 1/2-inch-dense graded, PG 70-22 HMA. Conform to the requirements as specified in Section 00745 of the Standard Specifications. Conform to the requirements as specified in Section 00745 of the Standard Specification.
2. Asphaltic concrete pavement delivered to the site shall be accompanied by a ticket with the approved "job mix formula" number shown. Loads without tickets identifying the job mix formula will not be accepted.
3. Percent of recycled asphalt pavement used in new asphalt pavement shall not exceed 30 percent. Recycled asphalt pavement may not be used in top wearing course unless otherwise approved by the Owner's Representative.

B. Tack Coat

In accordance with Standard Specifications. Use AR 4000, AC-20 asphalt or CSS-1 emulsified asphalt C.

C. Seal and Cover Coat

Asphalt material shall be CRS-2 cationic emulsified asphalt. Cover stone shall conform to size 1/4-inch -#10 aggregate in the Standard Specifications.

D. Subgrade Geotextile

1. Dense Graded AC Mix-For subgrade separation using dense graded asphalt concrete, use subgrade geotextile with Certification Level B as specified in Section 02320 of the Standard Specifications.

E. Subgrade Stabilization

1. In the event that unstable materials are encountered during excavation, the additional excavation and installation of geotextile fabric and twelve (12) inches of rock substructure will be required, as directed. Conform to the requirements as specified in Section 00331 of the Standard Specifications. For subgrade separation, use subgrade geotextile with Certification Level B as specified in Section 02320 of the Standard Specifications.

PART 3 EXECUTION

3.1 AGGREGATE PAVEMENT BASE

- A. Place pavement base to the depth shown on the plans or as specified in all cases, pavement base shall be compacted to a minimum depth of 6 inches. Bring the top of the pavement base to a smooth, even grade at a distance below finished grade equivalent to the required pavement depth.
- B. Compact the pavement base with mechanical vibratory or impact tampers to a density of not less than 95 percent of the maximum density, as determined by AASHTO T-99.
- C. Obtain the Owner's Representative's acceptance of the subgrade before beginning construction of the aggregate base course.
- D. When, in the judgment of the Owner's Representative, the weather is such that satisfactory results cannot be secured, suspend operations. Place no aggregate base course in snow or in soft, muddy, or frozen subgrade.
- E. If the required compacted depth of aggregate base course exceeds six (6) inches, construct in two or more lifts of approximately equal thickness. Maximum compacted thickness of any one lift shall not exceed six (6) inches. Compact each layer to the specified density before a succeeding lift is placed.

3.2 ASPHALT CONCRETE PAVEMENT

- A. Construct asphalt concrete pavement in accordance with Section 00745 of the Standard Specifications.
- B. Conform to the requirements for prime coat and tack coat in the Standard Specifications. Tack coat all edges of existing pavement, manhole and clean out frames, inlet boxes and like items. When rate is not specified, asphalt will be applied at the rate of 0.1 gallon per square yard.
- C. Obtain the Owner's Representative's acceptance of the aggregate base course before beginning construction of the asphalt concrete wearing course.
- D. Hot mix asphalt shall be placed on dry, prepared surfaces, when air temperature in the shade of 40 degrees Fahrenheit or warmer, unless otherwise authorized by the Owner's Representative.
- E. Placing asphalt pavement during rain or other adverse weather conditions will not be permitted unless otherwise authorized by the Owner's Representative, except that asphalt mix in transit at the time these adverse conditions occur may be placed provided it is of proper temperature, the mix has been covered during transit, and it is placed on a foundation free from mud or free-standing water.

- F. Correct any defects in material and workmanship, as directed, when determined detrimental by the Owner's Representative. These include segregation of materials, non-uniform texture, and fouled surfaces preventing full bond between successive spreads of mixture. The corrections or replacement of defective material or workmanship shall be at the Contractor's expense.
- G. Compact the bituminous mixture to at least 92 percent of the Theoretical Maximum Density.
- H. The finished surface of each course of layer of mixture shall be of uniform texture, smooth, and free of defects and shall closely parallel that specified for the top surface finished grade. Remove and replace boils and slicks immediately with suitable materials.
- I. The surface of each layer when tested with a Contractor-furnished 10-foot straightedge shall not vary from the testing edge by more than 0.02-foot for underlying courses of pavements and 0.015-foot for finished top courses or wearing courses of pavements. At no point shall the finished top of the wearing course vary more than 0.03-foot from the specified finished grade.
- J. Lift thickness shall be as shown on the drawings or specified, but not to exceed 3 inches.
- K. Do not place asphalt concrete pavement on emulsified asphalt (tack coat) until the asphalt separates from the water (breaks) but before it loses its tackiness.
- L. Asphalt and sand seal edges where new asphalt concrete meets existing pavement.

3.3 FIELD QUALITY CONTROL

- A. Job mix will be sampled immediately behind the paving machine.
- B. Temperature of the mix will be measured immediately behind the paver.
- C. The theoretical maximum specific gravity of the bituminous mixture will be determined in accordance with ASTM D2041.
- D. Properties of the job mix will be measured using ASTM D2041.
- E. Density of the compacted job mix will be measured in accordance with ASTM D2922.

3.4 ADJUSTMENT OF EXISTING MANHOLE COVERS AND VALVE BOXES

- A. Prior to placing asphalt concrete pavement, the Contractor shall make all necessary adjustments to existing manhole frames and covers and valve box covers to ensure that the tops of the manhole covers or valve box lids are flush with the finished grade

of the adjoining pavement or ground surface, and that valve boxes and PVC pipes are centered and plumb over operating nut valve.

END OF SECTION

SECTION 33 05 50 - EXISTING PIPE ABANDONMENT

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the removal of existing buried piping and abandonment in place of existing buried piping.
- B. Section includes:
 - 1. Pipe removal.
 - 2. In-place abandonment of pipe.
- C. Related Sections:
 - 1. Section 03 60 00 - Grouting
 - 2. Section 31 23 16 - Excavation
 - 3. Section 31 23 17 - Trenching
 - 4. Section 31 23 19 - Dewatering
 - 5. Section 31 23 23 - Fill
 - 6. Section 31 23 24 - Flowable Fill

1.2 SUBMITTALS

- A. Provide all submittals in accordance with Section 01 33 00, Submittal Procedures.
- B. Piping Abandonment Plan:
 - 1. Identify locations specified for pipe abandonment.
 - 2. Provide method to be utilized to abandon the pipe, including whether the pipe will be left in place or removed in its entirety.
- C. Non-Shrink Grout: Product data in accordance with Section 03 60 00, Grouting.
- D. Controlled Low-Strength Material (CLSM): Mix designs in accordance with Submittal requirements of Section 31 23 24, Flowable Fill.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

- A. Permits: The Contractor is responsible for obtaining all necessary permits required for completion of the work described herein.

- B. Protection of Persons and Property: Meet all federal, state, and local safety requirements for the protection of workmen, other persons, and property in the vicinity of the work and requirements of the General Provisions.

1.4 PROTECTION OF EXISTING WORK

- A. Carefully examine the Contract Documents to determine the extent of the work of this Section.
- B. Carefully coordinate the work of this Section with all other work and construction.
- C. Take all necessary precautions to prevent damage to existing facilities or utilities which are to remain in place and be responsible for any damages to existing facilities or utilities, which are caused by the operations.

1.5 REPAIR OF DAMAGE

- A. Work procedures shall provide for safe conduct of the work; careful removal and disposition of materials and equipment; protection of facilities, utilities and property which are to remain undisturbed; coordination with existing facilities and utilities to remain in service.
- B. Any damage to existing facilities or utilities to remain as caused by the Contractor's operations shall be repaired to acceptance of Owner's Representative.
- C. Damaged items shall be repaired or replaced with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of work of this contract.

1.6 EXISTING CONDITIONS

- A. If the pipe material contains any hazardous materials, such as asbestos, requiring special handling upon removal, it is the responsibility of the Contractor to remove and dispose of the material in accordance with all applicable federal, state, and local regulations.

PART 2 PRODUCTS

2.1 OWNERSHIP OF EXISTING MATERIALS

- A. All materials, equipment, miscellaneous items, and debris involved, occurring, or resulting from pipe removal work shall become the property of the Contractor at the place of origin, unless otherwise specified in the Drawings or by the Owner's Representative.

2.2 CONTROLLED LOW STRENGTH MATERIAL

- A. As specified in Section 31 23 24, Flowable Fill.

PART 3 EXECUTION

3.1 PIPE REMOVAL

- A. Where identified on the Drawings, remove, and dispose of all pipe material and associated appurtenances.
 - 1. All fire hydrants, air release valves service lines and appurtenances being abandoned shall be removed to 36 inches below finished grade.
 - 2. Existing service line appurtenances, including valve and meter boxes, shall be removed to 36 inches below finished grade.
- B. All exposed ends of pipes and fittings to remain in service shall be capped or plugged with an appropriate ductile iron blind flange, cap or plug and restrained.
 - 1. A pipe shall be considered in service if it is possible to flood the pipe with water by opening valves in the water system.
- C. All excavation and backfilling associated with pipe removal shall be performed in accordance with 31 23 17, Trenching.

3.2 IN-PLACE ABANDONMENT OF PIPING

- A. Where identified on the Drawings, abandon pipe in place.
- B. All exposed ends of pipes being abandoned in place shall be cut and plugged with a minimum of two (2) feet of non-shrink grout.
- C. Prior to placing grout, roughen the interior pipe surface and apply epoxy bonding agent.

3.3 FILLING PIPE WITH CLSM

- A. Where identified on the Plans, pipes greater than 12 inches in diameter to be abandoned-in-place shall be filled with CLSM.
- B. CLSM shall be placed in a manner to ensure complete filling of the pipe, leaving no cavities or voids.
- C. Install hot taps, saddles, fill lines and appurtenances as necessary for pumping CLSM from the surface into the pipe being filled.

- D. CLSM shall be pumped up grade from fill lines rigidly connected to the pipes being filled.
- E. Placement of CLSM by free flowing (non-pumped) methods will not be acceptable.
- F. Fill lines shall be located at elevations lower than the pipe being filled.
- G. As the CLSM is being placed, use other fill lines as view ports to ensure complete filling of the pipes.
- H. Relocate pumping equipment as necessary to complete filling of the pipes.
- I. Excavate and cut access holes in the pipes as necessary to complete filling operations.
- J. Perform pipe filling operations in a manner to eliminate all air pockets.
- K. Submit volume calculations for CLSM placed in each filled segment of piping to verify that pipelines have been completely filled.

3.4 CLEANUP

- A. During and upon completion of work of this Section, promptly remove all unused tools and equipment, surplus materials, and debris.
- B. Adjacent areas shall be returned to their existing condition prior to the start of work.

END OF SECTION

SECTION 33 05 64 - PRECAST CONCRETE VALVE VAULTS AND METER BOXES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Precast concrete valve vaults.
2. Precast concrete meter boxes.

B. Related Section:

1. Section 05 50 00 - Metal Fabrications
2. Section 31 05 16 - Aggregates for Earthwork
3. Section 31 23 16 - Excavation
4. Section 31 23 23 - Fill
5. Section 40 05 13 - Common Work Results for Process Piping
6. Section 40 05 51 - Common Work Results for Process Valves

1.2 REFERENCE STANDARDS

A. ASTM International (ASTM):

1. ASTM A48 - Standard Specification for Gray Iron Castings.
2. ASTM A185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
3. ASTM A536 - Standard Specification for Ductile Iron Castings.
4. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
5. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
6. ASTM C33 - Standard Specification for Concrete Aggregates.
7. ASTM C150 - Standard Specification for Portland Cement.
8. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
9. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.

10. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
11. ASTM C890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.
12. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
13. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
14. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
15. ASTM D4104 - Standard Test Method (Analytical Procedure) for Determining Transmissivity of Nonleaky Confined Aquifers by Overdamped Well Response to Instantaneous Change in Head (Slug Tests).
16. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.3 COORDINATION

- A. Coordinate Work with utilities within construction area.
- B. The drawings identify precast vaults and meter boxes by Manufacturer and model number. This information is provided for dimensional information only. Provide precast items in accordance with the requirements of this Section.

1.4 PREINSTALLATION MEETINGS

- A. Convene a minimum of 1 week prior to commencing Work of this Section to confirm finished floor and finished grade elevations.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on valve vaults and meter boxes.
- C. Shop Drawings for Precast Concrete Valve Vaults:
 1. Indicate plan, location, and inverts of connecting piping.
 2. All interior and exterior dimensions.
 3. Location and type of lifting inserts, connection embeds, and joints.
 4. Details of reinforcement.
 5. Covers or hatches.

- 6. Ladders and grating.
- D. Manufacturer's Certificate: Certify that precast concrete valve vaults and meter boxes meet or exceed ASTM standards and specified requirements.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations and inverts of buried pipe, components, and connections.

1.7 QUALITY ASSURANCE

- A. Perform Work according to standards identified in Article 1.2 herein.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.
- B. Transport and handle precast concrete units with equipment designed to protect units from damage.
- C. Storage:
 - 1. Store precast concrete valve vaults and meter boxes according to Manufacturer instructions.
 - 2. Do not place concrete units in position to cause overstress, warping, or twisting.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

- A. Performance and Design Criteria:
 - 1. Watertight, Precast, Reinforced, Air-Entrained Concrete Structures:
 - a. Manufactured to conform to ASTM C913.
 - 2. Loading:
 - a. Design to ASTM C890-A16 / AASHTO HS20 live loading and installation conditions.

- b. Where vaults are below grade, a dead load of 125 pounds per cubic foot shall be added for the soil.
- c. Lateral loads:
 - 1) Static: 105 x Depth of fill per square foot (psf) triangular equivalent fluid pressure plus a surcharge of an additional 3 feet of soil depth in areas subject to vehicular traffic (assume traffic load in all areas, unless indicated otherwise by the Contract Documents).
 - 2) Seismic acceleration: UBC Zone 3 requirements ($I = 1.25$) where $I =$ importance factor, $I = 1.25$, but not less than 0.20 grams (g) acting on structure mass. Seismic loading need not be considered simultaneously with traffic surcharge.
- 3. Minimum 28-Day Compressive Strength: 3,000 pounds per square inch (psi).
- 4. Honeycombed or re-tempered concrete is not permitted.
- 5. No knockouts shall be cast into vault walls. All pipe penetrations shall be preformed or core-drilled at the required locations.
- 6. Accessories: Accessories such as ladders, floor grates at sumps, and other features shall be provided as shown on the Drawings.
- 7. Size: Vault dimensions shall be as required by the Drawings.

2.2 PRECAST CONCRETE VALVES AND METER BOXES

A. Manufacturers:

- 1. Furnish materials according to Owner's standards as shown in the details of the Drawings.

B. Valve Vault and Meter Box Frames and Covers:

1. Cast Iron Castings:

- a. ASTM A48, Class 30 or better.
- b. Free of bubbles, sand, air holes, and other imperfections.

C. Access Steps:

1. Steel reinforced formed polypropylene:

- a. ASTM C478
- b. Reinforced rod: ASTM A615, Grade 60, 1/2-inch diameter

2. Aluminum: ASTM B221, Alloy 6061-T6
3. Width: Minimum 12 inches
4. Spacing: 12 inches on center vertically.

2.3 ACCESS HATCHES AND LIDS

- A. Unless noted otherwise elsewhere in the Contract Documents, vaults shall have concrete top slabs with access openings as shown on the Drawings.
- B. Hatches shall be in accordance with Section 05 50 00, Metal Fabrications.
- C. Lids shall have lifting holes.
- D. When leveling bolts are used to set the vault top sections, ensure the load from the top slab is transferred through grout to the vault walls so that the load is not carried by the leveling bolts.

2.4 MATERIALS

- A. Portland Cement:
 1. ASTM C150, Type II
- B. Coarse Aggregates:
 1. ASTM C33
 2. Graded 1 inch to No. 4 sieve
- C. Sand:
 1. ASTM C33
 2. Fineness Modulus: 2.35
- D. Water:
 1. Potable.
 2. Clean and free of injurious amounts of acids, alkalis, salts, organic materials, and substances incompatible with concrete or steel.
- E. Air-Entraining Admixtures: ASTM C260
- F. Reinforcing Steel:
 1. Deformed Bars: ASTM A615, Grade 40 minimum

2. Welded Wire Fabric: ASTM A185
- G. Gaskets:
1. Rubber gaskets: ASTM C443
- H. Joint Sealant:
1. ASTM C990
- I. Bedding:
1. Aggregate Bedding Material: Fill Type A1 as specified in Section 31 05 16, Aggregates for Earthwork. Size as shown in the Drawings.

2.5 FABRICATION

- A. Fabricate precast reinforced concrete structures according to ASTM C913, to dimensions indicated on Drawings, and to specified design criteria.
- B. Vaults may be formed with separate top and bottom slabs.
- C. Walls shall be cast so that all sides are continuous at corners and their full length with no block-outs or knockouts.
- D. Horizontal joints may be provided so that walls can be placed in horizontal segments.
- E. All horizontal joints shall be keyed to prevent offsets and shall be provided with a watertight gasket.
- F. Finish:
1. Formed surfaces shall be smooth and uniform with no fins, bulges, or other irregularities.
 2. Any void greater in width than 1/2-inch or deeper than 3/8-inch shall be repaired.
 3. Unformed interior slab surfaces shall have a smooth steel trowel finish.
 4. Unformed exterior slab surfaces shall have a light broom finish applied to a steel trowel finish.

2.6 MIXES

- A. Design concrete mix to produce required concrete strength, air-entrainment, watertight properties, and loading requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that piping connections, sizes, locations, and inverts are as indicated on Drawings.

3.2 PREPARATION

- A. Ream pipe ends and remove burrs.
- B. Remove scale and dirt from components before assembly.
- C. Establish invert elevations for each component in system.
- D. Hand trim excavation to suit valve vaults and meter boxes; remove stones, roots, and other obstructions.

3.3 INSTALLATION

- A. Vaults/Meter and Bedding:
 - 1. Excavate as specified in Section 31 23 16, Excavation for Work of this Section.
 - 2. Hand trim excavation for accurate placement of vaults and meter boxes to elevations indicated.
 - 3. Place bedding material level in one continuous layer to a minimum compacted depth of 6 inches.
 - 4. Compact bedding material to 95 percent maximum density.
 - 5. Bases for precast concrete structures shall be set level so that bedding material fully and uniformly supports them in true alignment with uniform bearing throughout full perimeter. Do not level bases by wedging gravel under the edges.
 - 6. Backfill around sides of vaults and meter boxes as required by the Drawings.
- B. Connect piping.

3.4 FIELD QUALITY CONTROL

- A. Request examination of subgrade by Owner's Representative prior to placing aggregate base under precast materials.
- B. Compaction Testing: In accordance with Field Quality Control requirements of Section 31 23 23, Fill.

- C. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.
- D. Frequency of Compaction Tests: In accordance with Section 01 45 00, Quality Control.

END OF SECTION

SECTION 33 11 10 - WATER UTILITY DISTRIBUTION AND TRANSMISSION PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Work under this Section applies to furnishing and installation of pipe materials, fittings, and appurtenances normally encountered with water distribution and transmission systems, including potable water and fire water systems.
- B. Section includes:
 - 1. Pipe and fittings
 - 2. Flanged coupling adapters
 - 3. Insulating flanged joints
 - 4. Tapping sleeves and valves
 - 5. Flexible expansion joints
 - 6. Bedding and cover materials
- C. Related Requirements:
 - 1. General
 - a. Furnish and install all piping systems shown and specified in accordance with the requirements of the Contract Documents.
 - b. Each buried piping system shall be complete, with all necessary fittings, valves, accessories, lining and coating, testing, excavation, backfill and encasement, to provide a functional installation.
 - c. Piping layouts shown in the Drawings are intended to define the general layout, configuration, and routing for pipe, as well as the size and type of piping to be installed. The piping plans are not pipe construction or fabrication drawings.
 - d. The Contractor shall cause the Supplier of pipes, valves, fittings, and appurtenances to coordinate piping installation such that all equipment is compatible and is capable of achieving the performance requirements specified in the Contract Documents.
 - e. It is the Contractor's responsibility to develop the details necessary to construct all piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, valves, gaskets, fittings, appurtenances etc., for a complete and functional system.

D. Related Sections:

1. Section 31 05 13 - Soils for Earthwork
2. Section 31 05 16 - Aggregates for Earthwork
3. Section 31 23 16 - Excavation
4. Section 31 23 17 - Trenching
5. Section 31 23 23 - Fill
6. Section 31 23 24 - Flowable Fill
7. Section 33 05 64 - Precast Concrete Valve Vaults and Meter Boxes
8. Section 33 12 16 - Water Utility Distribution and Transmission Valves
9. Section 33 12 19 - Fire Hydrants
10. Section 33 13 00 - Testing and Disinfection of Water Utility Piping

1.2 REFERENCE STANDARDS

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

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

B. American Society of Mechanical Engineers (ASME):

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
2. ASME B16.5 - Pipe Flanges and Flanged Fittings, Steel Nickel Alloy, and other Special Alloys
3. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges
4. ASME B31.10 - Standards of Pressure Piping

C. ASTM International (ASTM):

1. ASTM A36 - Standard Specification for Carbon Structural Steel
2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
3. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
4. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
5. ASTM A536, Standard Specification for Ductile Iron Castings.

6. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
 7. ASTM D1598 - Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
 8. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
 9. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
 10. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
 11. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
 12. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
 13. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- D. American Water Works Association (AWWA):
1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
 2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems
 3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings
 4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 5. AWWA C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
 6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast
 7. AWWA C153 - Ductile-Iron Compact Fittings
 8. AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe
 9. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances
 10. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water

- 11. AWWA C606 - Grooved and Shouldered Joints
- 12. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm), for Water Transmission and Distribution
- E. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP-60 - Connecting Flange Joints between Tapping Sleeves and Tapping Valves
- F. NSF International (NSF):
 - 1. NSF Standard 61 - Drinking Water System Components – Health Effects
 - 2. NSF Standard 372 - Drinking Water System Components – Lead Content
 - 3. NSF 600 - Health Effects Evaluation and Criteria for Chemicals in Drinking Water
- G. SUBMITTALS
- H. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- I. Product Data: Submit data on pipe materials, pipe fittings, restrained joint systems, and accessories.
- J. Shop Drawings: Indicate piping layout, including piping specialties.
 - 1. Layout Schedule for applicable segments of proposed transmission main alignment. Schedule shall include layout plan and dimensions, schedule of pipe fittings and specials, materials and class for each size and type of pipe, joint details, pipe supports, and any special provisions required for assembly.
- K. Lining and coating data.
- L. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- M. Manufacturer's handling, delivery, storage, and installation requirements.
- N. Field Quality-Control Submittals:
 - 1. Pipeline hydrostatic testing plan.
 - 2. Indicate results of Contractor-furnished tests and inspections.
- O. Preconstruction Photographs:
 - 1. Submit digital files of colored photographs of Work areas and material storage areas.

1.3 CLOSEOUT SUBMITTALS

A. As-Built Drawings:

1. Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.
2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.4 QUALITY ASSURANCE

A. Materials:

1. Unless otherwise noted, all water works materials provided for the Project shall be new, of first-class quality and shall be made by reputable manufacturers.
2. All material of a like kind shall be provided from a single manufacturer unless otherwise approved by the Owner's Representative.
3. All material shall be carefully handled and installed in good working order free from defect in manufacture, storage, and handling.

B. Markings:

1. Pipes and Fittings: Mark each pipe and fitting at plant. Include date of manufacture, Manufacturer's identification, specification standard, inside diameter of pipe, dimension ratio as applicable, pipe class as applicable, pipe number for laying purposes as applicable, and other information required for type of pipe.
2. Bolting materials (washers, nuts, and bolts) shall be marked with material type.

C. Testing:

1. Except where otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable Specifications and Standards.

1.5 MATERIAL DELIVERY, STORAGE, AND HANDLING

- A. In accordance with manufacturer's written recommendations and as specified in these Contract Documents.
- B. Pipe, specials, and fittings delivered to Project Site in damaged condition will not be accepted.

C. Storage:

1. Store and support pipe securely to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials.
2. Pipe and fittings shall not be stored on rocks, gravel, or other hard material that might damage pipe. This includes storage area and along pipe trench.
3. Do not store materials in direct sunlight.
4. Gaskets: Do not allow contact with oils, fuels, petroleum, or solvents.

D. Handling:

1. Pipe and appurtenances shall be handled in accordance with Manufacturer's recommendations or requirements contained in this section or subsequent sections dealing with the specific pipe material, whichever is more stringent.
2. Pipe shall be handled with proper equipment in a manner to prevent distortion or damage. Use of hooks, chains, wire ropes, or clamps that could damage pipe, damage coating or lining, or kink and bend pipe ends is not permitted.
3. Use heavy canvas, or nylon slings of suitable strength for lifting and supporting materials.
4. Lifting pipe during unloading or lifting into trench shall be done using two slings placed at quarter point of pipe section. Pipe may be lifted using one sling near center of pipe, provided pipe is guided to prevent uncontrolled swinging and no damage will result to pipe or harm to workers. Slings shall bear uniformly against pipe.

E. Pipe Plugs:

1. Provide and install a cap or plug on each end of pipe during transportation and onsite storage to protect linings and coatings from debris. Install watertight plug-in end of installed pipe at the end of the workday. Under no circumstances shall materials be dropped or dumped into the trench.

PART 2 PRODUCTS

2.1 WATER PIPING

A. General

1. All piping materials and specials shall meet the specifications of this Section and of the appropriate AWWA Standard Specifications. In the case of conflict, the more stringent specifications shall apply.
2. All coatings and materials specified herein which may come in contact with potable water shall conform to National Sanitation Foundation (NSF) Standard 61, 372, and 600.
3. Minimum Pressure Ratings: Unless otherwise specified herein or shown in the Drawings, the minimum working pressure rating of all water works materials specified herein shall be 1-1/2 times the operating pressure or 150 pounds per square inch (psi) minimum.
4. Gaskets:
 - a. Material: Neoprene rubber composition, 55-65 durometer hardness.

B. Ductile Iron Pipe:

1. Centrifugally cast, conforming to AWWA Standard C151.
2. Coating: Asphaltic exterior coating in accordance with AWWA Standard C151.
3. Pipe Mortar Lining: Shop-applied NSF 61 cement mortar lining, smoothed finish, complying with AWWA C104.
4. Pipe Thickness Class:
 - a. Comply with AWWA C151.
 - b. Class 52, unless shown to be greater in the Plans.
 - 1) The Contractor shall be aware ductile iron piping with thickness class greater than Class 52 may have long fabrication and supplier lead times. The Contractor shall be responsible for coordinating product submittal and delivery times accordingly such as not to delay construction.
5. Gauged Pipe:
 - a. All ductile iron pipe 24-inch diameter or greater to be cut in the field shall be gauged full length. The select piping shall meet the outside diameter standard

dimensions and tolerances required for spigot ends along the full length of pipe to within 2 feet of the bell end.

- b. In addition to pipe supplied for anticipated cutting, a minimum of 5 percent of each size of piping 24-inch diameter or greater shall be provided gauged full length as described above.
 - c. Pipe shall be externally marked, in Manufacturer's color, indicating gauged pipe.
6. Polyethylene Encasement: Not required.
7. Joints:
- a. Joint types shall be provided as identified in the Drawings and as required for the application.
 - b. Mechanical Joints:
 - 1) Comply with AWWA C111.
 - c. Push-on Joints:
 - 1) Comply with AWWA C111.
 - 2) Manufacturers, without exception:
 - a) Tyton Joint by American Cast Iron Pipe Company, U.S. Pipe and Foundry Company, McWane, and Pacific States Cast Iron Pipe.
 - b) Fastite Joint by American Cast Iron Pipe Company.
 - d. Restrained Joints:
 - 1) Joint restraint for pipe shall be accomplished with an integral lock mechanism, except as may be otherwise specified.
 - a) Any such system shall be a manufacturer's standard proprietary design, shall be as recommended by the Manufacturer for the application, and shall be performance proven.
 - 2) Restraining components:
 - a) Ductile iron complying with AWWA C110 and/or C153, with the exception of a manufacturer's proprietary design dimensions.
 - b) Push-on joints for such fittings shall comply with AWWA C111.

3) Deflection:

- a) The maximum pipe deflection shall not exceed one-half of the Manufacturer's stated joint deflection allowance.

4) Manufacturers:

- a) "TR Flex", United States Pipe and Foundry Company.
- b) "Field-Lok", United States Pipe and Foundry Company.
- c) "MJ-TJ" pipe with "MEGALUGs", Pacific States Cast Iron Pipe Company.
- d) "MEGALUG", EBAA Iron, Inc.

- (1) Where any restrained joint system requires the use of a wedge-type mechanical restraint gland for restraint, the glands shall be provided in quantities as may be required and shall be considered incidental to the joint restraint system.

- (2) Wedge-type mechanical restraining glands shall not be used to restrain the plain end of plain end ductile iron or cast iron fittings.

e. Flanged Joints:

- 1) Flat faced, complying with AWWA C111 and C115, unless otherwise specified.
- 2) Bolt hole drilling according to ASME/ANSI B16.1, Class 125, or ASME/ANSI B16.1, Class 250, where specified. Flanges shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown.
- 3) The Contractor shall coordinate with pipe, valve, and fitting suppliers to make certain mating pipe, valve, and fitting flanges match in bolt pattern.
- 4) Pressure rating of flange joints shall not exceed the rating of the pipe or fitting of which they are a part, and the maximum pressure rating of the joint shall be 250 psi.
- 5) Flange joint connections shall not be exposed to test pressures greater than 1-1/2 times their rated working pressure.
- 6) Threaded flanges:
 - a) Ductile iron pipe spools with threaded flanges shall conform to AWWA C115.

b) Installed only on pipe with a minimum Class 53 wall thickness.

7) Buried flanges:

a) Flanged connections shall not be buried unless shown as such on the Drawings.

b) Buried flanges shall be wrapped with 2 layers of 10-mil tape along edges of flanges.

8) Gaskets:

a) Full faced, composed of neoprene rubber, 1/8-inch-thick, and 55-65 durometer hardness. Dimensions conforming to ANSI B16.21.

b) Ring gaskets shall not be permitted.

c) Flange gasket manufacturers:

(1) Garlock, Style 7986

(2) Or approved equal.

d) Gaskets for insulating flanged joints shall be as follows:

(1) Full faced, conform to ANSI 16.21.

(2) Material: Non-asbestos.

(3) Suitable for operating and test pressures of the pipe system.

(4) Manufacturer:

(a) Garlock GYLON Style 3505 or equal.

C. PVC:

1. All PVC pressure pipe shall be manufactured with an integral bell design capable of receiving an elastomeric gasket.

2. All PVC pressure pipe shall be dimensionally compatible with standard cast/ductile iron fittings produced according to AWWA C110 or AWWA C153, as applicable.

3. Deflection:

a. PVC pressure pipe may be deflected both horizontally and vertically at the joints after assembly.

- b. Deflection by bending of the pipe rather than at the joints is not allowed.
 - c. The maximum pipe deflection shall not exceed one half of the Manufacturer's stated joint deflection allowance.
4. Joints:
- a. Solvent-cement couplings are not permitted.
5. Gaskets: Comply with ASTM F477.
6. Size: 4-inch through 12-inch diameter
- a. Comply with AWWA C900, DR 14, Class 305, unless shown otherwise in the Drawings or specified elsewhere.
7. Size: 14-inch through 48-inch diameter
- a. Comply with AWWA C900, DR 18, Class 235, unless shown otherwise in the Drawings or specified elsewhere.
8. Restrained Joints:
- a. For push-on pipe joint at pipe bells:
 - 1) Material:
 - a) Body: Ductile iron. Comply with ASTM A536.
 - b) Bell Restraint Systems: Corten steel tie rods.
 - 2) Coatings: Shop-applied liquid epoxy.
 - 3) Construction:
 - a) A split serrated ring shall be used behind the pipe bell. A split serrated ring shall also be used to grip the pipe and a sufficient number of bolts shall be used to connect the bell ring and the gripping ring.
 - b) System shall be designed for a minimum 2 to 1 safety factor.
 - 4) Manufacturers:
 - a) 4-inch through 12-inch diameter: EBAA Iron, Inc. - Series 1900 Bell Restraint Harness.
 - b) 14-inch through 48-inch diameter: EBAA Iron, Inc. - Series 2800 Bell Restraint Harness.

- b. At mechanical joint fittings:
 - 1) Material: Ductile iron. Comply with ASTM A536.
 - 2) Coatings: Shop-applied liquid epoxy.
 - 3) Construction:
 - a) Restraint accomplished by a restraint device consisting of a follower gland utilizing multiple gripping wedges.
 - b) The restraint system shall have a sufficient number of fastening bolts to connect the ring to the mechanical joint.
 - c) System shall be designed for a minimum 2 to 1 safety factor.
 - 4) Fasteners:
 - a) T-bolts and nuts: High strength, low alloy steel.
 - b) Comply with AWWA C111.
 - 5) Manufacturers:
 - a) EBAA Iron, Inc. - MEGALUG, Series 2000PV
 - b) Romac Industries, Inc. – 470 Series Pipe Restraining System

2.2 FITTINGS

- A. Material: Ductile iron, complying with AWWA Standard C110.
 - 1. Fittings conforming to AWWA C153 may be substituted in lieu of AWWA C110 fittings.
- B. Fittings used for joining ductile iron and PVC pipe shall be of the type, size, and strength designated on the Plans, elsewhere in the specifications.
 - 1. Fittings shall be mechanical joint, push-on type, flanged or plain-end as required and shown on the Drawings.
 - 2. All restraint systems and flanged fittings shall be provided with bolts and gaskets as specified herein.
- C. Pressure ratings: As specified for joining pipe above and as shown on the Drawings.
- D. Coating and Lining:
 - 1. Asphaltic exterior coating in accordance with AWWA Standard C110.

- 2. Cement Mortar Lining: Comply with AWWA C104.
- E. Following information cast upon fittings:
 - 1. Manufacturer's identification.
 - 2. Country of manufacture.
 - 3. Pressure rating.
 - 4. For bends, number of degrees and/or fractions of a circle.
- F. Owner may require additional metallurgical documentation or other certifications.

2.3 NUTS, BOLTS, AND WASHERS

- A. All bolts shall have heavy hex head with heavy hex nuts.
- B. For operating pressures greater than 150 psi:
 - 1. Bolts: Steel alloy composition. Comply with ASTM A193.
 - 2. Nuts: Comply with ASTM A194, Grade 2H.
 - 3. Washers: Comply with ASTM F436.
- C. For operation pressures of 150 psi or less:
 - 1. Bolts: Low-carbon steel composition. Comply with ASTM A307, Grade B.
 - 2. Nuts: Comply with ASTM A563A, Heavy Hex.
 - 3. Washers: Comply with ASTM F844.
- D. Higher-strength bolts with higher torque values as specified above for operation pressures greater than 150 psi shall not be used for assembly of flange joints including gray-iron flanges.

2.4 NOT USED

2.5 NOT USED

2.6 NOT USED

2.7 NOT USED

2.8 UNDERGROUND PIPE MARKERS

- A. As specified in Section 31 23 17, Trenching.

2.9 NOT USED

2.10 BEDDING AND COVER MATERIALS

A. Bedding and Cover:

1. Pipe Bedding: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.
2. Pipe Zone Backfill: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.
3. Trench Backfill from Pipe Zone to Finish Grade:
 - a. Material type varies by location, as shown in the Drawings.
 - b. Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.

2.11 NOT USED

2.12 ACCESSORIES

A. Concrete for Thrust Restraints: As specified in the Drawings.

B. Miscellaneous Steel Rods, Bolt, Lugs, and Brackets:

1. Comply with ASTM A36 or ASTM A307.
2. Grade A carbon steel.

PART 3 EXECUTION

3.1 EXAMINATION

- #### A. Verify that existing utility water main size, location, and invert are as indicated on Drawings.

3.2 PREPARATION

A. Preconstruction Site Photos:

1. Take photographs along centerline of proposed pipe trench; minimum one photograph for each 50 feet of pipe trench.
2. Show mailboxes, curbing, lawns, driveways, signs, culverts, and other existing Site features.

3. Include Project name, date taken, and sequential number of each photograph in physical log or CD.
- B. Inspection:
1. All pipe sections, specials, and jointing materials shall be carefully examined for defects.
 2. No piping or related materials shall be laid that is known to be defective. Any defective piece installed shall be removed and replaced with a new pipe section in a manner satisfactory to the Owner's Representative at the Contractor's expense.
 3. Defective material shall be marked and removed from the job site before the end of the day.
- C. Pipe Cutting:
1. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, and remove burrs.
 2. Use only equipment specifically designed for pipe cutting; use of chisels or hand saws is not permitted.
 3. Grind edges smooth with beveled end for push-on connections.
 4. Prior to assembly of field cut pipe, the reference mark shall be re-established with a pencil or crayon. The location of the reference mark at the proper distance from the bevel end shall be in accordance with the Manufacturer's recommendations.
- D. Remove scale and dirt on inside and outside before assembly. Cleaning of each pipe or fitting shall be accomplished by swabbing out, brushing out, blowing out with compressed air, or washing to remove all foreign matter.
- E. Prepare pipe connections to equipment with flanges or unions.

3.3 INSTALLATION

A. Bedding:

1. Excavation:

- a. Excavate pipe trench as specified in Section 31 23 17, Trenching for Work of this Section.
- b. All pipe trenches shall be excavated below the proposed pipe invert as required to accommodate the depths of pipe bedding material as scheduled on the Drawings.

- c. Remove large stones or other hard matter which could damage pipe or impede consistent pipe bedding backfilling or compaction.
 - d. Trench base shall be inspected prior to placement of pipe.
 - e. Hand trim excavation for accurate placement of pipe to elevations as indicated on Drawings.
 - 2. Dewater excavation as specified in Section 31 23 19, Dewatering to maintain dry conditions and to preserve final grades at bottom of excavation.
 - 3. Provide sheeting and shoring as specified in Section 31 23 17, Trenching.
 - 4. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 6 inches compacted depth and compact to 95 percent of maximum density.
- B. Piping:
- 1. Install pipe according to AWWA C600 AND AWWA C605.
 - 2. Handle and assemble pipe according to Manufacturer instructions and as indicated on Drawings.
 - 3. Lift or roll pipe into position. Do not drop or drag pipe over prepared bedding.
 - 4. Steel Rods, Bolt, Lugs, and Brackets: Coat buried steel with one coat of coal tar coating before backfilling.
 - 5. Sanitary Sewer Separation:
 - a. Install new water lines and appurtenances in compliance with local and state regulations governing the horizontal and vertical separations between water and sewer facilities.
 - b. Variance:
 - 1) If a variance is proposed due to requested design revisions or if an existing facility has been installed at a different location or elevation than indicated on the Plans, submit written proposal for review and approval by the Owner's Representative.
 - 2) Include the reason for the variance, type of material and condition of the sewer line, location of the water and sewer facilities, horizontal and vertical skin-to-skin clearances and corrective measures proposed.
 - 3) Each variance will be considered on a case-by-case basis.

- 4) Review Time: Allow a minimum of 5 working days' review and response to each proposal.
6. Install ductile iron fittings according to AWWA C600.
7. Joints:
 - a. Pipe jointing surfaces shall be clean and dry when preparing surfaces for joining.
 - b. Lubricants, primers, adhesives, etc. shall be used as recommended by the Pipe or Joint Manufacturer's specifications.
 - c. The jointing materials or factory-fabricated joints shall then be placed, fitted, joined, and adjusted in such a manner as to obtain a watertight joint.
 - d. Trenches shall be kept water-free and as dry as possible during bedding, laying, and jointing.
 - e. As soon as possible after the joint is made, sufficient backfill material shall be placed along each side of the pipe to prevent movement of the pipe from any cause.
8. Flanged Joints: Not to be used in underground installations except within structures, unless shown otherwise in the Drawings.
9. Deflection:
 - a. PVC pressure pipe may be deflected both horizontally and vertically at the joints after assembly.
 - b. Deflection by bending of the pipe rather than at the joints is not allowed.
 - c. The maximum pipe deflection shall not exceed one-half of the Manufacturer's stated joint deflection allowance.
 - d. Set a laser, string line, or other approved alignment guide along the centerline of previously installed pipe to the point where pipe joint deflection is required. The approved alignment guide shall extend to the end of the proposed subsequent pipe length. A measurement will be taken from the alignment guide to the centerline of the subsequent pipe length to determine the amount of pipe joint deflection proposed. Measured deflection shall not exceed the specified allowable deflection for the purposes of aligning the pipe.
10. Install pipe and fittings to the line and grade specified on the Drawings, with joints centered, pipe properly supported and restrained against movement, and all valve stems plumb. Re-lay pipe that is out of alignment or grade.

11. High Points:

- a. Install pipe with no high points, unless otherwise shown in the Drawings.
- b. If unforeseen field conditions arise that necessitate high points, install air release valves as directed by Owner's Representative.

12. Bearing:

- a. Install pipe to have bearing along entire length of pipe.
- b. Excavate bell holes to permit proper joint installation where necessary or as directed by Owner's Representative.
- c. Do not lay pipe in wet or frozen trench.

13. Prevent foreign material from entering pipe during placement.

14. Install pipe to allow for expansion and contraction without stressing pipe or joints.

15. Close pipe openings with watertight plugs during Work stoppages.

16. All pipe ends which are to be permanently closed shall be plugged or capped and restrained against internal pressure.

17. Install access fittings to permit disinfection of water system performed under Section 33 13 00 – Testing and Disinfecting of Water Utility Piping.

18. Cover:

- a. Water mains shall be installed with a minimum cover of 30 inches to proposed roadway subgrade and 36 inches to existing grades to remain, unless indicated otherwise in the Drawings.
- b. Measure depth of cover from final surface grade to top of pipe barrel.

19. Pipe Markers:

- a. Install as specified in Section 31 23 17, Trenching.

C. Tapping Sleeves and Valves:

1. As indicated on Drawings and according to Manufacturer instructions.

D. Polyethylene Encasement:

1. Not required.

E. Thrust Restraints:

1. Provide valves, tees, bends, caps, and plugs with concrete thrust blocks at locations shown in the Drawings and as required to facilitate testing of lines.
2. Pour concrete thrust blocks against undisturbed earth.
3. Locate thrust blocks to ensure that pipe and fitting joints will be accessible for repair.
4. Provide thrust restraint bearing area on subsoil as shown in details within the Drawings.
5. Install tie rods, clamps, setscrew retainer glands, or restrained joints.
6. Protect metal-restrained joint components against corrosion with polyethylene film or wax tape as specified herein.
7. Avoid encasing mechanical and flanged joints in concrete. Provide clearance between concrete and mechanical and flange joints to allow future bolt removal.

F. Backfilling:

1. Backfill of piping systems shall be as specified in Section 31 23 17, Trenching.

G. Testing and Disinfection of Potable Water Piping System:

1. In accordance with AWWA C600, AWWA C605, and AWWA C651 and as specified in Section 33 13 00, Testing and Disinfection of Water Utility Piping.
2. All chlorinated water used in disinfection of the water main shall either be discharged through an approved connection to a public sanitary sewer system or shall be dechlorinated to limits acceptable by the Oregon State Department of Environmental Quality (DEQ) prior to discharge into any storm drainage system or open drainage way.
3. No chlorinated water shall be discharged into a storm drainage system or open drainage way without a dechlorination under a plan meeting DEQ's requirements.

3.4 FIELD QUALITY CONTROL

- A. Compaction Testing: See Section 31 23 17, Trenching for Compaction Testing requirements for piping trenches.

END OF SECTION

SECTION 33 12 16 - WATER UTILITY DISTRIBUTION AND TRANSMISSION VALVES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes valves and valve boxes for installation with buried water distribution and transmission main, including fire hydrants and tapping sleeves.
- B. Section Includes:
 - 1. Valves.
 - 2. Valve boxes.
 - 3. Valve operator extensions.
- C. Related Sections:
 - 1. Section 33 11 10 - Water Utility Distribution and Transmission Piping: Piping trenching, backfilling, and compaction requirements.
 - 2. Section 33 12 19 - Fire Hydrants: Execution requirements for fire hydrants.
 - 3. Section 33 13 00 - Testing and Disinfection of Water Utility Piping: Flushing and disinfection requirements.

1.2 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
 - 2. ASME B16.5 - Pipe Flanges and Flanged Fittings, Steel Nickel Alloy, and other Special Alloys
 - 3. ASME 1.20.1 - General Purpose Pipe Threads (Inch)
- B. American Water Works Association (AWWA):
 - 1. AWWA C504 - Rubber-Seated Butterfly Valves, 3 In. Through 72 In.
 - 2. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service
 - 3. AWWA C550 - Protecting Interior Coatings for Valves and Hydrants
 - 4. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances

5. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
- C. ASTM International (ASTM):
1. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings
 2. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications
- D. NSF International (NSF):
1. NSF 61 - Drinking Water System Components - Health Effects
 2. NSF 372 - Drinking Water System Components - Lead Content

1.3 COORDINATION

- A. The Contractor shall cause the Supplier of valves to coordinate installation such that all pipes, valves, fittings, appurtenances, and equipment are compatible and capable of achieving the performance requirements specified in the Contract Documents.
- B. Coordinate Work of this Section with City of Pendleton standards and utilities within construction area.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit Manufacturer's latest published literature. Include illustrations, installation and maintenance instructions, and parts lists.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- E. Lining and coating data.
- F. Valve Labeling: Schedule of valves to be labeled indicating in each case the valve location and the proposed labeling for the valve.
- G. Certification of Valves Larger than 12 inches: Furnish certified copies of hydrostatic factory tests, indicating compliance with applicable standards.
- H. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

- I. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves.
- B. Operation and Maintenance Data: Submit information for valves.

1.6 NOT USED

1.7 QUALITY ASSURANCE

- A. Cast Manufacturer's name, maximum working pressure, size of valve, and year of fabrication into valve body.
- B. Valve Testing: Each valve body shall be tested under a test pressure equal to twice its design water-working pressure.
- C. Certification: Prior to shipment, submit for all valves over 12 inches in diameter, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, American National Standards Institute (ANSI), ASTM, etc. Valves tested and supplied shall be trackable and traceable by serial number, tagged or otherwise noted on valve, upon arrival to Site.
- D. Unless otherwise noted, all water works materials provided for the Project shall be new, of first-class quality and shall be made by reputable manufacturers.
- E. All material of a like kind shall be provided from a single manufacturer, unless otherwise approved by the Owner's Representative.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves and accessories for shipment according to applicable AWWA standards.
- B. Seal valve and ends to prevent entry of foreign matter.
- C. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.
- D. Storage:
 - 1. Store materials in areas protected from weather, moisture, or other potential damage.
 - 2. Do not store materials directly on ground.
- E. Handle products carefully to prevent damage to interior or exterior surfaces.

- F. All defective or damaged materials shall be replaced with new materials at no cost to the Owner.

PART 2 PRODUCTS

2.1 GENERAL

- A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.
 - 1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.
 - 2. All brass in contact with potable water shall comply with ASTM B584.

2.2 RESILIENT WEDGE GATE VALVES

- A. As specified in Section 40 05 23.15, Gate Valves.
- B. Connecting Hardware:
 - 1. As specified in Article 2.3, Nuts, Bolts and Washers of Section 33 11 10, Water Utility Distribution and Transmission Piping.
- C. Gaskets:
 - 1. As required for the end connection types specified in Section 33 11 10, Water Utility Distribution and Transmission Piping.

2.3 NOT USED

2.4 NOT USED

2.5 RUBBER-SEATED BUTTERFLY VALVES

- A. As specified in Section 40 05 23.18, Butterfly Valves.
- B. Operation:
 - 1. All buried valves shall be provided with 2-inch square operating nuts.

- C. Connecting Hardware:
 - 1. As specified in Article 2.3, Nuts, Bolts and Washers of Section 33 11 10, Water Utility Distribution and Transmission Piping.
- D. Gaskets:
 - 1. As required for the end connection types specified in Section 33 11 10, Water Utility Distribution and Transmission Piping.

2.6 ACTUATORS

- A. Unless otherwise indicated, all valves shall be furnished with manual actuators.
- B. Actuators shall be sized for the valve design pressure in accordance with AWWA C504.
- C. All gear-assisted valves that are buried and submerged shall have the actuators hermetically sealed and grease-packed.
- D. All valves 6 inches to 30 inches in diameter may have traveling-nut actuators, worm-gear actuators, spur- or bevel-gear actuators, as appropriate for each valve.

2.7 VALVE BOXES

- A. Provide all buried valves with valve boxes, covers and risers.
- B. Valve Boxes:
 - 1. Materials: Cast iron.
 - 2. Construction:
 - a. Walls not less than 3/16-inch thick at any point.
 - b. Internal diameter not less than 5 inches.
 - 3. Type: Two-piece extension.
 - 4. Manufacturers:
 - a. Olympic Foundry.
 - b. Brooks Products.
- C. Covers:
 - 1. Construction:
 - a. Prevents dislodging and rotation from traffic.

- b. Allows a hand-held pry bar to be applied for easy removal.
 - 2. Materials: Cast iron.
 - 3. Lid Inscription: WATER.
 - 4. Manufacturers: Matching that of valve box.
- D. Riser:
- 1. Polyvinyl Chloride (PVC) Pipe:
 - a. ASTM D3034, SDR 35 PVC.
 - b. White, Schedule 40, 8-inch diameter.
 - c. Length as shown on details in the Drawings.

2.8 VALVE OPERATOR EXTENSIONS

- A. As shown in the Drawings.
- B. Provide operator extensions to a maximum of 12 inches below grade where depth to valve exceeds 36 inches.

2.9 ACCESSORIES

- A. Concrete for Thrust Restraints: Concrete type as specified in Section 03 11 00 - Concrete Work.

PART 3 EXECUTION

3.1 PREPARATION

- A. Conduct operations to not interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures, utilities, and landscape in immediate or adjacent areas.
- B. Identify required lines, levels, contours, and datum locations.
- C. Locate, identify, and protect from damage utilities to remain.
- D. Access:
 - 1. All valves shall be installed to provide easy access for operation, removal, and maintenance.

2. Avoid conflicts between valve operators and above grade construction such as structural members or handrails.
- E. Valve Accessories:
1. Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the Contractor to properly assemble and install these various items so that all systems are compatible and operating properly.
 2. The relationship between interrelated items shall be clearly noted on shop drawing submittals.

3.2 INSTALLATION

- A. General:
1. All valves, operating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the Manufacturer's written instructions and as shown in the Drawings and as specified herein.
 2. Valves shall be firmly supported to avoid undue stresses on the pipe.
 3. Stem extensions shall be braced at no greater than 10 feet intervals and be provided with double universal joints to allow for misalignment, where applicable.
- B. Perform trench excavation, backfilling, and compaction as specified in Section 33 11 10, Water Utility Distribution and Transmission Piping.
- C. Install valves in conjunction with pipe laying.
- D. Set valves plumb.
- E. Provide buried valves with valve boxes installed flush with finished grade.
1. Valves installed out of paved or otherwise hard-surfaced areas shall be set in a concrete pad at finished grade.
 2. Concrete valve box pads shall be 18 inches square and be not less than 6 inches thick.
- F. Disinfection of Water Piping System:
1. Flush and disinfect system as specified in Section 33 13 00, Testing and Disinfection of Water Utility Piping.

3.3 FIELD QUALITY CONTROL

- A. Pressure test valving for water distribution system according to AWWA C600 and in accordance with Section 33 13 00, Testing and Disinfection of Water Utility Piping.
- B. Field Testing of Valves:
 - 1. All valves 18-inch diameter or larger, and all in-line transmission main valves, shall be pressure and leakage tested at the Site and shall pass the field testing prior to installation.
 - 2. Valves shall be tested at 1.5 times normal operating pressure, 200 pounds per square inch (psi) minimum.
 - 3. No valve shall be accepted for installation that fails to pass the field pressure test. Any valves failing field pressure tests shall be replaced by the Contractor at no additional cost to the Owner.
 - 4. Owner's Representative shall witness field testing.

END OF SECTION

SECTION 33 12 19 - FIRE HYDRANTS

PART 1 GENERAL

1.1 SUMMARY

- A. This Section addresses dry-barrel fire hydrants used in water supply service.
- B. Section includes:
 - 1. Fire hydrants used in water main installations.
- C. Related Sections:
 - 1. Section 03 11 00 - Concrete Work
 - 2. Section 31 05 16 - Aggregates for Earthwork
 - 3. Section 31 23 17 - Trenching
 - 4. Section 33 13 00 - Testing and Disinfection of Water Utility Piping

1.2 REFERENCE STANDARDS

- A. American Water Works Association (AWWA):
 - 1. AWWA C502 - Dry-Barrel Fire Hydrants
 - 2. AWWA C550 - Protective Interior Coatings for Valves and Hydrants
 - 3. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances
- B. National Fire Protection Association (NFPA):
 - 1. NFPA 291 - Recommended Practice for Fire Flow Testing and Marking of Hydrants

1.3 COORDINATION

- A. All hydrants supplied for the Project shall be of like kind from a single manufacturer.

1.4 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit Manufacturer's latest published literature, including illustrations, installation and maintenance instructions, and parts lists.
- C. Shop Drawings: Submit description of proposed installation.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

- E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of fire hydrants and service valves.
- B. Operation and Maintenance Data: Submit data for hydrants.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare hydrants and accessories for shipment according to AWWA standards.
- B. Seal hydrant and ends to prevent entry of foreign matter.
- C. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.
- D. Storage:
 - 1. Store materials in areas protected from weather, moisture, or potential damage.
 - 2. Do not store materials directly on ground.
- E. Handle materials in a way that prevents damage to interior and exterior surfaces.

PART 2 PRODUCTS

2.1 FIRE HYDRANTS

- A. Manufacturers:
 - 1. M & H, No. 129.
 - 2. Mueller Company, Super Centurion Model A-423.
 - 3. Clow, No. F-2500.
 - 4. Waterous, No. WB-67.
 - 5. Kennedy, No K-11 or K-81A.
 - 6. US Pipe, Metropolitan or Pacific States.
- B. Dry-Barrel Breakaway Type:
 - 1. Comply with AWWA C502.
 - 2. Body: Cast iron.
 - 3. Valve: Compression type.

4. Burial Depth: As indicated on Drawings.
5. Inlet Connection Size: 6 inches (150 millimeters).
6. Valve Opening: 5-1/4 inches (133 millimeters) in diameter.
7. End Connections: Mechanical joint or bell end.
8. Bolts and Nuts: Galvanized steel.
9. Interior Coating: Comply with AWWA C550.
10. Direction of Opening: Counterclockwise unless otherwise indicated.

C. Hose Connections:

1. One 4-1/2-inch diameter pumper, two 2-1/2-inch diameter hose nozzles.
2. Obtain thread type and size from local fire department.
3. Attach nozzle caps by separate chains.

D. Finishes:

1. Primer and two coats of enamel.
2. Color: As designed by City of Pendleton standards.

2.2 NSF INTERNATIONAL (NSF) REQUIREMENTS

- A. All fire hydrants must be NSF/ANSI Standard 61 certified and meet the "lead free" requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.

2.3 ACCESSORIES

- A. Concrete for Thrust Restraints: Concrete type as specified in Section 03 11 00, Concrete Work.
- B. Aggregate: Aggregate for hydrant drainage as specified in Section 31 05 16, Aggregates for Earthwork.

2.4 OUT OF SERVICE COVERS/OUT OF SERVICE RINGS

- A. Provide orange plastic bag with reflective tape, or red plastic hydrant out of service rings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify location and size of hydrants from Drawings. Final location of hydrants to be determined by Owner's Representative in the field.

- B. Obtain clarification and directions from Owner's Representative prior to execution of Work.
- C. If installing a hydrant on an existing water system, verify invert elevation of existing piping is as indicated on Drawings prior to excavation and installation of fire hydrant.

3.2 PREPARATION

- A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures, utilities, and landscape in immediate or adjacent areas.
- B. Identify required lines, levels, contours, and datum locations.
- C. Locate, identify, and protect from damage utilities to remain.
- D. Do not interrupt existing utilities without permission and without making arrangements to provide temporary utility services.
 - 1. Notify Owner and Owner's Representative not less than 48 hours in advance of proposed utility interruption.
 - 2. Do not proceed without written permission from Owner's Representative.
 - 3. Only District staff shall operate valves in existing system.

3.3 INSTALLATION

- A. Perform trench excavation, backfilling, and compaction as specified in Section 31 23 17, Trenching.
- B. Install pier support block and drainage gravel for fire hydrants; do not block drain hole.
 - 1. Place drainage gravel around the pier block and bottom of hydrant to 6 inches above the hydrant drain opening.
 - 2. Place textile fabric to cover drain rock prior to placement of backfill.
 - 3. Setting shall allow the hydrant barrel to drain into drainage gravel at base of hydrant.
- C. Set fire hydrants plumb with pumper nozzle facing roadway.
- D. Set fire hydrants with centerline of pumper nozzle 18 inches (450 millimeters) above finished grade, and with safety flange not more than 6 inches (150 millimeters) nor less than 2 inches (50 millimeters) above grade. Install hydrant extensions where required and as approved.

- E. Paint hydrants according to color scheme of local authorities having jurisdiction. Touch up paint after hydrant installation and testing.
- F. After hydrostatic testing, flush hydrants, and check for proper drainage.
- G. Disinfection of Water Piping System:
 - 1. Flush and disinfect system as specified in Section 33 13 00, Testing and Disinfection of Water Utility Piping.

3.4 FIELD QUALITY CONTROL

- A. Pressure test water distribution system according to AWWA C600 and Section 33 11 10, Water Utility Distribution and Transmission Piping, Field Quality Control.

3.5 CONCRETE HYDRANT PADS

- A. When hydrant is place within sidewalks, form and pour-in-place 36-inch by 36-inch by 6-inch, 4,000 pounds per square inch (psi) concrete pad around the hydrant after the hydrant has been installed and set to grade.
- B. Center hydrant pad on the hydrant. Set hydrant pad so top of pad is flush with surrounding surface, or as directed by the Owner's Representative.
- C. Hydrant pads may be adjusted to reach the back of curb if the hydrant pad is no less than 1-foot in any one direction.

3.6 OUT-OF-SERVICE HYDRANT PADS

- A. To indicate that the fire hydrant is NOT operational, secure reflective tape, an orange plastic bag over the entire hydrant assembly or an approved out-of-service cover.
- B. An out-of-service ring may also be used in addition to the bag or cover in case of removal of the cover.
- C. Maintain the plastic bag up until the waterline is accepted by the Owner.

END OF SECTION

SECTION 33 13 00 - TESTING AND DISINFECTION OF WATER UTILITY PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes hydrostatic pressure testing, disinfection, and purity testing of potable water systems piping, fittings, valves, and domestic water services.
- B. Section Includes:
 - 1. Pressure testing and disinfection of potable water distribution and transmission piping systems and appurtenances.
 - 2. Testing and reporting of results.
- C. Related Sections:
 - 1. Section 33 11 10 - Water Utility Distribution and Transmission Piping
 - 2. Section 33 12 16 - Water Utility Distribution and Transmission Valves
 - 3. Section 33 12 19 - Fire Hydrants

1.2 REFERENCE STANDARDS

- A. American Water Works Association (AWWA):
 - 1. AWWA B300 - Hypochlorites
 - 2. AWWA B301 - Liquid Chlorine
 - 3. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances
 - 4. AWWA C605 - Underground Installation of PVC and PVCO Pressure Pipe and Fittings
 - 5. AWWA C651 - Disinfecting Water Mains
 - 6. AWWA C655 - Field Dechlorination

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittals Procedures: Requirements for submittals.
- B. Product Data: Submit procedures, proposed chemicals, and treatment levels.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

- D. Pipeline Testing and Disinfection Plan: To be submitted for review and approval by the Owner's Representative a minimum of 1 month before testing is to start. As a minimum, the plan shall include the following:
1. Testing schedule.
 2. Hydrostatic Testing Plan:
 - a. Narrative of the proposed process.
 - b. Proposed equipment to be used.
 - c. Disposal location for excess water used to fill mains.
 3. Disinfection Plan:
 - a. Narrative of the proposed process.
 - b. Proposed chemicals and equipment (including list of all pumps and meters) to be used.
 - c. Calculations for the amount of chlorine required to achieve required chlorine residual levels.
 - d. Proposed method of mixing, injecting, and distributing of chlorine solution throughout all portions of the new water system facilities.
 - e. Proposed plan for testing chlorine levels throughout the length of pipeline.
 4. Proposed testing locations.
 5. Proposed plan for water conveyance, including flow rates.
 6. Proposed plan for water control.
 7. Proposed plan for water disposal, including flow rates. Include proposed plan for dechlorination of disinfection water, including discharge points.
 8. Proposed measures to be incorporated in the Project to minimize erosion while discharging water from the pipeline.

1.4 CLOSEOUT SUBMITTALS

- A. Disinfection Report:
1. Type and form of disinfectant used.
 2. Date and time of disinfectant injection start and time of completion.

3. Test locations.
4. Name of person collecting samples.
5. Initial and 24-hour disinfectant residuals in treated water in parts-per million (ppm) for each outlet tested.
6. Date and time of flushing start and completion.
7. Disinfectant residual after flushing in ppm for each outlet tested.

1.5 QUALITY ASSURANCE

- A. Perform Work according to AWWA C651.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. All test equipment, chemicals for chlorination, temporary valves, bulkheads, or other water control equipment and materials shall be determined and furnished by the Contractor subject to the Owner's Representative's review. No materials shall be used which would be injurious to the construction or its future functions.
- B. All temporary thrust restraint and equipment and facilities required for hydrostatic testing will be considered incidental.
- C. As a minimum, furnish the following equipment and materials for the testing:

Amount	Description
2	Graduated containers approved by the Owner's Representative.
1	Hydraulic pump approved by the Owner's Representative with hoses, valves, and fittings as needed and required for the testing and disinfection of the facilities.
1	High range chlorine test kit, as approved by Owner's Representative, with digital readout. Range of detection shall be between 5 and 200 ppm. Accuracy of 3 percent.
2	Pressure gauges with pressure range at least 120 percent greater than the required maximum test pressure with graduations in 2 pounds per square inch (psi) increments. Gauges shall have been calibrated with 90 days of pressure testing.

2.2 DISINFECTION CHEMICALS

A. Chemicals:

1. Hypochlorite: Comply with AWWA B300.
2. Liquid chlorine: Comply with AWWA B301.

2.3 DECHLORINATION CHEMICALS

A. Chemicals:

1. Comply with AWWA C655.

PART 3 EXECUTION

3.1 HYDROSTATIC TESTING OF WATER PIPING

- A. Make all necessary provisions for conveying water to the points of use and for the disposal of test water.
- B. No section of the pipeline shall be hydrostatically tested until backfill has been placed, compacted, and passed required density testing and all field-placed concrete or mortar has attained full strength.
1. At the Contractor's option, early strength concrete may be used when the full-strength requirements conflict with schedule requirements.
 2. All such substitutions and installations shall be approved by the Owner's Representative prior to installation.
- C. Provide 72-hour notification to the Owner's Representative and Owner prior to conducting hydrostatic testing.
1. Provide coordination and scheduling required for the Owner and Owner's Representative to witness and provide necessary labor for operating Owner's existing system during hydrostatic testing and disinfecting procedures.
 2. The Contractor shall not operate any part of the existing water systems.
- D. Pipe Filling:
1. Fill pipes slowly from the lowest elevation to highest point along test section with potable water.
 2. Take all required precautions to prevent entrapping air in the pipes.

3. Allow for natural absorption of water by the lining of the pipe to occur.
 4. Apply specified test pressure by pumping.
- E. Testing of Mains:
1. Ductile Iron: In accordance with AWWA C600.
 2. Polyvinyl chloride (PVC): In accordance with AWWA C605.
 3. General:
 - a. Tests shall be conducted under a hydrostatic test pressure not less than 1.25 times the stated anticipated maximum sustained working pressure of the pipeline measured at the highest elevation along the test section and not less than 1.5 times the stated working pressure at the lowest elevation of the test section, minimum 200 psi, unless otherwise shown in the Drawings.
 - b. In no case shall the test pressure exceed the rated working pressure for any joint, thrust restraint, valve, fitting, or other connected appurtenance of the test section.
 - c. Testing shall be performed by applying the specified test pressure by pumping.
 - d. Once the test pressure has been attained, the pump shall be valved off.
 - e. The test will be conducted for a 2-hour period with the allowable leakage not to exceed the value as calculated per the Allowable Leakage formula below.
 - f. During the test period, there shall be no appreciable or abrupt loss in pressure.
 4. Allowable Leakage:
 - a. Flanged Joints: Pipe, fittings, and valves with flanged joints shall be completely watertight. No leakage allowed.
 - b. Mechanical or Push-on Joints: Pipe, fittings, and valves with rubber gasketed joints shall have a measured loss not to exceed the rate given in the following Allowable Leakage formula:

$$AL = \frac{ND(P)^{1/2}}{11,000}$$

In the above formula:

AL = Allowable leakage, in gallons per hour
 N = Number of joints in the length of pipeline installed

- D = Nominal diameter of pipe, in inches
- P = Average test pressure during the leakage test, in pounds per square inch.

5. Maintaining Pressure:

- a. During the test period, operate the pump as required to maintain pressure in the pipe within 5 psi of the specified test pressure at all times.
- b. At the end of test period, operate the pump until the specified test pressure is again obtained.
 - 1) The pump suction shall be in a clean, graduated barrel, or similar device or metered so that the amount of water required to restore the test pressure may be accurately measured.
 - 2) Sterilize this makeup water by adding chlorine to a concentration of 25 milligrams per liter (mg/L).
- c. The Owner's Representative will determine the quantity of water required to maintain and restore the required pressure at the end of the test period.
- d. Each hour's loss stands on its own and will not be averaged.

6. Defects, Leakage, Failure:

- a. If the test reveals any defects, leakage in excess of the allowable, or failure, furnish all labor, equipment, and materials required to locate and make necessary repairs.
- b. Correct any visible leakage regardless of the allowable leakage specified above.
- c. All leaks shall be repaired in a manner acceptable to the Owner's Representative.
- d. The testing of the line shall be repeated until a test satisfactory to the Owner's Representative has been achieved.

3.2 DISINFECTION OF WATER PIPING

- A. Disinfection shall be in accordance with the latest version of AWWA C651 following Owner's Representative's acceptance of hydrostatic testing.
- B. Chlorination by means of tablets or powders (calcium hypochlorite) placed in each length of pipe during installation is specifically prohibited.

- C. Flush all foreign matter from the pipeline, branches, and services.
 - 1. Provide at no additional cost to the Owner, hoses, temporary pipes, ditches, etc., as required to dispose of flushing water without damage to adjacent properties.
 - 2. Flushing velocities shall be at least 2.5 feet per second (fps).
 - 3. For large diameter pipe where it is impractical or impossible to flush the pipe at 2.5 fps velocity, clean the pipe in place from the inside by brushing and sweeping, then flush the line at a lower velocity.

- D. Chlorine Application:
 - 1. Fill the test section of main from the lowest elevation and maintain a steady flow rate while injecting the water main with chlorinated water.
 - 2. Flow (bleed) a blow-off, standpipe or hydrant at the water main's high point(s) to allow air to escape and ensure all interior pipe surfaces are wetted.

- E. Chlorine Residual:
 - 1. Measure chlorine residual with a high-range chlorine test kit at a point near to the injection point while filling the main.
 - 2. Adjust the dose rate as necessary to maintain the target dose rate.

- F. Potable water piping shall be disinfected with a solution containing a minimum 25 ppm and a maximum 50 ppm chlorine.
 - 1. Once the main is completely filled with super-chlorinated water, measure the chlorine residual a minimum of once every 200 feet of main and once for each main branch, 2-inch service, or as directed by the Owner's Representative.
 - 2. The chlorine solution shall remain in the piping system for a period of 24 hours, after which time the sterilizing mixture shall have a strength of at least 10 ppm of chlorine.
 - 3. If check samples fail to produce acceptable results, the disinfection procedure shall be repeated at the expense of the Contractor until satisfactory results are obtained.

- G. Flush piping, branches, and services with municipal potable water until the chlorine residual is below 1.5 ppm and approximately the same as the source water.
 - 1. There is no minimum flushing velocity for this step.

- H. Disposal of any water containing chlorine shall be performed in accordance with the latest edition of AWWA C651 and C655, and all state or local requirements.
 - 1. Disposal may be made into existing sanitary sewer systems providing approvals are obtained from the respective system owners.
 - 2. Any chlorinated water discharged to open stream channels must be dechlorinated prior to discharge to levels acceptable by Oregon State Department of Environmental Quality (DEQ).

3.3 DISINFECTION AND TESTING OF WATER MAIN END CONNECTIONS AND TIE-INS

- A. Disinfection of potable water piping and appurtenances at end connections and tie-ins to the existing system which are required to remain in service due to restrictions in allowable shutdown time shall be disinfected as described below.
- B. Prior to connecting new potable water piping and appurtenances with existing piping and appurtenances, the interior of all new pipe, fittings, valves, and appurtenances shall be swabbed or sprayed with a 1 percent to 5 percent calcium hypochlorite solution.
- C. In accordance with AWWA C651, swabbing or spraying of connection piping is allowed only if the total length of piping is equal to or less than one pipe length (18 feet). All runs of new piping over 18 feet in total length will require hydrostatic pressure testing, flushing and disinfection as detailed elsewhere in this Section.
- D. Following the disinfection procedures described above, connection of the new piping and appurtenances to the existing water system shall be made.
 - 1. During the system startup, the Owner's Representative and Contractor shall visually inspect all new fittings, piping, valves, and appurtenances for evidence of leakage.
 - 2. Any leakage observed during this period shall be promptly repaired by the Contractor, at Contractor's expense, as required by the Owner's Representative.

3.4 FIELD QUALITY CONTROL

- A. Bacteriological Sampling and Testing:
 - 1. The Owner will collect samples after the line is flushed in accordance with the latest edition of AWWA C651.
 - a. The locations for sample collection shall be at the sole discretion of the Owner and Owner's Representative.

- b. The chlorine residual must be below 1.5 ppm or restored to the level maintained in the Owner's distribution system, when the sample is taken.
2. Bacterial Testing: After completing the chlorination procedure, test the main according to the following:
- a. Bacterial Sampling
 - 1) Option A:
 - a) Take an initial set of samples using sampling site procedures outlined herein.
 - b) Resample after a minimum of 24 hours' time has elapsed using sampling site procedures outlined herein.
 - c) Both sets of successive samples must pass for the main to be approved for service.
 - 2) Option B:
 - a) Allow main to sit for a minimum of 24 hours without any water use.
 - b) Using sampling site procedures outlined herein, collect two sets of samples a minimum of 15 minutes apart while the sampling taps are left running.
 - c) Both sets of samples must pass for the main to be approved for service.
 - 3) Allow 24 hours for the test results for each sample set.
 - b. Sampling Locations
 - 1) The Owner will take one bacteriological sample from the end of the main and on each branch.
 - 2) For long runs of main, at least one sample will be taken for every 1,200 feet of new main and as directed.
 - c. Sample Testing
 - 1) The Owner will test the sample set for coliform bacteria and publish the test results within 24 hours.

d. Evaluating the Test Results

- 1) If one or more of the sample set tests positive for coliforms (fails), repeat chlorination and sampling processes specified herein after correcting the cause of the failure and as directed by the Owner's Representative.
- 2) When two consecutive sample sets test negative (passing) for coliform bacteria, the bacterial testing is complete.

e. Completion of Bacterial Testing

- 1) Upon completion of bacterial testing, notify the Owner shall notify the Owner's Representative and Contractor in writing that the testing is complete and the main is ready for tie-in.

f. Multiple Positive (Failing) Test Results

- 1) If sample sets continue to test positive for coliforms, the Owner's Representative will determine how to proceed, up to and including repeating the chlorination procedure or rejecting the pipe.
3. Results of the bacteriological testing shall be satisfactory with the Oregon Health Authority and/or other appropriate regulatory agencies, or disinfection shall be repeated by the Contractor.

B. Optional Sampling and Testing

1. If a pipeline is not promptly returned to service, the situation will be evaluated by the Owner to determine if the water quality may have been impacted and if additional testing as specified herein is warranted.

END OF SECTION

SECTION 40 05 13 - COMMON WORK RESULTS FOR PROCESS PIPING

PART 1 GENERAL

1.1 SUMMARY

This Section applies to the furnishing and installation of piping inside a building, structure, enclosure piping and miscellaneous yard piping.

A. Related Sections:

1. Section 05 50 00 - Metal Fabrications
2. Section 09 90 00 - Painting and Coating
3. Section 31 23 17 - Trenching
4. Section 33 11 10 - Water Utility Distribution and Transmission Piping
5. Section 33 05 64 - Precast Concrete Valve Vaults and Meter Boxes
6. Section 33 13 00 - Testing and Disinfection of Water Utility Piping

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. ASME B1.20.1 Pipe Threads, General Purpose (inch)
2. ASME A13.1 - Scheme for the Identification of Piping Systems.
3. ASME B16.5 Pipe Flanges and Flanged Fittings, Steel Nickel Alloy, and other Special Alloys
4. ASME B16.15 - Cast Copper Alloy Threaded Fittings: Classes 125 and 250.
5. ASME B31.3 - Process Piping.
6. ASME B31.9 - Building Services Piping.

B. ASTM International (ASTM):

1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A307 - Specification for Carbon Steel Bolts and Studs, 6,000 psi Tensile.
3. ASTM A325 - Specification for High-Strength Bolts for Structural Steel Joints.
4. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes.

5. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 6. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
 7. ASTM D792 - Test Methods for Specific Gravity and Density of Plastics by Displacement.
 8. ASTM D1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
 9. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 10. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 11. ASTM D2000 - Classification System for Rubber Products in Automotive Applications.
 12. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 13. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
 14. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- C. American Water Works Association (AWWA):
1. AWWA C200 - Steel Water Pipe - 6 In. (150 mm) and Larger.
 2. AWWA C207 - Steel Pipe Flanges for Water Works Service, Sizes 4 in through 144 in.
 3. AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe.
 4. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.
 5. AWWA C510 - Double Check Valve Backflow Prevention Assembly.
 6. AWWA C511 - Reduced-Pressure Principal Backflow Prevention Assembly.
 7. AWWA C606 - Grooved and Shouldered Joints.

8. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.
- D. American Welding Society (AWS):
1. AWS D1.1 - Structural Welding Code.
- E. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry:
1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- F. NSF International (NSF):
1. NSF 61 - Drinking Water System Components - Health Effects.
 2. NSF 372 - Drinking Water System Components - Lead Content.

1.3 COORDINATION

- A. Coordinate installation of specified items with installation of valves and equipment.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
1. Submit Manufacturer catalog information for each product specified.
- C. Shop Drawings:
1. Identification:
 - a. Submit list of wording, symbols, letter size, and color coding for pipe identification.
 - b. Comply with ASME A13.1.
 2. Provide all necessary dimensions and details on pipe joints, restraints, fittings, fitting specials, valves, appurtenances, design calculations, and material lists.
 3. Provide detailed layout, spool, or fabrication drawings which show all pipe spools, spacers, adapters, connectors, fittings, couplings, and pipe supports necessary to accommodate the equipment and valves provided in a complete and functional system.

- D. Manufacturer's Statement: Certifying pipe fabrication and products meet or exceed specified requirements.
- E. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS and ASME qualification within previous 12 months.
- F. Manufacturer Instructions: Submit special procedures and setting dimensions.
- G. Source Quality-Control Submittals: Indicate results of shop tests and inspections.
- H. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of piping appurtenances.
- B. Identify and describe unexpected variations to pipe routing or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

- A. Drawings:
 - 1. Piping layouts shown in the Drawings are intended to define the general layout, configuration, routing, method of support, pipe size, and pipe type. The mechanical drawings are not pipe construction or fabrication drawings. It is the Contractor's responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, etc., for a complete and functional system.
- B. Inspection:
 - 1. All pipe shall be subject to inspection at the place of manufacture.
 - 2. During the manufacture of the pipe, the Owner's Representative shall be given access to all areas where manufacturing is in progress and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
- C. Welding:
 - 1. All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1.
 - 2. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot, and bell ring

attachments, reinforcing plates and ring flange welds, and plates for lug connections.

D. Welders:

1. Skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used shall do all welding.
2. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local approved testing agency prior to commencing work on the pipeline.
3. Machines and electrodes similar to those used in the Work shall be used in qualification tests.
4. The Contractor shall furnish all material and bear the expense of qualifying welders.

E. Tests: Except where otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable Specifications and Standards. Welds shall be tested as specified. The Contractor shall perform all tests at no additional cost to the Owner.

1.7 MATERIAL DELIVERY, STORAGE, AND INSPECTION

A. Inspection:

1. Accept materials on Site in Manufacturer's original packaging and inspect for damage.
2. All piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition.

B. Storage:

1. Store materials according to Manufacturer instructions.
2. Store materials off the ground, to provide protection against oxidation caused by ground contact

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.

- 3. Provide additional protection according to Manufacturer instructions.
- D. All defective or damaged materials shall be replaced with new materials.

1.8 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 GENERAL

- A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.
 - 1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.
 - 2. All brass in contact with potable water shall comply with ASTM B584.
- B. Unless specified otherwise or indicated differently in the Drawings, all piping systems and process piping materials shall be as listed in the table below or as shown on the Drawings:

Service	Material
Drainage/Sanitary Sewer	See Division 33.
Exposed ≥ 4”	Class 52 Ductile Iron or Heavy Wall Welded Steel
Buried ≥ 4”	Class 52 Ductile Iron
Submerged/Buried < 4”	Stainless Steel - Type 316 Schedule 40 Threaded - ASTM A 312 Fittings Welded or Threaded
Exposed < 4”	Brass - ASTM B 43, Fittings - Bronze - ASTM B 62 Threaded - ANSI/ASME B 16.15
Buried < 4”	Copper Tubing - ASTM B88 Type K Soft / Fittings - Wrought Copper - ANSI B16.22, Joints-Soldered
Miscellaneous Pipelines	As shown in the Drawings

2.2 FLANGED DUCTILE IRON PIPE AND FITTINGS

- A. Centrifugally cast, conforming to AWWA C151 and AWWA Standard C115.
- B. Coating: The exterior surfaces of pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of rust-inhibitive primer. Field coating shall be in accordance with the requirements of Section 09 90 00 – Painting and Coatings.
- C. Pipe Mortar Lining: Shop-applied NSF 61 cement mortar lining, smoothed finish, complying with AWWA C104.
- D. Pipe Thickness Class:
 - 1. Comply with AWWA C115.
 - 2. Class 52, unless shown to be greater in the Plans.
 - 3. Flanged Joints:
 - a. Flat faced, complying with AWWA C111 and C115, unless otherwise specified.
 - b. Bolt hole drilling according to ASME/ANSI B16.1, Class 125, or ASME/ANSI B16.1, Class 250, where specified. Flanges shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown.
 - c. The Contractor shall coordinate with pipe, valve, and fitting suppliers to make certain mating pipe, valve, and fitting flanges match in bolt pattern.
 - d. Flange joint connections shall not be exposed to test pressures greater than 1-1/2 times their rated working pressure.
 - e. Gaskets:
 - 1) Full faced, composed of neoprene rubber, 55-65 durometer hardness, 1/8-inch thick. Dimensions shall be per ANSI B16.21.
 - 2) Ring gaskets shall not be permitted.
 - 3) Flange Gasket Manufacturers:
 - a) Garlock, style 7986
 - b) Or approved equal
 - 4) Insulating flanged joints:
 - a) Full faced, conform to ANSI 16.21.

- b) Material: Non-asbestos.
- c) Suitable for operating and test pressures of the pipe system.
- d) Manufacturer:
 - (1) Garlock GYLON Style 3505 or equal.

E. FITTINGS:

- 1. Material: Ductile iron, complying with AWWA Standard C110.
 - a. Fittings conforming to AWWA C153 may be substituted in lieu of AWWA C110 fittings.
 - b. Fittings shall be flanged as required and shown on the Drawings.
 - c. All restraint systems and flanged fittings shall be provided with bolts and gaskets as specified herein.
- 2. Coating and Lining:
 - a. Coating: The exterior surfaces of pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of rust-inhibitive primer. Field coating shall be in accordance with the requirements of Section 09 90 00 – Painting and Coatings
 - b. Cement Mortar Lining: Comply with AWWA C104,
- 3. Following information cast upon fittings:
 - a. Manufacturer's identification.
 - b. Country of manufacture.
 - c. Pressure rating.
 - d. For bends, number of degrees and/or fractions of a circle.

F. NUTS, BOLTS, AND WASHERS:

- 1. All bolts shall have heavy hex head with heavy hex nuts.
- 2. For operating pressures greater than 150 psi:
 - a. Bolts: Steel alloy composition. Comply with ASTM A193.
 - b. Nuts: Comply with ASTM A194, Grade 2H.
 - c. Washers: Comply with ASTM F436.

3. For operation pressures of 150 psi or less:
 - a. Bolts: Low-carbon steel composition. Comply with ASTM A307, Grade B.
 - b. Nuts: Comply with ASTM A563A, Heavy Hex.
 - c. Washers: Comply with ASTM F844.
- G. Higher-strength bolts with higher torque values as specified above for operation pressures greater than 150 psi shall not be used for assembly of flange joints including gray-iron flanges.
- H. See Article 2.1.B, Ductile Iron Pipe of Section 33 11 10, Water Utility Distribution and Transmission Piping.

2.3 NOT USED

2.4 COPPER PIPE AND FITTINGS

- A. Description:
 1. Seamless; ASTM B88.
 2. Type:
 - a. Type L, hard drawn.
 - b. For pipe under floor slabs, underground or cast in concrete: Type K, annealed, seamless.
- B. Joints:
 1. Compression.
 2. Manufacturer: Mueller Model 110 or equal
- C. Dissimilar Metals: See Dielectric Unions specified herein.

2.5 BRASS PIPE AND FITTINGS

- A. Pipe: ASTM B43, chrome plated.
- B. Fittings:
 1. ASTM B584, brass.
 2. ASTM B16.15.
- C. Joints:
 1. Mechanical compression.

2. Threaded: Tapered and smooth threads, ASME B1.20.1 and ASTM B43.

D. Dissimilar Metals: See Dielectric Unions specified herein.

2.6 POLYVINYL CHLORIDE (PVC) WATER PIPE AND FITTINGS

A. PVC Pipe and Fittings:

1. Four-inch diameter and smaller:

- a. Pipe: ASTM D1785, Schedule 40.
- b. Fittings: ASTM D2466, Schedule 40.
- c. Joints: Socket, solvent-welded, ASTM D2855.
- d. Materials: ASTM D1784, minimum cell classification 12545-C.

2. Six-inch diameter and larger:

- a. Pipe: AWWA C900, Class 235.
- b. Fittings: AWWA C111, cast iron.
- c. Joints: ASTM D3139, compression gasket ring.
- d. Materials: ASTM D1784, minimum cell classification 12545-C.

2.7 FLEXIBLE TUBING

A. Polyethylene thermoplastic tubing:

1. Standard weight, conforming to ASTM D1248 Type 1, Class A, Category 4, Grade E5.

2.8 GALVANIZED STEEL PIPE AND FITTINGS

A. Pipe: Seamless, or electric resistance welded, ASTM A53, Schedule 40.

B. Joints: Threaded.

C. Fittings:

1. Threaded, 150-pound malleable iron, galvanized, ASTM A197 or ASTM A47, dimensions conforming to ANSI B16.3.
2. Unions, 300-pound malleable iron, galvanized with dimensions conforming to ANSI B16.3, brass to iron seat.
3. Thread lubricant shall be Teflon tape or joint compound that is insoluble in water.

2.9 NOT USED

2.10 NOT USED

2.11 FLEXIBLE COUPLINGS

A. Description:

1. Sleeve-type, couplings. Comply with AWWA C219.
2. Minimum design pressure rating: 150 pounds per square inch (psi).
3. Middle Ring: As required for coupling based upon connecting pipe materials, steel, or ASTM A536, ductile iron.
4. Followers: As required for coupling based upon connecting pipe materials, steel, or ASTM A536, ductile iron.
5. Gaskets:
 - a. Material: Buna-N.
 - b. Comply with ASTM D2000.
6. Bolts:
 - a. Buried: Steel.
 - b. Submerged: Stainless steel.
7. Center Pipe Stop: Required where shown on the Drawings.

B. Finishes:

1. Buried Couplings, Bolts: Factory epoxy coated.

C. Manufacturers:

1. For ductile iron and steel pipe:
 - a. Dresser, Style 38.
 - b. Romac, Model 501.
 - c. Smith-Blair.
2. For PVC pipe:
 - a. Romac, Model 501 or equal.
3. For flanged steel and ductile pipe:
 - a. Dresser, Style 128 or equal.

2.12 RESTRAINED FLANGE ADAPTERS FOR DUCTILE IRON PIPE

A. Description:

1. ASTM A536, ductile iron.
2. Flange bolt circles compatible with ANSI/AWWA C115/A21.15.
3. Restraint for the flange adapter shall consist of a plurality of individually actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of the gripping wedges.
4. Capable of deflection during assembly or permit lengths of pipe to be field cut to allow a minimum 0.6-inch gap between the end of the pipe and the mating flange without affecting the integrity of the seal.
5. Safety factor of 2:1 minimum.
6. Manufacturer:
 - a. EBAA Iron, Series 2100 Megaflange or equal.

2.13 FLANGED INSULATING JOINTS

A. Set shall include a full faced gasket, a full-length insulating sleeve for each flange bolt, and two insulating washers and two steel washers for each bolt.

1. Gaskets:
 - a. Full-face, comply with ASME 16.21.
 - b. Non-asbestos and non-phenolic compressed sheet packing with nitrile rubber binder.
 - c. Manufacturer: Garlock, Style 3505, or equal.
2. Insulating sleeves:
 - a. G-10 glass epoxy.
 - b. Extend the full width of both flanges, except where one flange hole is threaded where the sleeve shall extend through one flange and the gasket.
3. Insulating washers:
 - a. G-10 glass epoxy.
 - b. One-eighth-inch thickness.

4. Washers:
 - a. Buried: Cadmium plated steel.
 - b. Submerged: Stainless steel.
- B. The complete assembly shall have an ANSI/AWWA pressure rating equal to or greater than that of the flanges between which is installed.
- C. After assembly, the joint shall be tested for continuity. Electrical resistance between flanges and between each bolt and each flange shall be not less than 100,000 ohms.

2.14 INSULATING UNION

- A. Description:
 1. Material: Galvanized malleable iron with a ground joint.
 2. Iron pipe threads: Conform to ANSI B2.1.
 3. Insulations: Nylon, bonded, and molded onto the metal body.
 4. Union: Rated for the operating and test pressures of the pipe system.
 5. Joint connections to copper alloy pipe and tube shall be copper solder or threaded brass ground joints.
 6. Isolation Barrier: Impervious to water.

2.15 BACKFLOW PREVENTERS

- A. Manufacturers:
 1. Nibco.
 2. Watts.
- B. Double Check Valve Backflow Preventer Assemblies:
 1. Size: 1/2-inch to 3 inches.
 2. Comply with AWWA C510.
 3. Materials:
 - a. Body: Bronze.
 - b. Internal Parts: Corrosion resistant.
 - c. Springs: Stainless steel.

4. Check Valves:
 - a. Quantity: Two, operating independently.
 - b. Intermediate atmospheric vent.
5. Ball Valves:
 - a. Type: Full port, resilient seated.
 - b. Quantity: Two.
 - c. Operation: Quarter turn.
 - d. Material: Bronze.
6. Accessories: Strainer and test cocks.

2.16 DISMANTLING JOINT

A. Description:

1. Comply with AWWA C219, where applicable.
2. Self-contained flanged restrained joint fitting, including both flanged components and sufficient harness bars to withstand the imposed thrust.
3. Design: No part of the restraint system extends outside the flange diameter. The internal bore shall match that of the pipe system.
4. Dismantling joints will allow for a minimum of 2 inches of longitudinal adjustment.
5. Furnish as a complete assembly consisting of spigot piece, flange adaptor, tie bars, and gasket.
6. The gasket seal and compression stud and nut arrangement shall be independent of the tie rod restraint system. Tie Rod diameter shall be compatible with the corresponding bolt diameter of the mating flange. The Tie Rod restraint system shall be capable of withstanding the full pressure thrust that the pipe system can develop at no more than 50 percent of the yield strength of tie rod material.
7. Pressure Rating:
 - a. Determined by the flange configuration, and all commonly used flanges shall be available.
 - b. Design pressure rating shall be equal to or greater than the mating flanges.
 - c. Dismantling joints will be specially fabricated to accommodate pressure requirements with ANSI B16.5 or ANSI B16.47 300-pound class flanges, depending on size of dismantling joint.

8. Lining and Coating:
 - a. Shop-applied fusion bonded epoxy coating applied by fluidized bed method, complying with the requirements of NSF 61 and AWWA C550 as applicable.
 - b. As an alternative, a shop-coat primer suitable for field applied coatings can be supplied.
9. Flanges: Flat-faced, rated to pressure requirements as shown on the Drawings.
 - a. Where design pressure is greater than 300 psi, flanges shall conform to ASME B16.5 and ASME B16.47 300-pound class.

B. Materials:

1. Spigot piece: Steel, ASTM A283 Grade C.
2. Flange adaptor:
 - a. Up to 12-inch diameter: Ductile iron, ASTM A536 Grade 65-45-12.
 - b. Above 12-inch diameter: Steel, ASTM A283 Grade C.
3. Tie bars: ASTM A193 Grade B7 threaded rod with rolled threads.
4. Gasket: EPDM Grade E.
5. Nuts, Bolts, and Washers: Type 304 stainless steel.

C. Manufacturer:

1. Romac or equal.

2.17 PIPE SUPPORTS

A. Floor Support for Pipe:

1. Flanged Pipe Support:
 - a. Construction:
 - 1) Adjustable vertical pipe support, flange plate, extension pipe from base cup to top collar cup with threaded stud.
 - 2) Bolts directly to flange.
 - 3) Anchorable base plate.
 - b. Material: Steel, comply with ASTM A36.

- c. Finish: Corrosion resistant, electro-galvanized, or prime coated.
 - d. Manufacturers:
 - 1) Standon - Model S89.
2. Cradle Pipe Support:
- a. Construction:
 - 1) Adjustable vertical pipe support with saddle strap, extension pipe from base cup to top collar cup with threaded stud.
 - 2) Anchorable base plate.
 - b. Material: Steel, comply with ASTM A36.
 - c. Finish: Corrosion resistant, electro-galvanized, or prime coated.
 - d. Manufacturers:
 - 1) Standon - Model S92.

2.18 PIPE PENETRATIONS

- A. Sleeves for Pipes through Walls and Floors:
 - 1. Material: Galvanized steel.
 - 2. Thickness: Schedule 40.
 - 3. Inside surface of all wall sleeves shall be coated with coal-tar.
 - 4. Annular space between penetrating pipe and wall sleeve shall be filled with an approved permanently flexible sealant.
 - 5. Diameter of wall sleeve shall be as shown in the Drawings.
- B. Mechanical Sleeve Seals:
 - 1. Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
 - 2. Manufacturer: Link-Seal or equal.

- C. Pipes Cast-In Walls and Floors:
 - 1. Material: Ductile iron or steel pipe, as required by the Drawings and the intended service.
 - 2. Diameter: As shown in the Drawings.
 - 3. End Type: As shown in the Drawings.
- D. Seep Rings:
 - 1. Material: 3/8-inch-thick steel plate conforming to ASTM A36, unless otherwise noted.
 - 2. Inside diameter: Equal to the outside diameter of the pipe or sleeve to which it is attached plus 1/4-inch.
 - 3. Outside diameter: As shown in the Drawings.
 - 4. Attach to the pipe or sleeve by means of a continuous seal weld located on both sides of the ring.

2.19 PIPE COATINGS

- A. See Section 09 90 00, Painting and Coating.

PART 3 EXECUTION

3.1 GENERAL

- A. Furnish and install all piping systems shown and specified, in accordance with the requirements of the Contract Documents. Each system shall be complete with all necessary fittings, hangers, supports, anchors, expansion joints, flexible connectors, valves, accessories, heat tracing, insulation, lining and coating, testing, disinfection, excavation, backfill, and encasement, to provide a functional installation.
- B. Pipe shall be installed in accordance with good trade practice. The methods employed in handling and placing of pipe, fittings, and equipment shall be such as to insure that after installation and testing they are in good condition. Should damage occur to the pipe, fitting or equipment, repairs satisfactory to the Owner's Representative shall be made.

3.2 INSTALLATION

A. Buried Piping Systems:

1. Establish elevations of buried piping with not less than 3 feet of cover.
2. Remove scale and dirt from inside of piping before assembly, as may be required.
3. Excavate pipe trench as specified in Section 31 23 17, Trenching.
4. Install pipe to accurate lines, elevations, and grades as shown on the Drawings.
5. Where grades are not shown, pipe shall be laid to grade between control elevations shown on the Drawings.
6. Place bedding material at trench bottom to provide uniform bedding for piping.
7. Level bedding material in one continuous layer not exceeding 6 inches compacted depth.
8. Install pipe on prepared bedding.
9. Route pipe in straight line.
10. Install pipe to allow for expansion and contraction without stressing of pipe or joints.
11. Install shutoff and drain valves at locations as indicated on Drawings and as specified in this Section.
12. Pipe Cover and Backfilling:
 - a. Backfill trench as specified in Section 31 23 17, Trenching.
13. All buried non-ferrous piping shall be installed with detectable tracer tape.
 - a. Tape shall be buried 12 inches above the top of the pipe or as recommended by Manufacturer.
 - b. Tape shall be continuous and labeled the same as the piping system.

B. Interior Piping Systems:

1. Install non-conducting dielectric connections wherever joining dissimilar metals.
2. Establish elevations of buried piping outside valve vault to obtain not less than 3 feet of cover.

3. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting as specified in Section 09 90 00, Painting and Coating.
 4. Install water piping according to ASME B31.9.
 5. Install unions downstream of valves and at equipment or apparatus connections.
 6. Install brass male adapters each side of valves in copper piped system, solder adapters to pipe.
- C. Backflow Preventer Assemblies:
1. Install backflow preventers of type, size, and capacity indicated.
 2. Comply with applicable code and authority having jurisdiction.
 3. Install airgap fitting on units with atmospheric vent connection.
 4. Pipe relief outlet drain to nearest floor drain.
 5. Do not install bypasses around backflow preventers.
- D. Pipe Supports and Hangers
1. Install pipe supports according to MSS SP-58 and ASME B31.10.
 2. All pipe shall be secured in place by use of blocking, hangers, brackets, clamps or other approved methods, and the weight thereof shall be carried independently of pump casings or equipment.
 3. Special hangers and supports are shown on the Drawings.
 4. The Contractor shall be responsible for determining the location of and providing all additional supports.
 5. Hanger supports shall be as noted below with at least one support adjacent to the joint for each length of pipe, at each change in direction and at each branch connection. Sufficient hangers shall be provided to maintain proper slope without sagging. Support spacing shall not exceed Manufacturer's recommendations, nor as listed below.

<u>Pipe</u>	<u>Maximum Support Spacing (Feet)</u>
Steel Pipe	
Under 3 inches	6
3 inches and Over	12
Cast or Ductile Iron	
Under 4 inches	6
4 inches and Over	12
Stainless Steel and Galvanized Iron	

<u>Pipe</u>	<u>Maximum Support Spacing (Feet)</u>
Under 1-1/2 inches	4
1-1/2 inches to 4 inches	6
Over 4 inches	12
Copper Pipe	6
PVC Pipe	
Under 2-1/2 inches	4
2-1/2 inches and Over	6

6. Spacing of clamps for support of vertical piping shall be close enough to keep the pipe in alignment as well as to support the weight of the piping and contents unless other vertical support is shown, but in no case shall be more than 12 feet.
7. Provide adjustable hangers for all pipes, complete with adjusters, swivels, rods, etc. Size hangers to clear insulation and guide where required, as well as support piping. All rigid hangers shall provide a means of vertical adjustment after erection. Hanger rods shall be machine threaded. Continuous threaded rods will not be allowed.
8. Clevis or band-type hangers (B-Line FIG B3100) or equal shall be provided as required. Strap hangers not permitted.
9. Provide floor stands, wall bracing, concrete piers, etc., for all lines running near the floors or near walls and which cannot be properly supported or suspended by the walls or floors. Pipelines near concrete or masonry walls may also be hung by hangers carried from wall brackets at a higher level than pipe. Hanging of any pipe from another is prohibited.
10. Equipment shall be positioned and aligned so that no strain shall be induced within the equipment during or subsequent to the installation of pipework.
11. When temporary supports are used, they shall be sufficiently rigid to prevent any shifting or distortion of the piping or related work.

E. Pipe Penetrations:

1. Exterior Watertight Entries: Seal with mechanical sleeve seals or grout, as shown in the Drawings.
2. Whenever a pipeline of any material terminates at or through a structural wall or floor, install piping or sleeve in advance of pouring of concrete required for the particular installation.
3. Plastic pipe shall not be cast in concrete or masonry walls.
4. Set sleeves in position in forms and provide reinforcing around sleeves.

5. Size sleeves large enough to allow for movement due to expansion and contraction and provide for continuous insulation wrapping.
6. Extend sleeves through floors 1-inch above finished floor level and caulk sleeves.
7. Pipe other than concrete, to be cast in water-bearing walls or more than 4 feet below grade shall have seep rings.
8. All buried piping entering structures shall have a flexible connection installed less than 2 feet outside the structure line or as close to the wall as practical.

3.3 CLEANING, TESTING, AND DISINFECTION

- A. Testing and Disinfection: Piping shall be hydrostatically tested, flushed, and disinfected as specified in Section 33 13 00, Testing and Disinfection of Water Utility Piping.

END OF SECTION

SECTION 40 05 51 - COMMON WORK RESULTS FOR PROCESS VALVES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes basic materials and methods related to valves commonly used for process systems, including utility vaults. This Section is to be used in conjunction with 40 05 51.15, Gate Valves, Section 40 05 51.18, Butterfly Valves, Section 40 05 67.36, Pressure-Regulating Valves, and Section 40 05 78, Miscellaneous Valves.
- B. Section Includes:
 - 1. Valves.
 - 2. Valve actuators.
- C. Related Sections
 - 1. Section 05 50 00 - Metal Fabrications
 - 2. Section 09 90 00 - Painting and Coating
 - 3. Section 33 11 10 - Water Utility Distribution and Transmission Piping
 - 4. Section 40 05 13 - Common Work Results for Process Piping
 - 5. Section 40 05 51.15 - Gate Valves
 - 6. Section 40 05 51.18 - Butterfly Valves
 - 7. Section 40 05 67.36 - Pressure-Reducing Valves
 - 8. Section 40 05 78 - Miscellaneous Valves

1.2 REFERENCE STANDARDS

- A. American Water Works Association (AWWA):
 - 1. AWWA C504 - Rubber-Seated Butterfly Valves, 3 In. Through 72 In.
 - 2. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.
 - 3. AWWA C541 - Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates.
 - 4. AWWA C550 - Protective Interior Coatings for Valves and Hydrants.
- B. ASTM International (ASTM):
 - 1. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
 - 2. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

- C. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):
 - 1. MSS SP-25 - Standard Marking System for Valves, Fittings, Flanges and Unions.
- D. NSF International (NSF):
 - 1. NSF 61 - Drinking Water System Components - Health Effects.
 - 2. NSF 372 - Drinking Water System Components - Lead Content.

1.3 COORDINATION

- A. Contractor shall be solely responsible to coordinate Work of this Section with piping, equipment, and appurtenances.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 - 1. Submit Manufacturer's latest published literature. Include illustrations, installation and maintenance instructions, and parts lists.
 - 2. Submit valve cavitation limits.
- C. NOT USED
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit installation instructions and special requirements, including storage and handling procedures.
- F. Lining and coating data.
- G. Valve Labeling Schedule: Indicate valve locations and nametag text.
- H. Certification of Valves Larger than 12 inches: Furnish certified copies of hydrostatic factory tests, indicating compliance with applicable standards.
- I. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- J. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections, including factory-applied coatings.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves and actuators.

- B. Operation and Maintenance Data: Submit information for valves.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare Parts:

- 1. Furnish one set of Manufacturer's recommended spare parts.

- B. Tools:

- 1. Furnish special wrenches and other devices required for Owner to maintain equipment.
 - 2. Furnish compatible and appropriately labeled toolbox when requested by Owner.

1.7 QUALITY ASSURANCE

- A. Cast Manufacturer's name, pressure rating, size of valve, and year of fabrication into valve body.
- B. Valve Testing: Each valve body shall be tested under a test pressure equal to twice its design water-working pressure.
- C. Certification: Prior to shipment, submit for all valves over 12 inches in diameter, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, ASTM, etc. Valves tested and supplied shall be trackable and traceable by serial number, tagged or otherwise noted on valve, upon arrival to Site.
- D. Maintain clearances as indicated on Drawings.
- E. Unless otherwise noted, all water works materials provided for the Project shall be new, of first-class quality and shall be made by reputable manufacturers.
- F. All material of a like kind shall be provided from a single manufacturer, unless otherwise approved by the Owner's Representative.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.
- B. Store materials according to Manufacturer instructions.
 - 1. Store materials in areas protected from weather, moisture, or other potential damage.

2. Do not store materials directly on ground.
- C. Protection:
1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.
 3. Provide additional protection according to Manufacturer instructions.
- D. Handle products carefully to prevent damage to interior or exterior surfaces.
- E. All defective or damaged materials shall be replaced with new materials at no cost to the Owner.

1.9 EXISTING CONDITIONS

- A. Field Measurements:
1. Verify field measurements prior to fabrication.
 2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 GENERAL

- A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the "lead free" requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.
1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for "lead free".
 2. All brass in contact with potable water shall comply with ASTM B584.

2.2 VALVES

- A. Description: Valves, operator, actuator, handwheel, chainwheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and other accessories as required and shown in the Drawings.

- B. Operation:
 - 1. Open by turning counterclockwise; close by turning clockwise.
 - 2. Cast directional arrow on valve or actuator with OPEN and CLOSE cast on valve in appropriate location.
- C. Valve Construction:
 - 1. Bodies: Rated for maximum temperature and pressure to which valve will be subjected as specified in valve Sections.
- D. Connecting Nuts and Bolts: Stainless steel.

2.3 RESILIENT-SEATED GATE VALVES

- A. As specified in Section 40 05 51.15, Gate Valves.

2.4 RUBBER-SEATED BUTTERFLY VALVES

- A. As specified in Section 40 05 51.18, Butterfly Valves.

2.5 VALVE ACTUATORS

- A. All valves shall be furnished with manual actuators, unless otherwise indicated in the Drawings.
- B. Valves in sizes up to and including 4 inches in diameter shall have direct acting lever or handwheel actuators of the Manufacturer's best standard design.
- C. Actuators shall be sized for the valve design pressure in accordance with AWWA C504.
- D. Provide actuators with position indicators for shutoff valves 6 inches and larger.
- E. Comply with AWWA C541 and C542, where applicable.
- F. Furnish gear operators for valves 8 inches and larger, and chainwheel operators for valves mounted over 7 feet above floor.
- G. Provide gear and power actuators with position indicators.
- H. Gear-Assisted Manual Actuators:
 - 1. Provide totally enclosed gears.
 - 2. Maximum Operating Force: 60-pound-force (lbf).
 - 3. Bearings: Permanently lubricated bronze.

4. Packing: Accessible for adjustment without requiring removal of actuator from valve.
- I. Handwheel:
 1. Furnish permanently attached handwheel for emergency manual operation.
 2. Rotation: None during powered operation.
 3. Permanently affix directional arrow and cast OPEN or CLOSE on handwheel to indicate appropriate direction to turn handwheel.
 4. Maximum Operating Force: 60 lbf.

2.6 SOURCE QUALITY CONTROL

- A. Testing: Test valves according to Manufacturer's standard testing protocol, including hydrostatic, seal, and performance testing.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that piping system is ready for valve installation.

3.2 PREPARATION

- A. Access: All valves shall be installed to provide easy access for operation, removal, and maintenance and to avoid conflicts between valve operators and structural members or handrails.
- B. Valve Accessories: Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the Contractor to properly assemble and install these various items so that all systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on shop drawing submittals.

3.3 INSTALLATION

- A. Install valves, actuators, extensions, and accessories according to Manufacturer instructions.
- B. Firmly support valves to avoid undue stresses on piping.
- C. Coat studs, bolts, and nuts with anti-seizing lubricant.

- D. Clean field welds of slag and splatter to provide a smooth surface.
- E. Install valves with stems upright or horizontal, not inverted.
- F. Install valves with clearance for installation of insulation and allowing access.
- G. Provide access where valves and fittings are not accessible.
- H. Comply with Division 40 - Process Interconnections for piping materials applying to various system types.
- I. Valve Applications:
 - 1. Install shutoff and drain valves at locations as indicated on Drawings and as specified in this Section.
 - 2. Install shutoff and isolation valves.
 - 3. Isolate equipment, part of systems, or vertical risers as indicated on Drawings.
 - 4. Install valves for throttling, bypass, or manual flow control services as indicated on Drawings.
- J. Disinfection of Water Piping System:
 - 1. Flush and disinfect system as specified in Section 33 13 00, Testing and Disinfection of Water Utility Piping.

3.4 FIELD QUALITY CONTROL

- A. Valve Field Testing:
 - 1. Test for proper alignment.
 - 2. If specified by valve Section, field test equipment to demonstrate operation without undue leakage, noise, vibration, or overheating.
 - 3. Owner's Representative will witness field testing.

END OF SECTION

SECTION 40 05 51.15 - GATE VALVES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes gate valves for use in buried service and utility vaults. Coordinate with Section 33 12 16, Water Utility Distribution and Transmission Valves and Section 40 05 23, Common Work Results for Process Valves.
- B. Section Includes:
 - 1. Resilient-seated gate valves.
- C. Related Sections:
 - 1. Section 33 12 16 - Water Utility Distribution and Transmission Valves
 - 2. Section 33 11 10 - Water Utility Distribution and Transmission Piping
 - 3. Section 40 05 13 - Common Work Results for Process Piping
 - 4. Section 40 05 51 - Common Work Results for Process Valves

1.2 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.
 - 2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 - Metric/Inch Standard.
 - 3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.
 - 4. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).
- B. ASTM International (ASTM):
 - 1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
 - 3. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

- C. American Water Works Association (AWWA):
 - 1. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.
 - 2. AWWA C550 - Protecting Interior Coatings for Valves and Hydrants.
- D. NSF International (NSF):
 - 1. NSF/ANSI Standard 61 - Drinking Water System Components - Health Effects
 - 2. NSF/ANSI Standard 372 - Drinking Water System Components - Lead Content

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. As required by Section 33 12 16 - Water Utility Distribution and Transmission Valves and Section 40 05 23, Common Work Results for Process Valves.

PART 2 PRODUCTS

2.1 GENERAL

- A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the "lead free" requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.
 - 1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for "lead free".
 - 2. All brass in contact with potable water shall comply with ASTM B584.

2.2 RESILIENT-SEATED GATE VALVES

- A. Description:
 - 1. Comply with AWWA C509.
 - 2. Minimum Pressure Rating:
 - a. Twelve-inch Diameter and Smaller: 200 pounds per square inch (gauge) (psig).
 - b. Sixteen-inch Diameter and Larger: 150 psig.
 - 3. End Connections: As shown in the Drawings.
 - a. Standard mechanical joint ends comply with ANSI/AWWA C111.

- D. Manufacturers:
 - 1. Clow Valve Company.
 - 2. M&H Valve.
 - 3. U.S. Pipe.
 - 4. American Flow Control.
 - 5. Mueller Company.

2.3 SOURCE QUALITY CONTROL

- A. Testing: Test gate valves according to AWWA C509.

PART 3 EXECUTION

3.1 INSTALLATION

- A. As required by Section 33 12 16, Water Utility Distribution and Transmission Valves and Section 40 05 23 - Common Work Results for Process Valves.
- B. Install according to Manufacturer's instructions.
- C. Support valves in plastic piping to prevent undue stresses on piping.

END OF SECTION

SECTION 40 05 51.18 - BUTTERFLY VALVES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes butterfly valves for use in buried service, and utility vaults. Coordinate with Section 33 12 16, Water Utility Distribution and Transmission Valves and Section 40 05 23, Common Work Results for Process Valves.
- B. Section Includes:
 - 1. Rubber-seated butterfly valves.
- C. Related Sections:
 - 1. Section 33 12 16 - Water Utility Distribution and Transmission Valves
 - 2. Section 33 11 10 - Water Utility Distribution and Transmission Piping
 - 3. Section 40 05 13 - Common Work Results for Process Piping
 - 4. Section 40 05 51 - Common Work Results for Process Valves

1.2 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.
 - 2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 - Metric/Inch Standard.
 - 3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.
- B. ASTM International (ASTM):
 - 1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. ASTM A536 - Standard Specification for Ductile Iron Castings.
 - 3. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
 - 4. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
- C. American Water Works Association (AWWA):
 - 1. AWWA C504 - Rubber-Seated Butterfly Valves, 3 In. (75 mm) Through 72 In. (1,800 mm).

2. AWWA C550 - Protecting Interior Coatings for Valves and Hydrants.
- D. NSF International (NSF):
1. NSF/ANSI Standard 61 - Drinking Water System Components - Health Effects
 2. NSF/ANSI Standard 372 - Drinking Water System Components - Lead Content

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. As required by Section 33 12 16 - Water Utility Distribution and Transmission Valves and Section 40 05 23, Common Work Results for Process Valves.]

PART 2 PRODUCTS

2.1 GENERAL

- A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the "lead free" requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.
 1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for "lead free".
 2. All brass in contact with potable water shall comply with ASTM B584.

2.2 RUBBER-SEATED BUTTERFLY VALVES

- A. Description:
 1. Comply with AWWA C504, Class 150B and 250B as indicated in the Drawings.
 2. Minimum Pressure Rating:
 - a. Twelve-inch (300-millimeter) Diameter and Smaller: 200 pounds per square inch (gauge) (psig).
 - b. Sixteen-inch (400-millimeter) Diameter and Larger: 150 psig.
 3. End Connections: As shown in the Drawings.
 - a. Standard mechanical joint ends comply with ANSI/AWWA C111.

- b. Flanged end dimensions and drilling comply with ANSI/ASME B16.1, Class 125, unless shown otherwise. Comply with AWWA C115 & ASME 16.5.
 - 1) The Contractor shall coordinate with pipe, valve, and fitting suppliers to make certain pipe, valve, and fitting flanges match in bolt pattern.
 - 4. Gear Actuators: Conforming to AWWA C504 for manual valves.
 - 5. Linings and Coatings:
 - a. Corrosion-resistant fusion bonded epoxy conforming to AWWA C550 and NSF 61.
 - b. All internal and external ferrous surfaces.
 - c. Do not coat flange faces of valves.
 - 6. Bubble-tight at the rated pressure for bi-directional flow.
 - 7. Style: Wafer.
 - 8. Shaft: Self-lubricating, sleeve-type bearings. One-piece, through-shaft construction.
 - a. Valve shafts shall be full size for that portion of the shaft extending through the valve bearings, valve disc, and shaft seal.
 - b. Any portion of the shaft turned down for any reason shall have fillets with radii equal to the offset to minimize stress concentrations at the junction of the different shaft diameters. The turned down portion of the shaft shall be capable of transmitting the maximum operator torque without exceeding a torsional steel stress of 11,500 pounds per square inch (psi).
 - 9. Seats: Mounted on body for valves 24 inches and smaller; field replaceable (mechanically retained in a machined groove) for valves larger than 24 inches.
 - 10. Packing: Replaceable without dismantling valve.
- B. Operation:
- 1. Open counterclockwise, unless otherwise indicated in the Drawings.
 - 2. Operators shall be of the traveling nut, self-locking type and shall be designed to hold the valve in any intermediate position between full open and fully closed without creeping or fluttering.
 - 3. Buried Valves: All buried valves shall be provided with 2-inch square operating nuts.

4. In-Plant Service Valves: Valves for in-plant or exposed service shall be furnished with handwheel operators, unless otherwise specified in Section 40 05 23, Common Work Results for Process Valves.

C. Materials:

1. Body: ASTM A126, cast iron or ASTM A536, ductile iron. Integrally cast flanged or mechanical end joints.
2. Shaft: Stainless steel.
3. Disc: ASTM A126, cast iron or ASTM A536, ductile iron.
4. Seats: Resilient, replaceable, Buna-N.
5. Seating Surfaces: Type 316 stainless steel.
6. Bearings:
 - a. Sleeve: Corrosion-resistant and self-lubricating.

D. Manufacturers:

1. M&H Valve.
2. Henry Pratt Company.
3. Mueller Company.
4. Kennedy Valve Company.
5. Dezurik.
6. Val-Matic Valve & Manufacturing Corporation.

2.3 SOURCE QUALITY CONTROL

- A. Testing: Test butterfly valves according to AWWA C504.

PART 3 EXECUTION

3.1 INSTALLATION

- A. As required by Section 33 12 16, Water Utility Distribution and Transmission Valves and/or Section 40 05 23 - Common Work Results for Process Valves].
- B. Install according to Manufacturer's instructions.

END OF SECTION

SECTION 40 05 78 - MISCELLANEOUS VALVES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes miscellaneous valves not included in other Sections for use in buried service and utility vaults.
- B. Section Includes:
 - 1. Air release valves.
 - 2. Combination air/vacuum valves.
 - 3. Blow-off hydrant assemblies.
 - 4. Ball valves, 2 inches and under.
- C. Related Sections:
 - 1. Section 05 50 00, Metal Fabrications
 - 2. Section 09 90 00, Painting and Coating
 - 3. Section 33 11 10, Water Utility Distribution and Transmission Piping.
 - 4. Section 40 05 13, Common Work Results for Process Piping.
 - 5. Section 40 05 51, Common Work Results for Process Valves.

1.2 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.
 - 2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 - Metric/Inch Standard.
 - 3. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded.
 - 4. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.
 - 5. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).
- B. ASTM International (ASTM):
 - 1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. ASTM A536 - Standard Specification for Ductile Iron Castings.

3. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

1.3 COORDINATION

- A. Contractor shall be solely responsible to coordinate Work of this Section with piping, equipment, and appurtenances.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 1. Submit Manufacturer's latest published literature. Include illustrations, installation and maintenance instructions, and parts lists.
 2. Submit valve sizing calculations.
 3. Submit valve cavitation limits.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit installation instructions and special requirements, including storage and handling procedures.
- E. Lining and coating data.
- F. Valve Labeling Schedule: Indicate valve locations and nametag text.
- G. Certification of Valves Larger than 12 inches: Furnish certified copies of hydrostatic factory tests, indicating compliance with applicable standards.
- H. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- I. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections, including factory-applied coatings.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves and actuators.
- B. Operation and Maintenance Data: Submit information for valves.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts:

1. Furnish one set of Manufacturer's recommended spare parts.

B. Tools:

1. Furnish special wrenches and other devices required for Owner to maintain equipment.
2. Furnish compatible and appropriately labeled toolbox when requested by Owner.

1.7 QUALITY ASSURANCE

A. Cast Manufacturer's name, pressure rating, size of valve, and year of fabrication into valve body.

B. Valve Testing: Each valve body shall be tested under a test pressure equal to twice its design water-working pressure.

C. Certification: Prior to shipment, submit for all valves over 12 inches in diameter, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, ASTM, etc. Valves tested and supplied shall be trackable and traceable by serial number, tagged or otherwise noted on valve, upon arrival to Site.

D. Maintain clearances as indicated on Drawings.

E. Unless otherwise noted, all water works materials provided for the Project shall be new, of first-class quality and shall be made by reputable manufacturers.

F. All material of a like kind shall be provided from a single manufacturer, unless otherwise approved by the Owner's Representative.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.

B. Store materials according to Manufacturer instructions.

1. Store materials in areas protected from weather, moisture, or other potential damage.
2. Do not store materials directly on ground.

- C. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.
 - 3. Provide additional protection according to Manufacturer instructions.
- D. Handle products carefully to prevent damage to interior or exterior surfaces.
- E. All defective or damaged materials shall be replaced with new materials at no cost to the Owner.

PART 2 PRODUCTS

2.1 GENERAL

- A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the "lead free" requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.
 - 1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for "lead free".
 - 2. All brass in contact with potable water shall comply with ASTM B584.

2.2 NOT USED

2.3 NOT USED

2.4 AIR RELEASE VALVES

- A. Description:
 - 1. Inlet Size: 2-inch diameter and smaller.
 - 2. Cast-iron body and cover. Comply with ASTM A126, Class B.
 - 3. Stainless steel orifice and float. Comply with ASTM A240.
 - 4. Design test pressure: 450 psig.
- B. Manufacturers:
 - 1. DeZurik - APCO Series 200A or equal.

2.5 COMBINATION AIR/VACUUM VALVES

A. Description:

1. Construction: Two independent valves: one air/vacuum valve, one air release valve.
2. Inlet Size: Greater than 2-inch diameter.
3. Cast iron body and cover. Comply with ASTM A126, Class B.
4. Stainless steel orifice and float. Comply with ASTM A240.
5. Valves seats: Buna-N.

B. Manufacturers:

1. DeZurik - APCO Series 1700 or equal.

2.6 BLOW-OFF HYDRANT ASSEMBLIES

A. Description:

1. Material: 100 percent low-lead brass.
2. Inlet: 2-inch diameter female iron pipe (FIP) vertical straight inlet.
3. Outlet: 2-inch diameter male iron pipe (MIP).
4. Operation:
 - a. By turning a top-mounted square operating nut.
 - b. Operation must seal drain outlet in all positions from 1/4-open to fully open.
5. Hydrant shall be non-freezing, self-draining.
6. Accessories: Provide Owner with one operating wrench.

B. Manufacturers:

1. Kupferle – Truflo #TF500 or equal.

2.7 NOT USED

2.8 NOT USED

2.9 BALL VALVES, 2 INCHES AND UNDER

A. Description:

1. Four hundred pound. Water, oil, and gas rating (WOG) with bronze body and trim, unless otherwise shown on the Drawings.

2. Seat ring: Tetrafluoroethylene (TFE).
 3. O-ring seals: Fluorocarbon.
 4. Three-piece construction so that maintenance can be performed without distributing the valve body after installation.
- B. Manufacturer:
1. Nibco T-590-Y or equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install valves per Manufacturer requirements and recommendations.
- B. Install all valves with valve seats level.
- C. Install protective strainers upstream of solenoid valves, pressure-reducing valves, and pressure-sustaining valves.

END OF SECTION

SECTION 40 61 21 - PROCESS CONTROL SYSTEM TESTING

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section specifies Contractor and Systems Integrator performance in testing and documentation of process instrumentation and control system materials and equipment.
- B. The term instrumentation covers field and panel instruments, analyzers, primary sensing elements, transmitters, power supplies, and monitoring devices.
- C. Provide the labor, tools, material, power, and services necessary to provide the process instrumentation and control system inspection and testing specified herein. Coordinate all testing with other sections:
 - 1. Pre-Operational Performance Testing Sequence:
 - a. Wiring Testing
 - b. Installation Inspection
 - c. Loop Testing
 - 2. Functional Acceptance Testing (FAT) Sequence:
 - a. Process Control Strategy Testing
 - b. Control System Closed Loop Testing
 - c. Functional Checkout
 - 3. Operational Testing:
 - a. System Acceptance Testing (SAT)

1.2 QUALITY ASSURANCE

- A. References:
 - 1. This section contains references to the following documents with additional references as specified.
 - a. All references shall be to the current edition of the document unless specifically stated otherwise. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

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

Reference	Title
ISA S51.1	Process Instrumentation Terminology

B. Project Labeling:

- 1. The items specifying project labeling herein shall include the following as a minimum: Owner’s name, facility name, project name, and project number.

1.3 SUBMITTALS

A. Submittal material shall consist of the following:

- 1. Qualification Submittal:
 - a. Provide the following submittal documentation:
 - 1) Example test forms per paragraph 3.1.D, Field Test Procedure Documentation, revised to show Project Labeling per paragraph 1.2.B, Project Labeling.
 - 2) Example I/O interface summary.
- 2. Definition Submittal: Provide the following submittal after review of the Qualification Submittal.
 - a. Control descriptions.
 - b. I/O Interface Summaries.
 - c. Testing status spreadsheets.
 - d. Test procedures per paragraph 3.1.D, Field Test Procedure Documentation.

- e. Proposed test forms per paragraph 3.1.D of this Section, detailed for each test for this project.
- f. Certified Factory Calibration Reports.
- g. Provide a copy of this specification and the referenced and applicable sections with addenda updates included with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
- h. Provide a copy of all Addenda updates marked to indicate requested deviations from specified requirements.
- i. Provide a copy of all referenced and applicable Instrumentation Drawings with addenda updates included, marked to indicate requested deviations from specified requirements.
- j. Provide a copy of all referenced and applicable City of as-built Electrical Drawing's, Control Diagrams with any applicable addenda updates included, marked to indicate requested deviations from specified requirements.
- k. Failure to include a copy of the specifications and proposed drawings with the submittal shall be cause for rejection of the entire submittal with no further consideration.

PART 2 PRODUCTS

2.1 PRODUCT DATA

- A. Provide the following product data submittal after completion of testing as part of the Operations and Maintenance Submittal.
- B. The following information shall be provided:
 - 1. Completed test forms per paragraph 3.1.D.
 - 2. List of factory calibrated items and calibration certificates.
 - 3. Final Test Report assembled in a three-ring binder and submitted at the completion of the inspection and testing activities.
 - a. The binder cover and spine shall be labeled to identify the project name. Test report shall include the applicable test procedures and the completed inspection and test report forms associated with the equipment and systems.

- b. Test results shall be organized by equipment item or system with individual, labeled tab dividers. System deficiencies and non-compliant test results identified in the final test report shall be acknowledged by the responsible testing entity as corrected.

PART 3 EXECUTION

3.1 GENERAL

A. General Requirements:

1. Materials, equipment, and construction included under this specification shall be inspected in accordance with this Section and subsequent Sections of this Division. Testing shall be performed by the Contractor in accordance with this and subsequent Sections.
2. No required test shall be applied without prior notice to the Owner. At least two weeks before the commencement of any testing activity, the Contractor shall provide a detailed step-by-step test procedure complete with forms for the recording of test results, testing equipment used, and a place for identification of the individual performing or, if applicable, witnessing the test.

B. Technician Qualifications:

1. Field instruments and analyzers shall be calibrated and set up by a certified instrument technician qualified to calibrate the instrumentation.
2. Technicians shall be qualified by completion and certification from training courses in accordance with the requirements of paragraph 40 90 00 1.2C.

C. Field Test Procedure Submittal:

1. Test procedures submitted for approval within 30 days from the date of Notice to Proceed. Field Test Procedure Submittal may be included with the Definitions Submittal specified in paragraph 1.3A.2 above.
2. Test procedures for each analog and discrete loop in the process control system shall be organized and assembled a single volume. Final test records shall be submitted in electronic form by scanning and converting the records and files to Adobe PDF format, to preserve actual signatures and signoffs.
3. Test procedure documentation shall include a detailed, step-by-step description of the required test procedure, panel and terminal block numbers for points of measurement, input test values, expected resultant values, test equipment required, process setup requirements, and safety precautions.

4. Test report forms for each loop, including forms for wiring, piping, and individual component tests, shall be included with the test procedure documentation. The actual test results shall be recorded on these forms and a final test report assembled and submitted for final approval.
 5. Test report forms shall be preprinted and completed to the extent possible prior to commencing testing. Test report forms that document the field test procedures shall include the following information:
 - a. Project name
 - b. Equipment under test.
 - c. Instrument loop description.
 - d. Instrument loop identification number.
 - e. Instrument nameplate data.
 - f. Instrument setup and configuration parameters.
 - g. Time and date of proposed test.
 - h. Inspection checklist with results column.
 - i. Reference to applicable test procedure.
 - j. Expected and actual test results fields for each test point in the loop to include programmable controller data table or register values.
 - k. Test equipment used.
 - l. Space for remarks regarding test procedure or results, observations, etc.
 - m. Name, date, and signature of testing personnel.
 - n. Test witness' name and signature.
- D. Performance Deviation Tolerances:
1. Tolerances shall be as specified. Where tolerances are not specified, refer to the manufacturer's published performance specifications.
 2. Overall accuracy requirements for loops consisting of two or more components shall be the root-summation-square (RSS) of the component accuracy specifications. Tolerances for each required calibration point shall be calculated and recorded on the associated test report form.

E. Installed Tests:

1. Contractor shall test equipment, system performance and operations of the PLC Control systems. The Contractor's Quality Assurance Manager shall coordinate, manage, and supervise the quality assurance program that includes:
 - a. Testing plan with the sequence for the test work.
 - b. Documentation program that records tests results.
 - c. Performance testing program systems.

F. Witnessing:

1. The Owner reserves the right to observe factory and field instrumentation testing and calibration procedures. The Owner shall be notified prior to testing, as specified herein.

3.2 PRE-OPERATIONAL PERFORMANCE TESTING

A. General Requirements:

1. In general, tests shall be performed in the following order:

B. Wiring Tests:

1. Electrical power and signal cable ring-out and resistance testing. Wiring tests shall not be conducted until cables have been properly terminated, tagged and inspected.
 - a. Power and Control.
 - b. Signal.

C. Loop Testing:

1. Each instrument loop shall be tested as an integrated system. Check operation from field instruments to transmitter to receiving components to the vendor panel or the Plant Control System Operator Interface Station. Test signals shall be injected at the process impulse line connection where the measuring technique permits, and otherwise at the most primary signal access point.
2. Testing of loops with an interface to a programmable logic controller shall include verification of the programmable logic controller input/output assignment and verification of operation of the input/output system and processor. Inspect the data table or register in the programmable logic controller memory to verify proper operation.

3. Verify data communications are functional between the PLCs, Remote I/O, Local HMI Panels and the SCADA Servers. Verify the operations of Tag Name values in SCADA/HMI match PLC register values.
4. If the output control or monitoring device fails to indicate properly, corrections to the loop circuitry or device shall be made. The test shall be repeated until devices and instruments operate as required.
5. Correct loop circuitry and repeat the test until the instruments operate properly.

3.3 FUNCTIONAL TESTING

A. Process Control Strategy/Functional Testing:

1. Control Strategy Testing shall not commence until the Loop Testing has been completed and documented to the satisfaction of the Owner.
2. Control Strategy Testing is performed by the Systems Integrator and consist of installing and debugging the PLC control logic program, verifying the interface points between the PLCs and field devices and equipment, and exercising the control strategies. Control Strategy Testing will be performed on one PLC chassis at a time.
3. Provide qualified personnel to immediately correct any deficiencies in the Work that may be encountered during Control Strategy Testing. Failure of the Contractor to provide such personnel in a timely manner may prolong the time allotted to complete Control Strategy Testing.

B. Control System Closed Loop Testing:

1. Closed-Loop Commissioning shall not commence until the Control Strategy Testing has been successfully completed and documented to the satisfaction of the Owner.
2. Closed-loop commissioning tests, performed as part of the system tests, shall demonstrate stable operation of each loop under operating conditions. Tests shall include adjustment of loop tuning parameters.
3. Tuning parameters: gain (or proportional band), integral time constant, and derivative time constant for each control loop, adjusted to provide 1/4-amplitude damping, unless otherwise specified.
4. The loop response to a step disturbance shall be provided for each loop. Two graphs shall be made for cascaded control loops, one showing the secondary loop response with its set point in manual, and the second showing overall loop response.

5. Control loops with "batch" features shall be adjusted to provide optimum response following start-up from an integral action saturation condition.
 6. SCADA Historical Trace printout shall be provided showing the response and made at sufficient speed and amplitude to show 1/4 amplitude damping. Label to show loop number and title, and settings of parameters and set point.
 7. Where a loop is controlled under the direction of a programmable logic controller, the Contractor will perform the necessary adjustment of loop tuning parameters and setpoints; Contractor shall record the loop response, adjusting final elements, and assuring total integrated loop performance as specified.
- C. Functional Checkout:
1. Conducted to verify the operation of discrete and hardwired control devices. Exercise the operable devices and energizing the control circuit. Operate control element, alarm device, and interlocks to verify the specified action occurs.

3.4 OPERATIONAL TESTING

- A. System Acceptance Test (SAT) shall be performed after component and subsystem tests have been completed. The test of the completed system shall be performed in full operation, shall demonstrate that all functional requirements of this specification have been met and shall be at least 24 hours in length. Acceptance tests shall not be initiated or performed over scheduled City recognized holidays. SAT shall demonstrate the following:
1. Each component of the system operates correctly with all other components of the system.
 2. Analog control loops operate in a stable manner.
 3. Hard-wired and software equipment interlocks perform correctly.
 4. Process control sequences perform correctly.
 5. PLC application program performs monitoring and control functions correctly.
 6. Operator interface graphics represent the monitoring and control functions correctly.

3.5 SUPPLEMENTS

A. The supplements listed below, following “End of Section,” are a part of this Specification:

1. Unit Process Startup Form.
2. Facility Performance Demonstration/Certification Form.
3. Loop Status Report—Example Format.

END OF SECTION

UNIT PROCESS STARTUP FORM

AGENCY: _____ **PROJECT:** _____

Unit Process Description: (Include description and equipment number of all equipment a devices):

Startup Procedure (Describe procedure for sequential startup and evaluation, including valves be opened/closed, order of equipment startup, etc.):

Startup Requirements (Water, power, chemicals, etc.): _____

Evaluation Comments: _____

FACILITY PERFORMANCE DEMONSTRATION/CERTIFICATION FORM

AGENCY: _____ **PROJECT:** _____

Unit Processes Description (List unit processes involved in facility startup):

Unit Processes Startup Sequence (Describe sequence for startup, including computerized operations, if any):

Contractor Certification that Facility is capable of performing its intended function(s), including fully automatic operation:

Contractor: _____ **Date:** _____,
20____

Owner: _____ **Date:** _____,
20____

(Authorized Signature)

LOOP STATUS REPORT—EXAMPLE FORMAT

Rev.06.05.92

Project Name: <i>City of Bend</i>					Project No. <i>123456</i>		
FUNCTIONAL REQUIREMENTS:							
<i>1. Measure, locally indicate, and transmit RAS flow to LP-10.</i>							
<i>2. At LP-10 indicate flow and provide flow control by modulation of FCV-10-2.</i>							
<i>3. Provide high RAS flow alarm on LP-10.</i>							
COMPONENT STATUS (Check and initial each item when complete)							
Tag Number	Delivered	Tag ID Checked	Installation	Termination Wiring	Termination Tubing	Calibration	
<i>FE/FIT-10-2</i>	<i>Jan-12-90 DWM</i>	<i>Jan-12-90 DWM</i>	<i>Feb-7-90 DWM</i>	<i>Mar-5-90 DWM</i>	<i>N.A.</i>	<i>May-6-90 VDA</i>	
<i>FIC-10-2</i>	<i>Jan-12-90 DWM</i>	<i>Jan-12-90 DWM</i>	<i>Mar-5-90 DWM</i>	<i>Apr-4-90 DWM</i>		<i>May-4-90 VDA</i>	
<i>FSH-10-2</i>	<i>Jan-12-90 DWM</i>	<i>Jan-12-90 DWM</i>	<i>Mar-5-90 DWM</i>	<i>Apr-4-90 DWM</i>		<i>May-7-90 VDA</i>	
<i>FAH-10-2</i>	<i>Jan-12-90 DWM</i>	<i>Jan-12-90 DWM</i>	<i>Mar-5-90 DWM</i>	<i>Apr-4-90 DWM</i>		<i>May-7-90 VDA</i>	
<i>FCV-10-2</i>	<i>Mar-2-90 DWM</i>	<i>Mar-2-90 DWM</i>	<i>Apr-20-90 DWM</i>	<i>Apr-30-90 DWM</i>		<i>May-16-90 VDA</i>	
REMARKS: <i>None.</i>							
Loop Ready for Operation		By: <i>D.W. Munzer</i>		Date: <i>May-18-90</i>		Loop No.: <i>10-2</i>	