

TECHNICAL SPECIFICATIONS
FOR
WALLA WALLA BASIN WATERSHED COUNCIL
CITY OF MILTON-FREEWATER WELL NO. 5
AQUIFER STORAGE AND RECOVERY DEMONSTRATION PROJECT

2018



RENEWS: 6-30-2020

ANDERSON PERRY & ASSOCIATES, INC.
Walla Walla, Washington
La Grande, Redmond, and Hermiston, Oregon

TABLE OF CONTENTS

TECHNICAL SPECIFICATIONS

Section 1	Underground Piping
Section 2	Wellhead Improvements
Section 3	Mobile Water Treatment Systems
Section 4	Intake Screen and Infeed Pump Station
Section 5	Painting

TABLE OF CONTENTS
SECTION 1
UNDERGROUND PIPING

PART 1 - General	1-1
1.1 Summary	1-1
1.2 Definitions	1-1
1.3 Submittals.....	1-2
1.4 Safety.....	1-2
1.5 Existing Utilities	1-6
1.6 Dust and Mud Control.....	1-10
1.7 Soil and Groundwater Conditions.....	1-10
1.8 Dewatering.....	1-10
 PART 2 - Materials.....	 1-11
2.1 Foundation Material	1-11
2.2 Bedding and Select Backfill	1-11
2.3 General Backfill.....	1-11
2.4 Controlled Density Fill (CDF)	1-12
2.5 Anti-Flotation, Dewatering, and Trench Stabilization Fabrics	1-12
2.6 Water Supply Pipe.....	1-12
2.7 Water Supply Fittings.....	1-13
2.8 Waste Pipe	1-14
2.9 Manholes.....	1-15
 PART 3 - Execution	 1-17
3.1 Clearing and Grubbing.....	1-17
3.2 Cutting of Asphalt Pavement, Concrete Sidewalks, Curbs, and Driveways.....	1-17
3.3 Trench Excavation	1-18
3.4 Shoring, Sheeting, and Bracing of Trenches	1-19
3.5 Dewatering Excavated Areas.....	1-19
3.6 Location of Excavated Materials	1-19
3.7 Disposal of Excavated Materials	1-20
3.8 Trench Backfill	1-20
3.9 Installation of Water Supply Pipe.....	1-23
3.10 Installation of Waste Pipe	1-24
3.11 Waste Pipe Testing.....	1-25
3.12 Connections to Existing Lines.....	1-28
3.13 Execution of Dust and Mud Control.....	1-29
3.14 Restoration, Finishing, and Cleanup	1-29
3.15 Other Installations.....	1-30
3.16 Removal and Salvage of Appurtenances, Fittings, and Other Items	1-30
3.17 Testing.....	1-30

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

PART 1 - GENERAL

1.1 Summary

- A. These Specifications cover the excavation and backfill of trenches for the installation of underground pipes and other underground utilities. Work shall be completed in accordance with these Specifications and Oregon Occupational Safety and Health standards.
- B. Items specified in this Technical Specification are intended to be broad in scope and may not always apply to all items of Work to be constructed. All applicable sections, as determined by the Engineer, shall apply to the Work outlined in the Contract Documents.

1.2 Definitions

- A. Foundation material or stabilization fabric will only be required when standard bedding requirements will not adequately support the pipe.
- B. Backfill is the filling of the trench to the existing ground level or the finish grade line shown on the Drawings.
- C. General trench excavation shall include whatever materials that are encountered (except solid rock) to the depths shown on the Drawings or as required to properly install the pipe.
- D. Solid Rock
 - 1. Solid rock is defined as being rock formations other than cemented gravels that require hard ripping, jackhammering, blasting, or other extra work beyond the capability of heavy-duty trench excavating equipment such as a Caterpillar 235 or 345B Excavator.
 - 2. Cemented gravel excavation may be included as "Rock Excavation" when said excavation requires hard ripping, jackhammering, or blasting and ONLY when, in the opinion of the Engineer, such conditions were unforeseen and are beyond the capability of heavy duty trench excavating equipment such as a Caterpillar 235 or 345B Excavator.

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

1.3 Submittals

- A. Water Supply Pipe and Fitting
- B. Waste Pipe and Fittings
- C. Manholes

1.4 Safety

- A. The Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work, including excavation safety. The Contractor shall comply with all applicable Laws and Regulations, ordinances, rules, and orders of any public body having jurisdiction as it relates to Project and Work safety.
- B. The Contractor shall maintain local access to area residents and emergency traffic throughout the life of the Project and coordinate construction activities closely with area residents to keep them informed of operations that may impact their use of any streets or roadways.
- C. All signs, barricades, barriers, lights, cones, trench boxes, shoring/bracing, and other such "devices" required to warn, protect, or direct the public and workmen during the life of the Contract shall be furnished, installed, moved, and removed by the Contractor. When conditions warrant their use, flagpersons shall also be provided by the Contractor. The determination of what measures are required, in addition to those specifically called for by the Drawings and Specifications, shall be solely the responsibility of the Contractor.
- D. The Engineer and Owner are not responsible for determining whether proper safety precautions, etc., are being utilized. Should the Contractor fail to furnish the necessary protective measures, the Owner or Engineer may, but shall not be required to, bring to the Contractor's attention by written notice of such failure and the Contractor shall undertake such corrective measures as is proper.
- E. All construction Work shall be performed in accordance with the provisions of the Occupational Safety and Health Regulations of the Oregon Occupational Safety and Health Division, and other applicable regulations. It shall be the Contractor's responsibility to meet all requirements of Chapter 437 of the State of Oregon Administrative Rules. In addition, Oregon Revised Statutes (ORS) 757.541 through 757.571 and Oregon Administrative Rules (OAR) 860-024-0006 and 860-024-0007 administered by the Oregon Public Utilities Commission shall apply.

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

- F. The materials used for and the installation of all warning and traffic control devices shall conform to the applicable provisions of the Oregon Standard Specifications for Construction - 2018 edition, Sections 00220 and 00225, and the Manual on Uniform Traffic Control Devices, U.S. Department of Transportation, Federal Highway Administration, current edition.
- G. It shall be the Contractor's sole responsibility to provide a "competent person" as defined in the regulations to be on the Project Site during all trenching operations. The "competent person" appointed by the Contractor shall fulfill all requirements of the regulations.
- H. Prior to opening an excavation, the Contractor shall arrange for field location of utility installations such as sewer, telephone, fuel, electric, gas, water lines, or any other underground installations that reasonably may be expected to be encountered during the excavation work. When excavation operations approach the estimated location of underground installations, the Contractor shall determine the exact location of the installations by safe and acceptable means. While the excavation is open, underground installations shall be protected, supported, or removed as necessary to safeguard workers.
- I. The Contractor shall ensure that structural ramps that are used by workers as a means of access or egress from an excavation shall be designed by a competent person, in accordance with all requirements of the regulations.
- J. Workers exposed to public vehicular traffic shall be provided with and shall wear warning vests or other suitable garments marked with, or made of, reflectorized or highly visible material. No worker shall be permitted underneath loads handled by lifting or digging equipment. Workers shall be required to stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials. Operators may remain in the cabs of vehicles being loaded or unloaded when the vehicles are equipped in accordance with the regulations to provide adequate protection for the operator during loading and unloading operations.
- K. The Contractor shall take adequate precautions, in accordance with the regulations, to prevent exposure to harmful levels of atmospheric contaminants and to assure acceptable atmospheric conditions. These precautions include providing proper respiratory protection or ventilation and, when controls are used that are intended to reduce the level of atmospheric contaminants to acceptable levels, the Contractor shall provide testing as often as necessary to ensure that the atmosphere remains safe. The Contractor shall provide emergency rescue equipment, such as breathing apparatus, safety harness, etc., where hazardous atmospheric conditions exist or may reasonably

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

be expected to develop during work in an excavation. This equipment shall be attended when in use.

- L. The Contractor shall not allow work in excavations in which there is accumulated water or in excavations where water is accumulating, unless adequate precautions have been taken to protect workers against the hazards posed by water accumulations. The precautions necessary to protect workers adequately vary with each situation, but include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of a safety harness and life line. If the Contractor is controlling water or preventing it from accumulating by the use of water removal equipment, the water removal equipment and operation shall be monitored by a competent person to ensure proper operation. If excavation work interrupts the natural drainage of surface water, such as streams, then diversion ditches, dikes or other suitable means shall be used to prevent surface water from entering the excavation and to provide adequate drainage of the area adjacent to the excavation.
- M. In situations where the Contractor feels their trench operations pose a risk to the stability of adjoining buildings, walls, or other structures, the Contractor shall notify the Engineer and shall provide adequate support systems per the requirements of the regulations. Excavation below the level of the base or footing of any foundation or retaining wall that could be reasonably expected to pose a hazard to workers shall not be permitted except when the Contractor has retained a Registered Professional Engineer and said Registered Professional Engineer has approved the determination that the structure is sufficiently removed from the excavation so as to be unaffected by the excavation activity, or said Registered Professional Engineer has approved the determination that such excavation will not pose a hazard to workers.
- N. Sidewalks, pavements, and appurtenant structures shall not be undermined unless a support system or other method of protection is provided to protect workers from the possible collapse of such structures. The Contractor shall provide adequate protection to all persons from loose rock or soil that could pose a hazard by falling or rolling from an excavation face. The Contractor shall also provide protection by placing and keeping excavated materials or equipment at least two feet from the edge of excavations, or by the use of retaining devices that are sufficient to prevent materials or equipment from falling or rolling into excavations or by a combination of both, if necessary.
- O. The Contractor shall ensure that daily inspections of excavations, the adjacent areas, and protective systems shall be made by a competent person appointed by the Contractor for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection shall be conducted by the competent person prior to the start of Work

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

and as needed throughout the shift. Inspection shall also be made after every rain storm or other hazard increasing occurrence. These inspections are only required when worker exposure can be reasonably anticipated. Where the competent person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, the Contractor shall remove workers from the hazardous area until the necessary precautions have been taken to ensure their safety.

- P. It shall be the Contractor's responsibility to provide all physical barrier protection at all excavations. All wells, pits, shafts, etc., shall be barricaded or covered. Further, no trenches shall be left open at any time unless guarded with adequate barricades, warning lamps, and signs. Proper traffic and pedestrian control shall be provided by the Contractor.
- Q. The Contractor shall ensure that each worker in an excavation shall be protected from cave-ins by an adequate protective system designed in accordance with the regulations.
- R. It shall be the Contractor's responsibility to design the sloping and benching systems for trench excavation in accordance with the requirements of the regulations stated herein. Where the Contractor takes the option to not utilize one of the standard tables or trench excavation designs contained in OAR Chapter 437, then it is the Contractor's responsibility to retain a Registered Professional Engineer to design said sloping and benching system. When the Contractor chooses this option, the design shall be in written form and shall include at least the following information:
 - S. The magnitude of the slopes that were determined to be safe for the particular Project.
 - T. The configurations that would determine to be safe for the particular Project.
 - U. The stamp and signature of the Registered Professional Engineer approving the design.
 - V. At least one copy of the design shall be maintained at the Project Site while the slope is being constructed. After that time the design need not be at the Project Site, but a copy shall be made available to the Owner upon request.
- W. Where the design of a support system, shield system, or other protective system is required, it shall be the Contractor's responsibility to meet all requirements of the regulations. It shall be the Contractor's responsibility to have on site at least one copy of the manufacturer's tabulated data which identifies the Registered Professional Engineer who approved the data or, when a support system or shield system or other protective system is not a standard manufactured item but is designed by a Registered Professional

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

Engineer, at least one copy of the design shall be maintained at the Project Site during construction of the protective system. After that time, the design may be stored off the Project Site, but a copy of the design shall be made available upon request.

- X. The determination of the safe trench width is the sole responsibility of the Contractor.

1.5 Existing Utilities

- A. The following utilities may be affected by the Contractor's Work:

1. Power
City of Milton-Freewater
722 S. Main / P.O. Box 6
Milton-Freewater, Oregon 97862
Rick Rambo
541-938-8231
2. Telephone/Fiber
CenturyLink
Craig Redelings
541-385-0296
Craig.redelings@centurylink.com
3. Gas
Cascade Natural Gas
300 S.W. 17th Street
Pendleton, Oregon 97801
Dan Harris
888-522-1130
4. Cable Television
Charter Communications
1145 Abadie Street
Walla Walla, Washington 99362
888-438-2427

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

5. Water
City of Milton-Freewater Public Works Department
501 Lamb / P.O. Box 6
Milton-Freewater, Oregon 97862
Shane Wright
541-938-8271
 6. Sewer
City of Milton-Freewater Public Works Department
501 Lamb / P.O. Box 6
Milton-Freewater, Oregon 97862
Bryan DeBeaumont
541-938-8271
- B. Known utilities and structures expected to be adjacent to or encountered in the Work are shown on the Drawings. Information on existing utilities may be provided by others and existing records may not be complete or accurate. It is expected there may be discrepancies and omissions in the location, size, and quantities of utilities and structures shown. Those shown are for convenience of the Contractor only, and no responsibility is assumed by either the Owner or Engineer for their accuracy. The Contractor shall work closely with the owner of any utilities or structures affected by the Work to avoid any damage.
- C. The Contractor shall be responsible for the actual locating and protecting of existing utilities. The Contractor, prior to commencement of Work, shall contact existing Utility Companies such as water, sewer, power, telephone, gas, etc., to have the Utility Companies locate all utilities which will be affected by the Work to be performed. The Contractor shall give 48-hour notification in accordance with ORS 757-541. The "call before you dig" number is 811 or 1-800-332-2344. The Contractor shall perform all necessary coordination work with the Utility Companies in performing the Work and shall be fully responsible for any damage to existing utilities caused by the Contractor's operations. The Contractor shall make any advance exploration necessary to protect all existing utilities and to properly plan the installation of pipelines or other work to the design line and grade. No payment shall be made for this work for up to two hours of advanced backhoe excavation work necessary to locate each existing utility at each specific site. The Work shall include all labor, equipment, etc., necessary to perform the location work. These costs shall be understood to be included in the Contract Prices. Should the Contractor be unable to locate the existing utility after its location has been marked by the appropriate utility company and diligent effort made by the Contractor to locate the utility including up to two hours of backhoe excavation work for each

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

utility at each location site, the Contractor may be entitled to additional compensation as outlined hereafter. When prior notice has been given to the Engineer and the Engineer gives approval, the Contractor shall be paid for all additional backhoe excavation work required to locate the utility on an hourly basis under the bid item "Additional Potholing" when listed in the Bid Schedule or through an approved Change Order. Any additional potholing work performed by the Contractor without prior written approval of the Engineer will not be paid for.

- D. If a conflict develops between the design line and grade of a pipeline or Project improvement and an existing utility, the Engineer may adjust the pipeline grade or have the existing utility relocated. The existing utility may be relocated by the owner of the utility or its designated representative or by the Contractor upon the approval of the utility owner and the Engineer. The Contractor shall perform all relocation work required by the Engineer. If the Contractor performs the relocation work, a Change Order shall be negotiated prior to any actual work unless payment for the work is specified otherwise.
- E. The owner of the utilities shall normally be responsible for taking the utility out of service if necessary for the performance of the Work; i.e., shutting valves, etc. In the case of water valves, the owner of the water system may operate the valves or request the Contractor to do so. When the Contractor is requested to do so, the Contractor shall operate water valves as a normal part of the Work at no additional cost to the Owner. All water valves shall be operated as instructed by the owner of the valves. It can be expected that some valves may not fully operate properly which may require that additional valves be operated. This situation shall be considered a normal requirement of the Work.
- F. The Contractor shall receive prior approval from the appropriate authority or utility owner before any public or private utility service is interrupted.
 - 1. The Contractor shall give a minimum of four hours notice to all utility customers who will be affected by the Contractor's operations. No utility service shall be disconnected or interrupted for more than nine hours or as required by the utility owner, whichever is less, in any 24-hour period. When disruption of service will be longer than nine hours in any one day, the Contractor shall provide safe and appropriate temporary service. All temporary service shall be coordinated with the utility owner.
 - 2. When regular utility service interruption is required during the course of the Work, the Contractor shall submit a written plan to the Engineer and utility owner which details proposed Work plan notification procedures, and estimated

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

extent of service interruption. The Contractor must obtain written approval of their plan from the utility owner prior to interrupting the utility service. As a minimum, notification shall include door hangers and public notification in the newspaper and radio, as appropriate. Personal contact shall be made where practical.

3. The Contractor shall make every effort possible to provide continuous utility service to all utility customers. When special conditions exist where an interruption of utility service would create an extra hardship on the utility customer or create a hazardous condition, the Contractor shall provide continuous service. Particular care and planning must be arranged to provide continuous service of existing services or temporary services as approved by the utility owner and the Engineer.
4. If the Contractor inadvertently damages or interrupts an existing utility, the Contractor shall immediately notify the affected utility company, Owner, Engineer, and utility users and make arrangements to provide temporary service to the parties affected.
5. The Contractor shall, as requested by the Engineer, either immediately arrange for the utility company to make the needed repairs or immediately make the repair to the damaged utility.
6. The Contractor shall pay the full cost of repair and damages when the utility was previously located and was within four feet on either side of the marked location as required by the Call Before You Dig notification system, or where negligence of the Contractor occurred.
7. The Contractor will be paid for the cost of repair and damages when existing utilities encountered during the performance of the Work were not previously located by the utility as required by the Call Before You Dig notification system, where existing utilities were farther than four feet away on either side of the marked location, and where damage to the utilities occurred due to no negligence of the Contractor.
8. If the Contractor fails to make immediate repairs and provide service as required, the Owner may have said Work performed by others and deduct the cost of said Work from payment to the Contractor.

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

- G. The Contractor shall support and otherwise protect all pipes, conduits, cables, poles, and other existing services where they cross the trench or are otherwise undermined or affected by their Work. The Contractor shall restore the support of an undermined existing utility using select backfill compacted to 95 percent maximum density as determined by ASTM D698, as applicable.

1.6 Dust and Mud Control

- A. The Contractor shall take appropriate action to control dust and mud caused by his operations. This shall include, but not be limited to, watering of exposed areas, cleaning of roadways, etc. This is considered a normal part of the construction Project.
- B. No measurement or payment shall be made for this Work.

1.7 Soil and Groundwater Conditions

- A. Soils data and groundwater conditions, when shown on the Drawings, are provided for the Contractor's information, may not be relied upon, and are a general description only. This information may or may not be shown. The Engineer assumes no responsibility for actual soil conditions.
- B. Soils data and groundwater conditions, when shown, shall not relieve the Contractor from the responsibility of making additional investigations. The Contractor shall perform investigations as deemed necessary to acquaint with actual conditions to be encountered in performing the Work. Groundwater conditions in particular should be carefully considered and are subject to change.

1.8 Dewatering

- A. The Work shall consist of the removal of surface water and groundwater as needed to perform the required construction. This also includes the dewatering of borrow sites. It shall include furnishing, construction, and operation of all temporary facilities and equipment. This construction specification also includes removal of temporary facilities.
- B. Protective measures needed to divert streamflow and other surface water shall be built, maintained, and operated during construction.
- C. The construction site shall be dewatered and kept free of standing water or excessively muddy conditions as needed for proper execution of the construction work. Dewatering shall include furnishing, installing, operating, and maintaining all equipment including pumps as needed.

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

- D. After the temporary work has served its purpose, it shall be removed or graded to present a slightly appearance without interfering with permanent drainage systems or stream flows.
- E. All temporary work shall be accomplished in such a manner that erosion and the transmission of sediment and other pollutants are minimized in accordance with NRCS Standards and Oregon Department of Environmental Quality requirements.

PART 2 - MATERIALS

2.1 Foundation Material

Foundation material shall be well-graded 2-1/2"-0 or 1-1/2"-0 crushed rock.

2.2 Bedding and Select Backfill

Bedding and select backfill shall be well-graded 3/4"-0 or 1"-0 crushed rock or approved equal. All bedding and select backfill materials shall be subject to the approval of the Engineer.

2.3 General Backfill

- A. General backfill will consist of material excavated from the trench, or material imported by the Contractor. General backfill material shall be free of vegetative matter, boulders (10-inch plus), frozen material and any other unsuitable material, and shall have a moisture content that will allow for the required compaction of the general backfill material unless approved otherwise by the Engineer. Use of backfill material containing consolidated masses 3 inch in diameter or greater is prohibited within 2 feet of the pipe. Masses 10 inch in diameter or greater are prohibited.
- B. When necessary, the Contractor shall selectively separate suitable general backfill material from unsuitable general backfill material.
- C. When the Engineer determines that the native material excavated from the trench is unsuitable or unacceptable for use as general backfill, the Engineer may require the Contractor to remove the unsuitable material from the project site and import suitable general backfill material. Suitable material shall be similar in nature to native soils as approved by the Engineer. When imported general backfill must be placed in or below the groundwater, the imported general backfill shall be free draining granular material with less than 20 percent passing a No. 4 sieve and less than 3 percent passing a No. 200 sieve.

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

2.4 Controlled Density Fill (CDF)

- A. CDF material shall be a flowable cement, sand or pea gravel, and Fly Ash Pozzolanic, or other approved materials, mixture that contains 75 to 120 pounds of Type II cement per cubic yard.
- B. The sand and other aggregates shall generally conform with the requirements of ASTM C33.
- C. Air-entraining agent shall be added at the rate of 3 to 5 ounce per cubic yard.
- D. The material shall have a 28-day compressive strength of 100 to 200 psi and have a slump of 7 inches plus or minus 1-1/2 inches at the time of placement. The Contractor shall provide a mix design and data on the CDF material proposed to use, along with typical compression test results.

2.5 Anti-Flotation, Dewatering, and Trench Stabilization Fabrics

- A. Fabric for anti-flotation and dewatering shall be Mirafi 500X or approved equal.
- B. Fabric for trench stabilization shall be Mirafi 140N Fabric or approved equal.

2.6 Water Supply Pipe

- A. Polyvinyl Chloride (PVC) Pipe
 - 1. AWWA C900, latest addition, DR 18 (235 pounds per square inch [psi]).
 - 2. Flexible rubber gasketed joints conforming to ASTM F477.
 - 3. JM Eagle Big Blue, North American Pipe Corporation Pipe, or approved equal.
- B. Ductile Iron (DI) Pipe
 - 1. DI pipe and fittings shall conform to AWWA C150, AWWA C115, AWWA C151, AWWA C153, and AWWA C110 and shall be minimum pressure Class 150 unless specified otherwise.
 - 2. All DI pipe shall have a bituminous sealed cement mortar lining conforming to AWWA C104 on the interior.

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

3. All joints unless otherwise specified shall be push-on rubber gasket joints conforming to AWWA C111 and shall be furnished complete with all necessary accessories.
 - a. Flanges for couplings and fittings shall conform to ANSI B16.1, 125-pound bolt hole template.
 - b. Mechanical joints shall conform to AWWA C111.
 4. When flanged pipe is required, the Contractor shall provide the DI pipe class required by the flange manufacturer to ensure the pipe and flange units are compatible. This data shall be provided to the Engineer for review prior to ordering these materials.
- C. HDPE Tubing
1. HDPE tubing shall be iron pipe size (IPS) meeting the requirements of AWWA C901 and ASTM D2239, SDR 7 (PE 4710), rated for 200 psi working pressure. Stainless steel inserts shall be installed at all compression fittings.

2.7 Water Supply Fittings

A. General

1. Unless specified otherwise, all fittings such as elbows, tees, crosses, valves, etc., shall have mechanical joints conforming to AWWA C111 and shall be short-bodied compact DI fittings conforming to AWWA C153, Class 350.
2. When called for, flanged cast iron fittings shall conform to AWWA C110 with ANSI B16.1, 125-pound bolt hole template.
3. All fittings shall be cement mortar lined in accordance with AWWA C104.
4. Gaskets shall be either ring or full faced, 1/8-inch thick, conforming to AWWA C111, Appendix C.

B. Restrained Fittings for PVC Pipe

1. All fittings shall be restrained by mechanical joint DI with "MEGALUG" field-installed restraint devices as manufactured by EBAA Iron, Inc., or approved equal.

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

2. All restrained fittings shall have a half-sized thrust block installed per the calculations from Sheet C-503.
- C. Restrained Pipe Joints and Fittings for Ductile Iron Pipe
1. Restrained Pipe Joints, 24-inch Diameter and Less
 - a. All restrained DI pipe joints shall be secured with FIELD LOK 350® Gaskets by U.S. Pipe, Fast Grip Gaskets by American Cast Iron Pipe Company, or approved equal.
- D. Couplings
1. Couplings shall be fabricated steel mechanically restrained couplings as manufactured by Romac Industries, Inc., or approved equal, conforming to AWWA C219.
 2. The Contractor shall provide the appropriate coupling and gaskets as required to match the irrigation pipe types and sizes being utilized.
 3. Couplings shall be rated for the working pressure of the pipe main for which they will be utilized.

2.8 Waste Pipe

- A. PVC Pipe
1. PVC gravity sewer pipe and fittings 15-inch diameter and smaller shall conform to ASTM D3034, SDR 35 unless called for otherwise on the Drawings.
 2. The joints shall be flexible joint with rubber ring gasket.
- B. Couplings
1. Couplings shall have stainless steel shear rings of the size and style required to match the pipe size and type being utilized. Couplings shall be manufactured by Fernco with stainless steel shear rings or approved equal.

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

2.9 Manholes

A. Precast Concrete Base Sections

1. Precast concrete base sections shall be approved by the Engineer and shall conform to ASTM C478. Concrete shall be consolidated by mechanical vibration. Reinforcing shall be provided in the base and walls. Minimum concrete thickness shall be 5 inches unless otherwise required for deep manholes.
2. Required "U" shaped channels shall be constructed by the use of properly shaped forms. Intersecting flow channels shall have smooth uniform transitions. All channels shall have smooth troweled finishes. All shelf area shall be uniformly shaped, have a rough float finish and shall slightly slope towards the channel. The shelf shall be above the top of the sewer pipe.
3. The Contractor shall be responsible for the determination of pipe hole orientation and grade. Precast base sections shall be used unless specifically called for otherwise on the Drawings or by the Engineer.

B. Precast Concrete Manhole Sections

1. Precast concrete manhole sections shall conform to ASTM C478 and consist of circular sections in the standard 48-inch diameter, unless otherwise noted. No more than two lift holes shall be cast into each section. Holes shall be located as to not damage reinforcing or expose it to corrosion. All lift holes shall be patched to prevent water seepage into the manhole, utilizing an approved, non-shrink grout.
2. Precast manhole cones shall be eccentric unless otherwise specified and shall meet ASTM C478.
3. Flat slab covers for manholes shall conform to ASTM C478. Slabs, cones and ring sections shall be free from fractures, cracks, rock pockets, or exposed reinforcement. Joint seal material shall be "Kent seal" mastic acrylic polymeric sealant, O-ring rubber gasket, or approved equal.
4. Manholes which have a depth of 5-1/2 feet or less, from the top of the manhole cover to the pipe invert, shall utilize a 48-inch diameter section and flat slab cover. Cone sections shall not be used for manholes less than 5-1/2 feet in depth, unless approved by the Engineer, or called for on the Drawings. Manholes

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

with a flat slab cover may be required for depths greater than 5-1/2 feet when called for on the Drawings.

C. Pipe Connection to Manholes

1. All pipe connections to manholes shall be constructed as shown on the Drawings, shall be flexible, and shall allow movement of the sewer pipe in all directions. Manhole pipe couplings shall be suitable for the sewer pipe type connecting to the manhole.
2. A-Lok field sleeve, or approved equal, may be used for cast-in-place manhole bases.
3. When precast base sections are used, an A-Lok pipe connector as manufactured by A-Lok Products, Inc., PSX Flexible Connector as manufactured by Press Seal Gasket Corporation, Kor-N-Seal as manufactured by Core and Seal Company, or approved equal shall be used.
4. Fittings for drop manholes shall be of the same material as the attached sewer pipe.

D. Manhole Rings and Covers

1. Castings shall be tough, close-grained, gray iron free from blow holes, shrinkage and cold sheets.
2. Manhole rings and covers shall conform to ASTM A48 and shall be smooth, sound, clean and free from blisters and defects. Castings and covers shall be planed and ground when necessary to insure flat and true surfaces. Covers shall be true and shall seat within the ring at all points.
3. Manhole rings and covers shall be Inland Foundry Co., Inc., No. 802 Suburban, no hole cover, Style 1 Blind Pickhole, or two hole cover, or approved equal.
4. When watertight cover is called for on the Drawings, an Inland Foundry No. 804 frame with watertight cover shall be provided, or equal. Provide two extra gaskets for each watertight cover furnished.

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

PART 3 - EXECUTION

3.1 Clearing and Grubbing

- A. The Contractor shall do all clearing and grubbing and removal of structures, etc., necessary to permit proper installation of the pipeline and to eliminate the possibility of stumps, logs, brush, or rubbish being mixed with the backfill material. A sufficient amount of all stumps and stump roots shall be removed so that any future removal of any remaining parts of the stumps and/or roots will not damage the pipeline. All stumps, roots, logs, brush, and rubbish shall be removed and disposed of in conformance with the requirements of local authorities controlling air pollution and solid waste disposal.
- B. Should the area in which construction takes place be served by rural mail carrier service, the Contractor shall cooperate with the mail service and re-install, in a convenient location, any rural mail boxes that will have to be removed or be blocked by construction operations. As soon as the Work is completed, all removed mail boxes shall be replaced undamaged in their original location.
- C. As soon as the Work is completed, all signs, guardrails, utility poles, fences, etc., that were moved for the construction operation shall be replaced undamaged in their original location. Damaged items shall be replaced by the Contractor with new items of equal quality.

3.2 Cutting of Asphalt Pavement, Concrete Sidewalks, Curbs, and Driveways

- A. Where the excavation is made in a paved street, the asphalt surface shall be cut on each side of the trench prior to excavation, to provide a vertical joint in the surface. Cutting of the asphalt will be made with a saw designed for the cutting of asphalt.
- B. The use of a jackhammer, wheel cutter, or other similar tool may be allowed by the Engineer only where the Contractor can demonstrate that the alternate method provides a neat straight edge.
- C. Prior to excavating across a concrete structure such as a curb, sidewalk, or driveway, the Contractor shall cut and remove a section of the structure to provide for excavation. The dimensions of the removed section shall be such that the Contractor's excavation will not result in undermining the remaining structure.
- D. The Contractor shall cut the concrete structure with a diamond saw or other equipment designed for that purpose such that a neat, straight, vertical edge is left on the

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

remaining concrete structure. The Contractor shall similarly cut and remove any such concrete structure undermined or damaged construction work.

- E. The Contractor shall repair streets and replace curbs, sidewalks, and/or driveways following proper backfill and compaction of the excavation, as specified herein and in conformance with the Drawings. If no Drawings are provided, repair streets and replace curbs, sidewalk, and/or driveways to equal or better condition prior to removal.

3.3 Trench Excavation

A. General

When solid rock is encountered in trench excavation, the Engineer shall be notified.

B. Trench Width

1. The maximum trench width in the pipe zone shall be 2 feet plus the O.D. of the pipe and the minimum trench width in the pipe zone shall be 1 foot plus the O.D. of the pipe. This width shall be maintained to the top of the pipe.
2. The maximum clear width above the top of the pipe will not be limited except in cases where excess width of excavation would cause damage to adjacent structures or utilities.

C. Unsuitable Material

1. When natural soil conditions exist in the bottom of the trench that are unsuitable for proper pipe installation, the Contractor shall immediately notify the Engineer. The Contractor shall then over-excavate the trench below the design grade to a depth specified by the Engineer. Such over-excavation shall be to provide for foundation material as specified herein. No additional payment will be made to the Contractor for additional excavation without prior approval of the Owner.
2. Foundation material or stabilization fabric, as shown on the Drawings, shall be provided by the Contractor only when specifically called for on the Drawings or in these Specifications or when required by the Engineer. No additional payment will be made to the Contractor for foundation material or stabilization fabric placed without prior written approval of the Owner of such additional payment.
3. As an alternative to over-excavation and placement of foundation material, a geotextile fabric may be used if field use proves acceptable. The fabric material

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

shall be placed on the bottom of the trench and the bedding material placed over the fabric to proper pipe grade. The fabric width shall be 1-foot wider than the trench bottom.

D. Exploratory Work

The Contractor shall perform appropriate exploratory work to locate utilities when they are known to exist, but the specific location is unknown or not marked accurately. Appropriate exploratory work shall be performed in these situations.

3.4 Shoring, Sheeting, and Bracing of Trenches

- A. The Contractor shall adequately sheet and brace the trench during excavation whenever necessary to satisfy trench safety standards, prevent cave-ins, or to protect adjacent structures or property. Where sheeting and bracing are used, the Contractor shall increase trench widths for the bracing material accordingly.
- B. The sheeting must be kept in place until the pipe has been placed, backfilled at the pipe zone, tested for defects, and repaired if necessary. All sheeting, shoring, and bracing of trenches shall conform to the requirements of the public agency having jurisdiction.

3.5 Dewatering Excavated Areas

- A. All groundwater, seepage, or stormwater that may occur or accumulate in the excavation during the progress of the Work shall be removed. In areas where the nature of soil and hydrostatic pressures are of such a character as to develop a quick condition in the earth mass of the trench, the dewatering operation shall be conducted so that the hydrostatic pressure will be reduced to or near zero in the immediate vicinity of the trench.
- B. All excavations shall be kept free of water during the construction or until otherwise requested by the Engineer.
- C. The Contractor shall dispose of all waste and water removed from the trench. Disposal shall be in accordance with all state and local regulations.

3.6 Location of Excavated Materials

- A. During trench excavation, the excavated material shall be located within the construction easement or right-of-way so that the excavated material will not obstruct any private or public traveled roadways or streets or cause undue damage to the streets.

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

- B. The Contractor shall provide means of containing overly saturated soils (i.e., muck or remove the muck from the Work area as it is excavated), if such soils are encountered in the excavation. The intent is to prevent excessive damage or disruption to street rights-of-way or easement beyond what would normally occur during such Work. Pile and maintain material from trenches so that the toe of the slope of the material excavated is at least two feet from the edge of the trench. It shall be the Contractor's responsibility to determine the safe loading of all trenches.

3.7 Disposal of Excavated Materials

The Contractor shall dispose of all excavated material, which is not required for or is unsuitable for backfill. The Contractor's method of disposal shall comply with regulations of the governing body having jurisdiction.

3.8 Trench Backfill

- A. All backfill material shall be placed into the trench so that free fall of the materials into the trench is prevented until at least 2 feet of cover is provided over the pipe. Under no circumstances shall sharp or heavy pieces of material be allowed to drop directly onto the pipe. Methods of backfilling, other than as specified herein, shall be used only upon the approval of the Engineer.
- B. Bedding and Select Backfill
 1. A minimum 4-inch depth of bedding shall be placed on the trench bottom, compacted to 85 percent of the maximum density as determined by ASTM D698, as applicable, and smoothed to provide uniform bedding so the pipe is supported along its full length and not by the bells. Bell holes at each joint shall be provided to ensure support along the entire pipe length.
 2. It shall be understood that the 4-inch depth is a minimum depth only, not an average depth and does not preclude the Contractor's option from placing additional depth of bedding to facilitate Work. Once the pipe is properly installed, the bedding material shall be brought up to the spring line of the pipe in 4-inch lifts and compacted to 85 percent density. Care shall be used to ensure the bedding material is properly worked under the haunch of the pipe for its full length. No additional payment will be made in the event the Contractor elects to use additional bedding material for convenience only. Payment for any additional bedding material used as foundation material must be approved by the Owner prior to any Work being performed.

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

3. Select backfill shall then be brought up from the spring line to the minimum distance above the top of the pipe shown on the Drawings, leveled and compacted to 85 percent of ASTM D698, as applicable, density. Compaction of the bedding and select backfill by hand tamping will be allowed if the 85 percent density is achieved; otherwise, mechanical tamping will be required.
 4. When an open-graded material is used for bedding or foundation material to facilitate trench dewatering, the open graded material shall be placed to the spring line of the pipe. The Contractor shall make provisions to ensure that fines from the select backfill do not migrate into the open graded bedding or foundation material. To prevent soil migration the Contractor may use any of the following:
 - a. Provide a properly graded select backfill approved by the Engineer;
 - b. Provide an approved fiber/fabric between the open graded bedding material and select backfill;
 - c. Hydraulically jet select backfill fines into open graded bedding material after dewatering is complete and before general backfill is placed; or
 - d. Provide an alternative approved by the Engineer.
- C. All general backfill material shall be pushed first onto the slope of the backfill previously placed and allowed to roll down into the trench. The Contractor shall not push the backfill material directly into the trench until at least 2 feet of cover is provided over the pipe.
- D. Compaction
1. In roadways, driveways, under curbs and sidewalks, as shown on the Drawings, or as required by the Engineer, general backfill shall be placed in horizontal lifts not to exceed 12 inches in depth and compacted to 90 percent of the laboratory density as determined by ASTM D1557, as applicable. The method of compaction shall be selected by the Contractor.
 2. The Contractor shall exercise extreme care to avoid damage to the pipe during compaction of the trench. Where materials consist of cobbles and coarse gravels, compaction of each lift shall be accomplished by at least five passes of an appropriate vibrating type compactor. When materials are such that

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

meaningful in place density test cannot be run, then the Contractor and Engineer will agree on a method of compaction that will provide adequate compaction.

3. In sections where specific compaction requirements are not specified or required by the Engineer, general backfill shall be compacted, as a minimum, to a density equal to that of the natural ground adjacent to the trench. All trenches shall be maintained for a period of one year after final acceptance of the Project. Any settlement of the trenches during the 1-year guarantee period shall be remedied promptly at the request of the Engineer and at no additional cost to the Owner.

E. Controlled Density Fill (CDF) Placement

1. When called for on the Drawings, the Contractor shall backfill trenches with CDF.
2. CDF shall be placed in the trench in such a manner to ensure the trench is completely filled to the lines and grades called for on the Drawings.
3. CDF shall be protected from traffic loads for a 3-hour period, after which required surface restoration work may be performed.

F. Canal or Irrigation Ditch Crossing

1. Where the trench crosses a canal, irrigation ditch or culvert, the backfill shall be compacted the entire trench depth with mechanical tampers to 90 percent of the laboratory density as determined by ASTM D1557.
2. All backfill material in the canal or ditch liner and in the trench cut-off wall shall be imported clay or a soil/bentonite mixture as approved by the Engineer. Unless required otherwise, the soil/bentonite mixture shall be 1-part bentonite to 10 parts soil by weight. A high-grade bentonite material shall be used.
3. The ditch lining, conduit, or pipe shall be restored to its original condition. The crossing shall be water tight and free of any leakage or seepage. The Contractor shall be fully responsible for repairing canal or ditch banks at no cost to the Owner should leakage occur at the crossing.

G. Anti-Flotation Fabric Placement

1. When called for on the Drawings or called for by the Engineer, the Contractor shall place geotextile fabric over the select backfill material prior to placing general backfill. This fabric will help reduce the exposure to pipeline flotation.

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

2. The fabric shall be placed in accordance with the requirements shown on the Drawings.

3.9 Installation of Water Supply Pipe

A. General

The installation of pipe fittings shall be in accordance with the Drawings and Specifications and the manufacturer's requirements.

- B. PVC pipe installation shall conform to the Uni-Bell Plastic Pipe Association, "Guide for Installation of PVC Pressure Pipe for Municipal Water Main Distribution Systems" and also AWWA M23 "PVC Pipe - Design and Installation."
- C. DI pipe installation shall conform to the requirements of AWWA C600.
- D. Irrigation pipe shall be installed with bell ends laid facing in the direction of laying, unless otherwise directed by the Engineer. Each pipe shall be properly bedded so as to be supported for the full length of the pipe. A suitable foundation shall be achieved by a slight excavation under the bell at each joint. All rubber ring joints shall be lubricated and installed in accordance with the installation instructions of the pipe manufacturer, taking particular care to avoid pinching or otherwise causing damage to the rubber ring. All joints shall be free of dirt and other foreign matter prior to the joining of the next pipe. All joints shall be restrained to prevent creep and misalignment of joints.
- E. Irrigation lines shall be installed to the minimum depths called for on the Drawings and to the lines and grades when shown.
 1. It shall be recognized that irrigation piping depths may vary from the minimum depths shown when adjustment of grade is required to avoid conflict with existing utilities.
 2. Additional fittings may also be required when a grade adjustment is required.
- F. No pipe shall be installed in water or when conditions exist that, in the opinion of the Engineer, are unsuitable for the laying of the pipe.
 1. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other approved means. This provision applies during the noon hour as well as overnight.

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

2. If there is water in the trench, the seal should remain in place until the trench is dewatered sufficiently to prevent groundwater from entering the pipe. Adequate provisions shall be made by the Contractor for final disposal of the groundwater pumped from trenches.
- G. All pipe shall be installed true to line. The Contractor may deflect pipe joints according to manufacturer's recommendations. Pipe bending is not allowed.
- H. Thrust and Anchor Blocks
1. Thrust and anchor blocks shall be constructed as shown on the Drawings and placed at all changes in direction, all changes in the diameter of the pipe, all dead-ends, as specifically shown on the Drawings and as required by the Engineer.
 2. All thrust blocks shall be placed between the undisturbed ground and the fitting to be anchored. Plastic sheeting shall be used to provide a bonding barrier between the fittings and the concrete. The quantity of concrete and the area of bearing on the soil shall be as shown on the Drawings or as approved by the Engineer.
 3. All thrust blocks shall be placed so that the entire pipe and fitting joints will be accessible for repairs. Bolts for mechanical and flange fittings shall not be covered with concrete. All bolts shall be accessible and removable without interference from the thrust block.
 4. Thrust blocks may not be required where approved restraint joint pipe and fittings are utilized.
 5. Concrete thrust blocks shall cure for 3 to 5 days before hydrostatic or leakage testing of pipelines, unless otherwise approved by the Engineer.
 6. No backfill of thrust blocks shall occur until the Work has been observed by the Owner's representative.

3.10 Installation of Waste Pipe

- A. Gravity service lines shall be constructed in accordance with the Drawings, Specifications, and applicable provisions of the International Plumbing Code (IPC) as amended by the State. The minimum slope of service lines shall be 1/4-inch per foot unless otherwise approved by the Engineer. The pipe size of gravity service lines shall be a minimum 4-inch diameter unless otherwise specified. The Contractor shall end gravity

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

service lines at the location as per the Drawings and at the invert elevation as shown on the Drawings or as set by the Engineer. Dead ends of service lines shall be marked with steel fence posts installed in the ground as shown on the Drawings.

- B. Connection of service lines to new or existing gravity sewer main lines shall be as per the Drawings and shall be inspected and accepted by the Engineer prior to backfilling. All sewer service connections shall be watertight utilizing appropriate sewer service saddles or wyes. An approved tee fitting shall be used when new sewer mains are being installed. All holes and taps into an existing sewer main shall be cut using an approved tapping machine.
- C. In the construction of new sewage collection systems, connection of new services allowing sewage into the system shall not be made until approval for connections has been given by the Engineer. No existing sewer service shall be interrupted without the approval of the Engineer and service owner. Connections of new service lines to existing service lines shall be by the proper adaptor coupling.
- D. The Contractor shall obtain all necessary permits required to construct service lines on private property. The Contractor must utilize a licensed plumber for service line work on private property when required by state or local regulations.

3.11 Waste Pipe Testing

A. General

The Contractor shall furnish all labor, necessary equipment, and other apparatus including, but not limited to, gauges, mechanical or pneumatic plugs, and air hoses, necessary to properly perform the testing of sewer lines as specified. The Contractor may low pressure test sections of sewer lines before backfilling at his own option; but the acceptance test shall be performed only after backfilling, cleaning, and flushing has been completed.

B. Acceptance Test

The Contractor shall perform all preliminary testing required to determine that the lines to be tested are acceptable and comply with the requirements of this section of the Specifications. After the Contractor has determined that the lines will pass the required test, the Contractor shall arrange for an acceptance test to be witnessed by the Engineer's representative. The Contractor shall coordinate the timing of this acceptance test with the Engineer's representative. The lines will not be accepted until the acceptance test has been witnessed and documented as passing.

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

C. Test Procedure

1. The method of testing follows the procedures outlined in the Oregon Standard Specifications for Construction, Part 00400, Section 00445.72(c), current edition. All air testing shall be by the Time Pressure Drop Method. Specific questions concerning test procedures may be referred to this publication. To facilitate test verification by the Engineer, all air used shall pass through a single, above-ground control panel. The pressure gauge used in air testing shall have minimum divisions of 0.10 psi and have an accuracy of 0.0625 psi (one ounce per square inch). The Engineer shall have the option of requiring the use of his own gauge. Test procedures are summarized below:
2. Field Test
 - a. The Contractor may wet the lines prior to testing.
 - b. Determine the average height of the groundwater over the line. The test pressures required shall be increased 0.433 psi for each foot of average water depth over the exterior crown of the pipe, but no greater than 9.0 psig.
 - c. Add air slowly to the section of system being tested until the internal air pressure is raised to 4.0 psig greater than the average back pressure due to groundwater.
 - d. After the test pressure is reached, allow at least two minutes for the air temperature to stabilize adding only the amount of air required to maintain pressure.
 - e. After the temperature stabilization period, disconnect the air supply.
 - f. Record the time in seconds that is required for the internal air pressure to drop from 3.5 psig to 2.5 psig greater than the average back pressure due to groundwater.
 - g. Compare the time recorded in the above step with the test time determined hereafter.

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

3. Acceptance
 - a. Record the diameter in inches and the length in feet of all pipe in the section to be tested, including the service connections on the worksheet found at the end of Technical Specifications - "Sanitary Sewer Lines."
 - b. Using the nomograph (Figure No. 1) found at the end of Technical Specifications - "Sanitary Sewer Lines," place a straightedge from the "d" column (diameter in inches) to the "L" column (length in feet). Read the corresponding "K" and "C" values for each of the pipes listed above, and record them on the worksheet.
 - c. Add all values of "K" and all values of "C" for the section being tested.
 - d. If the total of all the "C" values is less than one, the time shall be the total of all the "K" values.
 - e. If the total of all the "C" values is greater than one, the time shall be found by dividing the total of all the "K" values by the total of all the "C" values. The result is the maximum test time. To make this division using the nomograph (Figure No. 1), use the total "C" and "K" values and read the time from the "tq" scale.
 - f. In the event that the "d" and "L" values for a particular section of the system do not fall within the limits of the nomograph, the values of "K" and "C" may be computed from the following equations: "K" = 0.011d²L; "C" = 0.0003882dL.

D. If the "actual time" (field test) is equal to or greater than the "test time" required for the pipe section being tested, the pipe section will have passed the pressure test. (See worksheet.)

E. Infiltration Allowance

Groundwater infiltration to the collection system, including manholes, shall not exceed 50 gallons/inch diameter of pipe/mile/day. Any infiltration in excess of this amount shall be corrected at the Contractor's expense.

F. Deflection Test for PVC Pipe

1. All sanitary sewers constructed of PVC pipe shall be able to pass a deflection test. The test shall be conducted by pulling a go-nogo solid pointed mandrel or

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

sewer ball through the completed pipeline. The diameter of the mandrel or ball shall not be less than 95 percent of the base inside pipe diameter as defined by ASTM D3034, SDR 35 and ASTM F679, T-1 pipe. The base inside pipe diameter and minimum mandrel diameter are as follows:

Nominal Pipe Size, In.	Minimum Mandrel Dia., In.	Base Inside Pipe Dia., In.
6	5.46	5.742
8	7.28	7.665
10	9.08	9.568
12	10.79	11.361
15	13.20	13.898
18	16.13	16.970
21	19.00	20.004
24	21.36	22.480
27	24.06	25.327

2. All lines shall be tested unless determined otherwise by the Engineer based upon his observations during pipeline installation and visual inspection of the pipeline. Testing shall be conducted on a manhole to manhole basis and shall be done after the line has been completely cleaned and flushed with water. The Contractor shall, at his own expense, locate and repair any sections failing to pass the deflection test. All areas failing the deflection test shall be retested after corrective action has been taken.

G. Equipment

The Contractor shall perform all Work and furnish all materials and equipment as required to perform all required tests.

3.12 Connections to Existing Lines

- A. Information shown on the Drawings indicating the size, type, class, and location of existing lines and associated fittings has been obtained from Record Drawings and other municipal records. It is expected that there may be some discrepancies and omissions in the information shown on the Drawings. Therefore, it shall be the responsibility of the Contractor to excavate and inspect existing irrigation piping requiring a connection to determine the exact fittings needed.
- B. In connecting to existing lines, the Contractor may select the combination of fittings, subject to approval of the Engineer. Approved fabricated steel couplings, repair bands, transition couplings, or tapping sleeves are among the options available to the

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

Contractor. The Contractor shall submit to the Engineer information on the type of couplings proposed to use.

- C. The Contractor shall provide watertight plugs and thrust restraints, as required, to cap old lines after they are disconnected.
- D. The Contractor shall provide special attention in providing thrust restraint for fittings installed as part of a connection to an existing line, when such connection will be placed into service before normal cast-in-place thrust blocks can achieve required strength. In such cases thrust restrained joints, precast thrust blocks, etc., must be utilized to provide thrust restraint. Methods used by the Contractor shall be approved by the Engineer.
- E. The Contractor shall not interrupt service for the purpose of connecting to an existing line until the required location is excavated, the connection point is visually inspected, and all fittings required for completion of the connection or connections are verified available on site. Isolation of a section of line to be modified will be accomplished by the Contractor only after consultation with the utility owner for the purpose of determining the proper valves to close to affect the isolation. The Contractor shall cooperate with the utility owner in accomplishing this isolation. When Work is started on a connection, it shall proceed continuously without interruption, and as rapidly as possible until completed. If the connection involves turning off the water, the Contractor shall be responsible for notifying the residents affected by the shutoff.

3.13 Execution of Dust and Mud Control

If the Contractor fails to properly control the dust and mud, the Engineer may request him to do so in writing. If, after 24 hours from this request, the Contractor has not corrected the dust or mud problem, the Owner may elect to have the corrective work performed and withhold the cost from the Contractor's payments.

3.14 Restoration, Finishing, and Cleanup

- A. The Contractor shall restore or replace all paved surfaces, graveled surfaces, curbing, sidewalks, trees and shrubbery, lawns, pastures and fences, or other existing facilities disturbed by the Work, unless otherwise specified. Restoration and cleanup shall be a continuing operation and shall be diligently pursued until completed.
- B. All surplus material and temporary structures, as well as excess excavation, shall be removed by the Contractor and the entire Site of Contractor operations shall be left in a neat and clean condition.

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

- C. All existing facilities shall be replaced or restored equal to their original condition.

3.15 Other Installations

Installations of valves and valve boxes shall be in accordance with the manufacturer's requirements and the Drawings.

3.16 Removal and Salvage of Appurtenances, Fittings, and Other Items

- A. The Contractor shall remove all existing facilities as required to properly perform the Work as shown in the Drawings. All such materials to be salvaged shall be transported to an area designated by the Owner and stockpiled. Materials shall be removed and handled in such a manner that will prevent damage.
- B. The abandoned existing pipe is to remain in the ground, unless otherwise specified.

3.17 Testing

- A. General

The Contractor shall furnish all necessary equipment and other apparatus, including gauges, necessary to properly perform the testing of irrigation lines as specified. Each section of the lines, before being tested and placed into service, shall be isolated and slowly filled with water. Air should be expelled from the line through hydrants or taps made at the high points. The Engineer shall have the option of requiring the use of his own gauges. Irrigation piping shall be generally tested in sections between valves and as the Work progresses. The Contractor shall be responsible for determining the length, timing, and section of lines to be tested, unless otherwise noted. When appropriate, testing intermediate sections of long lines should be considered. The Contractor shall provide any temporary test heads, fittings, blocking, etc., as may be required to properly test any given irrigation piping section. The Contractor shall be responsible for locating and repairing any defects in the irrigation piping that fail to pass the required test.

- B. Acceptance Test

The Contractor shall perform all preliminary testing required to determine that the lines to be tested are acceptable and comply with the requirements of this section of the Specifications. After the Contractor has determined that the lines will pass the required test, the Contractor shall arrange for an acceptance test to be witnessed by the Engineer's representative. The Contractor shall coordinate the timing of this acceptance test with the Engineer's representative. The lines will not be accepted until the acceptance test has been witnessed and documented as passing. Forms for performing

TECHNICAL SPECIFICATIONS

SECTION 1

UNDERGROUND PIPING

the various tests are included at the end of this Technical Specification for use and reference by the Contractor.

C. Hydrostatic Testing of Pressure Lines

All lines shall be pressure tested at 150 psi gauge or 1.5 times the actual working pressure, whichever is greater, for one hour, unless otherwise indicated on the Drawings. Any cracked or defective pipe, joints, or fittings shall be removed and replaced.

D. Leakage Test

Each section of the line, after all backfill and compaction work has been completed and before being placed into service, shall be tested for leakage for a period of 2 hours at a minimum average gauge pressure of 100 psi. Leakage is defined as the quantity of water supplied into the section of line being tested, during and at the end of the test, that quantity being such that the pressure at the end of the test is equal to the pressure at the beginning of the test. Should any test disclose leakage greater than that specified, the Contractor shall locate and repair the defective joints until the leakage is within the specified allowance.

$$\text{PVC Pipe: } L = \frac{ND\sqrt{P}}{7,400} \quad \text{DI Pipe: } L = \frac{SD\sqrt{P}}{148,000}$$

In which:

- L = Allowable Leakage Gal/Hr
- S = Length of Pipe Tested in Ft.
- N = Number of Joints or Connections
- D = Nominal Diameter in Inches
- P = Gauge Pressure in psi

END OF SECTION

TABLE OF CONTENTS
SECTION 2
WELLHEAD IMPROVEMENTS

PART 1 - General	2-1
1.1 Scope	2-1
1.2 Submittals.....	2-1
 PART 2 - Materials.....	 2-1
2.1 Pipe.....	2-1
2.2 Fittings.....	2-2
2.3 Valves	2-4
2.4 Pressure Gauges.....	2-7
2.5 Down Hole Well Valve.....	2-7
 PART 3 - Execution	 2-8
3.1 Pipe Installation and Testing	2-8
3.2 Painting.....	2-10

ATTACHMENT

Test Worksheet for the Water Lines – Leakage Test

TECHNICAL SPECIFICATIONS
SECTION 2
WELLHEAD IMPROVEMENTS

PART 1 - GENERAL

1.1 Scope

- A. These Specifications cover general mechanical requirements for aboveground and/or vaulted pipe, valves, downhole well valve, and associated fittings for improvements to the existing Well No. 5 wellhouse. For additional requirements and related work, refer to other Technical Specifications and the Drawings.
- B. Items specified in this Technical Specification are intended to be broad in scope and may not always apply to all items of Work to be constructed. All applicable sections, as determined by the Engineer, shall apply to the Work outlined in the Contract Documents.

1.2 Submittals

- A. Pipe
- B. Fittings
- C. Valves

PART 2 - MATERIALS

2.1 Pipe

- A. General

Pipe shall be of the type called for on the Drawings and shall conform to the following Specifications. Pipe substitutions may be made only with prior approval of the Engineer.

- B. Ductile Iron Pipe
 - 1. Ductile iron pipe and fittings shall conform to AWWA C150, AWWA C115, AWWA C151, and AWWA C110 and shall be minimum special Class 350, unless specified otherwise. All ductile iron pipe shall have a bituminous sealed cement mortar lining conforming to AWWA C104. All joints for buried service, unless otherwise specified, shall be push-on rubber gasket joints conforming to AWWA C111. When required for fittings, mechanical joints shall conform to AWWA C111.
 - 2. When flanged pipe is required, the Contractor shall provide the ductile iron pipe class required by the flange manufacturer to ensure the pipe and flange units are compatible. This data shall be provided to the Engineer for review prior to

TECHNICAL SPECIFICATIONS
SECTION 2
WELLHEAD IMPROVEMENTS

ordering these materials. Flanges for couplings and fittings shall conform to ANSI B16.1, 125-pound bolt hole template.

C. Galvanized Pipe

Galvanized wrought iron pipe, when required, shall conform to ASTM A120.

D. Copper Tubing and Fittings

Copper tubing shall be Type K or Type L as called for on the Drawings and shall conform to ASTM B88. Fittings shall be cast bronze conforming to ANSI B16.18 or wrought copper fittings conforming to ANSI B16.22.

E. PVC Pipe - 2-inch Diameter or Smaller

PVC pipe shall be the size and type called for on the Drawings and shall conform to the following applicable ASTM Standards:

1. D1784, PVC and CPVC plastic compounds
2. D1785, Schedules 40, 80, and 120 PVC pipe

F. Miscellaneous Pipe

Miscellaneous small pipe, not otherwise specified, shall be of first class material and suitable for the intended service.

2.2 Fittings

A. Fittings for Iron and PVC Pipe

1. Unless specified otherwise, all fittings such as elbows, tees, crosses, etc., for buried pipe shall be mechanical joint short-bodied compact ductile iron fittings conforming to AWWA C153, Class 350.
2. When called for, flanged cast iron fittings shall conform to AWWA C110 with ANSI B16.1, 125-pound bolt hole template.
3. All fittings shall be cement mortar lined in accordance with AWWA C104.
4. Gaskets shall be either ring or full faced, 1/8-inch thick conforming to AWWA C111, Appendix B.

TECHNICAL SPECIFICATIONS

SECTION 2

WELLHEAD IMPROVEMENTS

B. Sleeve Type Straight Couplings

Sleeve type couplings shall be ductile iron or fabricated steel as manufactured by Dresser, Ford, Romac, or approved equal conforming to AWWA C219. The Contractor shall provide the appropriate coupling and gaskets as required to match the water line types and sizes being utilized. Couplings shall be rated for the working pressure of the pipe main for which they will be utilized.

C. Restrained Joint Pipe and Fittings

1. Where called for on the Drawings, restrained joint pipe and fittings shall be:

a. Restrained Push-on Joint Pipe

When restrained joint ductile iron pipe is required, the pipe shall be the same class and type as the ductile iron pipe specified herein. Joints shall be Tyton Joint with Field Lok 350 gaskets, or approved equal. The restraint shall be boltless, integral restraining system, rated for 350 psi in accordance with the performance requirements of ANSI/AWWA C111/A21.11.

b. Restrained Fittings

All mechanical joint fittings called out to be restrained shall be equipped with a MEGALUG Series 1100 mechanical joint restraint system as manufactured by EBAA Iron, Inc., or approved equal.

2. Dismantling joints, when specified, shall be Viking Johnson, Romac DJ400, or approved equal.

D. PVC Fittings

PVC fittings shall be the size and type called for on the Drawings and shall conform to the following applicable ASTM standards:

1. D2464, Threaded Schedule 80 PVC fittings
2. D2466, Socket-type Schedule 40 PVC fittings
3. D2467, Socket-type Schedule 80 PVC fittings
4. D2564, PVC solvent cements

TECHNICAL SPECIFICATIONS
SECTION 2
WELLHEAD IMPROVEMENTS

E. Pipe Taps

1. Pipe taps for accessories such as pressure gauges, flow switches, pressure switches, air release valves, hose bibs shall be made as follows:
 - a. Ductile Iron Pipe - Drilled and tapped or saddle tap.
 - b. PVC Pipe - Saddle tap, direct tapping not acceptable.
2. All taps for accessories shall be provided with an isolation valve between the tap and accessory.

2.3 Valves

A. General

Valves shall be of the type called for on the Drawings and shall conform to the following:

B. Gate Valves

1. Gate Valves, 2 inches and smaller

Valves shall be all bronze, non-rising stem, conforming to Federal Specification MSS-SP-80, rated for a minimum working pressure of 125 psi.

2. Gate Valves, 2-1/2-inch to 12-inch

- a. Valves shall conform to AWWA C509 or C515. Valves shall be designed for 200 psi minimum working pressure and shall be of iron body, resilient seat, non-rising stem construction. Valves shall be equipped with O-ring type packing.
- b. Unless shown otherwise on the Drawings, aboveground valves shall have a handwheel operator and shall have position indicators.
- c. Buried valves shall have a 2-inch AWWA operating nut, or as called for on the Drawings.
- d. The valve ends shall be of the type required to match the pipe to which they will be connected, or as shown on the Drawings.
- e. Valves shall be resilient seated Kennedy KSRW or KSF, M&H Style 4067 or 7000, Clow, or equal.

TECHNICAL SPECIFICATIONS
SECTION 2
WELLHEAD IMPROVEMENTS

C. Ball Valves

1. Type V300 Ball Valve, 3 inches and Smaller, for General Water and Air Service
 - a. All-bronze body and end piece, hard chrome-plated solid bronze or brass ball, end entry type, RTFE seats and packing, hand lever operator, rated 600-pound WOG, 150-pound SWP, complies with MSS SP-110.
 - b. Bronze ball valves shall be installed where shown on the Drawings.
 - c. Manufacturers and Products:
 - 1) Milwaukee Valve UPBA100
 - 2) Nibco T-585-80
 - 3) Or approved equal
2. Type V330 PVC Ball Valve, 2 inches and Smaller

Rated 150 psi at 73°F, with ASTM D1784, Type I, Grade 1 polyvinyl chloride body, ball, and stem, end entry, double union design, solvent-weld socket ends, elastomer seat, Viton or Teflon "O" ring stem seals, to block flow in both directions. Valves shall be Spears, True Union, or approved equal. PVC ball valves shall be installed where shown on the Drawings.

D. Butterfly Valves

1. Butterfly valves shall be of the rubber seated tight-closing type and shall meet or exceed the requirements of AWWA C504.
2. Unless otherwise shown on the Drawings, aboveground valves shall have handwheel operator with closing turns approximately equal to that of the same sized gate valve.
3. Buried valves shall have an AWWA 2-inch operating nut.
4. Valves shall be M&H 4500 or approved equal.
5. Position indicators shall be provided with all aboveground butterfly valves. The valve ends shall be of the type required to match the pipe to which they are connected.

TECHNICAL SPECIFICATIONS

SECTION 2

WELLHEAD IMPROVEMENTS

E. Check Valves

1. Check valves shall be of the non-slam type as called for on the Drawings. Non-slam type check valves shall have semi-steel body, stainless steel trim (plug, seat, etc.), stainless steel return spring, and shall have a plug guided at both ends. Pressure drop shall not exceed 1 psi at 5 fps. Valve shall be APCO Series 600 as manufactured by Valve and Primer Corporation, or approved equal.
2. Where called for on the Drawing, ball check valves shall be ball style check valve with sinking ball as manufactured by Flygt Model HDL, or approved equal.
3. Swing check valves shall be swing-type, lever-operated valves. The valve shall have a cast iron body and disc, bronze seat, rubber seat ring, and 303 stainless steel shaft. The external lever shall have an adjustable weight. The valve shall be equipped with an air cushion device for slowed opening and closing of the valve. Swing check valves shall be Mueller, Kennedy, or equal.

F. Control Valves

1. Control valves shall be furnished and installed as shown on the Drawings and in accordance with the manufacturer's instructions. The types of control valves included under these Specifications are:
 - a. CV-1 : 1 – 8 inch 636EA-03BPSVYKCKR CLA-VAL reduced port solenoid control valve, energized to open, valve to be built and installed in reverse flow, ductile iron body with stainless steel trim, epoxy coated, 150 flanged ends, epoxy coated in/out, with X101 valve position indicator installed, 120/60 AC, P1 0-60 psi, P2 0-60 psi. **Valve to be built and installed in reverse flow.**
 - b. CV-3: 1 – 4 inch 610G-09BPSKC, CLA-VAL reduced port combination altitude and back pressure valve, ductile iron body stainless steel trim, 150 Flange ends, epoxy coated in and out, 5- to 40-foot spring range CDS6A, 0-75 on CRL, P1 0-60 PSI, P2 0-60 psi, and X101 valve position indicator installed

G. Miscellaneous Valves

Miscellaneous valves not specified herein or on the Drawings shall be of first class construction and shall be suitable for the intended purpose.

TECHNICAL SPECIFICATIONS
SECTION 2
WELLHEAD IMPROVEMENTS

H. Valve Labels

1. A valve label shall be provided for buried valves associated with pumping stations, reservoirs, etc.
2. The label shall be permanently cast into a concrete collar at each valve box.
3. The label shall note the valve number, if applicable, and valve function, as required by the Engineer.

2.4 Pressure Gauges

A. Clean Water

1. Pressure gauges for clean water shall have stainless steel bourdon tube and movement with stainless steel bodies and polycarbonate lenses.
2. Pressure gauges shall be glycerin-filled 500 series as manufactured by NoShok.
3. Graduation intervals shall be the smallest available for the pressure range required.
4. Pressure gauges shall have a minimum 4-inch diameter dial face and be provided with a pressure snubber and ball-type isolation valve.

2.5 Down Hole Well Valve

A. The well downhole control valve shall be NSF 61 approved, fully automated complete system, vertically sliding with spring close on failure, hydraulically actuated valve system with independent PLC valve controller, piston assembly, pressure sensors, and position indicators. The downhole control valve system shall have the following components:

1. Pistons: Lead free materials and NSF 61 certified
2. Sensors: 0 – 2,500 psi
3. Programmable Logic Controller: Equal to Allen Bradley L16 Compact Logix
4. Hydraulic Hoses: Equal to Diebolt NSF
5. Seals: NSF 61 certified

TECHNICAL SPECIFICATIONS

SECTION 2

WELLHEAD IMPROVEMENTS

6. Hydraulic fluid: Equal to Clarion® Food Machinery AW 68
 7. 5-Year Warranty: 5-year warranty on the valve and one-year warranty on all other parts, plus a 10 percent refund of the purchase price to be used to remove and install the valve if there should be a failure during the warranty time.
- B. See Drawings for valve size.
- C. Valve to be installed inline of well column pipe above the well pump and below the pumping water level.
- D. The well downhole valve shall be 3R Valve as manufactured by 3RValve LLC (541) 376-8107; <http://3rvalve.com> or equivalent.

PART 3 - EXECUTION

3.1 Pipe Installation and Testing

A. General

Pipe shall be installed in accordance with good trade practice with respect to handling, joining, supporting, and testing. A calibrated torque wrench shall be provided and used where specific torque requirements are specified by the manufacturer.

B. Pipe Supports and Couplings

All pipe shall be rigidly secured in place by means of blocking, hangers, brackets, clamps, or by other approved methods, in such a manner to adequately support the pipe under all operating conditions, whether or not such supports are shown on the Drawings. Sufficient unions and couplings shall be provided to facilitate the installation of any section of piping.

C. Testing

1. The Contractor shall furnish all necessary equipment and other apparatus, including gauges, necessary to properly perform the testing and disinfection of water lines as specified. Lines to be tested include mains and service lines. Each section of the lines before being tested and placed into service shall be isolated and slowly filled with water. Air should be expelled from the line through hydrants or taps made at the high points. The Engineer shall have the option of requiring the use of his own gauges.

TECHNICAL SPECIFICATIONS

SECTION 2

WELLHEAD IMPROVEMENTS

2. The Contractor shall perform all preliminary testing required to determine that the lines to be tested are acceptable and comply with the requirements of this section of the Specifications. After the Contractor has determined that the lines will pass the required test, the Contractor shall arrange for an acceptance test to be witnessed by the Engineer's representative. The Contractor shall coordinate the timing of this acceptance test with the Engineer's representative. The lines will not be accepted until the acceptance test has been witnessed and documented as passing. Forms for performing the various tests are included at the end of this Technical Specification for use and reference by the Contractor.
3. All lines shall be pressure tested at 150 psi gauge or 1.5 times the actual working pressure, whichever is greater, for one hour. Any cracked or defective pipe, joints, or fittings shall be removed and replaced.
4. Each section of the line, after all backfill and compaction work has been completed and before being placed into service, shall be tested for leakage for a period of 2 hours at a minimum average gauge pressure of 100 psi. Leakage is defined as the quantity of water supplied into the section of line being tested, during and at the end of the test, that quantity being such that the pressure at the end of the test is equal to the pressure at the beginning of the test. Should any test disclose leakage greater than that specified, the Contractor shall locate and repair the defective joints until the leakage is within the specified allowance.

$$\text{PVC Pipe: } L = \frac{ND\sqrt{P}}{7,400}$$

$$\text{DI Pipe: } L = \frac{SD\sqrt{P}}{133,200}$$

In which:

- L = Allowable Leakage Gal/Hr
- S = Length of Pipe Tested in Ft.
- N = Number of Joints or Connections
- D = Nominal Diameter in Inches
- P = Gauge Pressure in psi

5. Should any test disclose leakage greater than that specified, the Contractor shall locate and repair the defective joints or pipe until the leakage is within the specified allowance. Prior to testing, potable water pipe and equipment shall be disinfected in accordance with Oregon Administrative Rules, Chapter 333, Public Water Systems, 1993, Section 333-61-050(10) "Disinfection of New Facilities" prepared by the DWS.

TECHNICAL SPECIFICATIONS
SECTION 2
WELLHEAD IMPROVEMENTS

3.2 Painting

All pipes, valves, and fittings shall be painted in accordance with Technical Specifications - "Painting" and the Drawings.

END OF SECTION

**TEST WORKSHEET FOR THE
WATER LINES - LEAKAGE TEST**

Project Name _____

Date _____ Job No. _____

Location of Test/Stationing _____

Hydrostatic Test

Test Pressure _____

Time Test Started _____

Time Test Completed _____

TOTAL TIME _____ minutes

Test Passed Yes No

Leakage Test (Min. Test Pressure 100 psi)

$$\text{PVC Pipe: } L = \frac{ND\sqrt{P}}{7,400} \qquad \text{DI Pipe: } L = \frac{SD\sqrt{P}}{133,200}$$

In which:

- L = Allowable Leakage Gal/Hr
- S = Length of Pipe Tested in Ft.
- N = Number of Joints or Connections
- D = Nominal Diameter in Inches
- P = Gauge Pressure in psi

Allowable Leakage

<u>Pipe Section</u>	<u>Nominal Diameter</u>	<u>Number of Joints or Connections</u>	<u>Length of Pipe</u>	<u>Allowable Leakage</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

Total Allowable Leakage _____ gal/hr

Time Test Started _____

Total Leakage Measured _____ gal.

Time Test Completed _____

Total Leakage Measured/Gal= _____ gal/hr

TOTAL TIME _____ mins. _____ Time (hr.)

Test Passed Yes No

Contractor's Firm Name: _____

Contractor's Representative Signature _____

Engineer's Representative Signature _____

Note: See Technical Specifications for directions of use.

TABLE OF CONTENTS
SECTION 3
MOBILE WATER TREATMENT SYSTEMS

PART 1 - General	3-1
1.1 Summary	3-1
PART 2 - Materials.....	3-1
2.1 Mobile Ultrafiltration Membrane Water Treatment Trailer.....	3-1
2.2 Ultraviolet Light Disinfection Unit.....	3-2
2.3 Filtered Water Storage Tank, TK-701.....	3-3
2.4 Temporary Piping.....	3-4
PART 3 - Execution	3-5
3.1 Site Preparation.....	3-5
3.2 Water System Assembly.....	3-5
3.3 Demonstration Test.....	3-5

TECHNICAL SPECIFICATIONS
SECTION 3
MOBILE WATER TREATMENT SYSTEM

PART 1 - GENERAL

1.1 Summary

- A. These Specifications cover general mechanical requirements for a mobile ultrafiltration and ultraviolet (UV) light water treatment system. This system includes a rental pre-engineered ultrafiltration water treatment trailer, a rental UV disinfection unit, temporary water storage, site security, and required electrical and plumbing connections and appurtenances. For additional requirements and related work, refer to other Technical Specifications and the Drawings.
- B. The Contractor shall furnish and install a complete and operable pump system as shown on the Drawings and specified herein.

PART 2 - MATERIALS

2.1 Mobile Ultrafiltration Membrane Water Treatment Trailer

- A. Designed to remove suspended solids and organic debris from a raw water source.
- B. Treatment Capacity and Requirements

1. Raw Water

Parameter	Maximum or Range
Flow	230-915 gpm typical 1,150 gpm maximum
Pressure	35-70 psig
Temperature	3-25 degrees C 37-77 degress F
pH	6-9
Total Organic Carbon	< 2.0 mg/L
Turbidity	< 20 NTU
Langelier Saturation Index	+0.5
Hardness	< 100 mg/L as CaCO ₃
Iron	< 0.3 mg/L
Dissolved Iron	< 0.1 mg/L
Manganese	< 0.05 mg/L
Dissolved Manganese	< 0.025 mg/L

TECHNICAL SPECIFICATIONS
SECTION 3
MOBILE WATER TREATMENT SYSTEM

2. Treated Water Quality

Parameter	Maximum or Range
Flow	200-800 gpm typical 1,000 gpm maximum
Pressure	15 psig
Turbidity	< 0.1 NTU 95% of time < 0.3 NTU 100% of time
Silt Density Index	< 3.0
Particle Removal	> 4.0 log removal

C. Equal to Evoqua Water Technologies MEMCOR CP II Membrane Filtration System.

2.2 Ultraviolet Light Disinfection Unit

A. Radiation

1. UV Dose Range: 186 millijoules per centimeter squared (mJ/cm²)
2. UVT Range: 70 percent to 98 percent
3. Water Temperature: 34°F to 104°F

B. Chamber

1. Type 316L stainless steel material
2. Minimum 6 lamps
3. Mounting feet
4. 150 psi maximum operating pressure
5. Automatic wiping system

C. Control Panel

1. Ballast Power Level: Electronic Variable Output (60 percent to 100 percent)
2. 240 V, single phase, 2 wire + ground, 60 Hz
3. Type 4X rating
4. Painted Mild Steel material
5. Input/Outputs: 5 analog in, 2 discrete in, 4 analog out, 7 discrete out

D. Instrumentation

1. One UV sensor per chamber

TECHNICAL SPECIFICATIONS
SECTION 3
MOBILE WATER TREATMENT SYSTEM

- E. Equal to TrojanUVSwift SC Model D06.
- F. Guarantee
 - 1. Unit shall have third-party performance guarantee to validate UV Dose range.
- G. Warranties

The manufacturer shall provide a written warranty that provides for:

- 1. Full replacement of all defective lamps within the first 3,000 hours of operation, provided that the system is operated continuously.
- 2. Full replacement of components against defects in materials and workmanship for a period of 1 year from date of final acceptance by the Owner.
- 3. Performance warranty as outlined in Paragraph 1.1, Scope and Paragraph 2.3.A. System Operating Conditions.

2.3 Filtered Water Storage Tank, TK-701

- A. Minimum 15,000-gallon operational capacity.
- B. Epoxy coated, NSF 61 approved.
- C. Penetrations
 - 1. One 8-inch diameter flanged inlet
 - 2. Two 8-inch diameter flanged outlets
 - 3. One 12-inch diameter flanged overflow
 - 4. One 12-inch diameter flanged air vent
- D. Material
 - 1. Fiberglass
 - 2. NSF 61 approved epoxy coated steel

TECHNICAL SPECIFICATIONS
SECTION 3
MOBILE WATER TREATMENT SYSTEM

2.4 Temporary Piping

A. PVC Pipe

1. PVC pipe shall be the size and type called for on the Drawings and shall conform to the following applicable ASTM Standards:
 - a. D 1784, PVC and CPVC plastic compounds
 - b. D 1785, Schedule 80, and 120 PVC pipe
2. Insulation
 - a. Heat Tape
 - b. Glycol Heater
 - c. Pre-Insulated
 - 1) Polyurethane foam insulation injected in annular space between carrier pipe and jacket

B. Steel Pipe and Fittings

1. Steel pipe shall conform to the provisions of AWWA Standards C201 and C202. Pipe 10 inch and smaller shall be Schedule 40; pipe over 10 inch shall have 0.375-inch wall thickness.
2. Fittings for steel pipe less than 3-inch diameter shall be threaded malleable iron. Fittings for pipe 3-inch diameter and larger shall be seamless steel welding fittings with wall thickness equal to the pipe with which they are joined.
3. Flanges shall conform to AWWA Standard C207 and shall be the flat face type. Flanges shall have ANSI B16.1, Class 125 bolt hole template. Gaskets shall be either ring or full face, 1/8-inch thick conforming to AWWA C111, Appendix B.
4. Unless other linings are required by the Drawings, pipe 3-inch diameter and smaller shall be hot dipped galvanized and pipe 4 inch and larger shall be epoxy lined and coated, AWWA C210.

TECHNICAL SPECIFICATIONS
SECTION 3
MOBILE WATER TREATMENT SYSTEM

PART 3 - EXECUTION

3.1 Site Preparation

- A. During trench and general excavation, the Contractor shall minimize the disturbance of adjacent gravel surfaces.
- B. Backfill of trenches and other work areas shall be in accordance with Technical Specifications - "Underground Piping" or other applicable requirements.

3.2 Water System Assembly

- A. Coordinate assembly of the mobile water treatment system with the manufacturer.
- B. Assembly shall result in operational system as shown on the Drawings.
- C. Filtered water shall meet all drinking parameters per Oregon Administrative Rule 333-61-0030.

3.3 Demonstration Test

Demonstration shall be operated continuously for 2 weeks followed by 2 weeks for recovery. This process shall be repeated for up to 3 months of operation.

END OF SECTION

TABLE OF CONTENTS
SECTION 4
INTAKE SCREEN AND INFEED PUMP STATION

PART 1 - General	4-1
1.1 Scope	4-1
1.2 Submittals.....	4-1
1.3 Storage of Equipment	4-1
PART 2 - Materials.....	4-2
2.1 Inferred Pump	4-2
2.2 Pressure Gauges.....	4-4
PART 3 - Execution	4-5
3.1 Inferred Pump Operation.....	4-5
3.2 Painting.....	4-5
3.3 Testing	4-5
3.4 Installation of Conduit for Pressure Transducer or Electric Probe	4-6

ATTACHMENT

Pump/Motor Installation Record

TECHNICAL SPECIFICATIONS

SECTION 4

INTAKE SCREEN AND INFEED PUMP STATION

PART 1 - GENERAL

1.1 Scope

- A. These Specifications cover general mechanical requirements for mechanical equipment for pump stations and well houses. For additional requirements and related work, refer to other Technical Specifications and the Drawings.
- B. Items specified in this Technical Specification are intended to be broad in scope and may not always apply to all items of Work to be constructed. All applicable sections, as determined by the Engineer, shall apply to the Work outlined in the Contract Documents.
- C. The Contractor shall furnish and install a complete and operable pump system as shown on the Drawings and specified herein.

1.2 Submittals

- A. Inferred Pump - Certified Pump Performance Curve

The Contractor shall provide a certified pump performance curve from the pump manufacturer for the actual pump to be furnished on the Project. The curve shall show the head capacity, efficiency, and horsepower, and shall cover the complete operating range of the pump from zero capacity to maximum capacity including the design point.

- B. Intake Screen
- C. Silent Check Valve
- D. Flexible Suction Hose
- E. Flexible Discharge Hose
- F. Shop Drawings of suction intake connection including dimensions, pipe material, and pipe fittings.

1.3 Storage of Equipment

The Contractor shall provide indoor storage facilities for all mechanical equipment including pumps, motors, and control equipment before they are installed. Any equipment that is damaged due to exposure to the weather shall be replaced at the Contractor's expense.

TECHNICAL SPECIFICATIONS

SECTION 4

INTAKE SCREEN AND INFEED PUMP STATION

PART 2 - MATERIALS

2.1 Inferred Pump

A. Pump Type

The pump shall be a single-stage, end-suction, vertical mounted, close-coupled centrifugal pump. The pump shall be Cornell 4HH-VM or equal.

B. Operating Conditions

1. The pump shall be capable of delivering water under the following conditions:

Pumping Capacity (Primary)	987 gpm at 115 ft. total dynamic head (TDH)
Minimum Pump Efficiency at Primary Point	77 percent
Suction Lift	10 ft.
Maximum Speed	1,870 RPM
Minimum Horsepower	40 Hp
Suitable for surface water	

2. It shall be the Contractor's and Supplier's responsibility to furnish a pump that will operate under the conditions listed above and as shown on the Drawings.

C. Performance Characteristics

A pump with a flat curve is desired to provide a wide range of flow and to extend the distance to the pump shutoff or maximum operating head.

D. Pump Construction

1. The pump shall be a close-coupled, horizontal end suction centrifugal pump with close grained cast iron or ductile iron case and replaceable bronze or stainless steel wear rings.
2. The impeller shall be bronze, stainless steel, or cast iron and shall be balanced. Impeller shall be keyed to the shaft and secured by a vibration resistant lock screw.

TECHNICAL SPECIFICATIONS

SECTION 4

INTAKE SCREEN AND INFEED PUMP STATION

3. The pump shall utilize a mechanical seal with a stainless steel or bronze shaft sleeve. Mechanical seals shall be constructed of 303 stainless steel with ceramic seals, Buna-N elastomers, Ni-resistant, and carbon washers. The pump shaft shall have O-ring seals.

E. Motor

1. Electric motor shall be of the high efficiency energy saver horizontal open drip-proof squirrel cage induction type, NEMA Design B, NEMA Code designation for applicable locked rotor kVA, for operation in 40°C ambient, with a service factor of 1.15 on sine wave or 1.0 on PWM inverter, motor shall meet NEMA MG-1 Part 31 requirements.
2. Class F insulation, continuous duty rated.
3. Motors shall be sized to ensure the motor will not be overloaded at any point on the pump operating curve without considering the service factor. Motor shall be suitable for 460 volt, 3-phase, 60 Hz power.
4. Motor lubrication instructions shall be stamped on a nameplate attached to the motor.
5. Inverter duty rated.

F. Spare Parts

Two spare mechanical seal kits shall be furnished with each pump.

G. Steel Pipe Manifolds

1. Fabricated steel piping manifolds will be acceptable for clean water applications.
2. Steel pipe shall be A53 Schedule 40 for up to 10-inch diameter and standard weight for pipes 12 inches and larger.
3. Flanges shall conform to AWWA C206-Class D and be compatible with ANSI B16.1 flanges on cast and ductile iron fittings.
4. All welds shall conform to the requirements of AWWA C206. All rough areas, spatter, etc., shall be ground smooth.

TECHNICAL SPECIFICATIONS

SECTION 4

INTAKE SCREEN AND INFEED PUMP STATION

5. The interior of the steel pipe manifold shall be painted with an epoxy system approved by the Engineer, and the exterior of the pipe shall be painted in accordance with Technical Specifications - "Painting."

2.2 Pressure Gauges

A. Clean Water

1. Pressure gauges for clean water shall have stainless steel bourdon tube and movement with stainless steel bodies and polycarbonate lenses.
2. Pressure gauges shall be glycerin-filled 500 series as manufactured by NoShok.
3. Graduation intervals shall be the smallest available for the pressure range required.
4. Pressure gauges shall have a minimum 4-inch diameter dial face and be provided with a pressure snubber and ball-type isolation valve.

B. Wastewater

1. Pressure gauges for wastewater shall have stainless steel bourdon tube and movement with stainless steel bodies and polycarbonate lenses.
2. Pressure gauges shall be glycerin-filled 500 series as manufactured by NoShok.
3. Pressure gauge shall have a NoShok 29-04-SS-SS-04-SS-F diaphragm seal with SS treaded orifice in the gauge.
4. Graduation intervals shall be the smallest available for the pressure range required.
5. Pressure gauges shall have a minimum 4-inch diameter dial face and be provided with a ball-type isolation valve.

TECHNICAL SPECIFICATIONS

SECTION 4

INTAKE SCREEN AND INFEED PUMP STATION

PART 3 - EXECUTION

3.1 Inferred Pump Operation

See Electrical Drawings for details.

3.2 Painting

All pipes, valves, and fittings shall be painted in accordance with Technical Specifications - "Painting" and the Drawings.

3.3 Testing

A. Field Test

1. The Contractor will arrange with the Engineer to witness a test of all mechanical systems and equipment after installation is completed. These tests shall demonstrate that the complete facility operates in accordance with the Drawings and Specifications and the required functions. All defects shall be corrected at the Contractor's expense before final acceptance. Refer to the General Requirements.
2. A field performance acceptance test shall be conducted on all pumps after completion of pump installation. The test shall be conducted by the installing Contractor and a representative of the pump manufacturer provided by the Contractor. The representative shall certify in writing that the pump installation is in accordance with the manufacturer's standards. The representative shall certify in writing, based upon actual field testing, that the pump meets the performance as shown on the applicable pump curve relative to discharge head, volume, and efficiency. A vibration test shall be made by the representative and he shall certify in writing that velocity and displacement of each pump are within the manufacturer's design tolerances. It shall be the Contractor's responsibility to take whatever corrective actions are necessary if the pumps do not meet the performance criteria.

B. Motor Rotation

1. Check for correct rotation of the motor. After the correct rotation is established, the amount of current unbalance between legs shall be calculated. Current unbalance between legs shall not exceed 5 percent. The current unbalance is defined and calculated as follows:

TECHNICAL SPECIFICATIONS

SECTION 4

INTAKE SCREEN AND INFEED PUMP STATION

$$\% \text{ current unbalance} = \frac{\text{Maximum current difference from average current}}{\text{average current}}$$

2. Current readings should be checked on all legs using the three possible hookups. The best hookup will have the lowest percentage of unbalance. To avoid changing motor rotation when taking the readings, the motor leads should be rolled across the starter terminals by moving them in the same direction. The hookup with the lowest percent of unbalance shall be used.

3.4 Installation of Conduit for Pressure Transducer or Electric Probe

Conduit for the installation of pressure transducers or electric probes shall be securely attached to the discharge column with stainless steel bands at a maximum spacing of 20 feet.

END OF SECTION

**THE FOLLOWING FORM SHALL BE COMPLETED
FOR EACH PUMP**

Pump/Motor Installation Record

Date _____ Filled In By _____

Installation

Installer: _____ Telephone _____

Street: _____ City _____ State _____ Zip _____

Owner/User: _____ City _____ State _____ Zip _____

Well Identification, If Any: _____

Well Is For: City/Town _____ OR _____

Water Is Pumped To: Storage Tank _____ Distribution Piping _____

OR

New Installation? Yes _____ No _____ If Not, It replaces _____

Well (When Applicable)

Well Diameter: _____ In. Well Depth _____ Ft. Cased _____ OR Uncased _____

Casing: _____ In. Length _____ Ft. _____ Screened _____ OR Unscreened _____

Casing Is: Steel _____ Stainless Steel _____ Plastic _____ OR _____

Screen _____ OR Perforated Casing _____ From _____ Ft. To _____ Ft. & _____ Ft. To _____ Ft.

Static Water Level Is: _____ Ft. Water Temperature Is: _____ °F

Drawdown Level Is: _____ Ft., After Pumping At _____ GPM

Pump/Motor Is Set At: _____ Ft., On Steel Pipe _____

Flow Sleeve On The Motor? Yes _____ No _____ If Yes, Mfr. _____

Size _____ Model _____

Wiring

Transformers: KVA No. 1 _____ No. 2 _____ No. 3 _____ Connected: Wye _____ Delta _____

Supply Cable: (Service Entrance To Control): _____ Ft. of No. _____ Copper _ Alum. _

Drop Cable: (Control To Motor): _____ Ft. of No. _____ Copper _____ Alum. _____

Cable is: Flat _____ Round _____ OR 3 Individual Conductors _____ Jacketed: Yes ___ No ___

Insulation Is: Neoprene _____ PVC _____ OR _____

Splice Is: Crimped ___ OR Soldered _____ And, Taped _____ Heat Shrink _____ OR _____

Controls and Protective Devices

Solid State Soft Start? Yes _____ No _____. If Yes, Type _____

Reduced Voltage Starter? Yes _____ No _____. If Yes, Type _____

Mfr. _____ Setting _____ % Full Voltage In _____ Seconds

Pump Panel? Yes _____ No _____. If Yes, Mfr. _____ Size _____

Magnetic Starter/Contactor: Mfr. _____ Model _____ Size _____

Heaters: Mfr. _____ No. _____ If Adjustable; Set At _____

Fuses: Mfr. _____ Size _____ Type _____

Lightning/Surge Arrester: Mfr. _____ Model _____

Controls Are Grounded: To _____ With No. _____ Wire _____

Phase Converter? Yes _____ No _____. If Yes, Mfr. _____ Model _____

Motor

Model No. _____ Serial No. _____ Date Code _____

Horsepower _____ Voltage _____ Phase _____ Diameter _____

Pump

Mfr. _____ Model _____ Rated _____ GPM At _____ Ft.

Operating Cycle

Pump/Motor Operates; Continuously (Non-Stop) _____ OR is controlled by: _____

Manual Switch _____ Pressure Switch _____ Float/Level Control _____ Flow Switch _____

Timer _____ OR

_____ Off _____

_____ On _____

_____ Minutes Or _____ Hours _____ Minutes Or _____ Hours

Startup Data

Insulation Check

Initial Megs: Motor & Lead Only Black _____ Yellow _____ Red _____

Installed Megs: Motor, Lead, & Cable Black _____ Yellow _____ Red _____

Voltage To Motor

Non-Operating: B-Y _____ Y-R _____ R-B _____

At Rated Flow of _____ GPM B-Y _____ Y-R _____ R-B _____

At Open Flow _____ GPM B-Y _____ Y-R _____ R-B _____

Amps To Motor

At Rated Flow of _____ GPM Black _____ Yellow _____ Red _____

At Open Flow _____ GPM Black _____ Yellow _____ Red _____

At Shut Off* Black _____ Yellow _____ Red _____

*Do NOT Run at Shut Off More Than Two (2) Minutes.

Comments: _____

TABLE OF CONTENTS

SECTION 5

PAINTING

PART 1 - General 5-1

 1.1 Scope 5-1

 1.2 Reference Standards 5-1

 1.3 Storage and Handling 5-3

 1.4 Submittals 5-3

 1.5 Quality Assurance 5-4

PART 2 - Materials 5-5

 2.1 General 5-5

PART 3 - Execution 5-6

 3.1 Surface Preparation 5-6

 3.2 Application 5-7

 3.3 Painting Schedule 5-8

 3.4 Inspection 5-8

 3.5 Colors 5-9

 3.6 Extra Paint 5-9

TECHNICAL SPECIFICATIONS

SECTION 5

PAINTING

PART 1 - GENERAL

1.1 Scope

- A. This Technical Specification covers the furnishing of labor, materials, and equipment necessary to provide surface preparation, coating application, and inspection for a complete coating system as specified.
- B. As a general guideline, exposed improvements shall be painted unless specifically noted otherwise on the Drawings or Specifications. For piping systems above ground and in vaults, all pipe, valves, flowmeters, pumps, motors, etc., shall be painted.
- C. In general, painting finishes are not required on the following, unless specifically noted otherwise on the Drawings or in the Specifications:
 - 1. Stainless steel items of equipment, materials, and furniture having a factory finish, if the factory finish is in good condition.
 - 2. Aluminum not in contact with concrete or masonry.
 - 3. Galvanized fencing materials.
 - 4. Manholes and covers.
 - 5. Buried or concealed improvements.
- D. Items specified in this Technical Specification are intended to be broad in scope and may not always apply to every item of Work to be constructed. All applicable sections, as determined by the Engineer, shall control the Work outlined in the Contract Documents.

1.2 Reference Standards

- A. Protective coatings on potable water structures shall conform to applicable standards of the Oregon Health Authority - Drinking Water Services (DWS), AWWA, and ANSI/NSF.
- B. Without limiting the general aspects of other requirements of these Specifications, all surface preparation, coating, and painting of interior and exterior surfaces shall conform to the applicable requirements of the National Association of Corrosion Engineers, the Steel Structures Painting Council, the DWS, and the paint system manufacturer's printed instructions.

TECHNICAL SPECIFICATIONS

SECTION 5

PAINTING

- C. The below listed standards in Table 1 are 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. Where standards of surface preparation are described by citing SSPC specification, numbered reference is made to the "Steel Structures Painting Manual," Volume 2, published by the Steel Structures Painting Council.

Table 1
Reference Standards

Reference	Title
ANSI-NSF 61	Drinking Water System Components – Health Effects
SSPC-SP1	Specification for Solvent Cleaning
SSPC-SP2	Specification for Hand Tool Cleaning
SSPC-SP3	Specification for Power Tool Cleaning
SSPC-SP5	Specification for White Metal Blast Cleaning
SSPC-SP6	Specification for Commercial Blast Cleaning
SSPC-SP10	Specification for Near-White Metal Blast Cleaning
SSPC-PA2	Measurement of Dry Film Thickness with Magnetic Gages
ASTM D4060	Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D2794	Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D4541	Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM F1249	Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor
ASTM B117	Test Method of Salt Spray (Fog) Testing
ASTM D741	Method for Evaluating Degree of Blistering of Paints
ASTM D870	Practice for Testing Water Resistance of Coatings Using Water Immersion
ASTM D1014	Method of Conducting Exterior Exposure Tests of Paints on Steel
ASTM D1653	Test Method for Water Vapor Permeability of Organic Coating Films
ASTM D1654	Method of Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D4585	Practice for Testing the Water Resistance of Coatings Using Controlled Condensation
ASTM D5894	Standard Practice for Cyclic Salt Fog/UV Exposure of Painted Metal (Alternating Exposure in a Fog/Dry Cabinet and a UV/Condensation Cabinet)

TECHNICAL SPECIFICATIONS

SECTION 5

PAINTING

1.3 Storage and Handling

- A. Materials shall be brought to the Project Site in original sealed containers. The containers shall bear a legible product designation, batch number, and date of manufacture on the side of each container. They shall not be used until the Engineer has inspected contents and obtained data from information on containers or labels. Materials exceeding storage life recommended by the manufacturer shall be rejected. Submit paint receipts/invoices, upon request, to the Engineer.
- B. Coating materials shall be handled and stored according to the manufacturer's latest published instructions, and shall be protected from damage, moisture, direct sunlight, and temperatures below 40°F or above 100°F. Flammable coatings and paints must be stored to conform with city, county, and state safety codes for flammable coating or paint materials. Water base coatings or paints shall be protected from freezing.

1.4 Submittals

- A. Submit in accordance with the General Requirements in one complete package.
- B. Prior to ordering material, submit a complete schedule of materials to be used. Include manufacturer's brand name, product name, and designation number for each coat of each system to be used. Include information indicating percent solids by volume, minimum recommended dry film thickness per coat, recommended surface preparation, recommended thinners, application instructions, and a statement indicating that the specified prime coat is recommended by the manufacturer for use with the specified intermediate and finish coats.
- C. Prior to commencing Work, submit a detailed list of all surfaces and equipment items upon which the Contractor intends to apply protective coatings.
- D. Provide the following information on each paint product:
 - 1. Abrasion resistance, ASTM D4060, 1 kg load at 1,000 cycles, CS-1 7 wheel
 - 2. Impact resistance, ASTM D2794, direct and reverse
 - 3. Moisture vapor transmission, ASTM F1249
 - 4. Adhesion, ASTM D4541
 - 5. Salt fog, ASTM B117

TECHNICAL SPECIFICATIONS

SECTION 5

PAINTING

6. QUV, ASTM G53 (exterior finish coat only)
 7. Fresh water immersion, ASTM D870 (immersed coatings only)
 8. Humidity, ASTM D4585
- E. If materials other than those listed are submitted, submit additional information to fully define the proposed substitution. The Engineer may further require the Contractor to furnish additional test results from an independent paint laboratory comparing the proposed substitution with one of the named products, at no additional cost to the Owner. For substituted materials, provide a list of references, including contact person and phone number, where proposed substitute paint system has been used in similar exposures. Provide a minimum of five references (no duplicate owners or agencies).
- F. Provide Material Safety Data Sheets (MSDSs) for all products.
- G. Manufacturer's Certification: That products furnished meet applicable air quality regulations as to allowable VOC content for the place of application and use intended.
- H. Submit to the Engineer a full range of the manufacturer's standard and let down finish colors for review and selection by the Owner. After final colors have been selected, submit two 8-1/2 by 11-inch Samples on cardboard of each color indexed as to manufacturer and color designation. Color chips 3/4-inch by 1-1/2-inch may be used for pipe color codes.

1.5 Quality Assurance

- A. The Contractor shall submit to the Engineer a written detailed description of the painting Subcontractor's qualifications and experience relative to the application of the specified coating systems. Such description shall include the following minimum information:
1. Name of the company that will be performing the painting work.
 2. Experience of the company on similar projects, including experience with sandblasting, preparation of steel structures, concrete, piping, buildings, equipment, etc., and use of the paint systems specified herein.
 3. List of similar projects that the company has completed (five minimum).
 4. List of contact persons and telephone numbers for each job reference.

TECHNICAL SPECIFICATIONS

SECTION 5

PAINTING

5. Names of personnel who will be performing the Work on this Project and their experience.
 6. Name of the on-the-job painting supervisor and his/her experience.
- B. Coating Manufacturer's Qualifications
1. Protective coatings furnished under this section shall:
 - a. Be of a manufacturer who has been regularly engaged in the manufacture of protective coatings with a minimum of 10 years of successful experience.
 - b. Demonstrate to the satisfaction of the Engineer successful performance on comparable projects.
- C. Applicator's Qualifications
- Applicator shall be experienced in application of specified protective coatings for a minimum of 5 years, practical experience in application of the specified coatings, and successful completion of a minimum of five projects of similar size and complexity within the last 3 years.
- D. Coating manufacturer's authorized representative shall provide a written statement attesting that the applicator has been instructed on proper preparation, mixing, and application procedures for coatings specified as well as the applicator's qualifications.
- E. The coating system manufacturer shall provide a qualified representative to visit the Site a minimum of two times during the coating operations. The manufacturer's representative shall provide a written report at the conclusion of each site visit.

PART 2 - MATERIALS

2.1 General

- A. TNEMEC products are listed as the basis of design and quality in terms of performance and characteristics. Other manufacturers' products will be considered subject to meeting the listed quality, performance, and characteristics of the standard/product(s) for the particular application and compliance with the Specifications. Substantiating Technical Data are required. Submit requests for substitution in accordance with the General and Supplementary Conditions. Substitutions that decrease the film thickness, solids by volume, or number of coats will not be considered. Requests for substitutions

TECHNICAL SPECIFICATIONS

SECTION 5

PAINTING

shall include test reports that demonstrate the product(s) meets or exceeds the performance and characteristics of the listed standard/product(s).

- B. The Contractor shall submit any proposed substitutions on Table 2 "Protective Coating - Substitution List" at the end of this section. Colors where not specified shall be approved by the Owner.

PART 3 - EXECUTION

3.1 Surface Preparation

- A. General

Surfaces to be painted shall be prepared in accordance with the manufacturer's instructions in a professional manner with the objective of obtaining a smooth, clean, and dry surface. No painting shall be done before the prepared surfaces are approved by the Engineer.

- B. Metal

1. Metal surfaces, including piping, not shop primed or painted shall be thoroughly cleaned by sandblasting, in accordance with the paint manufacturer's instructions, and as specified herein prior to painting. Any metal items with a paint incompatible with the specified finish shall be primed as recommended by the paint manufacturer.
2. Previously painted surfaces such as piping which are pitted, scaling, rusty, etc., or in otherwise poor condition shall have existing paint removed to bare metal or as approved by the Engineer. Oils, dirt, and other surface contaminants, shall be removed so that surfaces are properly prepared for painting. Priming and painting shall then be applied in accordance with these Specifications.

- C. Wood

Wood surfaces exposed to view shall be sanded to remove any dirt or blemishes. Roof decking and beams need not be sanded if protected during construction such that no blemishes occur. Existing wood surfaces previously painted shall be scraped, sanded, and cleaned as required prior to painting.

TECHNICAL SPECIFICATIONS

SECTION 5

PAINTING

D. Concrete and Masonry

Concrete and masonry surfaces shall be cleaned of all dust, form oil, curing compounds, and other foreign matter. Concrete intended for immersion service shall be brush blasted prior to coating.

E. Concrete Floors

Concrete floors must be swept blasted to provide a light profile. ASTM WET MAT TEST shall be conducted by the Contractor on concrete that has not cured for 28 days.

3.2 Application

- A. Paint shall be applied in a neat, professional manner. Finished surfaces shall be uniform and pleasing in appearance, free of runs, drips, sags, or variable texture. Defective painting shall be removed and replaced.
- B. The painter shall apply each coating at the rate specified for application by the manufacturer. If material has thickened or must be diluted for application by spray gun, the coating shall be built up to the same film thickness achieved with undiluted material.
- C. Drying time shall be construed to mean "under normal conditions." Where conditions are other than normal because of the weather or because painting must be done in confined spaces, longer drying time will be necessary. Additional coats of paint shall not be applied nor shall units be put into service until paints are thoroughly dry.
- D. Where thinning is necessary, only the products of the manufacturer furnishing the paint, and for the particular purpose, shall be allowed, and all such thinning shall be done strictly in accordance with the manufacturer's instructions, as well as with the full knowledge and approval of the Engineer.
- E. No paint shall be applied in fog, snow, rain, or to wet or damp surfaces, or when air temperatures are below 40°F and surface temperatures are below 35°F or when the relative humidity exceeds 85 percent. The Contractor shall provide heaters, fans, etc., when necessary to keep moisture off of piping to be painted.
- F. Coating materials shall not be applied when the ambient air temperature, surface temperature, or humidity is outside the boundaries as stated on the product data sheets.
- G. Materials shall be evenly applied to form a smooth, continuous, unbroken film.

TECHNICAL SPECIFICATIONS

SECTION 5

PAINTING

- H. Dirt, grease, oil, paint chalk, or any other contamination will not be permitted between coats.
- I. Welds, bolt heads, nuts, rivets, and connections shall be stripe coated by brush with primer prior to applying full coat of primer.
- J. Concrete and masonry surfaces shall be thoroughly cured and free of other surface contaminants prior to application of protective coatings. Curing compounds shall not be used where painting will be required.
- K. Each application of protective coatings, with the exception of coal tars, shall be a different shade in color than the specified finish.

3.3 Painting Schedule

Painting schedule for the Work is given in Table 3 (end of section).

3.4 Inspection

A. Dry Film Thickness

After application of each coating in the specified system, the total dry film thickness shall be taken as follows:

1. Make 5 separate spot measurements spaced evenly over each section of 100 square feet in area per SSPC-PA 2. Measurements, as much as possible, should be taken at surfaces with dissimilar exposures, that is, at different angles, faces, bolts, etc., to ensure uniformity of the coatings.
2. No single spot measurement (average of 3 readings) in any section shall be less than 80 percent of the specified thicknesses.

B. Documentation

Applicator is to keep a log of ambient and surface temperature, humidity, dew point, and dry film thicknesses (paragraph 3.4.A.). These are to be logged every day at the beginning, middle, and end of each shift. This log is to be current and available at all times for the Owner, Engineer, and coatings manufacturer to verify.

TECHNICAL SPECIFICATIONS

SECTION 5

PAINTING

3.5 Colors

A. General

Colors shall be as called for on the Drawings or as approved by the Owner and directed by the Engineer. The Contractor shall provide color charts to the Engineer when required.

B. Color Pipe Coding

1. To facilitate identification of piping in plants and pumping stations, the color scheme given in Table 4 (end of section) shall be utilized. Final color selection will be as approved by the Engineer.
2. In situations where two colors do not have sufficient contrast to easily differentiate between them, a six-inch band of contrasting color should be painted on one of the pipes at approximately 30-inch intervals. Identification labels shall also be painted on the pipe. Paint arrows indicating the direction of flow. For each pipe to be provided with labeling, the Engineer shall provide the Contractor with the list of identification labels.

3.6 Extra Paint

The Contractor shall provide a minimum of one gallon of extra paint for each major color and system used. A minimum of one quart of extra paint shall be provided for colors used as trim or for minor items as determined by the Engineer. The Contractor shall provide either fresh labels from paint cans with a list of places used, or a written description of painting systems, locations used, and applications requirements.

TECHNICAL SPECIFICATIONS

SECTION 5

PAINTING

Table 2
Protective Coatings – Substitution List

System No.	Specified Coating		Substitute Coating Manufacturer's Name, Generic, Performance, Percent Solids, Surface Preparation, No. Coats, Industrial Use, Standards
	Generic	Coating Name ¹	
1	Modified Aromatic Polyurethane (Primer)	Series 1	
	Aliphatic Acrylic Polyurethane (Finish)	Series 73	
2	Modified Aromatic Polyurethane (Primer)	Series 1	
	Alkyd (Finish)	Series 2H	
3	Modified Aromatic Polyurethane (Primer)	Series 1	
	Polyamidoamine Epoxy (Intermediate)	Series N69	
	Polyamidoamine Epoxy (Finish)	Series N69	
4	Modified Aromatic Polyurethane (Primer)	Series 1	
	Polyamidoamine Epoxy (Finish)	Series N69	
5	Modified Alkyd (Primer)	Series 10	
	HDP Acrylic Polymer (Finish)	Series 1029	
6	Epoxy Modified Cementitious Mortar (Surface Filler)	Series 218	
	Polyamidoamine Epoxy (Primer)	Series N69	
	Polyamidoamine Epoxy (Finish)	Series N69	
7	Polyamide Epoxy (Primer and Finish)	Series 20	
8	Coal Tar	Series 46-465	
9	Acrylate (Primer and Finish)	Series 156	
10	Water Repellent Sealer	Degussa Protectosil Chem-Trete 40 VOC	
11	Acrylate (Primer and Finish)	Series 156	
12	Modified Polyamine Epoxy (Primer and Finish)	Series 280	
13	Vinyl Acrylic (Primer)	Series 51-792 PVA	
	Self-Crosslinking Hydrophobic Acrylic (Finish)	Series 115	
14	Vinyl Acrylic (Primer)	Series 51-792 PVA	
	Self-Crosslinking Hydrophobic Acrylic (Intermediate)	Series 115	
	Waterborne Acrylic Epoxy (Finish)	Series 113	
15	Polyamidoamine Epoxy (Primer and Finish)	Series N69	
16	Waterborne Modified Polyamine Epoxy (Primer)	Series 151-1051	
	Acrylic Emulsion (Finish)	Series 6	

¹ All listed coating names are TNEMEC products, except System No. 10.

TECHNICAL SPECIFICATIONS

SECTION 5

PAINTING

Table 3
Painting Schedule

Paint System No., Type, and Location	Surface Preparation	Prime Coat ^(1,2)	Intermediate/Finish Coat ^(1,2)
Ferrous Surfaces			
No. 1 - MC Polyurethane and Polyurethane Protective Coating - Exterior non-immersed ferrous surfaces such as exterior pipes, valves, supports, handrails, braces, covers, fabrications, etc.	New - Blast clean per SSPC-SP 6. Dry abrasive blasting performed with media that provides 1 to 2 mil anchor profile. Touchup - SSPC 1, 2, or 3	TNEMEC Series 1 Omnithane, 2.5 to 3.5 mils DFT	Finish - TNEMEC Series 73 Endurashield, 3 to 5 mils DFT
No. 2 - Alkyd Protective Coating - Interior non-immersed ferrous surfaces such as interior pipes, valves, flowmeters, pumps, motors, supports, braces, lids, fabrications, etc.	New - Cleaned with SSPC-SP3. Spot blast to SSPC-SP6 for highly corroded areas or areas in poor condition as determined by Engineer. Touchup - SSPC 1, 2, or 3	TNEMEC Series 1 Omnithane, 2.5 to 3.5 mils DFT	Finish - TNEMEC 2H Hi Build TNEMEC gloss, 2.5 to 3.5 mils DFT
No. 3 - Epoxy Protective Coating - Immersed or below grade ferrous surfaces that are shop primed and field finished such as flood gates, sewage plant equipment, non-potable water applications, etc.	New - Blast clean per SSPC-SP 5. Dry abrasive blasting performed with media that provides 2 to 3 mil anchor profile. Touchup - same as New.	TNEMEC Series 1 Omnithane, 2.5 to 3.5 mils DFT	Intermediate - TNEMEC Series N69 Hi Build Epoxoline, 3 to 5 mils DFT Finish - TNEMEC Series N69 Hi Build Epoxoline, 8 to 10 mils DFT
No. 4 - Epoxy Protective Coating - Immersed or below grade ferrous surfaces that are field primed and finished such as flood gates, sewage plant equipment, non-potable water applications, etc.	New - Blast clean per SSPC-SP 5. Dry abrasive blasting performed with media that provides 2 to 3 mil anchor profile. Touchup - same as New.	TNEMEC Series 1 Omnithane, 2.5 to 3.5 mils DFT	Finish - TNEMEC Series N69 Hi Build Epoxoline, 8 to 10 mils DFT
No. 5 - Acrylic Protective Coating - Interior and exterior architectural ferrous surfaces such as structural steel, metal roofing, siding, sashes, trim, doors, etc.	New - Prepared in accordance with SSPC –SP 6. Touchup - same as New.	TNEMEC Series 10 Primer, 2 to 3 mils DFT	Finish - TNEMEC Series 1029 Enduratone, 2 to 3 mils DFT
Masonry and Concrete Surfaces			
No. 6 - Epoxy Protective Coating Immersed masonry and concrete surfaces, non-potable such as storage tanks, basins, flumes, wetwells, etc.	New - Allow concrete to cure for 28 days or until passing the ASTM D4263 plastic mat test. Remove dirt, grease, oil, loose masonry, efflorescence, or any other contamination. Brush off blasting to provide anchor profile similar to medium grit sandpaper. Touchup - spot blast as described under New.	TNEMEC Series 218 Mortar Clad at 1/16-inch to fill surface voids flush to plane to ensure finish is monolithic and pinhole free; TNEMEC Series N69 Hi Build Epoxoline, 3 to 5 mils DFT	Finish - TNEMEC Series N69 Hi Build Epoxoline, 8 to 10 mils DFT

TECHNICAL SPECIFICATIONS

SECTION 5

PAINTING

**Table 3 (cont.)
Painting Schedule**

Masonry and Concrete Surfaces (cont.)			
No. 7 - Epoxy Protective Coating - Immersed masonry and concrete, potable application such as water tanks, basins, wetwells, etc.	New - Allow concrete to cure for 28 days or until passing the ASTM D4263 plastic mat test. Remove dirt, grease, oil, loose masonry, efflorescence, or any other contamination. Brush off blasting to provide anchor profile similar to medium grit sandpaper. Touchup - spot blast as described under New.	TNEMEC Series 20 POTA-POX, 4 to 6 mils DFT.	TNEMEC Series 20 POTA-POX, 4 to 6 mils DFT.
No. 8 - Coal Tar Protective Coating - Damp Proofing of masonry surfaces such as below grade vapor barrier for walls of buildings, pump stations, and other structures, etc.	New - Allow concrete to cure for 28 days or until passing the ASTM D4263 plastic mat test. Remove dirt, grease, oil, loose masonry, efflorescence, or any other contamination. Brush off blasting to provide anchor profile similar to medium grit sandpaper. Touchup - spot blast as described under New.		TNEMEC 46-465 H.B. TNEMECOL, 12 mils DFT
No. 9 - Exterior Acrylic/Latex Protective Coating - Non-immersed, non-colored masonry concrete block such as visible walls	New - Remove dirt, grease, oil, loose masonry, efflorescence, or any other contamination.	TNEMEC Series 156 ENVIRO-CRETE, 6 to 8 mils DFT	TNEMEC Series 156 ENVIRO-CRETE, 8 to 9 mils DFT
No. 10 - Water Repellent Sealer - Non-immersed colored masonry concrete block such as outside walls	New - Remove dirt, grease, oil, loose masonry, efflorescence, or any other contamination.	Same as Finish Coat	Degussa Protectosil Chem-Trete 40 VOC applied according to manufacturer's recommendations
No. 11 - Exterior Acrylic/Latex Protective Coating - poured or precast concrete, stucco such as outside walls	New - Remove dirt, grease, oil, loose masonry, efflorescence, or any other contamination. Touchup same as New	TNEMEC Series 156 ENVIRO-CRETE, 6 to 8 mils DFT	TNEMEC Series 156 ENVIRO-CRETE, 8 to 9 mils DFT
No. 12 - Modified Polyamine Epoxy Protective Coating - concrete Floors	New - Remove dirt, grease, oil, loose masonry, efflorescence, or any other contamination. Brush off blasting to provide anchor profile similar to medium grit sandpaper. Touchup - spot blast as described under New.	TNEMEC Series 280 TNEME-GLAZE, 6-8 mils DFT. Broadcast aggregate into wet primer per manufacturer's recommendations	TNEMEC Series 280 TNEME-GLAZE, 8 to 12 mils DFT with anti-skid sand per manufacturer's recommendations

TECHNICAL SPECIFICATIONS

SECTION 5

PAINTING

**Table 3 (cont.)
Painting Schedule**

Drywall and Plaster Board Surfaces			
No. 13 - Hydrophobic Acrylic - normal interior conditions.	New - Remove dirt, grease, oil or any other contamination. Touchup - same as New.	TNEMEC Series 51-792 PVA Sealer, 1.5 to 2 mils DFT	TNEMEC Series 115 Uni-Bond DF, 3 to 4 mils DFT
No. 14 - Acrylic Epoxy - interior humid conditions.	New - Remove dirt, grease, oil or any other contamination. Touchup - same as New.	TNEMEC Series 51-792 PVA Sealer, 1.5 to 2 mils DFT	Intermediate - TNEMEC Series 115 Uni-Bond DF, 2 to 3 mils DFT Finish - TNEMEC Series 113 H.B. TNEMEC-Tufcoat, 4 to 6 mils DFT
Aluminum			
No. 15 - Polyamidoamine Epoxy - aluminum in contact with concrete or masonry	New - Remove dirt, grease, oil or any other contamination. Touchup - same as New.	Same as Finish coat	TNEMEC Series N69 Epoxoline, 8 to 10 mils DFT
Interior and Exterior Wood			
No. 16 - Penetrating Alkyd Acrylic Emulsion - wood surfaces, trim etc.	New - Remove dirt, grease, oil, loose masonry, efflorescence, or any other contamination. Brush off blasting to provide anchor profile similar to medium grit sandpaper.	TNEMEC Series 151-1051, 1.0 to 1.5 mils DFT	TNEMEC Series 6 TNEMEC CRYL A7, 2 to 3 mils DFT, two coats required.
No. 17 - Wood Penetrating Alkyd Resin Sealer - Primer - exposed roof deck and beams.	New - Remove dirt, grease, oil, loose masonry, efflorescence, or any other contamination.	Same as Finish Coat	TNEMEC Chemprobe Wood Saver Plus at 150 to 200 square feet per gallon
Other Surfaces not defined herein requiring painting for protection or finished appearance	Per Engineer's approval	Per Engineer's approval	Per Engineer's approval

(1) – Prime and finish coats for touch-up or spot work shall be of the same system and dry film thickness (DFT) as the specified coating system.

(2) – DFT = dry film thickness

TECHNICAL SPECIFICATIONS

SECTION 5

PAINTING

Table 4
Color Pipe Coding

Type of Pipe	Color
Water Lines	
Raw	Olive Green
Settled or Clarified	Aqua
Finished or Potable	Dark Blue
Chemical Lines	
Alum	Orange
Ammonia	White
Carbon Slurry	Black
Chlorine (Gas and Solution)	Yellow
Chlorine (Sample)	Light Yellow
Fluoride	Light Blue with Red Bands
Lime Slurry	Light Green
Potassium Permanganate	Violet
Sulfur Dioxide (Gas and Solution)	Green with Yellow Bands
Sulfur Dioxide (Sample)	Light Green with Yellow Bands
Waste Lines	
Backwash Waste	Light Brown
Sludge	Dark Brown
Sewer (Sanitary or Other)	Dark Gray
Other	
Compressed Air	Dark Green
Gas	Red
Other Lines	Light Gray

END OF SECTION