TECHNICAL SPECIFICATIONS

WESTERN PULASKI COUNTY WATER DISTRICT
PULASKI COUNTY, KENTUCKY

WATER SYSTEM IMPROVEMENTS & REPLACEMENTS
CONTRACT 1
HICKORY NUT WATER STORAGE TANK REPLACEMENT

PROJECT NO. 1534

SEPTEMBER 2016

Monarch Engineering, Inc.

STATE OF KENTUCKY
DERON S. BYRNE
28127
LICENSED PROFESSIONAL ENGINEER

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5ABLE OF CONTENTS

SECTION 1 - MULTI-COLUMN ELEVATED WATER STORAGE TANK

1.0 Work Included & General Requirements. The CONTRACTOR shall be responsible for all labor, materials and equipment necessary for the design, fabrication, delivery, construction, painting, disinfection and testing of an elevated, welded carbon steel water storage tank supported by a series of supporting columns and cross bracing. This style of tank is commonly referred to as a "Multi-Column" Tank. Design and construction of the Elevated Tank shall conform to all requirements of AWWA D100 Standard for Welded Carbon Steel Tanks for Water Storage, except as modified by the requirements of these contract documents.

The structure is to be complete with all accessories specified herein, and is to be erected on foundations to be designed and constructed by the CONTRACTOR. The CONTRACTOR shall be responsible for the influent/effluent piping, overflow piping, tank drain line, valve vault and all other appurtenances as shown on the Drawings. Additionally, the CONTRACTOR will be responsible for all site work related to the construction of the storage tank, including the construction of an acceptable entrance to the site, clearing and grubbing, retaining wall construction, removal of excess fill material, and final cleanup including the establishment of an acceptable ground cover on the entire tank site. The final location of the all piping and appurtenances shall be determined in the field and will require final approval of the ENGINEER.

The design and construction of the water storage tank shall only be undertaken by a Contractor with a minimum of ten years experience with elevated tank construction. The CONTRACTOR must be able to demonstrate experience of the completed the design, construction, and commissioning of at least ten (10) multi-column elevated tanks with an equal or greater capacity of that required for this project.

The CONTRACTOR shall own and operate their fabrication facilities. Divided responsibilities between erection and fabrication is not permitted. A qualified supervisor employed by the CONTRACTOR shall be on site at all times during construction of the steel support structure and water tank. The CONTRACTOR shall not subcontract the design or erection of the steel tank and support assembly.

1.1 Related Documents. The Project Drawings and the general provisions of this document, including General Conditions, Supplemental General Conditions, Special Provisions and other Sections apply to work in this Section. Should there be any discrepancies between this section and other sections of the Contract Documents, this section shall take precedence.

1.2 Standard Specifications & References. As applicable, all work on the water storage tank shall fully conform to the requirements of the latest published editions of the following Specifications, Codes and Standards. The following apply and may be

referenced in this Section.

1.2.1 American Concrete Institute (ACI).

117-10	Standard Tolerances for Concrete Construction and Materials
228.1R-03	In-Place Methods to Estimate Concrete Strength
301-05	Specification for Structural Concrete for Buildings
304-00	Guide for Measuring, Mixing, Transporting and Placing Concrete
305-10	Hot Weather Concreting
306-10	Cold Weather Concreting
318-08	Building Code Requirements for Structural Concrete
347-04	Guide to Formwork for Concrete
371R-08	Guide for the Analysis, Design and Construction of Elevated Concrete and Composite Steel-Concrete Water Storage Tanks

1.2.2 American Institute of Steel Construction (AISC).

S335	Specification for Structural Steel Buildings

1.2.3 American National Standards Institute (ANSI).

B16.5	Pipe Flanges and Flanged Fittings

1.2.4 American Society of Civil Engineers (ASCE).

ASCE 7	Minimum Design Loads for Buildings and Other Structures

1.2.5 American Society for Testing Materials (ASTM).

A 123	Zinc Coatings on Iron and Steel Products
A 240	Stainless Steel Plate, Sheet and Strip for Pressure Vessels
A 285	Pressure Vessel Plates, Carbon Steel
A 774	Welded Stainless Steel Fittings
A 778	Welded Stainless Steel Tubular Products

1.2.6 American Water Works Association (AWWA).

D107-10	Composite Elevated Tanks for Water Storage
D100-11	Welded Steel Tanks for Water Storage
D102-11	Coating Steel Water Storage Tanks
C652-02	Disinfection of Water-Storage Facilities

1.2.7 American Welding Society (AWS).

D1.1	Structural Steel Certification

1.2.8 Federal Aviation Administration (FAA).

70/7460-1H	Obstruction Marking and Lighting

1.2.9 National Association of Corrosion Engineers (NACE).

RP0178	Recommended Practice - Fabrication Details, Surface Finish Requirements and Proper Design Considerations for Tanks and Vessels to be Lined for Immersion Service

1.2.10 National Fire Protection Association (NFPA) / National Electric Code (NEC).

780	Standard for the Installation of Lightning Protection Systems
NEC	National Electric Code

1.2.11 National Sanitation Foundation (NSF).

61	Standard for Drinking Water System Components

1.2.12 Occupational Safety and Health Administration (OSHA).

29 CFR	Safety and Health Regulations for Construction

1.2.13 Steel Structures Painting Council (SSPC).

VIS-89	Visual Standard for Abrasive Blast Cleaned Steel
Volume 1	Good Painting Practice
Volume 2	Systems & Specifications

1.3 System Description - Elevated Storage Tank. The proposed water storage tank shall be an elevated welded carbon steel water storage tank supported by a series of supporting columns and cross bracing. The tank shall be a Toro Ellipsoidal (Torus Bottom) style Multi Column structure. The storage tank shall be in accordance with the shape, dimensions and details required by these Specifications and Drawings. The elevated tank shall be all-welded construction of the most economical design. All members of structural steel or of reinforced concrete shall be designed to safely withstand the maximum stresses to which they may be subjected during erection and operation.

1.3.1 Operating Parameters.

- The minimum operating capacity of the storage tank will be 300,000 US gallons.
- The capacity of the tank, low to high water level, shall be contained within a maximum operating range of 30’-4” (+/- 1’).
- The storage tank overflow/ top capacity level elevation shall be 1336.25’.
- The height of the tank, top of foundation to overflow shall be 96’-3”’.
- Top of foundation elevation shall be 1242.00 +/-.
- The existing ground elevation varies from 1247’ to 1232’.
- The finished ground elevation shall be 1240’ +/-.

1.3.2 General Design.

1.3.2.1 Design Standards. The structural design of the elevated water storage tank shall conform to the following design standards except as modified or clarified by this Section. In case of conflict between the Standards and the criteria listed below, the more stringent requirement shall apply.

- Reinforced Concrete Foundations: AWWA D100 & ACI 318
- Welded Steel Water Tank: AWWA D100
- Steel Water Storage Tank Coatings: AWWA D102
- Environmental Loading: AWWA D100 & ASCE 7

1.3.3 Environmental Loads.

1.3.3.1 Wind Load. Wind pressure shall be determined in accordance with AWWA D100, Section 3.1.4. Basic wind speed used in the Wind Pressure formula shall be determined using the mapped site location and Figure 1 of AWWA D100. At a minimum the tank shall be designed for a minimum wind velocity of 100 MPH.

1.3.3.2 Seismic Load. All structure designs shall be performed in accordance with criteria set forth in AWWA D100, Section 13

- Region Dependent Transition Period (TL) = *
- Site Class B
- MCE Spectral Response Acceleration at 0.2sec (SS) and 1sec (S1)
  - SS = *
  - S1 = *

  * *In accordance with AWWA D100*
- Importance Factor (I) = * (Sec. 4.2.7.7)
- Latitude and Longitude of tank center: 37˚07’ 37.76” N 84˚48’ 09.14” W

1.3.3.3 Snow Load. Snow load shall be determined in accordance with AWWA D100, Section 3.1.3.1 (20 psf minimum loading).

1.3.4 Foundation Loads. A Geotechnical investigation has been carried out at the site and a copy of the report is included within the Contract Documents. Allowable bearing capacities are defined in this report.

The concrete foundation shall be designed and constructed by the CONTRACTOR based upon the recommendations in the geotechnical report. The foundation shall be designed by the CONTRACTOR to safely support the structure based on the foundation recommendations within the geotechnical consultant’s soil report. Foundations shall be sized in accordance with AWWA D-100 subject to the following modifications:

- Allowable permanent soil pressure shall not be exceeded under D+F.
- Allowable short term soil pressure shall not be exceeded under D+F+E or D+F+W.
- No uplift under D+W or D+F+.75E unless anchorage is provided.
- No overturning under D+1.5W or D+F+1.5E.

D = Effect of dead load including net weight of the foundation.
F = Effect of water load.
E = Effect of seismic load.
W = Effect of wind load.

1.4 Submittals.

1.4.1 Proposal. The bidder shall submit the following with the proposal.

1.4.1.1 Experience List. A completed contracts summary shall demonstrate a minimum of ten (10) years experience in the design and construction of elevated water storage tanks. CONTRACTOR shall provide a list of a minimum of ten (10) multi-column elevated tanks with an equal or greater capacity of that required for this project. Provide the location, capacity, Owner's name and contact information, Engineer's name and contact information and year completed. Failure to provide this information shall be cause for rejection of the bid

1.4.1.2 Tank Drawing. A preliminary drawing of the elevated water storage tank proposed for this project. The drawing shall include sufficient detail to illustrate tank geometry, materials of construction, primary dimensions, the sizes of all principal and secondary structural members, thickness of all plates, arrangement of members, the high and low water elevation levels, and other information required to show compliance with this Specification. If the proposed design does not comply with this Specification, the bid shall be rejected.

1.4.1.2 Foundation Drawing. A drawing of the preliminary design of the foundation proposed for this project. The drawing shall include sufficient detail to illustrate foundation geometry, materials of construction, preliminary dimensions and approximate quantities of concrete and reinforcing steel. Failure to provide this information shall be cause for rejection of the bid.

1.4.2 Construction Drawings. After contract award and prior to construction, the CONTRACTOR shall provide engineering drawings for the elevated steel tank and the foundation. Drawings shall show all proposed work to include the tank foundation, concrete mix design, tank structure showing plate thicknesses, members, details of all connections, special details and member loads, the specified strength and grade of all materials, piping, valves, painting and other pertinent information as required per the project plans and specifications.

Reinforced concrete details shall include construction joints, openings and inserts. Reinforcement shall be clearly indicated on the structural drawings and identified by mark numbers that are used on the fabrication schedule. Location, spacing and splice dimensions shall also be shown. Placement and fabrication details shall conform to ACI 318.

Steel tank details shall include weld joints and a layout showing all primary and secondary shop and field welds. The CONTRACTOR shall provide shop and field weld procedures for all structural joints on the steel tank.

The submission shall be sealed by a professional engineer registered in the State of Kentucky.

1.4.4 Design Data and Calculations. The CONTRACTOR shall provide a table showing capacity of the tank in gallons at all levels in one ft. increments.

The CONTRACTOR shall provide a summary of the design for the foundation, concrete support structure, welded steel water tank and other components. The design coefficients and resultant loads for snow, wind and seismic forces, and the methods of analysis shall be documented.

The submission shall be sealed by a professional engineer registered in the State of Kentucky.

1.4.5 Product Data. The contactor shall provide separate concrete mix designs for each specified concrete compressive strength indicated on the drawings.

The CONTRACTOR shall provide technical data and manufacturer's standard color chart of all coating products to be used.

Provide manufacturer's descriptive information for appurtenant equipment and accessories that are not detailed on the construction drawings.

1.4.6 Reports/Certification. The CONTRACTOR shall provide documentation of all tests, inspections and certifications required by this Section.

The CONTRACTOR shall provide general qualifications of all welders.

1.4.7 Operation/Maintenance. Following completion of construction, the contactor shall provide operating instructions and maintenance procedures for the elevated water storage tank and applicable appurtenant equipment, mechanical components and miscellaneous accessories.

1.5 Quality Assurance.

1.5.1 Qualification of Manufacturer. A turnkey elevated tank contractor shall perform the work described in this Section. No part of the design or construction of the support structure or welded steel water tank shall be subcontracted. The CONTRACTOR shall have designed, constructed and placed in service a minimum of ten (10) multi-column

elevated tanks with an equal or greater capacity of that required for this project.

The CONTRACTOR shall directly employ a full-time Professional Engineer with a minimum ten (10) years cumulative experience in the design and construction of multi-column elevated tanks. The CONTRACTOR'S engineer shall be registered in accordance with these specifications and shall be in responsible charge of the work.

1.5.1 Regulatory Requirements. The Specifications, Codes and Standards referenced in Section 1.2 shall govern the work with regard to materials, design, construction, inspection and testing to the extent specified.

The elevated water storage tank shall be designed and constructed in compliance with applicable federal, state and local regulations.

Personnel safety equipment shall be provided in accordance with OSHA requirements and the manufacturers' documentation.

1.6 Delivery, Storage & Handling.

1.6.1 Handling and Shipping. The CONTRACTOR shall handle materials and fabricated components in a manner that will protect them from damage. Allow painted materials adequate cure time prior to stacking or shipping.

1.6.2 Storage and Protection. Protect delivered materials and equipment from damage. Store in well drained areas and provide blocking to minimize contact with the ground.

1.7 Project Conditions.

1.7.1 Permits and Easements. Permits, licenses and easements required for permanent structures, changes in existing facilities or necessary advancement of the specified construction shall be secured and paid for by the OWNER prior to the start of construction. These include building permits, airspace authority approval, site access easements, highway crossing permits, etc.

Licenses or permits of a temporary nature required by specific trades shall be the responsibility of the CONTRACTOR.

1.7.2 Existing Conditions. A geotechnical investigation has been carried out at the site and a copy of the report is included within the Contract Documents. The net allowable bearing pressure of the shallow foundation and/or the allowable capacity of deep foundation elements have been defined in this report. The CONTRACTOR shall be responsible for securing any further geotechnical information required beyond that provided in this report. The OWNER shall retain the services of the Geotechnical consultant to verify the adequacy of the bearing stratum after the CONTRACTOR has

carried out the excavation and before any concrete or reinforcement is placed.

1.7.2a Access. The CONTRACTOR shall provide an access road extending from the nearest public roadway to the tank site. Unless otherwise specified on the Plans, the properties of the access road shall be the minimum necessary to meet the needs of the CONTRACTOR during construction.

1.7.3 Working Conditions.

1.7.3.1 Safety and Health. The CONTRACTOR shall comply with safe working practices and all health and safety regulations of OSHA, state and local health regulatory agencies and Material Safety Data Sheets (MSDS). Provide protective and lifesaving equipment for persons working at the site.

1.7.3.2 Times for Work. Working times shall comply with local, state and federal regulations and laws. No work shall be performed on weekends or holidays unless approved by the Resident Engineer. Any request to perform work during these periods shall be made at least seven days prior to the expected date of the work.

1.8 Sequencing and Scheduling.

1.8.1 Schedule. The CONTRACTOR shall provide an anticipated schedule for design, submittals, site work and the major components of construction including foundation, concrete support structure and welded steel water tank, tank painting, electrical installation and other significant activities. The schedule shall be updated as required.

1.8.2 Notification. The CONTRACTOR shall provide notification of the intent to start work at least seven days prior to commencing each major phase of work.

1.8.3 Certifications. Provide certification from the Engineer of Record that the elevated water storage tank has been completely designed in accordance with the requirements of these specifications.

Provide certification that field testing and inspection requirements related to field quality control have been performed and that the results comply with the requirements of these specifications.

1.9 Guarantees. The CONTRACTOR shall guarantee the structure, appurtenant equipment and accessories provided under this Section against defective design, workmanship, or materials for a period of one year from the date of substantial completion. If notified within this period, the CONTRACTOR shall repair any defects caused by faulty design, workmanship, or material furnished under these specifications at no cost to the OWNER. Defects caused by damaging service conditions, such as electrolytic, chemical, or abrasive, are not covered by this guarantee.

All guarantees from any manufacturer or installer of paint, materials, equipment and accessories not manufactured by the CONTRACTOR and that are provided under this Section, shall be obtained by the CONTRACTOR and submitted to the OWNER.

1.10 Materials.

1.10.1 Reinforced Concrete. Concrete materials and reinforcement shall comply with ACI 318, except as modified in this Section.

1.10.2 Steel Tank. Welded steel water tank components, including steel plates, sheets, structural shapes and filler metals shall be in accordance with AWWA D100.

1.11 Concrete Foundation. The foundation shall be designed and constructed to safely and permanently support the structure. The basis of the foundation construction shall be consistent with the soils investigation data included herein at the end of these specifications. The concrete foundation shall be constructed in accordance with ACI 301. Minimum specified compressive strength shall be 4000 psi at 28 days. Reinforcing steel shall be ASTM A615 Grade 60.

1.12 Welded Steel Tank.

1.12.1 General. The steel tank shall be all welded construction and shall be designed, fabricated and erected in accordance with applicable sections of AWWA D100. The required capacity and dimensions of the tank are noted on the drawings and in this Section of the specifications. All exposed lap joints shall be continuously seal welded on both sides. This shall include penetrations of roof accessories.

1.12.2 Plate Thickness. All members shall be designed to safely withstand the maximum stress to which they may be subjected during erection and normal operation. The minimum thickness of any steel plate in contact with water shall be 1/4 in. The minimum thickness of any steel plate not in contact with water shall be 3/16 in.

1.13 Appurtenances and Accessories.

1.13.1 General. Accessories shall comply with the minimum requirements of the Specifications, Codes and Standards listed in Section 1.2, current applicable OSHA safety regulations and the operating requirements of the structure.

1.13.2 Ladder Access. Access ladders shall be provided as follows:

- An exterior ladder shall be provided on one column of the tower, extending from approximately 8 feet above the foundation up through the balcony floor and terminating at the balcony railing.
- An exterior ladder shall be provided from the balcony to the roof manway and other pertinent roof accessories.

- An interior ladder shall be provided, extending from the roof manway to the bottom of the tank.
- An interior ladder shall be provided, extending from the shell manway to the bottom of the tank.
- An interior ladder shall be provided within the riser, starting 36" above the base of the riser and extending to the top of the riser.

Ladder side rails shall be a minimum 3/8 in. by 2 in. with a 16 in. clear spacing. Rungs shall be minimum 3/4 in. diameter, spaced at 12 in. centers and plug welded into holes drilled in the side rails. Tank interior ladders shall be provided with 1 in. diameter rungs and 1/2 in. x 2 in. side rails and shall be fully seal welded. The surface of the rungs shall be knurled, dimpled, or otherwise treated to minimize slipping.

Ladders shall be secured to the adjacent structure by brackets located at intervals not exceeding 10 ft. Brackets shall be of sufficient length to provide a minimum distance of 7 in. from the center of the rung to the nearest permanent object behind the ladder. Ladders shall not, in any place, have a backward slope.

1.13.3 Safe Climbing Device / Safety Equipment. OSHA compliant safe climbing system shall be provided on all ladders. The safe climbing system shall be rigid rail safe and be composed of high strength aluminum. Rails shall be center mounted and extend from 3 ft. above the ladder bottom to the top of the ladder section. Mounting brackets, fasteners and splice bars shall be provided as required for a rigid installation.

Three trolleys with snap hooks shall be provided that are designed to be operated with the aluminum rail. A complete safety body harnesses with front and side rings equipped with shock resistant lanyards shall be supplied for each trolley.

1.13.4 Rest Platforms. Rest platforms shall be provided at maximum 30 ft. intervals along the exterior tower ladder. The platforms shall be nominal 3 ft. x 3 ft. minimum and be complete with handrails, mid rails and toe plates in accordance with OSHA requirements. Grating shall be used for the walking surface and shall be suitably hinged at the ladder penetration. Openings shall be provided in the landings to accommodate the ladder that shall have a straight-run its full height and be operable without removing fall prevention equipment.

1.13.5 Tank Openings.

1.13.5.1 Riser Manway. Provide a hinged riser manway not less than 30" inches in diameter. The manway shall be located approximately 36 inches above the riser baseplate.

1.13.5.2 Riser Handrail. Provide a complete handrail assembly in the bottom of the storage tank around the top of the riser opening. The assembly shall be complete with handrails, mid rails and slotted toe plates in accordance with OSHA requirements.

1.13.5.3 Shell Manway. Provide a tank shell shall have a manway not less than 30 inches in diameter. The manway lid shall be supported with a hinged davit arm that is welded to the tank shell. The manway shall be located approximately 30 inches above the balcony floor.

1.13.5.4 Roof Hatches. Provide two access hatches on the roof of the tank.

- One hatch shall be 30 inch diameter and allow access from the roof to the interior tank ladder. The hatch opening shall have a minimum 4 in. curb. The hatch cover to be constructed of aluminum and shall have a 2 in. downward edge, stainless steel hardware, hold open arm, and locking mechanism.
- The second hatch will be 24 inch diameter and flanged with a removable cover so constructed that an exhaust fan may be connected for ventilation during painting operations. The opening shall have a minimum 4 inch curb.

1.13.6 Balcony. The tank shall be provided with a balcony at least 30 inches in width complete with handrails, mid rails and slotted toe plates in accordance with OSHA requirements. The floor plate shall be at least 1/4 inch steel, perforated for drainage.

1.13.7 Rigging/Utility Rails. Provide permanently installed exterior utility rings suitable for the attachment of rigging at the top of the riser.

1.13.8 Piping.

1.13.8.1 General. Provide standard weight carbon steel pipe painted with the tank interior paint system shall be used where pipe is exposed to stored water inside the tank. Piping below the grade slab shall be flanged cement lined ductile iron suitably restrained to prevent movement. All piping shall be designed to support related static and dynamic loads.

1.13.8.2 Inlet Piping. Provide an 8-inch diameter vertical inlet pipe extending from the base elbow located within the riser pier up through the riser and storage tank and terminating at the same elevation as the overflow weir. A suitable transition from the carbon steel pipe to the base elbow shall be provided. Appropriate brackets, guides and hangers shall be provided within the riser and storage tank structure at intervals not exceeding 20 ft.

1.13.8.3 Outlet Piping. Provide an 8-inch diameter vertical outlet pipe extending from the base elbow located within the riser pier up through the bottom of the riser and terminating 12 to 18 inches above the base of the riser. A suitable transition from the carbon steel pipe to the base elbow shall be provided. The outlet pipe shall be equipped with a protective cap to prevent entry of foreign materials dropping from above.

1.13.8.4 Overflow Piping. Provide an 8-inch diameter overflow pipe designed for a minimum flow rate of 800 GPM. A suitable weir shall be provided at the entrance to

the overflow pipe with the crest located at the specified high water level. The weir shall be equipped with vortex prevention device. The overflow design shall be based on the water level cresting no more than 6 inches above the overflow elevation. The overflow pipe shall be routed from the weir through the tank shell, then closely matching the roof contour before being extended down the one of the support columns to ground level.

A suitable transition from the carbon steel pipe to ductile iron piping shall be provided just above ground level. The piping shall then extend to approximately 30 inches below grade to the discharge point as indicated on the site plan. The point of discharge shall have a reinforced concrete headwall, and a flap valve equipped with stainless steel mesh screening as shown on the drawings.

1.13.9 Ventilation.

1.13.9.1 Tank Ventilation. A tank vent shall be provided, located near the center of the tank roof above the maximum weir crest elevation. It shall consist of a stainless steel or aluminum components, including a support frame, screened area and cap. The support shall be fastened to a flanged opening in the tank roof. The vent cap shall be provided with sufficient overhang to prevent the entrance of wind driven debris and precipitation. A minimum of 4 in. shall be provided between the roof surface and the vent cap.

The tank vent shall have an intake and relief capacity sized to prevent excessive pressure differential during the maximum flow rate of water, either entering or leaving the tank. The overflow pipe will not be considered as a vent. The maximum flow rate of water exiting the tank shall be calculated assuming a break in the inlet/outlet at grade when the tank is full. The vent shall be provided with an insect screen so as to prevent the ingress of wind driven debris, insects, birds and animals. Vent capacity shall be determined based on open area provided by the screen. The vent shall be designed to operate when frosted over or otherwise clogged. The screens or relief material shall not be damaged by the occurrence and shall return automatically to operating position after the blockage is cleared.

1.13.10 Level Monitoring / Sample Tap. Provide one 3/4 inch tap within the valve vault. The tap shall be located on the outlet line, on the tank side of the check valve. The tap shall be equipped with brass nipple, an isolation ball valve, a pressure gauge, and a brass spigot via threaded connections. The pressure gauge shall have shall be 4-1/2 in. diameter dial with black markings on white background and have a pressure range of 0 to 100 psi.

1.13.11 Identification Plate. A bronze tank identification plate shall be mounted just above the riser manway. The identification plate shall contain the following information:

- Tank Contractor
- Date Erected
- Tank Capacity in U.S. gallons
- Tank Height to High Water Level
- Tank Head Range
- Contractor's project or file number

1.13.13 Electrical. A below grade 100 amp electrical service shall be established on the tank site in accordance with all applicable codes. The electrical panel shall be installed at or near the southern tank site boundary. The panel assembly shall be weather proof and be mounted on a uni-stut base. At a minimum, one four-plug ground fault exterior convenience outlet shall be installed near the panel assembly.

1.13.19 Cable Rack. A cable rack shall be installed on the tank support column adjacent to the tower ladder extending from ground level through the bottom of the balcony. Three (3) 3-inch diameter pipe penetrations (with threaded caps) shall be provided where the cable rack terminates at the balcony. The rack shall be two foot wide and capable of handling 3-inch conduit or cable.

1.14 Execution.

1.14.1 Examination.

1.14.1.1 Foundation Excavation. The foundation bearing surface and excavation shall be inspected and verified by a geotechnical engineer retained by the OWNER prior to construction of the foundation.

1.14.1.2 Environmental Conditions. Prior to performing any work, verify the expected temperature, humidity and weather conditions are within the specified limitations for executing the work.

1.14.1.3 Elevated Tank Components. At completion of each major component and prior to proceeding with the next stage of construction, verify that tolerance inspections and material quality control tests conform to this specification.

1.14.2 Foundation.

1.14.2.1 Excavation. The foundation bearing surface and excavation shall be inspected by a representative of the geotechnical engineer prior to foundation construction. Verification of the applicable design and construction recommendations is required. After verification of the foundation bearing surface, provide a 2 in. thick concrete working slab within the lower excavation limits. Grade the site to prevent runoff from entering the excavation.

1.14.2.2 Concrete Construction. For shallow foundations, reinforcement placed adjacent to a concrete working slab shall have a 2 in. minimum cover, and shall be supported by precast concrete block, metal or plastic bar supports.

The sides of foundations shall be formed using any suitable system conforming to ACI 318. Earth cuts shall not be used as forms for vertical surfaces. Forms shall be provided on top sloping surfaces steeper than 2.5 horizontal to 1 vertical. Straight form panels may be used to form circular foundation shapes. The minimum design radius shall be maintained at all sections.

1.14.2.3 Finish. Formed surfaces shall have a smooth form finish when exposed and a rough form finish when not exposed. Unformed surfaces shall have a troweled finish when exposed and floated finish when not exposed.

1.14.3 Reinforced Concrete Construction.

1.14.3.1 Reinforcement. Fabrication, placement, development and splicing of reinforcement shall be in accordance with ACI 318 and ACI 117. Reinforcement shall be clearly indicated on the construction drawings. Locations, spacing, as well as lap slice lengths of reinforcement and concrete cover shall be shown.

The CONTRACTOR shall supply a reinforcing bar schedule showing the number of each bar type, its dimension and shape, the bar size, and the mark number of identification. The construction drawings shall show all slabs, elevations of walls, and have sufficient sections to facilitate confirmation of reinforcement placement.

Concrete support structure reinforcement shall be installed with plastic supports. Maximum spacing of supports for welded wire fabric shall be 5 ft. centers, horizontal and vertically.

The minimum clear distance between the reinforcing steel and the surface of the concrete shall be as follows:

- Concrete foundations permanently exposed to earth:
  - Cast against earth — 3 inches
  - Cast against forms or mud slabs
    - No. 6 bar and larger — 2 inches
    - No. 5 bar and smaller — 1.5 inches
- Concrete foundations above grade:
  - Exterior surfaces
    - No. 6 bar and larger — 2 inches
    - No. 5 bar and smaller — 1.5 inches
  - Interior surfaces — 1 inch

1.14.3.2 Concrete. Concrete proportioning, production, placement, quality control and curing procedures shall comply with ACI 318 and ACI 117. Concrete shall satisfy the specific structural, durability and architectural requirements of the completed components.

1.14.3.2.1 Proportioning. The proportions of materials for concrete shall be established to provide adequate workability and proper consistency to permit concrete to be worked readily into the forms and around reinforcement without excessive segregation or bleeding. If high range water reducer is used, concrete slump prior to addition shall be 3 to 4 in. The water to cement ration shall not exceed .45. The slump, after addition of high range water reducer, shall be a maximum of 9 in. Air shall be entrained to provide concrete with 3.5% to 6.5% air content.

1.14.3.2.2 Production. Concrete that arrives at the project with slump below that suitable for placing may have water added within the limits of the maximum permissible water-cement ratio. Maximum slump shall not be exceeded. The water shall be incorporated by additional mixing equal to at least half of the total mixing time required. For concrete with site-administered high range water reducer, the pre-plasticized minimum slump requirement shall be attained as permissible by addition of water and mixing prior to the addition of the water reducer.

1.14.3.2.3 Placement. Prior to concrete placement, all snow, ice, water, or other foreign material shall be removed from the spaces that the concrete will occupy. Concrete shall be deposited in its final position in accordance with ACI 318 or the applicable building code. Drop chutes or tremies shall be used in walls and columns to prevent free-fall of the concrete over 5 ft. and to allow the concrete to be placed through the cage of reinforcing steel. These shall be moved at short intervals to prevent stacking of concrete.

1.14.3.2.4 Vibration. All concrete shall be consolidated by vibration so that the concrete is thoroughly worked into the corners of forms and around the reinforcement and embedded items to eliminate all air or stone pockets which may cause honeycombing. Internal vibrators shall be the largest practical size that can be used in the work and shall be operated by competent workmen.

1.14.3.2.5 Finish. Provide a smooth form finish for all exposed concrete. Tie holes shall be plugged using grout on the interior and manufactured plugs on the exterior that match the color of the cured concrete as closely as possible. All fins exceeding 1/4 inch in height shall be removed by shipping or rubbing. Provide a light sandblast to the exposed exterior surface.

1.14.3.3 Weather. Concrete shall not be placed during precipitation or extreme temperatures unless protection is provided. During hot or cold weather the recommendations of ACI 305 and ACI 306 shall be followed.

1.14.4 Welded Steel Tank Construction.

1.14.4.1 General. All parts forming the structure shall be built in accordance with approved drawings. The erection of the steel tank shall comply with the requirements of AWWA D100 except as modified by these documents.

1.14.4.2 Welding. Welding procedures and general welding requirements shall be in accordance with AWWA D100, Sections 8 and 10. Welding shall only be performed by ASME qualified welders. Records of these qualification tests shall be available to the ENGINEER. The work at all times shall be open to the ENGINEER or their representative.

To minimize corrosion and rust staining on the underside of the roof, the roof plate laps and rafter-to-roof plate seams shall be continuously seal welded. The minimum thickness for seal welded roof plates shall be 1/4 inch.

The edges or surfaces of the pieces to be joined by welding shall be prepared by flame cutting, plasma arc cutting, arc gouging, machining, shearing, grinding or chipping and shall be cleaned of detrimental oil, grease, scale and rust. The edges of the pieces may have a protective coating applied to them which need not be removed before they are welded unless specifically prohibited by the welding procedures.

Field and shop welding may be done by the shielded metal arc welding process, the gas metal arc welding process, the flux core arc welding process and the submerged arc welding process.

No structural welding is permitted to any steel embedded in hardened concrete, unless the weld is at least 2 ft. from the embedment interface.

In order to assist in the maximization of the paint's lifecycle, all welds on the tank exterior shall be ground smooth and blended to a NACE-D profile. All welds on the tank interior shall be ground smooth and blended to a NACE-D profile. Welds on the interior dry support column can remain in an as-welded condition but must have a profile adequate for the specified paint system. The ENGINEER/OWNER reserves the right to provide third-party inspection to ensure compliance to this requirement.

1.14.4.3 Fabrication. Layout, cutting, forming, edge preparation and workmanship for steel tank components and fabrications shall be in accordance with AWWA D100.

1.14.4.4 Tank Erection. Steel tank erection procedures and general requirements shall be in accordance with AWWA D100.

Plates subjected to stress by the weight or pressure of the contained liquid shall be assembled and welded in such a manner that the proper curvature of the plates in both directions is maintained. Plates shall be assembled and welded together by a procedure that will result in a minimum of distortion from weld shrinkage. Surfaces to be welded shall be free from loose scale, slag, heavy rust, grease, paint and other foreign material.

1.14.5 Field Quality Control.

1.14.5.1 Concrete Testing and Inspection. The evaluation and acceptance of concrete shall be in accordance with Section 5.6 of ACI 318 and ACI 117, except as modified in this Section.

Five cylinders shall be cast from each pour. Cylinders shall be tested at 3 days, 7 days, and two at 28 days. One cylinder shall be held as a spare and tested at a later date, if necessary. Slump, air, temperature and compressive cylinder testing shall be performed by an independent laboratory. The CONTRACTOR shall retain the independent laboratory and provide the OWNER with copies of all test results.

1.14.5.2 Welded Steel Tank Testing & Inspection. Inspection procedures for the welded steel tank shall be as required by AWWA D100, Section 11, "Inspection and Testing". Radiographic inspection shall be performed by an independent testing agency with all costs included in the CONTRACTOR'S bid and paid by the CONTRACTOR. The radiographic film test results will become the property of the OWNER. All inspection shall be performed prior to interior and exterior field painting.

1.15 Safety. The CONTRACTOR shall strictly comply with all applicable statutes, regulations, orders, rules, requirements and standards of all governmental authorities having jurisdiction with respect to the project, including without limitation, federal, state, and local OSHA and health regulations as well as the latest professional practices.

The CONTRACTOR shall, at its own expense, protect its employees and other persons from risk of injury, bodily harm, or death arising out of or in any way connected with work performed. Prior to commencing work, all personnel on the jobsite will have a minimum ten (10) hours of OSHA safety training or equivalent training within the previous year.

1.16 Payment. Payment shall be included in the payment for the work to which it is subsidiary in the Bid Schedule.

SECTION 2 – TANK COATING SYSTEM

2.0 General. The items covered by this Section include cleaning, abrasive blast cleaning and painting of all interior and exterior surfaces on welded steel storage tanks. This section also includes acceptable disinfection and testing procedures for water storage tank

2.1 Standard Specifications & References. All work on the water storage tank shall fully conform to the requirements of the latest published editions of the following Specifications, Codes and Standards. The following apply and may be referenced in this Section.

2.1.1 American National Standards Institute (ANSI) / National Sanitation Foundation (NSF).

61 Drinking Water System Components - Health Effects

2.1.2 American Society for Testing Materials (ASTM).

D 16 Terminology Relating to Paint, Varnish, Lacquer, and Related Products

2.1.3 American Water Works Association (AWWA).

C 652 Disinfection of Water-Storage Facilities
D102-06 Coating Steel Water Storage Tanks

2.1.4 Code of Federal Regulations (CFR).

40 CFR, Part 63, Subpart MMMM National Emission Standards for Hazardous Air Pollutants (NESHAPs) for Surface Coating of Miscellaneous Metal Parts and Products

2.1.5 National Association of Corrosion Engineers (NACE).

2 Near-White Metal Blast Cleaning
3 Commercial Blast Cleaning
SP0188-06 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.

2.1.5 The Society for Protective Coatings (SSPC).

PA 2 Measurement of Dry Coating Thickness with Magnetic Gages.
SP 6 Commercial Blast Cleaning.
SP 10 Near-White Metal Blast Cleaning.
SP 11 Power Tool Cleaning to Bare Metal
SP 15 Commercial Grade Power Tool Cleaning

2.2 Definitions.

2.2.1 Definitions of Painting Terms. All painting related terms shall be defined by ASTM D 16, unless otherwise specified.

2.2.2 Dry Film Thickness (DFT). Thickness of a coat of cured paint measured in mils (1/1000 inch).

2.3 Submittals. Before beginning the work the CONTRACTOR shall provide the ENGINEER with the following information:

- Information regarding the protective coating supplier and manufacturer's data for the paint system being used.
- A listing of the specific products proposed for use including but not limited to: abrasive materials, paint, solvents, thinners, etc.
- Product data sheets for each of the proposed materials.
- Samples of the color specified for OWNER approval.

2.4 Quality Assurance. The CONTRACTOR shall supply only paint and painting materials as specified herein. All manufacturers' instructions shall be carefully followed in the preparation, application, curing or drying and handling of the paint. Applicators shall be experienced in application of specified coatings for a minimum of 5 years on projects of similar size and complexity to this work.

All prime, intermediate and finish coating materials shall be applied in different color shades. Paint shall be stored in a location that is protected from the elements, well ventilated and free from excessive heat or open flame sources.

The CONTRACTOR shall obtain the Inspector's written approval of the steel surface preparation and of each coat of paint, before applying succeeding coats. Such approval will not relieve the CONTRACTOR of his obligations under the contract. Inspections may be waived by written notice to the CONTRACTOR.

The CONTRACTOR shall record environmental conditions, at the beginning of each daily operation, thirty minutes before painting beings and every hour during painting operations.

2.5 Health and Safety. The CONTRACTOR shall comply with all regulations as established by the Occupational Safety and Health Act and other government authorities. Up to date Material Safety Data Sheets shall be available on site for all products used. Workers shall wear the applicable and proper protection devices. Where ventilation is used, all equipment shall be explosion proof. Temporary ladders and scaffolding systems shall conform to applicable safety requirements. It shall be the responsibility of the CONTRACTOR to adequately protect, shield or cover all structure, machinery, equipment and openings as required to prevent damage or contamination from the work procedures. The work area shall be kept clean at all times, consistent with the type of work being performed.

2.6 Delivery, Storage, and Handling.

2.6.1 Delivery. Paint and other materials shall be delivered in unbroken containers bearing the designated name, manufacturer, specification number, color name and number, batch or lot number, date of manufacture, and directions for use.

2.6.2 Storage. Materials shall be stored in a clean, dry area, and within temperature range in accordance with Coating Manufacturer's instructions. All containers shall remain sealed until ready for use. Materials shall not be used beyond Coating Manufacturer's shelf life limits.

2.6.2 Handling. Protect materials during handling and application to prevent damage or contamination.

2.7 Environmental Requirements.

2.7.1 Weather.

2.7.1.1 Air and Surface Temperatures. Prepare surfaces and apply and cure coatings within air and surface temperature range in accordance with Coating Manufacturer's instructions.

2.7.1.2 Surface Temperature. Maintain surfaces temperatures a minimum of 5 degrees F (3 degrees C) above dew point at the time of final surface preparation, material mixing, and application.

2.7.1.3 Relative Humidity. Prepare surfaces and apply and cure coatings within relative humidity range in accordance with Coating Manufacturer's instructions.

2.7.1.4 Precipitation. Do not prepare surfaces or apply coatings in rain, snow, fog, or mist.

2.7.1.5 Wind. Do not spray coatings if wind velocity is above Coating Manufacturer's limit.

2.7.2 Ventilation. Provide ventilation during coating evaporation stage in confined or enclosed areas in accordance with AWWA D102-06, Section A.7.5. Forced air ventilation shall be maintained for a minimum of four (4) days following interior coating application to assist in the curing process.

2.7.3 Dust and Contaminants. Schedule coating works in an effort avoid excessive dust and airborne contaminants. Protect work areas from excessive dust and airborne contaminants during coating application and curing.

2.8 Coating Materials. All coatings shall be manufactured by TNEMEC COMPANY, INC., THE SHERWIN-WILLIAMS COMPANY, or approved equal. Products for each specified function and system shall be of a single manufacturer.

2.8.1 Interior Coating System.

- System Type: *Zinc / Epoxy / Epoxy.*
- AWWA D102 Paint System: *ICS-5.*
- Surface Preparation: *SSPC-SP 10 / NACE 2 (surface profile of 1.5-2.0 mils)*
- Primer: *Tnemec Series 94-H2O Hydro-Zinc or Sherwin-Williams Corothane I Galvapac Zinc Primer, DFT 2.5 to 4.0 mils.*
- Filler & Sealer (Seams): *All interior roof stiffener seams and lapped seams shall be caulked with Sika Flex-1A after the finish coat is applied. Gapped or skip weld seams below the high water level shall be caulked after priming with TNEMEC Series 215 SURFACING EPOXY.*
- Intermediate Coat: *Tnemec Series N140 Pota-Pox Plus (Tnemec Series N140F Pota-Pox Plus when temperature is between 35°F and 60°F) or Sherwin-Williams Macropoxy 646 PW, DFT 4.0 to 6.0 mils. Color to contrast with primer and finish coats.*
- Finish Coat: *Tnemec Series N140 Pota-Pox Plus (Tnemec Series N140F Pota-Pox Plus when temperature is between 35°F and 60°F) or Sherwin-Williams Macropoxy 646 PW, DFT 4.0 to 6.0 mils. Finish coat color shall be Tank White or similar*
- Total DFT: *Minimum 12.0 mils.*

2.8.2 Exterior Coating System.

- System Type: *Zinc / Polyurethane / Fluoropolymer*
- AWWA D102 Paint System: *OCS-5.*
- Surface Preparation: *SSPC-SP 10 / NACE 2 (surface profile of 1.5-2.0 mils)*
- Primer: *Tnemec Series 94-H2O Hydro-Zinc or Sherwin-Williams Corothane I Galvapac Zinc Primer, DFT 2.5 to 4.0 mils.*
- Weld Seams (Stripe Coat): *Tnemec Series 73 Endura-Shield or Sherwin-Williams Acrolon 218 HS Acrylic Polyurethane, DFT 2.0 to 4.0 mils. Color to contrast with primer and finish coat*
- Intermediate Coat: *Tnemec Series 73 Endura-Shield or Sherwin-Williams Acrolon 218 HS Acrylic Polyurethane, DFT 2.0 to 4.0 mils. Color to contrast with primer and finish coats.*
- Finish Coat and Logo: *Tnemec Series 700 Hydroflon or Sherwin-Williams Fluorokem HS Fluoropolymer Urethane, DFT 2.0 to 4.0 mils. Color to be selected by the OWNER.*

- Total DFT: *Minimum 10.0 mils.*

2.8.3 Caulk. Where underwater caulking is required, it shall be TNEMEC Series 215 Surfacing Epoxy, or equal. Seam caulking may be performed using SIKA Flex-1A, Thiokol 2235M, or equivalent.

2.8.4 Alternate Manufactures. Equivalent products by other manufacturers are acceptable, providing they meet or exceed all performance criteria of the specified materials. No products shall be considered that would decrease film thickness or offer a change in generic type of coating specified.

In the event the CONTRACTOR submits a different paint, the CONTRACTOR shall submit complete data with bid including performance data as determined by an independent testing laboratory and mark bid as alternate to base bid. The CONTRACTOR shall submit a price for base bid also in order for the OWNER to review cost savings for using an alternate paint.

Products for each specified function and system shall be of a single manufacturer.

2.9 Execution.

2.9.1 Examination. Examine areas and conditions under which coating systems are to be applied. Notify General CONTRACTOR and ENGINEER of areas or conditions not acceptable. Do not begin surface preparation or application until unacceptable areas or conditions have been corrected.

2.9.2 Protection of Surfaces Not Scheduled to be Coated. Protect surrounding areas and surfaces not scheduled to be coated from damage during surface preparation and application of coatings. Immediately remove coatings that fall on surrounding areas and surfaces not scheduled to be coated.

2.9.3 Surface Preparation. All steel surfaces are to be prepared in accordance with Coating Manufacturer's instructions. Prior to the application of any coatings ensure surfaces are dry.

When working on the interior substrate the CONTRACTOR shall remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 10/NACE 2. A blast profile shall be created that is in accordance with the Coating Manufacturer's recommendations.

When working on the exterior substrate the CONTRACTOR shall remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 6/NACE 3. A blast profile shall be created that is in accordance with the Coating Manufacturer's recommendations.

Prior to field touch up of shop primed steel, all surfaces shall be cleaned to remove all

surface contamination including oil, grease, dust, dirt and foreign matter.

All rusted, abraded, and unpainted areas on the interior wet area shall be abrasive blast cleaned to a near white finish in accordance with SSPC-SP 10/NACE 2. All other rusted, abraded and unpainted areas shall be either abrasive blast cleaned in accordance with SSPC-SP 6/NACE 3. SSPC- SP11 or SP15 may be used for areas less than one square foot. All shop primed steel shall receive a field sweep blast prior to the application of subsequent coats.

The CONTRACTOR shall coat all abrasive blast-cleaned surfaces with primer immediately following the blast cleaning activities before visible rust forms on surface. If rust or any other visible contamination appears as a result of delay in primer application, the surface shall be re-cleaned to specified surface preparation.

2.9.4 Coating Application. Coatings shall be applied in accordance with Coating Manufacturer's instructions. Coatings, including multi-component materials, shall be mixed and thinned in accordance with Coating Manufacturer's instructions. Mixed coatings shall not be used beyond pot life limits. Care should be taken to keep containers closed when not in use to avoid contamination.

Coating application equipment, tools, pressure settings, and techniques shall be in accordance with manufacturer's instructions.

After sufficient cure of the field primer, brush apply a stripe coat to critical locations on steel such as welds, corners, and edges using specified intermediate coat. The stripe coat shall be applied using a brush or a roller, no exceptions.

Coatings shall be uniformly applied at the spreading rate required to achieve specified DFT. Coatings shall be applied free of film characteristics or defects that would adversely affect performance of the coating system. Furthermore, exterior coatings shall be applied free of film characteristics or defects that adversely affect appearance.

All interior unwelded roof seams, connections, and crevices shall be caulked to prevent corrosion and staining.

2.9.5 Field Quality Control. The CONTRACTOR shall provide the inspections and documentation which verify the following:

- Coatings and other materials are provided as specified.
- Environmental conditions are as specified.
- Surface preparation and application are completed as specified.
- The DFT of each coat and total DFT of each coating system are as specified using wet film and dry film gauges. DFT's shall be measured in accordance with SSPC-PA2.
- Coatings are inspected for film characteristics or defects that would adversely affect performance of coating systems.

- Exterior coatings are inspected for film characteristics or defects that adversely affect appearance.
- Steel immersion surfaces are tested for holidays on using a holiday detector in accordance with NACE SP0188-06.

The CONTRACTOR shall prepare inspection reports daily. The reports should contain information describing inspections made and actions taken to correct nonconforming work. Copies of all reports shall be forwarded to the ENGINEER.

The Coating Manufacturer's representative shall be readily available to provide technical assistance and guidance for surface preparation, application, and repair of coating systems.

2.9.6 Repair. The CONTRACTOR shall repair or replace damaged materials and surfaces not scheduled to be coated. Damage coatings shall be touched-up or repaired as needed. Touch-up of minor damage shall be acceptable where result is not visibly different from adjacent surfaces.

Coatings that exhibit film characteristics or defects that would adversely affect performance or appearance of coating systems shall be repaired in accordance with Coating Manufacturer's instructions coatings.

2.10 Tank Lettering/Logo. The tank shell shall be lettered on one side with the wording as follows: "NORTH SHELBY WATER COMPANY" or an alternative logo at the locations as directed by the OWNER. Lettering/ Logo color shall be selected by the OWNER.

2.11 Disinfection. Allow the number of days required in accordance with manufacturer's instructions and as directed by ENGINEER for full cure of coating systems on water contact surfaces before flushing, disinfecting, or filling with water. Furthermore, the water contact surfaces shall not be disinfected or filled until the field quality control inspection is complete.

Disinfection shall be accomplished in accordance with AWWA C 652 Method 2 or 3.

Water used by the CONTRACTOR shall be paid for by the CONTRACTOR at the rate of $5.00 per 1,000 gallons.

2.12 Bacteriological Testing. Upon completion of the disinfection process the OWNER or his representative shall arrange for bacteriological testing of water samples. The tank shall not be put into service until safe test results are obtained.

2.13 Cleanup. After completion of painting, remove all traces of splashed materials, paint droppings, and spots from finished and adjacent surfaces. Remove temporary coverings and protection of surrounding areas and surfaces.

2.14 Warranty. The CONTRACTOR shall guarantee its work for a period of one year

from the completion date defined in the contract documents to the extent that it will repair any defects caused by faulty application, workmanship or material furnished under the specifications.

The OWNER will set a date for one-year inspection of coating systems at or near the warranty expiration date. The OWNER shall be responsible for draining the tank prior to the inspection as well as maintaining system operation and pressure during the inspection and repair, if any. The inspection shall be attended by OWNER, ENGINEER, CONTRACTOR, and a representative of the Coating Manufacturer. Any deficiencies in coating systems as will be repaired as determined by ENGINEER in accordance with the Coating Manufacturer's instructions.

2.15 Payment. Payment shall be included in the payment for the work to which it is subsidiary in the Bid Schedule.

SECTION 3 - PIPE WORK

3.0 Work Included. Under these items, the CONTRACTOR shall provide all labor, tools, equipment and materials required to furnish and install the process piping, valves and appurtenances and as shown on PLANS and as directed by the ENGINEER.

3.1 Piping. All pipe materials listed below shall conform to manufacturer's standard lengths and diameters. Testing as required by the OWNER shall be done in accordance with the ASTM standards applicable to the material specified.

3.1.1 Polyvinyl Chloride (PVC) Piping (SDR 17) or (SDR 21) All PVC pipe shall comply with ASTM D1784 and shall be Class 250 (SDR 17) or Class 200 (SDR 21) as shown on the PLANS or otherwise indicated in the bid proposal form. All PVC pipe shall conform to the latest revisions of the following specifications:

ASTM D2241 (PVC Plastic Pipe SDR-PR and Class T)
National Sanitation Foundation Testing Laboratories (NSF)

The manufacturer of the pipe must be found on the current listing of Plastic Materials for Potable Water Application, published by the NSF (National Sanitation Foundation), Ann Arbor, Michigan, and must meet the requirements of the Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe, D1784, 12454-B (PVC 1120) as published by ASTM.

The pipe shall be homogeneous throughout and free from cracks, holes, foreign inclusions, or other defects. The pipe shall be as uniform as commercially practical in color. Pipe shall have a ring painted around spigot ends in such a manner as to allow field checking of setting depth of pipe in the socket. Pipe must be delivered to the job site by means which provide adequately support, and do not inflict undue stress. In particular, the load shall be so supported that the bottom rows of pipe are not damaged by crushing. Pipe shall be unloaded carefully and strung or stored as close to the final point of placement as is practical.

Wall thickness shall be in accordance with ASTM D-2241. Pipe ends shall be beveled to accept the gasketed coupling. The bell section shall be designed to be at least as strong as the pipe wall. Solvent-cement couplings or joints shall not be used. PVC joints using elastomeric gaskets shall be tested as assembled joints and shall meet the laboratory performance requirements specified in ASTM D-3139.

Joint lubricant shall be water soluble, non-toxic, non-objectionable in taste and odor imparted to the fluid, non-supporting of bacteria growth, and have no deterioration effect on the PVC or rubber gaskets.

PVC Pipe shall include the following markings, printed continuously down the length:

Manufacturer's Name
Manufacture’s Identification Code
PVC 1120 Code Designation
Standard Dimension Ratio Number
Nominal Size
NSF Seal
Pressure Class Rating

Pipe shall be furnished in standard laying lengths of 20 ft. ± 1 in. A maximum of 15 percent of each pipe size may be furnished in random lengths of not less than 10 ft. each.

Under all circumstances, samples of pipe and both physical and chemical data sheets shall be submitted to the ENGINEER for approval. Unconditional approval shall be obtained before pipe is purchased.

3.1.2 Polyvinyl Chloride (PVC) Piping – Cast Iron Pipe Size. All PVC pipe shall meet the requirements of AWWA C900-75, latest revision, "Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4" through 12" for water" and shall be furnished in cast-iron pipe equivalent outside diameters with rubber-gasketed couplings. Pipe shall be pressure Class 200, DR 14 or Class 150, DR 18 (Dimension Ratio), as shown on the PLANS or otherwise indicated in the bid proposal form.

The pipe shall be made from Class 12454-A or Class 12454-B virgin compounds as defined in ASTM D-1784. The standard code designation shall be PVC 1120. The PVC compounds shall be tested and certified as suitable for potable water products by the NSF Testing Laboratory and shall carry the NSF approval marking.

The pipe shall be homogeneous throughout and free from cracks, holes, foreign inclusions, or other defects. The pipe shall be as uniform as commercially practical in color. Pipe shall have a ring painted around spigot ends in such a manner as to allow field checking of setting depth of pipe in the socket. Pipe must be delivered to the job site by means which provide adequately support, and do not inflict undue stress. In particular, the load shall be so supported that the bottom rows of pipe are not damaged by crushing. Pipe shall be unloaded carefully and strung or stored as close to the final point of placement as is practical.

Pipe ends shall be beveled to accept the gasketed coupling. The bell section shall be designed to be at least as strong as the pipe wall. Solvent-cement couplings or joints shall not be used. PVC joints using elastomeric gaskets shall be tested as assembled joints and shall meet the laboratory performance requirements specified in ASTM D-3139.

Joint lubricant shall be water soluble, non-toxic, non-objectionable in taste and odor imparted to the fluid, non-supporting of bacteria growth, and have no deterioration effect on the PVC or rubber gaskets.

Pipe and couplings shall meet or exceed the following test requirements:

Sustained Pressure - ASTM D-1598 (1000 Hrs.)

DR	Sustained Pressure
14	650
18	500

Burst Pressure - ASTM D-1599 (60-70 seconds)

DR	Minimum Burst Pressure
14	985
18	755

Each standard and random length of pipe shall be proof-tested at four times its rated class pressure for a minimum of 5 seconds. Bells or couplings shall be tested with pipe.

The pipe shall not split, crack, or break when tested by the parallel-plato method as specified by ASTM D-2241.

The pipe shall not flake or disintegrate when tested by the acetone-immersion method as specified in ASTM D-2241.

PVC Pipe shall include the following markings, printed continuously down the length:

Manufacturer's Name	Nominal Size & Outside Diameter
Manufacture's Identification Code	NSF Seal
PVC 1120 Code Designation	AWWA Designation (AWWA C900)
Dimension Ratio Number	AWWA Pressure Class Rating

Pipe shall be furnished in standard laying lengths of 20 ft. $\pm$ 1 in. A maximum of 15 percent of each pipe size may be furnished in random lengths of not less than 10 ft. each.

Under all circumstances, samples of pipe and both physical and chemical data sheets shall be submitted to the ENGINEER for approval. Unconditional approval shall be obtained before pipe is purchased.

3.1.3 Ductile Iron Pipe. Ductile iron pipe shall be designed in accordance with AWWA (ASA A21.50) and be suitable for the indicated pressures and conditions. Pipe shall conform to AWWA C-151 (ASA A21.51.) and shall be cement lined in accordance with AWWA C104 (ASA A21.4). The specified thickness will be determined for the given internal and external loading requirements in accordance with ASA A21.50. The class of pipe, wall thickness, joint type and coatings required shall be as shown on the PLANS or otherwise indicated in the bid proposal form.

Hydrostatic and acceptance tests shall be in accordance with AWWA Specification C-106 for "Cast Iron Pipe Centrifugally Cast In Metal Molds" or C-108 for sand molds. The ENGINEER shall be provided with five (5) copies of each of the following tests for each contract involved:

a. Talbot strip test.
b. Ring and full length bursting tests.
c. Chemical analysis of pipe.
d. Certification that pipe was hydrostatically tested.

All exposed pipe and fittings shall have a shop prime coat applied that is compatible with the subsequent field enamel paint coats. Where applicable, the final field coat colors shall match that of corresponding existing piping.

The net weight, class or nominal thickness and sampling period shall be marked on each pipe.

Pipe joints shall be as indicated on the PLANS mechanical joint, rubber ring slip joint, flanged, or locked mechanical joint equal to AWWA C- 111.

Pipe may be furnished in 12, 16, 16 1/2, 18 or 20 feet nominal laying lengths.

Under all circumstances, samples of pipe and both physical and chemical data sheets shall be submitted to the ENGINEER for approval. Any pipe not meeting the AWWA Specifications quoted above shall be rejected. Unconditional approval shall be obtained before pipe is purchased.

3.1.4 Fittings. Ductile iron fittings with appropriate adapters shall be used with Ductile Iron & PVC pipe. All such fittings shall be approved by the pipe manufacturer, and complete data forwarded to the ENGINEER, including the manufacturer's approval, for review. Fittings shall comply with AWWA C-110 or C-111 and shall be manufactured for the size and pressure class of the line on which they are used.

The joint connection category of the fittings shall be appropriate for the installation which they are used. Mechanical joint fittings shall be used for buried piping and flanged fittings for exposed or interior piping.

3.1.5 Mechanical Joint Restraints. Restraint devices shall be utilized with all mechanical joint fittings on both Ductile Iron and PVC pipe. Restraints shall conform to either ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A2153 and shall be manufactured for size and pressure class of the line on which they are used. Restraint devices for nominal pipe sizes 3-inch through 36-inch shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10. Mechanical joint restraints shall be MEGALUG® Restraint Series 2000 as manufactured by EBAA Iron, Inc., or approved equal.

3.1.6 Saddles. Service saddle shall have a ductile iron body per ASTM A536. The saddle shall have an outlet for the service connection that will allow an NPT or AWWA thread to be tapped into it. The saddle shall have two carbon steel bales per ASTM A108 (C1018) and be electro-galvanized with dichromate seal per ASTM B633. The nuts shall be heavy hex steel A563 with an electro-galvanized finish and a di-chromate seal per ASTM B633. The washers shall be carbon steel per ASTM A108 and electro-galvanized with dichromate seal per ASTM B633. The gasket shall have a hydro-mechanical lip that seals better on the pipe surface as the line content pressure increases. The gasket shall be made of Nitrile (BunaN) and NSF 61 listed. The gasket shall be compounded to resist: water, oil acids, alkalis, most (aliphatic) hydrocarbon fluids and many other chemicals. The gasket shall have a temperature range of -20ºF to +180ºF. The gasket shall be fully cemented into a cavity to hold it in place around the outlet during installation.

Saddles shall be as manufactured by Smith-Blair, Inc., Series 313 or approved equal.

3.1.7 Pipe Handling & Installation. Pipe delivered to site in general, will be stored, handled, distributed, installed in accordance with the Manufacturer's recommendation unless instructed otherwise by these specifications or by the ENGINEER.

3.2 Valves & Other Appurtenances.

3.2.1 Gate Valves. Gate valves shall be resilient wedge type which fully comply with the latest revision of AWWA C509, and shall also be UL listed and FM approved. The valves shall be tested and certified to ANSI/NSF 61. The valves shall have a 250 psig working pressure. The valve type shall be NRS (non-rising stem) with an arrow cast on the operator which shows the opening direction. The direction of opening shall be shall to the left (counter clockwise.)

Hardware used to secure the stuffing box and bonnet shall be of the following compositions:

a. Steel, ASTM A-307, Grade B zinc plated.
b. Type 304 stainless steel.
c. Type 316 stainless steel.

Valve stems shall be made of bronze ASTM B-132 alloy C67600 bar stock material. The stem shall have at least one “anti-friction” thrust washer above and below the stem collar to reduce operating torque. The design of the valve stem shall be such that if excessive input torque is applied, stem failure shall occur above the stuffing box at such a point as to enable the operation of the valve with a pipe wrench or other readily available tool. The stem material shall provide a minimum 70,000 psi tensile strength with 15% elongation and yield strength of 30,000 psi. Valves with cast stems or two piece stem collars are not acceptable.

Valves shall have a stuffing box that is o-ring sealed. Two o-rings shall be placed above and one o-ring below the stem thrust collar. The thrust collar shall be factory lubricated. The thrust collar and its lubrication shall be isolated by the o-rings from the waterway and from outside contamination providing permanent lubrication for long term ease of operation. Valves without a stuffing box are unacceptable. Valves without at least three stem o-rings are also unacceptable. The valve body, bonnet, stuffing box, and disc shall be composed of ASTM A-126 Class B grey iron or ASTM A395 or A536 ductile iron. The body and bonnet shall also adhere to the minimum wall thickness as set forth in Table 2, section 4.3.1 of AWWA C509.

Valves shall have all internal and external ferrous surfaces coated with a fusion bonded thermosetting powder epoxy coating of 10 mils nominal thickness. The coating shall conform to AWWA C550. Valve disc and guide lugs must be fully (100%) encapsulated in SBR ASTM D2000 rubber material. The peel strength shall not be less than 75 pounds per inch. Guide caps of an acetal bearing material shall be placed over solid guide lugs to prevent abrasion and to reduce the operating torque.

Tapping valves shall have an inlet flange conforming to ANSI B16.1 Class 125 for attachment to a tapping sleeve or cross. In addition, the valve inlet flange shall have a

machined projection or raised face complying with MSS SP-60 for accurate alignment to the mating recess in the tapping sleeve flange. The seat opening of the tapping valves shall be at least .30” larger than the nominal pipe size to permit full diameter cuts.

The valves shall be warranted by the manufacturer against defects in materials or workmanship for a period of ten (10) years from the date of manufacture. The manufacturing facility for the valves must have current ISO certification. Each valve shall have the manufacturer’s initials, pressure rating, and the year in which manufactured, cast onto the body.

Gate valves designated for direct bury installations shall be installed in accordance with the detailed drawings. They shall be furnished with mechanical joint end connections, a 2-inch square operating nut and an accompanying valve box. Valve boxes shall be of cast iron construction, be extension type with screw adjustments and include a removal lid marked “WATER”. The minimum metal thickness shall be 3/16". Following installation, valve boxes shall be plumb and straight with the operating nut centered. In paved areas the top of the lid should project ¼” above final grade line. In all other areas this projection shall be 1”, with the lid being protected by a three foot diameter, 4” thick, concrete slab.

Gate valves designated for interior or exposed piping applications shall be furnished with flanged end connections complying with ANSI B16.1, Class 125. Valves shall be equipped with an appropriated sized hand wheel operator oriented as shown on the drawings.

Gate Valves shall be as manufactured by Mueller Co. 2360 series or approved equal

3.2.2 Butterfly Valves. Butterfly valves shall be of the tight closing, rubber seated type and fully comply with the latest revision of AWWA Standard C504, Class as required, and ANSI/NSF 61. Valves shall be bubble-tight at rated pressure class in either direction, and shall be satisfactory for applications, involving throttling service and for applications requiring valve actuation after long periods of inactivity. Valve discs shall rotate 90° from the full open position to the tight shut position. Regardless of valve size, angular disposition of disc can be up to 1” off center without leakage.

The valves shall be rated for minimum operating pressure of 250 psi. Valve bodies shall be constructed of ductile iron ASTM-A536, Grade 65-45-12. Flanged valves shall be fully faced and drilled in accordance with ANSI Standards B16.1, Class 250. Rubber body seats shall be of one piece construction, simultaneously molded and bonded into a recessed cavity in the valve body protecting the leading edge of the seat from shearing force of the line flow. Seats may not be located on the disc or be retained by segments and/or screws. For wafer style valves, the seat shall cover the entire inner surface of the valve body and extend over the outside face of the valve body to form a flange gasket.

Valve shaft shall be stainless steel ASTM-A564 Type 630 Condition H-1100. Stub shafts or through shafts are acceptable. At the operator end of the valve shaft, a packing gland utilizing “V” type chevron packing shall be utilized. “O” ring and “U” cup packing is not allowed. Bearings shall be of a self-lubricating, nonmetallic material to

effectively isolate the disc-shaft assembly from the valve body. Metal-to metal thrust bearings in the flow stream are not allowed.

Valve discs shall be an on-center, lens-shaped design to afford minimal pressure drop and line turbulence. Materials of construction shall be: ASTM A126, Class B cast iron disc and a stainless steel type 316 edge with a minimum width equal to the width of disc edge. Discs shall be retained by stainless steel pin, extending through the full diameter of the shaft to withstand the specified line pressure up to valve rating and the torque required to operate the valve. Disc stops located in the flow stream are not allowed.

All surfaces of the valve interior shall be clean, dry and free from grease before painting. The valve surfaces except for disc edge, rubber seat and finished portions shall be a minimum of 8 mils Ameron 370. All coatings shall conform to AWWA C550.

Operators shall be totally enclosed, permanently lubricated and sealed gear reducers. A vent shall be provided between the valve trunnion and actuator base to prevent infiltration of fluid into the actuator. The operator case shall be completely watertight, sealed by means of approved gaskets, gasket compounds, O-rings or threaded plugs. Operators shall be filled with a suitable oil lubricant or thoroughly coated with an approved grease at the factory. If the operator lubricant is oil, provide suitable fill and drain plugs. Operators shall be self-locking with a permanent factory set stop at each end of travel. Operators shall be self-locking with open and close stops provided to limit valve disc travel. They shall ensure that the disc will not creep or flutter under service conditions and that the seat will close at an angle of 90° from full open.

Valve Operators shall comply with AWWA C504, unless otherwise specified in these Specifications. The operational torque of each valve and operator shall be in accordance with Appendix of AWWA Standard C504 for velocity of 16 fps and applicable pressure drop across valve. Operators shall be sized for bi-directional flow and 450 ft-lb input torque. The required input torque shall allow a maximum hand wheel pull of 80 ft.-lbs. for hand wheels and chain wheels, or 150 ft.-lbs. for operating nuts.

Butterfly valves designated for direct bury installations shall be installed in accordance with the detailed drawings. They shall be furnished with mechanical joint end connections, a 2-inch square operating nut and an accompanying valve box. Valve boxes shall be of cast iron construction, be extension type with screw adjustments and include a removal lid marked “WATER”. The minimum metal thickness shall be 3/16". Following installation, valve boxes shall be plumb and straight with the operating nut centered. In paved areas the top of the lid should project ¼” above final grade line. In all other areas this projection shall be 1”, with the lid being protected by a three foot diameter, 4” thick, concrete slab.

Butterfly valves designated for interior or exposed piping applications shall be furnished with flanged end connections complying with ANSI B16.1, Class 250. Valves shall be equipped with an appropriate sized hand wheel operator with position

indicators. Install valves with the valve shaft oriented in horizontal position unless otherwise shown on the drawings.

Butterfly Valves shall be as manufactured by Mueller Co. Lineseal XP series or approved equal

3.2.3 Ball Valves. For applications less than 3" in diameter, ball valves shall be used. The ball valves shall meet or exceed to ASME B16.44. The ball valves will be 2-piece forged brass body, full port, blow out proof stem, PTFE seats, PTFE packing with adjustable stem packing gland. The valves will be equipped with NPT threaded pattern connections on both end and shall come complete with lever operators. Maximum working pressure shall be rate at a minimum of 400 psi.

Ball valves shall be manufactured by Nibco, Model T-FP-600A or approved equal.

3.2.4 Check Valves. All check valves shall be iron body bronze mounted swing check valves. Valves shall be suitable for non-shock cold water service and comply with all applicable parts of ANSI/AWWA C508. Valves shall have a clear full opening waterway when disc is in fully open position. Valves shall be lever and weight operated with an adjustable position weight and lever arm attached to disc assembly for variable closure force. The weight & lever assembly should be available for use on either side of the valve. All operating parts should be accessible through top opening, ensuring trouble free maintenance. Valves shall be equipped with a "D" shaped cover equipped with a flow direction indicator insuring that it cannot be incorrectly assembled and cause flow direction error.

The valve body, cover, and weights shall all be composed of ASTM 126 Grade B cast iron. The hinge pin shall be supported by heavy bronze bearings and be pressure sealed with O-rings. Each valve shall be equipped with an ASTM A307 steel test plug. Valves shall be equipped with an ASTM 126 Grade B cast iron disk and ASTM B584 Alloy C84400 cast bronze disk facing. The disk facing shall be permanently pressing into disc. Valves shall employ an ASTM A267 Type 303 stainless steel hinge pin and an ASTM B584 Alloy C84400 cast bronze clapper arm. All gaskets and o-rings shall be ASTM D2000 rubber. The valve shall be coated in water reducible alkyd enamel primer paint.

Valves shall be designed for a minimum water working pressure of not less than 175 pounds per square inch. Prior to shipment from the factory each valve shall be tested at a hydraulic pressure of at least 350 pounds per square inch. Each valve shall have cast on the body, the maker's initials, pressure rating and the year in which the valve was manufactured.

Check valves shall be as manufactured by Mueller Co. or approved equal.

3.2.5 Hydrants. Hydrants shall meet or exceed all applicable requirements and tests of ANSI and the latest revisions of AWWA Standard C502. They shall also meet all test requirements and be listed by Underwriters Laboratories Inc. They shall also meet all

test requirements and have full approval of Factory Mutual. Hydrants shall be of the compression type, opening against the pressure and closing with the pressure and shall be rated for a minimum working pressure of 250 psi. They shall have a minimum 4-1/2" main valve opening and a minimum inside lower/upper barrel diameter (I.D.) of 6" to assure maximum flow performance. All hydrants shall be three-way in design, having one 4-1/2" pumper nozzle and two 2-1/2" hose nozzle(s). Nozzles shall thread counterclockwise into hydrant barrel utilizing "o" ring seals. A suitable nozzle lock shall be in place to prevent inadvertent nozzle removal.

The hydrant bonnet shall be attached to the upper barrel by not less than eight bolts and nuts and sealed by an "o" ring. The bonnet assembly shall provide an oil reservoir and lubrication system that automatically circulates lubricant to all stem threads and bearing surfaces each time the hydrant is operated. This lubrication system shall be sealed from the waterway and any external contaminants by use of "o "ring seals. An anti-friction washer shall be in place above the thrust collar to further minimize operating torque. The oil reservoir shall be factory filled with a low viscosity, FDA approved, non-toxic oil lubricant which will remain fluid through a temperature range of -60^0 F. to $+150^0$ F.

The operating nut shall be a one piece design, pentagon/square in shape manufactured of ASTM B-584 bronze. The operating nut shall be affixed to the bonnet by means of an ASTM B-584 bronze hold down nut. The hold down nut shall be threaded into the bonnet in such a manner as to prevent accidental disengagement during the opening cycle of the hydrant. The use of Allen head set screws as a means of retention is unacceptable. A resilient weather seal shall be incorporated into the hold down nut, for the purpose of protecting the operating mechanism from the elements. The direction of the opening shall be as specified by the counterclockwise. An arrow shall be cast on the bonnet flange to indicate the opening direction.

Hydrants shall be a "traffic-model" having upper and lower barrels joined at the ground line by a separate and breakable "swivel" flange providing 360° rotation of upper barrel for proper nozzle facing. This flange shall employ not less than eight bolts. The safety flange segments shall be located under the upper barrel flange to prevent the segments from falling into the lower barrel when the hydrant is struck. The pressure seal between the barrels shall be an "o" ring. The proper ground line shall be cast clearly on the lower barrel and shall provide not less than 18" of clearance from the centerline of the lowest nozzle to the ground.

The operating stem shall consist of two pieces, not less than 1 1/4" diameter (excluding threaded or machined areas) and shall be connected by a stainless steel safety coupling. The safety coupling shall have an integral internal stop to prevent the coupling from sliding down into the lower barrel when the hydrant is struck. Screws, pins, bolts, or fasteners used in conjunction with the stem couplings shall also be stainless steel. The top of the lower stem shall be recessed 2" below the face of the safety flange to prevent water hammer in the event of a "drive over" where a vehicle tire might accidentally depress the main valve. The lower barrel shall be an integrally cast unit. The use of threaded on or mechanically attached flanges is deemed unacceptable. The hydrant bury depth shall be clearly marked on the hydrant lower barrel.

Composition of the main valve shall be a molded rubber having a durometer hardness of 95 +/- 5 and shall be reversible in design to provide a spare in place. Plastic (polyurethane) main valves are unacceptable. The main valve shall have a cross section not less than 1".

Hydrants shall be equipped with (2) two drain valves which drain the barrel when the hydrant is closed and seal shut when the hydrant is opened. These drain valves shall be an integral part of the one piece bronze upper valve plate. They shall operate without the use of springs, toggles, tubes, levers or other intricate synchronizing mechanisms.

The upper valve plate, seat ring and drain ring (shoe bushing) must be ASTM B-584 bronze and work in conjunction to form an all bronze drain way. A minimum of two (2) internal and two (2) external drain openings are required. Drains ported through an iron shoe must be bronze lined. The bronze seat ring shall thread into a bronze drain ring (or shoe bushing) providing a bronze to bronze connection. Seat rings shall be "o" ring pressure sealed
The interior of the shoe including the lower valve plate and stem cap nut shall have a protective coating that meets the requirements of AWWA C-550. If a stem cap nut is utilized, it must be locked in place by a stainless steel lock washer or similar non-corrosive device that will prevent the cap nut from backing-off during normal use.

The hydrant shall be coated with a prime coat and two finish coats of paint as suggested by the manufacturer and approved by the ENGINEER. The shop drawings shall indicate the coating and color proposal.

Hydrants shall be warranteed by the manufacturer against defects in materials or workmanship for a period of ten (10) years from the date of manufacture. The manufacturing facility for the valves must have current ISO certification. Each hydrant shall have the manufacturer's initials, pressure rating, and the year in which manufactured, cast onto the body.

Hydrants shall be installed in accordance with the detailed drawings, complete with a companion gate valve and connection appurtenances. The hydrant shall be installed perpendicular to the surrounding ground surface and the hydrant riser shall be completely buried. The depth of bury shall be the same as the adjoining water line. The shoe of the hydrant shall be encased in Class B concrete and the concrete shall extend to undisturbed earth. Gravel shall be placed around the hydrant on top of the concrete thrust restraint and at the weep hole a minimum depth of twelve inches in depth. Select earth backfill shall be compacted to fill the remaining excavated void and the surface shall match the surrounding surface. The hydrant shall be secured to the companion gate valve by means of a hydrant adapter and joint restrainer or by other approved means. The hydrant adapter shall be the swivel by solid adapter with swivel gland type. The direct connection of mechanical joint (MJ) fittings to adjacent in-line valves shall be made using Foster adapters

Hydrant adapters shall be the swivel by solid adapter with swivel gland type as manufactured by Tyler Pipe/Union Foundry Company, or approved equal.

Foster adapters shall be constructed of ductile iron and comply with applicable AWWA Standards and shall be lined and coated in accordance with AWWA C104 and C110 as manufactured by Infact Corporation, or approved equal.

Hydrants shall be as manufactured by Mueller Co. Super Centurion 250 or approved equal.

3.2.7 Meters. All meters shall be cold water Magnetic Drive Positive Displacement Disc Meters type as manufactured by a registered ISO 9001 quality standard facility and have a minimum of ten years of successful field use. Meters must also meet or exceed the latest revision of AWWA C701 Class I Standards.

The maincase and cover shall be of an NSF/ANSI 61, Bronze. The main case shall contain both the measuring element and the integral strainer. The integral strainers shall be of stainless steel and must have an effective straining area of at least two (2) times the nominal pipe size of the meter. The size, model, and arrows indicating direction of flow shall be cast in raised characters on the maincase or cover. The meter serial number shall be imprinted on the meter maincase or cover as well as the register box cover. The maincase and cover shall have a rated working pressure of 150 psi.

Registers shall be permanently roll-sealed, straight reading, indicating in gallons and shall include a center-sweep test hand and a low flow indicator. Registers shall allow for in-line serviceability. The manufacturer and the meter serial number shall be clearly identifiable and located on the register box cover. The register box shall be affixed to the top cover by means of a plastic tamperproof seal pin that must be destroyed in order to remove the register. The measuring chamber shall be a nutation disc assembly. All water must pass through the measuring element.

Registration accuracy over the normal operating range shall be 95% to 101.5%. All meters shall be equipped with encoder remote registers per AWWA C707 and meet all AWWA C701 performance standards.

All meters shall be compatible with the OWNERS existing Radio Read Meter system. Each meter shall include a Meter Interface Unit (MIU) module which transmits hourly profile consumption data for a minimum of 170 days when initialized to provide an historic usage profile for the meter. MIU models unable to store and transmit consumption data will not be considered. MIUs must have ability to be utilized in a future fixed-based AMI system the District may implement. The proposed radio MIU shall be designed to encode water consumption, leak detection (small and large leaks), backflow, no flow, wire tampering and the duration of these events at the meter, store this data, and transmit this data to the data collection device. This information must be instantly available for viewing by the meter reader as soon as the meter is read by the drive-by system. The Utility is committed to selecting the technology that provides the most efficient, cost effective and flexible solution. Proposed radio MIU modules must be of an open architecture design and be compatible for use with water meters that utilize positional encoded registers manufactured by a major meter manufacturer. Proprietary systems will not be considered. The MIU units must transmit the encoded reading and event/duration data via radio frequency signal. The MIU units must be

capable of operating in bubble-up (one way) mode only. The signal must be continually transmitted at a predetermined 2-second time interval in bubble-up mode to provide high performance meter reading. The meter module must last in the field without need for servicing for a minimum of 20 years. MIU modules must be programmed at the manufacturer and should require no additional field programming. The MIU modules must operate with one-way radio transmissions and continually transmit meter readings at the pre-selected 2-second interval without need of a wake-up call. MIU modules must transmit encoded meter data information on a radio frequency (902-928MHz) that does not require an FCC license. MIUs for all meters require integral mount MIU that has no exposed wire for both pit and indoor installations.

All meters shall included Absolute Encoder Register Technology. Each register shall be a true absolute encoder register that provides direct electronic transfer of meter reading information to any number of AMR device options. Minimally, a Touch Pad, Remote Visual Counter or Radio MIU device shall read the encoder register. Only encoded-type registers will be considered. Pulse type registers or registers utilizing piezo, reed, or similar switch technology are not an acceptable alternative and will not be considered. The encoder register shall send data in ASCII format (American Standard code for Information Interchange) to the interrogation device. The encoder register shall transmit the complete odometer wheel reading, 6 digits and all 10 positions and an 8-digit identification number that has been factory set and never duplicated shall be sent to the reading device. A Locating Clip shall be affixed to each of the odometer wheels in close proximity to the Segment Pads located on the encoder's printed circuit board. When an AMR device interrogates the encoder register, the microprocessor shall determine the true position of each number wheel, encode the reading and send it to the AMR device. The Locating Clip shall not make physical contact with the Segment Pad in order to prevent wear of the clip and pads. For pit set installations, the encoder register shall be permanently factory sealed with an epoxy coating of all terminal connections. Encoder registers requiring field sealing of the wire connection will not be allowed. No wire connections or wire splicing of any kind shall be required to be performed during installation for pit set encoder registers.

All meters shall be Mueller Systems Hersey® 500 Series IIS Magnetic Drive Positive Displacement Disc Meters, 6 wheel, pre-wired with a RF Pit Unit, or approved equal.

Meters shall be installed as shown on the Drawings and be mounted using a coppersetter equal to the Ford Catalog No. VH77-12B-44-77 having a maximum rise of fifteen inches and being appropriate for the meter specified herein. The coppersetter shall be complete with an inlet ball valve, outlet check valve and a bypass equipped with an inline ball valve. The coppersetter shall be supported at the appropriate height using solid concrete blocks as required. Sections of 1" brass piping a minimum of 18" long shall be installed through the brace eye supports to provide vertical stability.

3.3 Pre-cast Concrete Vault and Appurtenances. The vault shall be design per ASTM C-890: Minimal structural design loading for underground precast concrete water and wastewater structures and ACI 318: Building code requirements for reinforced concrete. All

concrete used in the construction of the vault shall have a minimum 28 day compressive strength of 4,500 psi. Reinforcing steel shall be ASTM A-6115, Grade 50 and used as required by design standards. Any joints shall be sealed with 1-inch conseal.

The vault shall include a floor drain which extends to daylight. The CONTRACTOR shall include up to 200 feet of 4-inch PVC drain line in the price of the vault. If the floor drain cannot be extended to daylight due the vault's location, the vault shall include gravel floor openings as shown on the plans which will be installed to facilitate proper drainage. Accordingly, the vault itself shall also be bedded with a sufficient layer (3 foot minimum) of acceptable gravel which will allow for adequate drainage.

The vault shall be equipped with one aluminum access hatch with a clear opening of no less than 60" x 60". The hatch shall be of non-skid design and be designed to handle a H-20 Uniform live load with a maximum allowable deflection of 1/150 of the span. A recessed, vandal proof locking device shall be provided as part of the hatch. A positive hold open bar shall also be provided to secure the hatch in the open position.

All hinges and hinge bolts shall be stainless steel. All hinge bolt nuts shall be tack welded to prevent removal of bolts. All fasteners used on the hatches shall be non-corrosive. All areas of hatch frames that will be in contact with concrete shall be coated with bitumastic paint. Bolts as required shall be threaded into the hatch frame from the concrete side and secured with stainless steel nuts. All bolts shall be installed to prevent interference when closing the hatch. Two (2) keys shall be provided, on a key ring complete with the manufacturer's identification. The hatch assembly shall be manufactured by Halliday Products, Series H1C.

3.4 Location. The CONTRACTOR shall be responsible for construction stakeout, based upon horizontal and vertical control points furnished by the ENGINEER. Adjustments in vertical and horizontal alignment may be required during construction due to unforeseen obstacles or changes in right-of-way. Changes in alignment shall be made as directed by the ENGINEER. Such modifications in alignment shall be accommodated by the CONTRACTOR and the completed work shall be paid using the unit prices bid for the work.

3.5 Excavation. The CONTRACTOR shall make trench excavations to only such width to provide ample room for proper construction. Sheeting and shoring shall be provided as required for proper safety and compliance with OSHA regulations. Rock excavation shall be taken to a depth of 6-inches below bottom of pipe. If poor foundation conditions exist due to organic material or quicksand, the trench shall be under-excavated to the depth required and filled with stone aggregate to obtain proper bearing capacity.

Watchmen or barricades, lanterns and other such signs and signals may be necessary to warn the public of the dangers associated with open trenches, excavations and other obstructions. Adequate precautionary measures shall be provided by and properly maintained at the expense of the CONTRACTOR.

Only one-half of street and road crossings shall be excavated before placing temporary bridges as required for the convenience of the traveling public.

3.6 Blasting and Rock Excavation. The CONTRACTOR shall make his own investigation as he deems necessary to ascertain the sub-surface conditions to be encountered in the work.

All blasting operations shall be conducted in accordance with municipal ordinances, state and federal laws and Section 9, Explosives, of the "Manual of Accident Prevention in Construction, published by the Associated General Contractors of America, Inc. Soil particle velocity shall not exceed limit set by Kentucky law. All explosives shall be stored in conformity with said ordinances, laws and safety regulations. No blasting shall be done within five feet of any water mains, sewer lines, natural or manufactured gas lines, liquid petroleum product lines or other utilities. Any damage done by blasting is the responsibility of the CONTRACTOR and shall be promptly and satisfactorily repaired by him.

The CONTRACTOR shall use delay caps or other approved methods to reduce earth vibrations and noise. Mud capping, as defined in the above manual, will not be permitted as a method of breaking boulders. No blasting shall be permitted on Sundays or after dark.

Prior to commencing with the work, the CONTRACTOR shall, during the preconstruction conference with the OWNER and ENGINEER, state clearly his approach to performing the excavations on the project. He shall be familiar with the laws and ordinances covering blasting and shall also give consideration to the use of hydraulically operated rock breaking devices in lieu of blasting where considered necessary. If blasting is not handled in an expert manner at all times, the ENGINEER reserves the right to suspend blasting and require the work to proceed without it. Prior to blasting, the CONTRACTOR shall make his own detailed pre-blast survey of adjacent walks, curbs, retaining walls, house foundations, etc. to determine conditions prior to the work. Such a file of information, including photographs, may be certified in such a manner as the CONTRACTOR believes necessary since this is information that may stand in his defense.

3.7 Storage of Excavated Material. All excavated material shall be stored in a manner that will not endanger the work and that will avoid obstructing roadways, sidewalks, and driveways. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire and police call boxes or other utility controls shall be left unobstructed and accessible. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural watercourses shall not be obstructed.

3.8 Shoring, Sheeting, and Bracing. The CONTRACTOR shall furnish, place and maintain such sheeting and bracing as may be required to support the sides of the excavation or to protect other structures from possible damage. All sheeting and bracing shall be removed upon completion of the work, unless permitted to be left in place by the ENGINEER. Any sheeting or bracing left in place shall be cut off at least two feet below

the finished ground surface elevation. The cost of furnishing, placing, maintaining and removing sheeting and bracing shall be included in the unit price bid for water lines. All work shall conform to OSHA requirements.

3.9 Removal of Water. The CONTRACTOR shall provide adequate pumps, temporary drains and appurtenant equipment to dewater excavations in such a manner that will not interfere with the progress of work.

3.10 Bedding. All process lines shall be bedded with 6- inches of #9 or approved equal stone under and on both sides of the pipe where necessary when rock or poor foundation conditions exist.

3.11 Thrust Blocks and Anchorage. Thrust blocks shall be installed whenever the pipe line changes direction, as at tees, bends, crosses, stops, as at a dead end; or at valves. The locations of thrust blocks depend on the direction of thrust and type of fitting. Their size and type depends on pressure, pipe size, kind of soil, and the type of fitting.
Where thrusts act upward (as at vertical curves) the weight of the pipe, the water in the pipe and the weight of the soil over the pipe should be determined to make certain that the total weight is sufficient to resist upward movement. If there is not enough soil or if it will not compact over the pipe or it is too soft and mushy to resist movement, then ballast or concrete may be placed around the pipe in sufficient weight and volume to counteract the thrust. Where a fitting is used to make a vertical bend, the fitting may be anchored to a concrete thrust block designed to key in to undisturbed soil and to have enough weight to resist upward and outward thrust, since the new placed backfill may not have sufficient holding power.

Thrust blocks shall be constructed of not less than Class B concrete conforming to KBH Specification 601 and placed between the fitting and the trench wall. It is important to place the concrete so it extends to undisturbed (freshly cut) trench wall. The thrust blocks shall be sized as shown on the drawings.

3.12 Backfill. Trenches shall be backfilled and "walked in" at once up to the height specified and shown in the PLANS. Backfill material shall be such that it may be compactly tamped around the pipe. No rock larger than two inches will be permitted within six inches of the pipe. No loose rock larger than six inches shall be less than 12 inches from the pipe. In open, unpaved, or unsurfaced areas the remainder of the fill may be thrown in loose and ridged up over the top of the trench. Mechanical backfilling shall be done with a rotobackfiller or angle dozer. When trenches are in the traveled areas or other places where property will be damaged by settlement of fill, sufficient compaction shall be made immediately. The remainder of the dirt shall be ridged up over the trench unless otherwise ordered by the ENGINEER. The CONTRACTOR at no time shall open up more than 500 feet of trench ahead of backfill and cleanup.

Any damage to underground structures, pipes, wires, drains, etc. shall not be backfilled until they have been satisfactorily repaired or replaced to the original serviceability at the CONTRACTOR'S expense and as approved by the ENGINEER. Settlement of backfill

may be done with water furnished by the CONTRACTOR under the direction of the ENGINEER where such will not endanger traffic or damage property. When excavated rock is used for backfilling, it shall have sufficient dirt or fine material to fill all voids and shall not be used within twelve inches of the pipe. All excess rock shall be cleaned up and taken away. No rock larger than two inches shall be left. In areas to be mowed, area shall be raked and smoothed with no rock larger than one inch.

The CONTRACTOR shall maintain the job in a neat and cleaned up condition at all times so as to cause minimum nuisance to the people. Procrastination of clean up and repair will not be tolerated. Minimum trench dirt shall be left outside trench and no soil outside trench shall be removed. Wherever it is necessary to tamp the trench because of traffic, sod placement, or other conditions, the ENGINEER will so instruct the CONTRACTOR who will include this cost in unit price bid. This tamping must have a compaction of at least 90 percent. The CONTRACTOR will be responsible for any settlement or damage due to settlement where tamping has been done. The tamping must be done the same day that trenching is done if there appears to be any danger of precipitation. If the weather appears to be safe, the ENGINEER may permit the CONTRACTOR to complete the tamping the following day. Where tamping is ordered, all excess dirt must be removed the day trenching is done or the following day.

3.13 Temporary Surfacing. All trenches in streets, roads or drives shall, following compacted backfill, receive a top layer of compacted dense grade stone. Such temporary surfacing shall be maintained, including nights and weekends, and such areas shall be paved within two weeks as soon as conditions permit. All public or private drives shall be promptly backfilled or bridged.

3.14 Hydrostatic Testing. The water line and appurtenances, as rapidly as valves are installed, shall be hydrostatically tested in accordance with these specifications. Defective joints of pipe shall be replaced as directed by the ENGINEER. Cracked or defective pipe, fittings, valves, or hydrants shall be replaced by the CONTRACTOR and the test shall be repeated until the test results are satisfied. Any meter settings and service tubing as shown on the drawings shall be included in the hydrostatic test.

The test pressure shall not be less than 1.25 times the working pressure at the highest point along the test section and the hydrostatic test shall be of at least a two hour duration. The test pressure shall not vary by more that five psi. for the duration of the test.

All leaks shall be repaired whenever or wherever there is evidence of a leak and the location is known or can be reasonably found.

3.14.1 Pressurization. After the pipe has been installed all or any valved section shall be subjected to the hydrostatic test. Each valved section of the pipe shall be slowly filled with water and the specified test pressure, corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the ENGINEER. As part of the testing equipment a meter shall be installed to measure all water added to the tested section.

3.14.2 Air Removal. Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the CONTRACTOR shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left in place at the discretion of the OWNER.

3.14.3 Leakage Defined. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within five psi. of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

3.14.4 Allowable Leakage. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{133{,}200}$$

Where:

L = allowable leakage in gallons per hour
S = length of pipe tested in feet
D = nominal diameter of the pipe in inches
P = average test pressure during the leakage test in pounds per square inch

This formula is based on an allowable leakage of 11.65 gpd./mi./in. of nominal diameter at a pressure of 150 psi.

3.15 Sterilization. Upon completion of a section of piping, disinfection shall be performed strictly in accordance with the procedure designated in Kentucky State Department of Health regulations which reads as follows: "All new water distribution systems including storage distribution tanks and repaired portions of or extensions to existing systems shall be thoroughly disinfected before being placed in service by the use of chlorine or chlorine compounds in such amounts as to produce a concentration of not less than 50 ppm and a residual of not less than 25 ppm at the end of 24 hours and followed by thorough flushing."

Putting small amounts of powdered chlorine in each joint will not be acceptable. Where the new system is connected to the present system the CONTRACTOR will install a 3/4" water meter for the CONTRACTOR on a regular water meter customer basis except that the CONTRACTOR will be charged a flat rate of $5.00 per 1,000 gallons.

3.16 Service Connections. Any utility connections encountered in the work shall be preserved and protected. Where relocation or repair is required to accommodate the

work, they shall be made in a manner acceptable to the utility having jurisdiction over the service connection. Accommodation of service connections shall not constitute any basis for extra payment.

3.17 As-built Drawings. As each line is installed, the CONTRACTOR shall maintain a carefully marked-up set of plans to show exact "as-built" location of all valves, fire hydrants, tees, blind flanges, tie-ins to existing lines, altitude valves, etc. All drawings shall pinpoint locations by two measured distances from prominent landmarks. As-built drawings shall also show the accurate location of other structures and utilities adjacent to or crossing the work. As-built drawings shall be delivered to the ENGINEER.

3.18 Coordination with other Utilities. Prior to construction, the CONTRACTOR shall arrange to meet with representatives of all utilities, and provide them with his anticipated work schedule. The CONTRACTOR shall have the utilities make their best determination of utility locations in the areas in which he is working. Throughout the progress of the work, such field markings of utilities shall be kept current. Repairs to any utilities damaged by the CONTRACTOR shall normally be performed by the utility at the CONTRACTOR'S expense, unless the CONTRACTOR and the utility negotiate other understandings and/or procedures.

3.19 Payment for Water. All water used from the OWNER supply shall be measured using meters supplied by the CONTRACTOR. The CONTRACTOR shall pay for such water monthly at the rate of $5.00/1,000 gallons. Water lost during line breakages shall be computed at the rate of $5.00/1,000 gallons. The quantity lost shall be computed on the basis of a discharge velocity of 7 feet/second, the diameter of the line, and the estimated duration of free uncontrolled discharge.

3.20 Cleanup. The CONTRACTOR shall provide effective cleanup of the work as it progresses. At the time of final inspection, no trenches shall show any undue evidence of the previous construction. All areas shall be left free of ruts due to construction equipment and shall have a clean and neat appearance without rubble or debris. The areas shall not be mounded up and shall be completely restored, and all yards and fields shall be reseeded so land may be cultivated, mowed, etc. Straw and fertilizer shall accompany the seeding and the seed mixture shall match existing ground cover. If necessary to hasten proper restoration of terraces, principally along ditch lines, the CONTRACTOR shall sod such areas at the ENGINEER'S direction.

3.21 Protection of Adjacent Landscape. Reasonable care shall be taken during construction of the process lines to avoid damage to vegetation. Ornamental shrubbery and tree branches shall be temporarily tied back, where appropriate, to minimize damage. Trees which receive damage to branches shall be trimmed of those branches to improve the appearance of the tree. Tree trunks receiving damage from equipment shall be treated with a tree dressing.

3.22 Underground Detection Wire. All buried piping shall be installed with a detection wire. Wire shall be installed with the pipe at the trench bottom and stubbed up at each service connection, valve, and flush hydrant. The wire shall be 12 gauge, solid strand, and insulated copper wire, commonly called “bell wire”.

3.23 Payment. Payment shall be included in the payment for the work to which it is subsidiary in the Bid Schedule.

SECTION 4 - SITE WORK

4.0 Work Included. Under this section the CONTRACTOR shall provide all labor, tools, equipment and materials to perform the sitework related to structures to be constructed. This work shall consist of site clearing, topsoil removal, excavation, the proper utilization or disposal of all excavated materials, necessary borrow, fill requirements, the shaping and finishing of all excavation work to the required lines and grades, preparation of subgrade, structure foundations, walks and pavements, engineered fill for support of structures, backfilling of foundations and trenches, roadway and pavement installation, and seeding and mulching.

4.1 Geotechnical Data. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that the OWNER will not be responsible for interpretation or conclusions drawn therefrom by the CONTRACTOR. Additional test borings and other exploratory operations may be made by CONTRACTOR at no cost to OWNER.

4.2 Existing Utilities. Prior to commencement of work, the CONTRACTOR shall locate existing underground utilities in areas of the work. If utilities are to remain in place, the CONTRACTOR shall provide adequate means of protection during earthwork operations.

4.3 Use of Explosives. The CONTRACTOR (or any of his subcontractors) shall not bring explosives onto the site or use in the work without prior written permission from the OWNER. The CONTRACTOR shall present a blasting plan to the OWNER and ENGINEER and not commence blasting operations until such plan is approved by the ENGINEER and OWNER. All activities involving explosives shall be in compliance with all the Federal, State and Local laws and regulations pertaining to blasting and use of explosives. The CONTRACTOR is solely responsible for handling, storage, and the use of explosive materials and the safety of others in the area when their use is permitted. The CONTRACTOR shall review all blasting procedures with the OWNER and ENGINEER prior to commencement of all blasting work. The CONTRACTOR is responsible for all blasting procedures. The particle velocity of all affected, adjacent structures shall be monitored with a seismograph located at that structure. The peak particle velocity shall not exceed two inches per second at a distance of 50 feet, or any velocity that may cause damage to adjacent structures. The CONTRACTOR is responsible for repair of any damaged structure.

No blasting shall be performed in areas where structural concrete is less than seven days old without the express written consent of the ENGINEER.

Protective material covering shall be used at all times to prevent flying rocks from damaging property or injuring personnel.

A copy of the required blasting log shall be available to the OWNER and ENGINEER.

4.4 Excavation. Excavation includes excavation to sub-grade elevations including excavation of earth, rock, bricks, wood, cinders and other debris. All excavation of materials shall be included in the lump sum portion of the work and will be unclassified and no additional payment will be made regardless of type of material encountered.

Unauthorized excavation consists of removal of materials beyond indicated sub-grade elevations or dimensions without specific direction of the ENGINEER. Unauthorized excavation, as well as remedial work directed by the ENGINEER, shall be at CONTRACTOR's expense.

4.4.1 Clearing & Grubbing. The CONTRACTOR shall cut and remove designated trees, stumps, brush, logs, fences, or other materials such as stumps, roots and other natural obstructions. No cleared or grubbed materials shall be used in backfills or embankment fills.

All stumps, roots and other objectionable material shall be grubbed up so that no roots larger than three inches in diameter remain less than 18 inches below the ground surface. All holes and depressions left by grubbing operations shall be filled with suitable material and compacted to grade.

The CONTRACTOR shall remove from the site and satisfactorily dispose of all miscellaneous rubbish including, but not limited to, masonry, scrap metal, rock, pavement, etc. that is under the fill or to be removed as shown on the Drawings, specified herein, or directed by the ENGINEER.

Existing improvements, adjacent property, utility and other facilities, and trees, plants and brush that are not to be removed shall be protected from injury or damage.

Trees and shrubs designated to remain or that are beyond the clearing and grubbing limits which are injured or damaged during construction operations shall be treated at the CONTRACTOR's expense by experienced tree surgery personnel.

4.4.2 Excavation for Structure. Excavation for structures shall conform to the elevations and dimensions shown within a tolerance of plus or minus 0.10 feet and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection. All loose material shall be removed from the excavation just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other work.

Protruding rock formations that would interfere with uniform footing bearing shall be removed such that the structure will bear upon uniform engineered fill at least 24 inches thick. No slab shall bear directly upon rock. All excavations shall extend to a depth that allows a minimum of 6 inch crushed stone base under slab.

All necessary precautions shall be taken to preserve the material below and beyond the lines of all excavation in the soundest possible condition. Any damage to the work due to the CONTRACTOR's operations, including shattering of the material beyond the

required excavation lines, shall be repaired at the expense of and by the CONTRACTOR. Any and all excess excavation for the convenience of the CONTRACTOR for any purpose or reason, except as may be ordered in writing by the ENGINEER and whether or not due to the fault of the CONTRACTOR, shall be at the expense of the CONTRACTOR. Where required to complete the work, all such excess excavation and over excavation shall be refilled with materials furnished and placed at the expense of and by the CONTRACTOR. Slopes shattered or loosened by blasting shall be taken down at the expense of and by the CONTRACTOR.

All excavation for embankment and structure foundations shall be performed in dry weather conditions. No excavation shall be made in wet weather or where frozen materials exist without written approval.

4.4.3 Backfill and Fill Material. All material to be used as backfill material shall be approved by the ENGINEER prior to backfilling excavations. With the exception of the organic debris, existing fill material, and topsoil, the on-site soil removed from the excavations will be used as fill or backfill material that is approved by the ENGINEER.

After clearing and stripping operations have been completed, all structure locations shall be proof-rolled with a loaded pan or heavy pneumatic tired vehicle to densify upper soils and to locate possible areas which will require undercutting, removal and/or re-compaction. This operation shall be conducted under the surveillance of the ENGINEER.

Before initiating filling operations, the CONTRACTOR shall receive approval of fill material by the ENGINEER. Proctor density tests shall be run on representative samples obtained from the proposed borrow material.

Where structures or other appurtenances are constructed on fill, the fill shall be placed in layers not over six inches deep, as measured before compaction and be thoroughly compacted. Compaction may be obtained by use of a sheeps foot roller or pneumatic-tired roller. Water shall be applied as directed to obtain close adhesion between layers and all parts of the material. Fill shall be compacted to a minimum of 95% of the Standard Proctor maximum dry density (ASTM Specifications D-698). A minimum of two compaction tests per each two feet of fill on a structure location shall be performed by a geotechnical engineer.

Only suitable material approved by the ENGINEER shall be used for backfilling around structures. Backfilling around structures shall have material placed in layers of six inch depth and compacted by pneumatic tools or other small equipment operated by hand. In no case shall the backfilling be allowed to obtain an elevation of one foot above any other area. It shall be uniformly compacted throughout the structure depth. Any deviation shall be cause for the ENGINEER to require the material deposited to be removed and re-compacted at the CONTRACTOR’s expense.

All backfilling shall be done in such a manner that the pipe or structure over or against which it is being placed will not be disturbed. Any pipe or structure damaged or moved

from its proper line or grade during backfilling operations shall be removed or repaired to the satisfaction of the ENGINEER and then backfilled.

4.4.4 Borrow Material. Borrow material shall consist of and include the required excavation and proper utilization of approved materials obtained from designated areas when sufficient quantities of suitable materials are not available from other required excavation.

The control of excavation in any borrow area and the selection of materials from shall at all times be as directed by the ENGINEER. On completion of excavation, all borrow pits shall be left in a neat and sightly condition. Unless otherwise approved by the ENGINEER, all borrow pits shall be so graded and dressed that water will readily drain therefrom, and away from all embankments, berms and structures. When shown on the drawings, terraces or diversions shall be constructed to protect the slopes of the borrow areas from erosion and shall be considered a subsidiary of this specification.

4.4.5 Disposal of Material. All surplus excavated material and/or waste materials shall be disposed of outside the floodplain in an area provided by the CONTRACTOR and approved by the ENGINEER. The material shall be compacted to a smooth condition and sloped to provide positive drainage.

Any material removed from an impoundment, river, stream or shore shall be removed from the area and disposed of outside of the floodplain as described above. Where shore areas are excavated and/or disturbed, the final contours shall be established by using rip-rap stone or other materials as shown on the Drawings.

4.4.6 Sheeting and Bracing. Sheeting and bracing as may be required to safely support the sides of excavations while maintaining the required side slopes shall comply with the safety precautions as outlined in current and accepted safety manuals, such as “Associated General Contractors Manual of Accident Prevention in Construction”. Where sheeting and bracing are necessary to prevent caving of the walls of excavations and to safeguard the workmen, the excavations shall be dug to such widths that proper allowance is made for the space occupied by the sheeting and bracing. The CONTRACTOR shall perform the additional excavation required and furnish and put in place the necessary sheeting and bracing and shall remove the same as the excavation is filled, at his own expense.

4.4.7 Removal of Water. The CONTRACTOR shall construct and maintain all necessary channels, flumes, and/or other temporary diversion and protective works; shall furnish all materials required therefore; and shall furnish, install, maintain and operate all well points, casings, pumps and other equipment for dewatering the various parts of the work and for maintaining the foundations, trenches and other parts of the work free from water as required for constructing each part of the work. After having served their purpose, all temporary protective works shall be removed, or leveled, to give a sightly appearance and so as not to interfere in any way with the operation, usefulness or stability of the permanent structures.

4.4.8 Finish Grading. Finish grading shall be to the finished elevations and grades shown, and shall be made to blend into conformation with remaining natural ground surfaces. All finish graded surfaces shall be left smooth and free to drain. Excess materials shall be spread and compacted as directed. Grading within the construction area and around the outside of building and structure lines shall be performed in a manner which will prevent accumulation of water within the area. Where necessary, or where shown, finish grading shall be extended to insure that water will be directed to drainage ditches, and the site area left smooth and free from depressions holding water.

4.4.9 Erosion Control. Temporary measures shall be applied throughout the construction site to control and to minimize siltation to adjacent properties and waterways. Such measures shall include, but not be limited to, the use of berms, baled straw silt barriers, gravel or crushed stone, mulch, slope drains and other methods. These temporary measures shall be applied to erodible material exposed by any activity associated with the construction of this project.

In addition to typical erosion control measures, a temporary construction boundary fence is required in some areas of the project. The specific site requirements and recommended soil erosion control devices are shown on the Drawings. All erosion control measures shall be incidental to the cost of installing other project components and no additional payment will be made.

4.5 Seeding and Mulching. All disturbed areas shall be seeded, fertilized and mulched as shown on the Drawings. The application of materials and execution shall be as follows:

4.5.1 Lime. Two tons of agricultural limestone per acre shall be required.

4.5.2 Fertilizer. The following amounts of fertilizer are required per acre:

(1) Nitrogen (N)	60 lbs.
(2) Phosphorous (P205)	120 lbs.
(3) Potash	120 lbs.

This requirement can be met by applying fertilizer having an analysis of 10-20-20 at the rate of 600 pounds per acre.

4.5.3 Seed. The following amounts of pure live seed are required per acre:

(1) KY-31 Fescue	60 lbs.
(2) Perennial Ryegrass	25 lbs.
(3) Red Clover	10 lbs.

4.5.4 Mulch. Mulch shall consist of wood fiber applied at a rate of 1600 pounds per acre, bituminous treated straw applied at a rate of 2000 pounds per acre or other mulch subject to the advance approval of the ENGINEER.

4.4.5 Execution. The seeding shall be completed within two weeks after completion of the work or as soon thereafter as conditions are favorable. Immediately prior to seedbed preparation, the CONTRACTOR shall apply the agricultural lime and fertilizer uniformly over the area to be seeded. The seedbed shall be prepared by pulverizing and breaking up the soil to a minimum depth of two inches with a disk harrow, drag harrow, spike tooth harrow or similar tool. All rocks, clods, and undesirable material that would interfere with seeding operations shall be removed.

The seeding operations shall be performed immediately after, or as soon as practicable, after the seedbed has been prepared. The seed shall be drilled or broadcast uniformly over the seedbed with regular approved type of equipment or method acceptable to the ENGINEER. The seeded area shall be passed over with a harrow or cultipacker to help cover more seed and improve seedling establishment. Excessive tillage shall be avoided. After all construction work is complete, prior to final payment, all exposed areas shall be cleaned and left in a sightly manner. All unused material shall be removed from the site.

The CONTRACTOR may hydroseed and mulch if the following requirements are met.

(1) The individual seed quantities shall be increased by 20%.

(2) The mulch shall be a processed hay or straw applied at a rate of 3/4 ton per acre with 80 lbs. per acre of an organic tackifier

(3) The hydroseeder slurry shall not be allowed to drop below a pH of 5.0.

The CONTRACTOR shall be responsible for the maintenance of all work under this section until final acceptance. Adequate protection of exposed slopes shall be provided at all times to prevent excessive erosion. No work will be accepted unless there is evidence of healthy growth and sufficient cover to prevent erosion.

Work executed under this section shall be guaranteed for one year with the guarantee beginning on the date of final acceptance of all work under this Contract. Any seeded areas of the site which are found to not have an adequate growth of cover during the guarantee period, shall be re-seeded as soon as weather conditions permit, at no cost to the OWNER.

4.6 Access Drive & Pavement. If required, the CONTRACTOR shall construct an access driveway and parking area in the location shown on the plans. The construction of these paved areas shall be as depicted on the plans and described herein. All paved areas shall be constructed with adequate pitch to ensure that drainage is directed away from any structures and that no water is allowed to pond on any area of the pavement.

4.6.1 Drainage Culverts. Piping material will be made of such material as specified on drawings. Installation shall be in accordance with general provisions of drainage pipe installation. In general, no offset grade stakes will be required for culverts less than 100 feet in length but good horizontal and vertical alignment will be required.

4.6.2 Sub-grade Excavation and Compaction. In preparation for pavement installation, the CONTRACTOR shall excavate the sub-grade the elevations indicated on the plans. At a minimum, the top 6-inches of existing sub-grade shall be removed. This requirement applies regardless of the character of surface and subsurface conditions encountered, including rock and any other soil materials. Excavations shall be in accordance with elevations and dimensions and cross sections depicted on the plans. The bottoms of excavations shall be taken below the intended elevations when so required in order to leave a solid base to receive other work. Sub-grades shall be proof rolled prior to filling or placing aggregate courses. This shall be accomplished with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated sub-grades.

The CONTRACTOR shall finalize sub-grade preparation through placement and compaction of fill material in appropriate layers to achieve the required elevations. Uniformly moisten or aerate the existing sub-grade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content. Any soil material that exceeds optimum moisture content by 2 percent and is therefore too wet to compact to the specified dry unit weight, shall be reworked and air dried or completely removed and replaced. Soil backfill shall be placed in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. At a minimum, the existing sub-grade and each layer of backfill material shall be compacted to not less ninety five percent (95%) of the maximum dry weight density according to ASTM D 698.

Following completion of sub-grade preparation, the CONTRACTOR shall take measures to prevent surface water and ground water from entering excavations and ponding on prepared sub-grades. Sub-grades shall be protected from softening, undermining, washout, and damage by rain, water accumulation and traffic. Sub-grades damaged by freezing temperatures, frost, rain, accumulated water, traffic or construction activities shall be reconstructed back to specified conditions prior to placement of aggregate courses.

4.6.3 Crushed Aggregate Base Course. Prior to application of asphalt pavement, CONTRACTOR shall install a crushed aggregate base above the prepared sub-grade. The base layer shall utilize dense graded limestone aggregate and be constructed in conformity with the lines, grades, notes and typical cross sections depicted in the plan sheets.

During installation, the base material shall be transported to the point where it is to be used, over crushed aggregate previously placed where possible, and dumped at the end of the preceding spread. Hauling over the sub-grade, or dumping on the sub-grade for further placement operations, will be permitted only when, in the opinion of the ENGINEER, such procedures will not adversely affect the integrity of the completed base and sub-grade. Spreading and final placement shall be accomplished by mechanical spreaders capable of producing an even distribution of the crushed concrete aggregate.

After spreading is completed the crushed concrete shall be uniformly compacted, with water being added as required, to a density of not less than ninety eight percent (98%) of the maximum density as determined by AASHTO T-180. Prior to final compaction operations, if the blading of any areas is necessary to obtain the true grade and cross section, the compacting operations for such areas shall be repeated.

4.6.4 Asphalt Paving. CONTRACTOR shall complete all areas scheduled for asphalt pavement with bituminous surfaces consisting of a prime coat of emulsified asphalt, a Class 1 Bituminous Base Course, and a Class 1 Bituminous Surface Coarse as specified by the Kentucky Bureau of Highways latest specifications. The paved areas shall be constructed in conformity with the lines, grades, notes and typical cross sections depicted in the plan sheets.

Immediately before placing asphalt materials, CONTRACTOR shall remove loose and deleterious material from substrate surfaces. At a minimum, sweep loose granular particles from surface of unbound-aggregate base course, taking care not to dislodge or disturb aggregate embedded in compacted surface of base course.

Initially, the crushed aggregate base course shall be prepared with a prime coat of emulsified asphalt. The prime coat shall be applied only when the base meets the required moisture and density requirements. At the time of priming, the base shall be firm, unyielding, and in such condition that no undue distortion will occur. The CONTRACTOR will be responsible for insuring that the true crown and template of the base are maintained, with no rutting or other distortion, and that the base meets all requirements at the time the surface course is applied.

The prime coat shall be applied uniformly over surface of the base course at a rate not less than 0.35 gallons per square yard, If prime coat is not entirely absorbed within 24 hours after application, the CONTRACTOR shall spread sand over surface to blot excess asphalt. The sand shall then be removed by sweeping before pavement is placed and after volatiles have evaporated.

Once the prime coat has cured, the base and surface courses of hot-mix asphalt can be placed on the prepared surface. Each course shall be placed appropriately in order to achieve the required grade, cross section, and thickness following compaction. The asphalt base course shall be placed in number of lifts desired by the CONTRACTOR in order to best achieve the thicknesses indicated on the plan sheets. However, the asphalt surface course shall be placed in a single lift. All asphalt courses shall be spread mix at minimum temperature of 250 deg F.

The installation of pavement shall begin along centerline of the crown for crowned sections and on high side of one-way slopes unless otherwise indicated. The CONTRACTOR shall regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat. Pavement shall be placed in consecutive strips not less than 5 feet wide unless infill edge strips of a lesser width are required. After first strip has been placed and compacted, place succeeding strips and extend compaction roller to overlap previous strips. Insure that all surface irregularities in paving course are promptly correct behind paver, before compaction. Use suitable

hand tools to remove excess material forming high spots and fill depressions with fresh hot-mix asphalt.

Following placement of asphalt mix, begin compaction as soon as paving will bear roller weight without excessive displacement. In areas inaccessible to rollers, compact paving with hot, hand tampers or with vibratory plate compactors. All compaction shall be achieved before mix temperature cools to 185 deg F. The compaction process shall begin with breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Any deficiencies noted in placement or compaction operations shall be corrected at this stage. Immediately after breakdown rolling is complete, begin intermediate rolling while asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to ninety six (96%) percent of reference laboratory density according to AASHTO T 245, but not less than ninety four percent (94%) nor greater than one hundred percent (100%). Once compaction is achieved, finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

Prior to final compaction, CONTRACTOR shall trim edges of pavement to proper alignment and appearance. As part of this process, all edges shall be beveled and compact thoroughly. Any paved areas which are found to be defective or contaminated with foreign materials shall be removed and replaced with fresh, hot-mix asphalt. All replacement areas shall be compacted by specified density and display a seamless transition to existing pavement. After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

CONTRACTOR shall ensure that each course is compacted to produce the thickness indicated on the plan sheets, within the following tolerances:

- Base Course: Plus or minus 1/2 inch.
- Surface Course: Plus 1/4 inch, no minus.

CONTRACTOR shall ensure that each course is compacted to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

- Base Course: 1/4 inch
- Surface Course: 1/8 inch

Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

4.6.5 Final Acceptance. All pavement shall be inspected prior to the final warranty period expiration. Any paved area found to be deteriorated or not uniform due to settlement of the disturbed subsurface shall be repaired before the work is recommended for final acceptance. The warranty period for all pavement replacement shall not commence until the final warranty period for the project in its entirety is initiated.

4.7 Payment. Payment for all site work that is required to complete the work as shown on the Drawings or described herein shall be included in the work to which it is subsidiary in the Bid Schedule and no measurement of the quantities will be made. The contours and elevations of the present ground are believed to be reasonably correct but are not guaranteed. The CONTRACTOR shall satisfy himself by actual examination of the site of work as to the existing elevations and contours and the amount of work required under this section.

SECTION 5 – TANK DEMOLITION AND REMOVAL

5.0 Work Included. Under this item the Contractor shall provide all labor, materials, equipment and incidentals required for the complete demolition, and removal and/or disposal of structures to be decommissioned as part of this project.

This includes the demolition and removal of the existing 100,000 gallon ground storage tank known as the existing "Hickory Nut Storage Tank." The location of this structure is indicated on the Plans. The work shall include removing all remnants of the tank structure, foundation, valve vault, site fencing and all other related appurtenances to a point two feet below existing ground level.

The Contractor will be responsible for the disconnection of the existing water mains as shown on the Drawings and as directed by the Engineer. This will be done before the tank demolition is started. Following these disconnections, there will be active water mains on site as indicated on the drawings, and others may be discovered during site excavations. It is essential that these facilities, when encountered, remain intact and in service during the proposed demolition. Consequently, the contractor shall exercise due concern for the operation of these facilities and shall diligently direct all his activities toward maintaining continuous operation of the existing facilities and minimizing operational inconvenience.

5.1 Working Area. The property boundary and access thereto is indicated on the Plans. All demolition work shall be confined to this area unless explicit written is granted by both the adjoining property owners and the engineer.

5.2 Site Examination. The Contractor shall examine the drawings, visit the site and determine for himself the extent of the work, the extent of work affected therein and all conditions under which he is required to perform the various tasks. It is highly recommended that prior to presentation of Bid Proposal, the bidder or qualified representative of the bidder visit the project site and review the conditions in the field.

5.3 Execution. The Contractor shall not proceed with the demolition and removal of the existing storage tanks until at least thirty (30) days following the completion and successful operation of the proposed Hickory Nut 300,000 Gallon Elevated Water Storage Tank. Furthermore, the Contractor must receive approval from both the Owner and Engineer before any demolition work can begin.

The Contractor shall issue written notices of planned demolition to companies or local authorities owning utility conduit, wires or pipes running to or through the project site. Copies of said notices shall be submitted to the Engineer. Contractor shall notify utility companies or local authorities furnishing electrical or telecom services to remove any equipment owned by them in structure to be demolished and to remove, disconnect, cap or plug their services to facilitate demolition.

Once all approvals are granted, the contractor shall completely demolish and remove all existing components and facilities associated with the existing water storage tank, as shown on the drawings and specified herein. This shall include removal of all below ground structures, vaults and underground utilities (water, electrical, etc.) as directed by the Engineer and specified herein. All material, equipment, rubble, debris and other products of the demolition shall become the property of the Contractor for his disposal off site in accordance with all applicable laws and ordinances, and at the Contractor's expense. The sale of salvageable materials by the Contractor shall only be conducted off-site. The sale of removed items on the site is prohibited by the Owner.

The Contractor shall not close or obstruct streets, drives or other occupied or used facilities without permission from the Owner/Engineer. If so allowed, the contractor must provide alternate routes around closed or obstructed traffic ways. The Contractor shall conduct operations to minimize damage by falling debris or other causes to adjacent buildings, structures, roadways, and other facilities. Provide interior and exterior shoring, bracing, or support to prevent movement or settlement or collapse of structures to be demolished. The Contractor shall promptly repair any damage caused to adjacent facilities as directed by the Engineer and at no cost to the Owner.

The Contractor shall provide pollution control, using water sprinkling, temporary enclosures, and other suitable methods as necessary to limit the amount of dust and dirt rising and scattering in the air to the lowest level of air pollution practical for the conditions of work. Compliance with all governing regulations is mandatory. Following construction, adjacent structures and improvements shall be cleaned of all dust, dirt and debris caused by demolition operations.

The Contractor shall maintain existing utilities to remain in service and protect against their damage during demolition operations. Existing utilities serving occupied or operational facilities shall not be interrupted except when authorized by Engineer. The Contractor shall provide temporary services as required during interruptions to existing utilities. The Contractor shall be solely responsible for making all necessary arrangements in conjunction with the discontinuance or interruption of any public or private utilities or services under the jurisdiction of outside utility companies. All utilities serving the structures to be demolished shall be disconnected and terminated at the service mains in conformance with the requirements of the utility companies controlling them.

5.4 Final Restoration and Cleanup. The Contractor shall remove all salvageable and non-salvageable materials, rubbish, and other debris from the site. The Contractor shall then fill and compact all voids left by the removal of piping, structures, etc. with an approved fill material to be provided to the site the Contractors expense. The site shall then be leveled smooth with contours similar to that which existed prior to the demolition operations. The final grade will provide for positive drainage of the disturbed area in a direction consistent with that of the surrounding area. All areas affected by the demolition procedures shall then be applied with a six-inch layer of topsoil, seeded with a lawn type seed, and mulched at a rate of one ton per acre.

5.5 Ownership of Materials. Equipment to be retained by the Owner will be removed by the Owner within thirty (30) days following the completion and successful operation of the proposed Hickory Nut 300,000 Gallon Elevated Water Storage Tank. Subject to the constraints of maintaining existing facilities in operation as shown or indicated on the Drawings, all other remaining equipment, non-buried valving and piping, and appurtenances shall be removed from the site.

The Owner will remove from the site(s) all salvageable or useable material or equipment to be retained by the Owner. Any and all materials not retained by the Owner shall become the Contractor's property and shall be removed from the site. The sale of removed items on-site is prohibited by the Owner; however the off-site sale of salvageable material by the Contractor is encouraged.

5.6 Disposal of Materials. All materials and debris resulting from the demolition operations shall be disposed of by the Contractor at locations outside the project site in a manner that will comply with all local, State and Federal regulations and as per OSHA (29CFR192663 and 354) and EPA Regulations.

A suitable disposal site shall be arranged for and secured by the Contractor, and he shall assume full responsibility for acceptable disposal of the material. Final acceptance of the work will not be made until the disposal areas are in acceptable condition with respect to the Contractor’s obligations as expressed above. The Contractor shall pay for any required permits or dumping fees.

The Contractor shall provide the Owner with information and evidence concerning disposal details and arrangements. Salvaged materials may be stored on the site temporarily, but not beyond seven days from the time of removal from their original position.

5.7 Submittals. Prior to beginning any demolition work, the Contractor shall submit to the Engineer for his approval, two (2) copies of his proposed methods of demolition and disposal as specified below. This shall include a schedule outlining the coordination of shut-off, capping and continuation of outside utility services as required.

The submittal shall provide a detailed sequence of demolition and removal work to ensure the uninterrupted operation of the Owner's system. Before commencing demolition work, all structural relocation, by-passing, disconnections or modifications required will be completed. Actual work will not begin until the Engineer has inspected and approved the prerequisite work, and authorized commencement of the demolition work.

5.8 Special Conditions Which Apply. The Owner and the Engineer assume no responsibility for the actual condition of the structures to be demolished or relocated. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner insofar as practicable. However, variations within each site may occur prior to the start of demolition work.

Certain information regarding the size, character and location of existing underground structures, pipes and conduit has been shown on the drawings. There is no certainty of the accuracy of this information, and the location of underground structures shown may be inaccurate and other obstructions than those shown may be encountered. The Contractor hereby distinctly agrees that the Owner is not responsible for the correctness or sufficiency of the information given; that in no event is this information to be considered as a part of the Contract; that he shall have no claim for delay or extra compensation on account of incorrectness of information regarding obstructions either revealed or not revealed by the drawings; and that he shall have no claim for relief from any obligation or responsibility under this Contract in case the location, size, or character of any pipe or other underground structure is not as indicated on the Drawings, or in case any pipe or other underground structure is encountered that is not shown on the Drawings.

5.9 Payment. Payment shall be included in the payment for the work to which it is subsidiary in the Bid Schedule.

SECTION 6 – CHAIN LINK FENCING

6.0 Worked Included. The Contractor shall furnish all labor, equipment and materials required to furnish and install chain link fence and gates complete including all erection accessories, fittings and fastenings, as specified herein, and any other incidental items of the types and sizes and at the locations shown on the Drawings.

6.1 Description. Chain link fence shall be installed after completion of clearing and grubbing. The fencing shall be of standard overall height of nine (9) feet and constructed of chain link fabric with three rows of barbed wire on top of steel brackets. Chain link fabric shall be one foot less than the complete overall height of the fence. Pedestrian gates shall have four foot openings. Vehicular gates shall be of the double swing type as shown and with the opening indicated on the Drawings.

6.2 Materials. The fence shall be constructed of one type material as indicated on the Drawings and as specified under this Section. Posts, braces and accessories shall conform to the standards of the Chain Link Fence Manufacturer's Institute (CLFMI) Specifications for industrial steel fences. Fence material, setting and accessories shall be as follows:

6.2.1 Fabric. Galvanized after woven, chain link copper bearing steel No. 9 gauge wire with 2-inch mesh with twisted and barbed finish at top and bottom and of a normal fabric width of eight feet.

6.2.2 Posts, Top Rail, and Braces. Shall be galvanized steel pipe, steel tube, H, I or U rolled sections, standard with the manufacturer.

6.2.3 Extended Arms. Shall be of the angle type and of pressed steel so as to receive three strands of barbed wire.

6.2.4 Barbed Wire. Shall be two-strand twisted No. 12-1/2 gauge double galvanized copper bearing steel wire with four point barbs of No. 14 gauge double galvanized copper bearing steel wire spaced approximately five inches apart.

6.2.5 Fence Installation and Post Setting. Shall conform to the CLFMI standards for chain link fence installation. The purpose of this fence is to keep people and animals out and therefore no crawl space beneath the fence will be allowed.

6.2.6 Gates. Frames shall be filled with fabric of the same specification as used in the chain link fence. Gates shall be equipped with offset hinges and latch for padlock arrangement, including 2-inch padlock, plus plunger rod and catch. Three keys shall be furnished with each padlock.

6.3 Payment. Payment shall be included in the payment for the work to which it is subsidiary in the Bid Schedule.

SECTION 7 – EROSION CONTROL

7.0 Scope of Work. It is intent of this specification to define the acceptable methods and materials for preparing storm water Best Management Plan and Notice of Intent, installing all applicable erosion control measures in accordance with Best Management Practice Plan and as specified and maintain erosion control measures as needed.

7.1 Installation Plan.

7.1.1 Minimize Disturbance and Buffer Strips Only areas necessary for construction shall be disturbed, cleared or graded. Vehicles and construction equipment shall be excluded from these areas so to preserve all natural vegetation. All areas that are disturbed during construction, including slopes, shall be protected during clearing and construction in accordance with the approved erosion and sediment control plan until they are permanently stabilized.

If top soil is needed for the re-establishment of vegetation, it shall be piled until the necessary amount needed to finish grading of all exposed areas. Areas that are to be filled shall be cleared, grubbed to remove trees, vegetation, roots and other objectionable material, and stripped of topsoil.

Areas to receive topsoil shall be scarified to a minimum depth of three inches prior to the placement of topsoil. All fills shall be compacted as required by building standards to reduce erosion, slippage, settlement, subsidence and other related problems. Fill intended to support buildings, structures, conduits, etc., shall be compacted in accordance with local requirements or codes.

7.1.2 Land Grading for Minimizing Erosion. Only areas necessary for construction shall be disturbed, cleared or graded. Vehicles and construction equipment shall be excluded from these areas so to preserve all natural vegetation. All areas that are disturbed during construction, including slopes, shall be protected during clearing and construction in accordance with the approved erosion and sediment control plan until they are permanently stabilized. All sediment control measures shall be constructed and maintained in accordance with the approved erosion and sediment control plan and according to the standards and specifications for the appropriate erosion control practices.

If top soil is needed for the re-establishment of vegetation, it shall be piled until the necessary amount needed to finish grading of all exposed areas. Areas to receive topsoil shall be scarified to a minimum depth of three inches prior to the placement of topsoil.

The outer face of the fill slope should always be allowed to stay loose, not rolled, compacted, or bladed smooth. A bulldozer may run up and down the fill slope so the dozer treads create groves perpendicular to the slope. Use slope breaks, such as diversions, benches, or contour furrows as appropriate, to reduce the length of cut-and-fill slopes to limit sheet and rill erosion and prevent gullying. The finish cut-and-fill slopes,

which are to be vegetated with grass and legumes, should not be steeper than two horizontal to one vertical.

Roughen the surface of all slopes during the construction operation to retain water, increase infiltration, and facilitate vegetation establishment.

Seeps or springs encountered during construction shall be handled in accordance with approved methods.

Stabilize all graded areas with vegetation, crushed stone, rip-rap, or other ground cover as soon as grading is completed or if work is interrupted for 21 working days or more.

Use mulch to stabilize areas temporarily where final grading must be delayed. Stockpiles, borrow areas and spoil areas shall be shown on the plans and shall be stabilized to prevent erosion and sedimentation.

7.1.3 Erosion Control Blankets and Matting.

A. Site Preparation. Proper Site Preparation is essential to ensure complete contact of the protection matting with the soil. Grade and shape area of installation. Remove all rocks, clods, vegetation or other obstructions so that the installed blankets, or mats will have direct contact with the soil. Prepare seedbed by loosening two to three inches of topsoil above final grade. Incorporate amendments, such as lime and fertilizer, into soil according to soil test and the seeding plan.

B. Seeding. Seed area before blanket installation for erosion control and re-vegetation or seed after mat installation for turf reinforcement. When seeding prior to blanket installation, all check slots and other areas disturbed during installation must be re-seeded. Where soil filling is specified, seed the matting and the entire disturbed area after installation and prior to filling the mat with soil.

C. Anchoring. U-shaped wire staples, metal geotextile stake pins or triangular wooden stakes can be used to anchor mats to the ground surface. Wire staples should be a minimum of 11 gauge. Metal stake pins should be 3/16 inch diameter steel with a 1 ½ inch steel washer at the head of the pin. Wire staples and metal stake should be driven flush to the soil surface. Two inches of wood staking should remain above the soil surface. All anchors should be six to eight inches long and have sufficient ground penetration to resist pullout. Longer anchors may be required for loose soils.

D. Installation on Slopes. Begin at the top of the slope and anchor its blanket in a six inches deep by six inches wide trench. Backfill trench and tamp earth firmly. Unroll blanket down slope in the direction of the water flow. Lay blankets loosely and maintain direct contact with the soil. Do not stretch. The edges of adjacent parallel rolls must be overlapped two to three inches and be stapled every three feet. When blankets must be spliced, place blankets end over end (shingle style) with six inches overlap. Staple through overlapped area, approximately twelve inches apart.

Blankets shall be stapled sufficiently to anchor blanket and maintain contact with the soil. Staples shall be placed down the center and staggered with the staples placed along the edges Steep slopes, 1:1 to 2:1, require 2 staples per square yard. Moderate slopes, 2:1 to 3:1, require 1 ½ staples per square yard (1 staple three feet on center). Gentle slopes require 1 staple per square yard.

E. Installation in Channels. Dig initial anchor trench twelve inches deep and six inches wide across the channel at the lower end of the project area. Excavate intermitten check slots, six inches deep and six inches wide across the channel at twenty five to thirty five foot intervals along the channel. Cut longitudinal channel anchor slots four inches deep and four inches wide along each side of the installation to bury edges of matting, whenever possible extend matting two to three inches above the crest of channel side slopes.

Beginning at the downstream end and in the center of the channel, place the initial end of the first roll in the anchor trench and secure with fastening devices at one foot intervals. Note: matting will initially be upside down in anchor trench.

In same manner, position adjacent rolls in anchor trench, overlapping the preceding roll a minimum of three inches. Secure these initial ends of the mats with anchors at one foot intervals, backfill and compact soil. Unroll center strip of matting upstream. Stop at next check slot or terminal anchor trench. Unroll adjacent mats upstream in similar fashion, maintaining three inch overlap.

Fold and secure all rolls of matting snugly into all transverse check slots. Lay mat in the bottom of the slot the fold back against itself. Anchor through both layers of mat at one foot intervals the backfill and compact soil. Continue rolling all mat widths upstream to the next check slot or terminal anchor trench. Alternate method for non-critical installations: place two rows of anchors on six inch centers at twenty five to thirty foot intervals in lieu of excavated check slots.

Shingle-lap spliced ends by a minimum of one foot with upstream mat on top to prevent uplifting by water or begin new rolls in a check slot. Anchor overlapped area by placing two rows of anchors, one foot apart on one foot intervals.

Place edges of outside mats in previously excavated longitudinal slots, anchor using prescribed staple pattern, backfill and compact soil.

Anchor, fill and compact upstream end of map in a twelve inch by six inch terminal trench. Secure mat to ground surface using U-shaped wire staples geotextile pins or wooden stakes. Seed and fill turf reinforcement matting with soil, if specified. After seeding, spread and lightly rake ½ inch to ¾ inch of fine topsoil into the mat apertures to completely fill mat thickness. Use backside of rake or other flat implement.

Spread topsoil using lightweight loader, backhoe, or other power equipment. Avoid sharp turns with equipment. Do not drive tracked or heavy equipment over mat. Avoid any

traffic over matting if loose or wet soil conditions exist. Use shovels, rakes or brooms for fine grading and touch up. Smooth out soil filling just exposing top netting of matrix.

F. Inspection and Maintenance. All blanket and mats should be inspected periodically following installation. Inspect installation after significant rainstorms to check for erosion and undermining. Any failure should be repaired immediately. If washout or breakage occurs, reinstall the material after repairing the damage to the slope or drainage way.

7.1.4 Topsoiling. Determine whether the quality and quantity of available topsoil justifies selective handling. Soils of the textural class of loam, sandy loam, and silt loam are best; sandy clay loam, silty clay loam, clay loam, and loamy sand are fair. Do not use heavy clay and organic soils such as peat or muck as topsoil.

Strip topsoil only from those areas that will be disturbed by excavation, filling, road building, or compaction by equipment. Determine depth of stripping by taking soil cores at several locations within each area to be stripped. Put sediment basins, diversions, and other controls into place before stripping. Select stockpile location to avoid slopes, natural drainage ways, and traffic routes. Use sediment fences or other barriers where necessary to retain sediment.

Protect topsoil stockpiles by temporarily seeding and/or mulching as soon as possible to assure the stored material is not exposed and allowed to erode.

If stockpiles will not be used within twelve months they must be stabilized with permanent vegetation to control erosion and weed growth.

Before spreading topsoil, establish erosion and sedimentation control practices such as diversions, berms, dikes, waterways, and sediment basins.

Where the pH of the existing subsoils 6.0 or less, or the soil is composed of heavy clays, incorporate agricultural limestone in amounts recommended by soil tests or specified for the seeding mixture to be used. Incorporate lime to a depth of at least two inches by disking.

Immediately prior to spreading the topsoil, loosen the subgrade by disking or scarifying to a depth of at least three inches, to ensure bonding of the topsoil and subsoil. If no amendments have been incorporated, loosen the soil to a depth of at least six inches before spreading topsoil.

Uniformly distribute topsoil to a minimum compacted depth of two inches on 3:1 slopes and four inches on flatter slopes.

Do not spread topsoil while it is frozen or muddy or when the subgrade is wet or frozen.

Correct any irregularities in the surface that result from topsoiling or other operations to prevent the formation of depressions or water pockets.

Compact the topsoil enough to ensure good contact with the underlying soil, but avoid excessive compaction, as it increases runoff and inhibits seed germination. Light packing with a roller is recommended where high maintenance turf is to be established.

7.1.5 Temporary Gravel Construction Entrance. The aggregate size for construction of the pad shall be two to three inch stone. Place the gravel to the specific grade and dimensions shown on the plans, and smooth it.

The thickness of the pad shall not be less than six inches. Use geotextile fabrics, if necessary, to improve stability of the foundation in locations subject to seepage or high water table.

The width of the pad shall not be less than the full width of all points of ingress or egress and in any case shall not be less than twelve feet wide.

The length of the pad shall be as required, but not less than fifty feet.

Locate construction entrances and exits to limit sediment leaving the site and to provide for maximum utility by all construction vehicles. Avoid entrances which have steep grades and entrances at curves in public roads.

The entrance shall be maintained in a condition that will prevent tracking or flowing of sediment onto public rights of way. This may require periodic top dressing with additional stone as conditions demand, and repair and/or clean out of any measures used to trap sediment.

All sediment spilled, dropped, washed or tracked onto public rights-of-way shall be removed immediately. Provide drainage to carry water to a sediment trap or other suitable outlet.

When necessary, wheels shall be cleaned to remove sediment prior to entrance onto public rights-of-way. When washing is required, it shall be done on an area stabilized with crushed stone that drains into an approved sediment trap or sediment basin.

All sediment shall be prevented from entering any storm drain, ditch or watercourse through use of sand bags, gravel, straw bales, or other approved methods.

Maintain the gravel pad in a condition to prevent mud or sediment from leaving the construction site. Replace gravel material when surface voids are visible. After each rainfall, inspect any structure used to trap sediment and clean it out as necessary. Immediately remove all objectionable material spilled, washed, or tracked onto public roadways. Remove all sediment deposited on paved roadways within 24 hours.

7.1.6 Rock, Log and Straw Bale Check Dams. The maximum spacing between the dams shall be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam.

Rock dams shall be constructed of two to fifteen inch rock. Keep the center rock (spill way) section at least six inches lower than the outer wall edges. Extend the abutments eighteen inches into the channel bank.

Straw bales shall be placed in a single row, lengthwise, oriented perpendicular to the flow, with the ends of adjacent bales tightly abutting one another. Straw bales shall be extended such that the bottoms of the end bales are higher in elevation than the top of the middle bale spillway to ensure that sediment-laden runoff will flow over the barrier, and not around it.

Each straw bale shall be embedded in the soil a minimum of four inches. Use straw, rocks, or filter fabric to fill any gaps between the bales and tamp the backfill material to prevent erosion under or around the bales. If the straw bales are wire bound, they should be oriented so the bindings are around the sides rather than along the top and bottom. Wire bindings that are placed in contact with the soil soon disintegrate and may allow the bale to fall apart.

Construct an energy dissipater to reduce downstream erosion.

The check dams shall be inspected for damage periodically during the winter and after each significant storm (one inch in 24 hours). Prompt repairs shall be made to ensure that the dam is functioning properly. Any erosion caused by flows around edges of the dam or under the structure shall be corrected immediately.

Remove sediment from behind the dams when they become sixty percent full, or as needed. The removed sediment shall be deposited in an area that will not contribute sediment off site and can be permanently stabilized. Remove check dams and stakes when stabilization is complete.

7.1.7 Straw Bale Dike. The bales shall be placed on the slope contour at the base of the slope or around the perimeter of the construction site. If the dike is constructed at the toe of a slope, place it five to six feet away from the slope if possible.

Do not construct the dike more than one bale high. Bales shall be placed in a row with the ends tightly abutting. Each bale shall be embedded in the soil a minimum of four inches. Use straw, rocks, or filter fabric to fill any gaps between the bales and tamp the backfill material to prevent erosion under or around the bales.

If the bales are wire bound, they should be oriented so the bindings are around the sides rather than along the top and bottom. Wire bindings that are placed in contact with the soil soon disintegrate and may allow the bale to fall apart.

The bales shall be securely anchored in place by two wooden stakes or rebar driven through the bales. The first stake in each bale shall be driven toward the previously laid bale to force the bales tightly together. Drive the stakes at least eighteen inches into the ground.

The straw bale dikes shall be inspected weekly and after each significant storm (one inch in 24 hours). Repairs and/or replacement shall be made promptly. Remove the straw bales when the upslope areas have been permanently stabilized. Remove sediment behind barrier when it reaches a depth of 6 inches.

7.1.8 Silt Fence. The height of a silt fence shall not exceed thirty six inches. Storage height shall never exceed eighteen inches. The fence line shall follow the contour as closely as possible. If possible, the filter fabric shall be cut from a continuous roll to avoid the use of joints. When joints are necessary, filter cloth shall be spliced only at a support post, with a maximum six inch overlap and both ends securely fastened to the post.

Posts shall be spaced a maximum of ten feet apart and driven securely into the ground (minimum of twelve inches). When extra strength fabric is used without the wire support fence, post spacing shall not exceed six feet. Turn the ends of the fence uphill.

A trench shall be excavated approximately four inches wide and six inches deep along the line of posts and upslope from the barrier.

When standard-strength filter fabric is used, a wire mesh support fence shall be fastened securely to the upslope side of the posts using heavy duty wire staples at least one inch long, tie wires or hog rings. The wire shall extend into the trench a minimum of two inches and shall not extend more than thirty six inches above the original ground surface.

The standard-strength filter fabric shall be stapled or wired to the fence, and six inches of the fabric shall extend into the trench. The fabric shall not extend more than thirty six inches above the original ground surface. Filter fabric shall not be stapled to existing trees.

When extra-strength filter fabric and closer post spacing are used, the wire mesh support fence may be eliminated. In such a case, the filter fabric is stapled or wired directly to the posts.

The trench shall be backfilled and the soil compacted over the toe of the filter fabric.

Silt fences placed at the toe of a slope shall be at least six feet from the toe in order to increase ponding volume.

Silt fences shall be removed when they have served their useful purpose, but not before the upslope area has been permanently stabilized, and any sediment stored behind the silt fence has been removed.

Silt fences and filter barriers shall be inspected weekly and after each significant storm (one inch in 24 hours). Any required repairs shall be made immediately. Sediment shall be removed when it reaches 1/3 height of the fence or nine inches maximum.

13.1.9 Drop Inlet Sediment Barriers.

A. Straw Bale Barrier. Excavate a four inch deep trench around the inlet and make the trench as wide as a straw bale in order to embed the bales properly. Orient the straw bales with the bindings around the sides of the bales so the wire does not come in contact with the soil.

Place bales lengthwise around the inlet and press the ends of adjacent bales together. The bales may be loosely joined if more gravel is utilized.

Drive two two by two inch stakes through each bale to anchor the bale securely in place.

Utilize ¾ inch to two inch gravel to fill the void spaces between the bales if necessary to dewater the ponded area more rapidly.

B. Silt Fence Sediment Barrier. Support posts for a silt fence must be steel fence posts or two inch by four inch wood, length three feet minimum, spacing three feet maximum, with a top frame support recommended. Excavate a trench four inches wide and six inches deep and bury the bottom of the silt fence in the trench. Backfill the trench with gravel or soil. Compact backfill well. The height of the silt fence shall be a maximum of eighteen inches measured from the top of the inlet.

Inspect the barrier after each rain and promptly make repairs as needed. Sediment shall be removed after each significant storm (one inch in 24 hours) to provide adequate storage volume for the next rain. The removed sediment shall be deposited in an area that will not contribute sediment off-site and can be permanently stabilized. For gravel filters, if the gravel becomes clogged with sediment it must be carefully removed from the inlet and either cleaned or replaced.

7.1.10 Curb Inlet Sediment Barriers. Place the barriers on gently sloping streets where water can pond. The barriers must allow for overflow from a severe storm event. Slope runoff shall be allowed to flow over blocks and gravel and not be bypassed over the curb. A spillway shall be constructed with the sandbag structures to allow overflow.

The sandbags should be of woven-type geotextile fabric since burlap bags deteriorate rapidly. Sandbags shall be filled with ¾ inch drain rock or ¼ inch pea gravel.

The sandbag shall be placed in a curved row from the top of the curb at least three feet into the street. The row should be curved at the ends, pointing uphill.

Several layers of bags should be overlapped and packed tightly. Leave a one-sandbag gap in the top row to act as a spillway.

Inspect and clean the barrier after each significant storm (one inch in 24 hours) and remove sediment from behind the structure after every storm. Any sediment and gravel shall be immediately removed from the traveled ways of roads. The removed sediment shall be placed where it cannot enter a storm drain, stream, or be transported off site.