MASTER SPECIFICATIONS

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DIVISION 2 SITE WORK

02211 GRADING FOR ROADS AND DRAINAGE

GENERAL

This section covers grading for the roadways and drives including all excavations, formation of embankments, preparation of subgrade for pavements and finishing and dressing of graded earth areas, shoulders, and ditches.

MATERIALS

Topsoil, material obtained from excavation suitable for topsoils, is defined as natural, friable soil, characteristics of representative soils in the vicinity that produce heavy growth of crops, grass, or other vegetation. Topsoil shall be free from roots, stones, and other materials that hinder grading, planting, and maintenance operations, and free from objectionable weed seeds.

Satisfactory soil materials are defined as those in accordance with AASHTO Soil Classification Groups, A-1, A-2-4, A-2-5 and A-3 (or in accordance with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, SP, SC.) as determined by the Engineer. Satisfactory material shall be free from roots, organic matter, trash, debris, frozen material or stones larger than three (3) inches in any dimension.

Unsatisfactory soil materials are defined as those in accordance with AASHTO Soil Classification Groups A-2-6, A-2-7, A-4, A-5, A-6, A-7 (or in accordance with ASTM D2487 soil classification groups GC, ML, MH, CL, CH, OL, OH, and PT) as determined by the Engineer.

Materials determined by the Engineer as too wet or too soft to provide a stable subgrade, foundation, or fill will be classified as unsatisfactory regardless of soil classification. The Engineer may require the Contractor to condition the wet and/or soft soils to provide a stable subgrade, foundation, or fill. The Contractor shall recondition the materials at no additional cost to the Owner.

CONSERVATION OF TOPSOIL

Areas designated for operations that contain a blanket of soil, which is more satisfactory for the growth of grass than the embankment material to be placed, shall be stripped to a depth of approximately four (4) to six (6) inches and placed in convenient stockpiles as directed in the field, for later use as a topsoil blanket on the new graded areas specified herein, or as designated. The stripping of material for use as topsoil shall be carefully determined and only the quantity required shall be stripped and stockpiled. Material ordered stockpiled shall be placed in a satisfactory manner to afford drainage. When grading operations permit, instead of stockpiling, the topsoil shall be hauled and spread directly on the areas to receive topsoil.

Topsoil shall be placed on all shoulders, slopes, ditches, and other earth areas graded under this contract, excluding borrow areas, unless otherwise specified on the plans. Topsoil shall be uniformly placed on these areas to a compacted depth of not less than three (3) inches or more than four (4) inches. The material shall be free from clods of soil, matted roots greater than ½ inch in diameter, and any other objectionable material which might hinder subsequent grass and mowing operations. The material shall be placed, leveled, and lightly compacted with at least one pass of a cultipacker, or other approved equipment weighing 100 to 160 pounds per linear foot of roller, to required cross sections, but shall be left one-tenth of a foot below the finished earth grade as specified in the paragraph FINISHED EXCAVATION.

BORROW EXCAVATION (Select Backfill)

Where satisfactory materials are not available in sufficient quantities from the required excavation, approved materials shall be obtained from borrow areas. Borrow excavation material shall be supplied by the Contractor from borrow areas located off-site. The work covered by this section shall consist of the excavation of approved material from borrow sources and the hauling and utilization of such material as required on the plans or directed by the Engineer. The borrow material shall be approved by the Engineer and shall not contain roots, root mats, stumps, highly plastic clay or other unsatisfactory materials. The material shall be a soil material which meets requirements of AASHTO Ml 45 for soil classification A-i-a, A-i-b, A-2-A, A-3 acceptable for select backfill. All borrow material shall be in accordance with the NCDOT Standard Specification for Roads and Structures, most recent edition. Borrow excavation shall be in accordance with the NCDOT Standard Specification for Roads and Structures, most recent edition. Excess material removed within the work limits, suitable for borrow excavation, during "Unclassified Excavation" operations shall not be considered or paid for as borrow excavation.

UNDERCUT EXCAVATION

When the Owner determines that the natural soil materials in areas where fill is to be placed, or in the finished graded subgrade roadway cross section, or in areas supporting structures or pipes, are determined to have a poor supporting value, the Engineer may require the Contractor to remove the materials and backfill with approved properly compacted material to the finished graded section. The Contractor shall conduct undercut operations in such a way that the Engineer can take the necessary measurements before any backfill is placed. Any material removed and backfilled without the approval of the Engineer, and/or all necessary measurements taken, and/or to a depth, length or width exceeding the dimensions shall not be considered undercut excavation and will not be paid for such. All undercut excavation shall be in accordance with the NCDOT Standard Specification for Roads and Structures, most recent edition. Undercut excavations suitable for backfill on toes of slopes and other approved areas will not be paid for as borrow excavation.

FINISHED EXCAVATION

All areas covered by the project, including excavated and filled sections and adjacent transition areas, shall be uniformly smooth-graded. The finished surface shall be reasonably smooth, compacted, and free from irregular surface changes. The degree of finish shall be that ordinarily obtainable from blade-grader operations, except as otherwise specified. Ditches shall be finished to permit adequate drainage. The surface of areas to be turfed shall be finished to a smoothness suitable for the application of turfing materials. Surfaces shall be finished not more than 0.15 foot above or below the established grade and approved cross section. In areas where the bulking of soil as a result of grassing operations will tend to retard surface drainage along the edge of pavements, the finished grades shall be left 0.1 foot below grade prior to grassing.

Newly graded areas shall be protected from traffic and from erosion, and any settlement or washing away that may occur from any cause, prior to acceptance, shall be repaired and grades re-established to the required elevations and slopes. Embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained in such a manner as to drain effectively at all times. The finished subgrade shall not be disturbed by traffic of other operations and shall be protected and maintained by the Contractor in a satisfactory condition until subbase, base, or pavement is placed. The storage or stockpiling of materials on the finished subgrade shall not be permitted. No base course or pavement shall be laid until the subgrade has been checked and approved, and in no case shall base, surfacing, or pavement be placed on a muddy, spongy, or frozen subgrade. All work shall be conducted in accordance with the environmental protection requirements of the contract.

DIVISION 2
SITE WORK

02222 EXCAVATION AND BACKFILLING FOR UTILITY SYSTEMS

GENERAL

Work described in this section consists of the excavation, backfill, compaction, and finish grading required to install the utility systems. The intent and purpose of these specifications is to require a complete and satisfactory installation in every respect and any defect in material or workmanship shall be cause for the replacement and correction of such defect as directed by the Public Works Commission.

RELATED SECTIONS

A. 02305 – Pipe Bursting
B. 02660 – Water Distribution
C. 02730 – Sanitary Sewer Systems
D. 02732 – Sewage Force Mains
E. Chapter 24 of the City of Fayetteville Ordinance (most recent version)

MATERIALS

Suitable soil materials are defined as those in accordance with AASHTO Soil Classification Groups A-1, A-2-4, A-2-5 and A-3 (or in accordance with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, SP, SC) as determined by the Public Works Commission. Suitable material shall be free from roots, organic matter, trash, debris, frozen material or stones larger than three (3) inches in any dimension.

Unsuitable soil materials are defined as those in accordance with AASHTO Soil Classification Groups A-2-6, A-2-7, A-4, A-5, A-6, A-7 (or in accordance with ASTM D2487 soil classification groups GC, ML, MH, CL, CH, OL, OH, and PT) as determined by the Public Works Commission. Unsuitable material as defined above shall be replaced with select material as determined by the Public Works Commission.

Suitable materials determined by the Public Works Commission as too wet or too soft to provide a stable subgrade, foundation, or fill will be deemed as unsuitable regardless of soil classification. Materials deemed unsuitable shall be conditioned or replaced, as directed by the Public Works Commission. The Contractor shall recondition and stockpile the materials at no additional cost to the Public Works Commission.

EXCAVATION

All excavation shall be to the lines and grades indicated. The work shall consist of the excavation, placement, and compaction of suitable material as outlined in this Specification and proper disposal of all unsuitable materials. During excavation, suitable material for backfilling shall be stockpiled. The stockpiles shall be protected from contamination by unsuitable excavated material or other material. If

any material becomes unsuitable, such material, if directed, shall be removed and replaced with suitable on-site or imported material from approved sources at no additional cost to the Public Works Commission.
Where the line parallels a creek and/or ditch the excavated material shall be stockpiled opposite the creek, with the trench separating the two. Adequate drainage shall be provided for the stockpiles and surrounding areas by means of ditches, dikes, or other approved methods. Grading shall be done to prevent surface water from entering the excavation. Any water within the trench shall be removed.

Suitable excavated material shall be stockpiled or placed in the excavation's backfill. Excavation and filling shall be performed in a manner and sequence that will provide drainage at all times. Unauthorized over excavation shall be backfilled with select bedding material at no additional cost to the Public Works Commission. The Contractor, at their expense, shall properly dispose of all excess excavated material unless directed to place it in another area of the project by the Public Works Commission. The Contractor's obligation to remove and dispose of excess materials shall in no manner convey to him any rights of property in any material taken from any excavation.

It shall be the Contractor's responsibility to investigate the site and existing conditions. No compensation will be allowed due to excavation and/or grading being different than anticipated.

TRENCH EXCAVATION

The trench width shall be in accordance with the PWC standard details. All work shall be in accordance with the applicable OSHA regulations.

The subgrade beneath the centerline of the pipe shall provide uniform support for each section of the pipe. Stones three (3) inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed.

Where unsuitable material is encountered at the elevation established for installation of pipe or structures, additional undercut excavation shall be done as directed by the Public Works Commission. The additional undercut excavated area shall be backfilled with stone bedding material. Unauthorized undercut excavation shall be backfilled with stone bedding material and compacted as directed by the Public Works Commission. The Contractor shall conduct undercut operations in such a way that the Public Works Commission can take the necessary measurements before any backfill is placed. Any material removed and backfilled without the approval of the Public Works Commission, and/or all necessary measurements taken, and/or to a depth, length or width exceeding the dimensions shall not be considered undercut excavation and will not be paid for such.

Where unsuitable material is encountered at the elevation established for installation of roads, parking lots, or other paved areas, additional undercut excavation shall be done as directed by the responsible agency (i.e., City of Fayetteville, Town of Hope Mills, NCDOT, etc.). The additional undercut excavated area shall be backfilled with stone bedding material. Unauthorized undercut excavation shall be backfilled with stone bedding material and compacted as directed by the responsible agency. The Contractor shall conduct undercut operations in such a way that the responsible agency can take the

necessary measurements before any backfill is placed. Any material removed and backfilled without the approval of the responsible agency, and/or all necessary measurements taken, and/or to a depth, length or width exceeding the dimensions shall not be considered undercut excavation. All undercut excavation shall be in accordance with the NCDOT Standard Specification for Roads and Structures (most recent edition), or the responsible agency's specifications.

Excavation for manholes, meter vaults, or similar structures shall leave a minimum of 12-inches clear space around the structure. Removal of unsuitable material shall be as specified above. Preparation of the subgrade shall be in accordance with the applicable detail and as directed by the Public Works Commission.

PIPE LAYING

All pipe shall be installed in accordance with PWC Specification Section 02660 – Water Distribution, Specification Section 02730 – Sanitary Sewer Systems, and/or PWC Specification Section 02732 – Sewage Force Mains.

TRENCH SAFETY

All excavations shall comply with all Federal, State, and local rules and regulations. The Contractor shall have a trenching and shoring "competent" person on the job at all times when there is an open excavation. Under no circumstance shall an employee of the Public Works Commission be considered the "competent" person for the operation.

TRENCH STABILIZATION (SHORING)

The Contractor shall furnish, install, and maintain all necessary shoring to ensure a safe excavation. The method of shoring and excavation shall be in strict accordance with OSHA Regulations. The Contractor shall be responsible for installation, maintenance, and removal of all trench stabilization measures. The Contractor shall be responsible for any damage to adjacent structures resulting from the installation, maintenance, removal, or absence of trench stabilization measures.

DEWATERING

Excavations shall be kept dry at all times. Any required dewatering shall be the Contractor's responsibility. The Contractor shall be responsible for any damage to the adjacent property resulting from the installation, maintenance, discharge, and removal of the dewatering system. All discharge from the dewatering system shall be in accordance with the applicable erosion control rules and regulations.

BACKFILL

Backfill shall consist of suitable material free from debris, stone, etc. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. The backfill operation shall be conducted to prevent damage and/or movement of the pipe.

Backfill material in trenches shall be placed in layers not exceeding six (6) inches loose thickness to a point at least 12-inches above the pipe compacted to 90 percent maximum density. The remainder of the trench shall be backfilled in layers not exceeding six (6) inches in loose thickness compacted as specified in subparagraph COMPACTION. Each layer shall be thoroughly compacted by an approved mechanical tamping device.

Backfill material around structures shall be placed in a manner that the structure will not be damaged. No backfill shall be placed around manholes, thrust blocks, or similar structures until the concrete has been allowed to cure for three (3) days. The backfill material shall be compacted as specified in subparagraph COMPACTION.

No backfilling will be allowed when weather conditions prevent compliance with these Specifications.

BORROW EXCAVATION (Select Backfill)

Borrow excavation material shall be supplied by the Contractor when sufficient quantities of suitable materials are not available within the project limits. The borrow material shall be approved by the Public Works Commission and shall not contain roots, root mats, stumps, highly plastic clay or other unsatisfactory materials. All borrow material shall be in accordance with the NCDOT Standard Specification for Roads and Structures, most recent edition.

COMPACTION

Backfill shall be compacted in accordance with the following table as a percentage of the maximum density at optimum moisture content as determined by the Standard Proctor Test, ASTM D-698.

Area	Percent ASTM D-698 Maximum Dry Density
Around and 1' above top of pipe	95
Remaining trench (within 4' of subgrade)	95
Pavement subgrade and shoulders	
Last 1' of fill (below subgrade)	100
Last 3' of fill to 12" below subgrade	98
Base material	100
Adjacent to structures (Areas not paved)	95
Under structures	98
Utility Outfalls (Cross Country)	95

Compaction testing may be performed at the option of the PWC Project Coordinator, or as required by the responsible agency (i.e., City of Fayetteville, NCDOT, etc.). Compaction testing shall be done in

accordance with the responsible agency's requirements. Deficiencies shall be corrected by the Contractor without additional cost to PWC.

FINISHED EXCAVATION

All areas covered by the project shall be uniformly graded to the established elevations and approved cross sections. Ditches shall be graded to permit proper drainage. Newly graded areas shall be protected from traffic and/or from erosion, and any settlement or washing prior to acceptance shall be repaired and the required grades re-established. Ditches and drains along the subgrade shall be maintained to drain at all times. The finished subgrade shall be protected and maintained by the Contractor. The storage or stockpiling of materials on the finished subgrade shall not be permitted. No base course or pavement shall be laid until the subgrade has been checked and approved. All work shall be conducted in accordance with the environmental protection requirements of the Contract.

DIVISION 2
SITE WORK

02272 EROSION CONTROL - GENERAL PROVISIONS

GENERAL

The Contractor shall be responsible for conducting his site grading and drainage operations in such manner as to prevent or lessen excessive soil erosion of the construction site work areas. He shall at all times provide satisfactory means to prevent or minimize the movement and washing of large quantities of soil. The Contractor is expected to review his site grading and drainage operations periodically to determine the areas most susceptible to erosion by excessive rainfall and periodically maintain all installed measures for the project duration. The Contractor shall correct any deficiencies or problem areas as directed by the Owner or the North Carolina Department of Environment and Natural Resources (NCDENR) inspector within 48 hours.

EXECUTION

The Contractor's attention is directed to the fact that unless exposed earth areas are properly cared for during construction, they may result in substantial sedimentation damage downstream from the construction area. He shall at all times provide satisfactory means to prevent or minimize the movement and washing of quantities of soil onto pavements or into adjacent ditches, swales, inlets, and drainage pipes, to avoid the possibility of these structures becoming clogged with soil. Should this happen as a result of erosion at the site of this construction, the Contractor will be required to immediately provide means for removal of the soil and/or debris from the structures to restore the proper functioning of these structures. The Contractor shall assume all responsibilities to the affected property owners for correction of all damages. The Contractor is expected to review his site grading and drainage operations periodically with the Owner with the view in mind of determining the areas most susceptible to erosion by excessive rainfall and shall take necessary temporary measures in sufficient time to minimize the washing away of the site soils that would likely occur before the areas are finished graded, topsoiled and planted. The temporary measures to be provided by the Contractor at the critical areas may consist of, but not limited to, any one or a combination of the following, or by other approved means selected by the Contractor:

Silt Fence
Gravel Construction Entrance/Exit
Inlet Protection

If any earthwork is to be suspended for any reason whatsoever for longer than 15 days, the disturbed areas shall be seeded with temporary vegetative cover or otherwise protected against excessive erosion during the suspended period. Suspension of work in any area of operation does not relieve the Contractor of the responsibility for the erosion control and temporary measures will not be considered cause for a change in the price bid.

MAINTENANCE

The Contractor shall inspect and maintain each erosion control measure until the project is stabilized and accepted. After each significant rainfall, the Contractor shall remove and dispose of silt accumulation from each individual measure. The following maintenance may be required for each specific erosion and sediment control measure:

Silt Fence: Fabric shall be removed and replaced whenever deteriorated to such an extent the effectiveness is reduced. The toe of the fabric shall be buried a minimum of 6 inches.

Gravel Construction Entrance/Exit: Periodic top dressing with two inches (2") of graded stone. Remove all objectionable materials spilled, washed or tracked onto public roadways.

Sediment Trap: Remove sediment and restore trap to original dimensions when accumulated silt volume equals ½ the design depth. Replace the contaminated gravel facing.

Gravel Inlet Protection: Remove sediment as necessary to provide adequate volume. Replace contaminated gravel facing if required.

Rip-Rap: Make repairs to dislodged stone and/or supplement as required if erosion occurs during heavy rainfalls.

REMOVAL

After the area has been stabilized and the project accepted, the Contractor shall remove all temporary erosion and sediment control measures. Silt fences shall be removed, sediment traps/pits and/or basins filled with suitable soil, compacted and seeded. The materials removed shall remain the property of the Contractor and shall be disposed of off-site, or may be reused in other locations if approved by the Owner.

DIVISION 2
SITE WORK

02273 TEMPORARY SILT FENCE

GENERAL

The work covered by this section consists of furnishing, installing, maintaining and removing a water permeable filter type silt fence for the purpose of removing suspended particles from the water passing through it.

The quantity of temporary silt fence to be installed will be affected by the actual conditions which occur during the construction of the project. The quantity of temporary silt fence may be increased, decreased, or eliminated entirely at the direction of the Owner. Such variations in quantity will not be considered as alterations in the details of construction or a change in the character of the work.

MATERIALS

Either wood posts or steel posts may be used. Wood posts shall be a minimum of 6 feet long, at least 3 inches in diameter, and straight enough to provide a fence without noticeable misalignment. Steel posts shall be 5 feet long, 1 3/4 inches wide and have projections for fastening the wire to the fence.

Wire fence fabric shall be at least 32 inches high, and shall have at least 6 horizontal wires. Vertical wires shall be spaced 12 inches apart. The top and bottom wires shall be at least 10 gage. All other wires shall be at least 12½ gage.

Burlap shall be at least 36 inches wide and shall weigh at least 6.7 ounces per square yard. Other materials may be used in lieu of burlap, provided those materials have been approved by the North Carolina Department of Environment and Natural Resources (NCDENR).

Wire staples shall be No. 9 staple and shall be at least 1½ inches long.

INSTALLATION

The Contractor shall install temporary silt fence as shown on the plans and details. The silt fence shall be constructed at the locations shown on the plans and at other locations directed by the Owner.

Posts shall be installed so that no more than 3 feet of the post shall protrude above the ground and at least18 inches are driven into the ground. Filter fabric shall be attached to the wire fence fabric by wire or other acceptable means. The fabric shall be continual in length. The fabric shall extend into a 6"x 6" trench along the uphill side of the fence. The trench shall be backfilled and compacted. Place 6 inches of No. 57 stone along the toe of the fence to secure the fabric in place. The single stripe located approximately 6 inches form the silt fence outer edge should not be visible if the fabric and fencing are installed properly.

DIVISION 2
SITE WORK

02274 GRAVEL CONSTRUCTION ENTRANCE/EXIT

GENERAL

The work covered by this section consists of furnishing, installing, maintaining and removing temporary gravel construction entrance/exits. The entrance/exit shall be located at points where vehicles enter and exit the project and as indicated on the plans to limit sediment "tracked" off the site.

Where there are differences or conflict between this specification and those requirements outlined in an approved Erosion Control Plan, the specifications in the erosion control plan shall take precedence

MATERIALS

The stone shall be two inch (2") to three inch (3") washed stone.

INSTALLATION

The Contractor shall install the gravel construction entrance as shown on the plans and details. The construction entrance shall be constructed at the locations shown on the plans and at other locations directed by the Engineer.

The area to receive the stone shall be cleared of all vegetation, roots and other objectionable materials. The subgrade shall be graded and properly compacted. Areas yielding shall be covered with engineering fabric or undercut as directed by the Engineer. The stone shall be placed, graded and compacted to a minimum depth of eight inches (8") and as shown on the plans. The minimum construction entrance dimensions shall be 50 feet in length and 12 feet in width. The construction entrance/exit shall be maintained and the stone supplemented throughout the life of the project and shall be removed upon stabilization and disposed of off-site at the Contractor's expense.

DIVISION 2
SITE WORK

02275 BLOCK AND GRAVEL INLET PROTECTION

GENERAL

The Contractor shall install block and gravel inlet protection when storm drain inlets are to be made operational before permanent stabilization of the disturbed drainage area. The inlet protection applies to areas of heavy runoff and provides for overflow capacity to prevent excessive ponding; however, shallow temporary flooding should be anticipated.

INSTALLATION

The Contractor shall install the block and gravel inlet protection as shown on the detail drawing and at the locations indicated. As an option, the concrete blocks may be omitted and the entire structure made of gravel and stone. A structure made entirely of stone is commonly called a "gravel doughnut". In this case, keep the stone slope toward the inlet at 3:1 or flatter. Stone shall be washed stone with minimum 3 inch size on the basin side for stability and 1 inch or smaller (No. 57) on the flow side.

DIVISION 2
SITE WORK

02301 BORING AND JACKING

GENERAL

Installation shall be by dry boring and jacking of a smooth wall steel pipe that is true to line and grade under roadways or where indicated on the plans, all in accordance with these specifications and recommendations of the pipe manufacturer. The Contractor shall notify the Public Works Commission's Project Coordinator a minimum of seven (7) days prior to any contemplated work. All required permits and approvals shall be secured prior to commencing work.

MATERIALS

Materials to be used shall be appropriate for the installation method chosen by the contractor. All materials shall be submitted to the Public Works Commission for approval, prior to the Contractor commencing operations.

Dry Boring & Jacking

The casing pipe shall be spiral welded or smooth wall steel pipe in accordance with ASTM A53, Grade B having minimum yield strength of 35,000 psi. The carrier pipe installed for water or force main applications, within the casing pipe shall be CL 50 ductile iron restrained joint pipe. Use of pressure class ductile iron pipe for water mains is acceptable, in accordance with Specification Section 02660. Mechanical joint restraint systems (i.e., Mega-Lugs, grip-rings, field-lok gaskets, etc.) are not an acceptable means of restraint within the casing pipe for water mains or force mains.

The material for the gravity sanitary sewer carrier pipe shall be CL 50 ductile iron restrained joint pipe. All carrier pipes in sewer service shall have the appropriate lining and coating. Use of restraining gaskets (i.e., field-lok gaskets) is an acceptable means of restraint for gravity sewer mains. Use of mega-lugs (or equivalent) is not approved for restraint within casings.

The casing pipe minimum size and minimum wall thickness shall be in accordance with the following chart unless indicated otherwise on the drawings.

CARRIER PIPE (dia, in inches)	MIN CASING SIZE (inches)	WALL THICKNESS (inches)	RAILROAD WALL THICKNESS (inches)
4	10	0.188	0.188
6	12	0.250	0.281
8	16	0.250	0.281
12	24	0.250	0.375
16	30	0.312	0.469

18	30	0.312	0.469
24	36	0.375	0.532
30	42	0.500	0.625
36	48	0.500	0.688

The Contractor may substitute larger size casing pipe (particularly for sewer mains where grade and alignment are critical) with the proper wall thickness. A manual steering head or other approved guidance system is recommended for casing pipe 30 inches and larger and/or bores exceeding 100 feet in length.

INSTALLATION

Installation using the selected method shall be true to line and grade, where indicated on the plans, all in accordance with these specifications and recommendations of the pipe manufacturer. The Contractor shall notify all affected parties a minimum of seven (7) days prior to any contemplated work.

It is recommended that the Contractor perform each bore before beginning the sewer line construction. The boring shall be performed from the “upstream” to “downstream” direction maintaining the critical downstream invert elevation. Should the bore termination not be on grade, a revised plan shall be submitted to PWC Water Resources Engineering for approval. No additional payment shall be made for any required corrective actions. The boring operations shall be conducted at all times in such a manner so as not to create a hazard to nor impede the flow of traffic.

The Contractor will be responsible for any repair costs if any settlement or damage to the roadway or railroad bed resulting from the boring operation occurs within one year after completion of the work. The Contractor shall maintain proper insurance as required by the permitting agency.

The Contractor shall submit all requested information as required by the permitting agency.

Dry Boring & Jacking

The alignment and grade of the jacking shall be carefully established prior to beginning the operation. A licensed professional land surveyor shall provide staking to establish the correct alignment and grade. The licensed surveyor (or a licensed professional engineer) shall provide cut sheets to the Public Works Commission and the contractor.

Lubricants such as bentonite may be applied to the outside of the pipe to reduce frictional resistance during jacking. The boring auger shall not be a greater diameter than the outside diameter of the encasement and removal of the excavated material ahead of the pipe will be held to a minimum to prevent the formation of voids.

Voids occurring outside the encasement pipe shall be filled with 1:3 Portland cement grout and the ends of the encasement pipe closed with masonry after the carrier pipe placement. The voids shall be filled with 1:3 Portland cement grout at sufficient pressure to prevent settlement of the roadway or railroad. The method of grouting shall be as approved by the permitting agency.

If the installed casing is deemed to be unusable by the Public Works Commission and/or the permitting agency, the casing shall be abandoned by bricking each end and filling the casing with grout, or as directed by the permitting agency.

The Contractor shall locate all existing utilities in the proposed location of the jack and bore. Design of the casing shall be in accordance with PWC standards, and subject to PWC approval. The casing should have a minimum separation of 12-inches from existing utilities.

In the event two parallel casings are being installed, the minimum separation between the outside edges of each casing shall be five (5) feet, or as directed by the permitting agency. In the event of a conflict between this specification and the permitting agency's requirements, the more stringent shall apply.

The use of "back-taps" is not encouraged. The design engineer shall take all necessary steps to determine the location of existing utilities and evaluate the necessity of a back-tap. Should it be necessary to install a back-tap, the top of casing shall be a minimum of 12-inches below the bottom of the pipe to be tapped. All pipe and fittings from the tap location to the carrier pipe shall be restrained joint. Use of mechanical joint restraint systems (i.e., mega-lugs, grip-rings, etc) are allowed in such instances. The Public Works Commission shall review and approve all proposed back-tap locations.

DIVISION 2
SITE WORK

02350 STEEL "H" PILES

GENERAL

The work covered by this section consists of furnishing and driving steel H piles as indicated on the plans and as directed by the Engineer, in conformity with these specifications and to the bearing and penetration required.

MATERIALS

Steel H piles shall be of the sizes and weights shown on the drawings and shall conform to the requirements of ASTM A-36. The Contractor shall submit a manufacturer's certification to the Engineer that the H piles are in accordance with the project specifications.

INSTALLATION

Steel piles shall be handled and stored by methods that will not injure the pile. The piles shall be stored above the ground on platforms, blocks, or other supports. The piles shall be kept free from dirt, grease, and other foreign matter and shall be protected in so far as practical from corrosion.

The Contractor shall furnish sufficient lengths to develop load requirements as stated on the plans. Full butt-welded splices shall be used. H piles shall be driven to a minimum penetration of 10 feet by an approved hammer developing not less than 7500 ft.-lbs. of energy per blow. The load capacity of each pile shall be determined by the following formula:

$$Ra = \frac{2E}{S + 0.3}$$

where:

Ra	=	Safe load (lbs.)
E	=	Energy per blow (ft.-lbs.)
S	=	Final penetration per blow (inches) (average of last 6 blows)

Deviation of the location of the top of the pile from that shown on the plans shall not exceed 2 inches. A suitable driving cap shall be provided to prevent undue damage to the top of the pile. Piles shall be cut off at the required elevations along a plane normal to the axis of the pile. Methods used in cutting off piles shall meet the approval of the Engineer.

SHOP PAINTING

All steel piling shall be sandblasted in the shop to a minimum of SSPC-SP6-63. All sandblasted surfaces shall receive one (1) coat of Epoxy Primer the same day that piles are blasted. The primer shall be applied at the rate of 385 sq. ft. per gallon, which will provide 1.5 mils dry film thickness. Application method of the primer can be made by brush, roller brush, and conventional or airless spray.

FIELD PAINTING

After the piles have been driven, exposed primed surfaces shall be cleaned of dust and other foreign materials prior to applying two (2) coats of Coal Tar Epoxy at the rate of 90-115 square feet per gallon, which will provide a dry thickness of 8-10 mils coat. The minimum dry film thickness for the two coats shall be 16 mils. Application may be by brush, roller, conventional air spray or airless spray.

The re-coat time for the Coal Tar Epoxy can be as little as three (3) hours, but must not exceed 24 hours. Drying time of the coating is greatly affected by the temperature and humidity. If the first coat has exceeded the allotted time, it will be necessary to treat the coating prior to application of the second coat. The Coal Tar Epoxy shall not be applied in the rain or when the temperature is lower than 50 degrees F. Damaged surface areas due to handling and field welding must be wire brushed to original surface preparation and then coated with two (2) coats of Coal Tar Epoxy with minimum dry film thickness of 16 mils as specified above.

DIVISION 2
SITE WORK

02500 – TRAFFIC CONTROL

GENERAL

The purpose of these specifications is to outline the Contractor's requirements for furnishing, erecting, maintaining, relocating, and removing traffic control devices for the maintenance of traffic during the Contractor's construction operations. The Contractor shall furnish all labor, materials, accessories, equipment and tools for performing all required traffic control operations.

REFERENCES

All work shall be in accordance with:

A. The North Carolina Department of Transportation Standards and Specifications for Roads and Structures (most recent edition)
B. The North Carolina Department of Transportation Roadway Standard Drawings (most recent edition)
C. The Manual on Uniform Traffic Control Devices (MUTCD) – most recent edition
D. The North Carolina Supplement to the MUTCD
E. Section 01000 – Special Conditions, of these Contract Documents

REQUIREMENTS

TRAFFIC CONTROL PLAN

The Contractor shall submit a traffic control and phasing plan for the overall project to be reviewed and approved by the PWC Project Engineer, prior to starting construction. The Contractor shall obtain an approved copy of the traffic control plan for the overall project area prior to any excavation within roadways. The plan must indicate how traffic will be managed, signage to be used, and potential traffic patterns resulting from plan implementation. The plan shall be submitted to the PWC Project Engineer in accordance with Section 01000 "Special Conditions" and Section 01300 "Submittals" of these Contract Documents. Failure of the Contractor to submit the required traffic control plan sufficiently in advance shall not entitle the Contractor to any extension of Contract Time.

TRAFFIC CONTROL DEVICES

The Contractor working in public rights-of-way on streets open to vehicular traffic, shall be required to provide, erect, and maintain all necessary traffic control devices throughout the project area to include any connecting streets affected by construction activities. The Contractor shall provide a sufficient number of personnel, and take all precautions for the protection of the work and safety of the public. All traffic control devices in place shall be in accordance with the approved traffic control plan. All traffic control devices and device installation shall be placed and maintained in strict accordance with the resources listed above.

The Contractor shall be liable for any damages resulting from using unapproved and/or inadequate work zone traffic control. The Fayetteville Public Works Commission reserves the

right to stop any work for non-compliance. The Contractor shall have no claim for delay due to stoppage of work as a result of non-compliance.

TRAFFIC CONTROL PLAN AND ROAD CLOSURE NOTIFICATION

1. TRAFFIC CONTROL PLAN – The Contractor shall notify the PWC Project Engineer, in writing, by 5:00 p.m. Wednesday, indicating which roadways will be affected by the work the following week. The Contractor shall notify NCDOT of work to be done per the terms of the approved encroachment agreement. The PWC Project Engineer shall receive copies of all correspondence via fax or email (PWC fax 910-829-0203; email addresses will be provided at the pre-construction meeting).

   Traffic cannot be altered without notification and approval from the appropriate agency as outlined in the above paragraph. Failure to do so will result in the Contractor not being able to work within the street the next week.

   No work on the individual streets shall start until all the traffic control devices required for the particular work activity have been installed in accordance with the approved traffic control plan.

2. ROAD CLOSURE NOTIFICATION - When deemed to be in the best interest of the public, the Fayetteville Public Works Commission and the Contractor, a street may be closed for a duration mutually agreed upon. The Contractor shall submit a request in writing to the PWC Project Engineer for approval to have a street closed. The PWC Project Engineer will forward the request to the appropriate agency (i.e., City, Hope Mills, NCDOT) for approval of the closure. The PWC Project Engineer will include their recommendation regarding approval or disapproval of the request. The PWC Project Engineer will respond in writing with any recommendation for approval or disapproval of the request.

   The request shall be submitted a minimum of five (5) business days prior to the desired closure date. The request shall include the street name and the limits of the closure based on the points of intersection. The request shall also state the proposed duration the street is to be closed and shall include a traffic control plan showing the detour route, traffic control devices, etc. The traffic control plan submitted shall be in accordance with the requirements listed in this Specification.

   Once the street closure has been approved, in writing, by the PWC Project Engineer, the Contractor accepts full responsibility for the closure, to include the installation, maintenance, and removal of all traffic control devices and all implied liability.

TRAFFIC CONTROL LOOPS

The Town of Hope Mills, City of Fayetteville, and NCDOT maintain traffic detection loops at various intersections throughout the project limits. Due to the location of the proposed utility improvements, it may be necessary for these detection loops to be damaged. The Contractor shall coordinate with the appropriate agency a minimum of three (3) days prior to excavating, in order for the agency to locate these loops, or make any necessary revisions to the traffic signal facilities.

The agency will hire a third-party contractor to repair the damaged traffic detection loops. The invoice for this work shall be submitted to the Contractor for payment. The cost for this shall be incidental to the Contract.

STEEL PLATING ROADWAYS

Steel plating shall not be used without the prior written approval of the Project Engineer. The Contractor shall submit their proposed plan to utilize steel plates a minimum of five (5) working days prior to the proposed activity. Plating shall only be considered if the trench depths are 14 feet or greater. Should plating be approved the Contractor shall adhere to the following:

1. The trench shall be adequately shored to support bridging and traffic loads.
2. The trench box shall be sealed so there are no open voids.
3. Steel plates shall rest on trench box.
4. Steel plates shall extend beyond the outer edges of the trench box on all four sides.
5. There must be a minimum of two (2) feet of compacted backfill above steel plates.
6. Compacted backfill shall match existing street grade.
7. Provide documentation that the plates are capable of supporting potential loads.

Steel plating shall not exceed two (2) consecutive calendar days in any given week. However, provided that work is progressing in that particular section of sewer the Contractor may be allowed to utilize plating for a longer duration as approved in writing by the Project Engineer.

STEEL PLATING ROADWAYS (NCDOT STREETS)

Steel plating shall not be used without the prior written approval of the Fayetteville Public Works Commission Project Engineer. The Contractor shall submit their proposed plan to utilize steel plates a minimum of five (5) business days prior to the proposed activity. Should plating be approved, the Contractor shall adhere to the following:

1. The plates shall be secured against any movement from traffic. Options include "countersinking" the plates to be flush with the existing pavement, or bolting the plates to the pavement.
2. The plates shall overlap the excavation a minimum of two (2) feet on all sides.
3. The plates shall be sufficient to withstand the expected traffic loads.
4. Provide documentation that the plates are capable of supporting potential loads.

Steel plating shall not exceed two (2) consecutive calendar days in any given week. However, provided that work is progressing in that particular section of the project, the Contractor may be allowed to utilize plating for a longer duration as approved in writing by the Fayetteville Public Works Commission Project Engineer.

MATERIALS

A. The Contractor shall utilize interim pavement marking paint as specified in the North Carolina Department of Transportation Standards and Specifications for Roads and Structures (most recent edition)

B. Traffic cones may be utilized when approved by the Fayetteville Public Works Commission Project Engineer. If approved, traffic cones shall either be double stacked or weighted to prevent movement by traffic.

C. All traffic control devices furnished by the Contractor shall remain the property of the Contractor, unless otherwise specified in these Contract Documents.

INSTALLATION

The furnishing, erecting, maintaining, relocating, and removal of traffic control devices shall be in accordance with the MUTCD (most recent edition), the requirements outlined in the approved traffic control plan, and these Contract Documents.

All traffic control devices shall be in place prior to the Contractor beginning work, removed during intervals when work is not on-going, and removed at the end of each business day (unless otherwise approved, as outlined in this specification).

The Contractor shall not obstruct or impede any traffic on adjacent streets, during the installation or removal of the traffic control devices, or during construction.

The Contractor shall not close a lane to through traffic after normal working hours and during periods of construction inactivity, unless otherwise approved in writing by the Fayetteville Public Works Commission Project Engineer.

The Fayetteville Public Works Commission Project Engineer may restrict the Contractor from placing lane closures during certain hours, holidays, or as deemed necessary for the convenience of the public. All lane closure types, hours of installation, and durations shall be as approved in writing by the Fayetteville Public Works Commission Project Engineer.

The use of police and/or trained flaggers to control traffic through the work site shall be provided by the Contractor as required. The Contractor shall be responsible for obtaining trained personnel to direct traffic and contacting local authorities for use of police for traffic control where applicable.

INTERIM PAVEMENT MARKINGS

The Contractor shall be required to place interim pavement markings (centerlines, lane lines, edgelines, railroad, and school symbols) daily on any street with existing pavement markings that have been obliterated.

THERMOPLASTIC PAVEMENT MARKINGS

The Contractor shall be required to place thermoplastic pavement marking centerlines, lane lines, and edge lines within three (3) calendar days after the completion of the resurfacing operation.

The Contractor shall be required to place all thermoplastic pavement marking symbols (arrows, crosswalks, stop lines, school symbols, railroad symbols, raised pavement markers, etc.) within seven (7) calendar days of the completion of the project.

NCDOT STREETS

All traffic control measures for work within NCDOT road rights-of-way shall be in accordance with the approved NCDOT encroachment agreement, and as specified herein. Where there is a conflict between the requirements of this specification and the approved encroachment, the requirements of the approved encroachment shall govern.

END OF SECTION

DIVISION 2
SITE WORK

02505 ADJUSTMENT OF EXISTING STRUCTURES

GENERAL

The work covered by this specification consists of the raising or lowering of existing manholes and valve boxes encountered within the limits of the project to match the adjacent finished work.

RELATED SECTIONS

A. 02222 – Excavation and Backfilling for Utility Systems
B. 02660 – Water Distribution
C. 02730 – Sanitary Sewer Systems

Where conflicts occur between the specifications, the more stringent requirement shall apply.

MATERIALS

All materials shall be in strict accordance with the requirements of the Public Works Commission and as set forth in this standard.

Adjustable riser rings are not approved for use within the Public Works Commission water and/or sewer system. All manhole adjustments shall be done utilizing a concrete grade ring. If a concrete grade ring cannot be utilized, the manhole shall be broken down and rebuilt to the proper grade, in accordance with PWC standards.

INSTALLATION

Adjustment of structures shall not be performed until after placement of base course and/or any leveling course, and prior to placement of final course. All adjustments of structures shall be accomplished a minimum of 72 hours prior to placing the final surface course. All defective, damaged, or worn castings shall be replaced with new castings provided by the Public Works Commission at no cost to the Contractor. The Contractor shall be responsible for exchanging castings at the Public Works Commission's facility.

The Contractor shall take all necessary precautions to prevent debris from entering the sanitary sewer system. Any debris that falls into the manhole or valve box during adjustment shall be removed immediately.

Manholes

For all manholes that need adjustment, the Contractor shall remove all concrete grade rings to the top of the cone section. All loose material shall be removed and properly disposed of. The Contractor shall utilize new concrete grade rings to ensure that the new manhole ring and cover will be at final grade. If no concrete grade rings are required to adjust the structure to final grade, the Contractor shall set the ring and cover in a bed of clean fresh mortar.

If the manhole needs to be lowered, and there are no existing concrete grade rings, then the Contractor shall tear down the existing manhole and rebuild it, utilizing new riser and cone sections, in order to ensure that the installed ring and cover will be at final grade. The Contractor shall remove all necessary sections of the existing manhole in order to make the adjustment.

If the manhole needs to be raised, and there are 12-inches of concrete grade rings already in place, the Contractor shall tear down the existing manhole and re-build it. The Contractor shall utilize new riser and cone sections, as required, to ensure that the installed ring and cover will be at final grade. The Contractor shall remove all necessary sections of the existing manhole in order to make the adjustment.

Valve Boxes

In order to adjust valve boxes, the top section of the valve box shall be raised or lowered as required to meet the final grade. If the height of the final grade exceeds the length of the existing top section, the Contractor shall remove the existing valve box and install a new one at final grade.

All adjustments shall be protected for at least 72 hours before the placement of any surfacing material, in order to allow the concrete to properly set. The Contractor shall be responsible for protecting the raised structure from damage due to traffic. After the 72 hours, a temporary asphalt transition shall be placed around the raised structure, to allow vehicular traffic to pass over. The asphalt transition shall extend a minimum of 18 inches from the structure in every direction. The Contractor shall be responsible for maintaining this asphalt transition until such time the final surface course is placed. Immediately prior to paving, the asphalt transition shall be removed. In the event paving is stopped for the day prior to completing the work, the Contractor shall re-install the temporary asphalt transition. The finish surface tolerance shall not vary more than ¼" (0.25 inch) in any direction. Every effort shall be made to ensure that the surface course and castings provide as smooth a ride as possible.

DIVISION 2
SITE WORK

02573 PERMANENT PAVEMENT PATCH

GENERAL

Permanent pavement patching shall be completed as indicated on the Contract Plans and in accordance with these Contract Documents. The intent and purpose of these specifications is to require a complete and satisfactory installation in every respect and any defect in material or workmanship shall be cause for replacement and correction of such defect as directed by the Public Works Commission. All materials and workmanship shall be in complete accordance with the standards and specifications of the Public Works Commission and subject to Public Works Commission inspection and approval. The materials and installation shall conform to the North Carolina Department of Transportation (NCDOT) Standards, (latest revision), the NCDOT HMA/QMS Manual (latest revision), and as specified herein.

REMOVAL

The Contractor shall cut the existing pavement to straight uniform widths parallel and perpendicular to the roadway. Jagged saw cuts will not be acceptable. The pavement shall be removed its entire depth. The Contractor shall properly dispose of all removed pavement. If the Contractor elects to mill the asphalt, the millings cannot exceed two (2) inches in size, and shall be swept into the trench and re-compacted. The removal limits shall extend a minimum of six (6) inches into solid undisturbed base course prior to patching or as directed by the Public Works Commission.

Pavement removal shall not exceed 3,000 feet total for the entire project at one time. It shall be the Contractor's responsibility to maintain the trench (swept, wetted, compacted, etc.) until paved.

PAVEMENT

Replacing the pavement shall consist of the following:

Tack Coat

All existing pavement edges shall be tacked in accordance with the North Carolina Department of Transportation Standard Specifications for Roads and Structures (latest revision).

Asphalt Surface Course

The asphalt surface course shall be Type S9.5, placed in accordance with the PWC Standard Detail M.2. All asphalt surface course shall be in accordance with the NCDOT HMA/QMS Manual (latest revision) and the North Carolina Department of Transportation Standard Specifications for Roads and Structures (latest revision).

The pavement repair shall be constructed to the line, grade, crown and cross section of the existing street. The asphalt plant mix shall be compacted to density in accordance with the HMA/QMS Manual (latest revision). The Contractor shall provide a smooth transition from the existing pavement to the top of the backfill, so as to have no vertical drop (in any direction). The transitions shall only be removed the day of patch paving.

The permanent pavement patch shall be made within 30 days of installation of the line. If settlement should occur within one (1) year warranty period, the Contractor shall be required to remove asphalt, re-compact base and sub-base, and re-patch any areas of settlement at no expense to PWC. All repairs shall be in accordance with these Contract Documents.

Base Course

The base course shall be aggregate base course (ABC) installed to a minimum eight (8) inches thickness (compacted) and extending a minimum of six (6) inches beyond the edge of the trench as indicated on the PWC Standard Detail M.2. The base course shall be compacted to 100% maximum dry density at optimum moisture content as determined by the AASHTO T-99 as modified by NCDOT.

The Contractor, with permission of the Public Works Commission, may use asphalt concrete intermediate course, placed in a minimum four (4) inch layer extending a minimum of six (6) inches beyond the edge of the trench as indicated on the Permanent Patch Detail. The Asphalt Concrete Intermediate Course shall be in accordance with the North Carolina Department of Transportation Standard Specifications (latest revision), and the NCDOT HMA/QMS Manual (latest revision).

Prior to patch paving, the Contractor shall remove the upper ten (10) inches of backfill, if ABC is to be used or upper six (6) inches if Asphalt Concrete Intermediate Course is to be used, in the trench. All asphalt edges along the trench shall be cut straight, uniform width, parallel and perpendicular to the road with no jagged edges. The outer six (6) inches (minimum) of the trench adjacent to the newly removed asphalt shall be on undisturbed soil.

The pavement repair shall be constructed to the line, grade, crown and cross section of the existing street. The asphalt plant mix shall be compacted to density in accordance with the HMA/QMS Manual.

Maintenance shall be performed at least weekly, after a rainfall, or at the direction of the Public Works Commission. Maintenance shall include sweeping the adjoining pavement, blading, wetting and compacting the stone to insure smooth drivable surface.

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DIVISION 2
SITE WORK

02660 WATER DISTRIBUTION

GENERAL

Water lines and all appurtenant items shall be constructed of materials specified and/or as indicated on the approved drawings. The intent and purpose of these specifications is to require a complete and satisfactory installation in every respect and any defects in material or workmanship shall be cause for the replacement and correction of such defect as directed by the Fayetteville Public Works Commission (PWC) at no expense to the Fayetteville Public Works Commission.

RELATED SECTIONS

A. 02211 – Grading, Utilities
B. 02222 – Excavation and Backfilling for Utility Systems
C. 02301 – Boring And Jacking (Roadways And Railroads)

MATERIALS

MANUALLY OPERATED GATE VALVES

All manually operated gate valves four (4) inches and larger shall be ductile iron or cast iron body resilient wedge type rated for 250 psig working pressure gate valves and shall conform to American Water Works Association (AWWA) C-509/C-515 and NSF 61. All valves must open counter-clockwise equipped with a two (2) inch square operating nut. The operating nut shall have an arrow cut in the metal, indicating the direction of opening. All valves shall have a non-rising stem. All valves up to and including thirty-six (36) inch diameter shall have triple "O" ring stem seals. The design and machining of valves shall be such as to permit the replacement of the upper two (2) "O" rings without undue leakage while the valve is wide open and in service. The wedge shall be ductile iron encapsulated in nitrile rubber (for four (4) inch through 12 inch) and SBR rubber for 14-inch through 24-inch sizes.. All internal and external surfaces of the valve body and bonnet shall have a fusion bonded epoxy coating complying with ANSI/AWWA C550 applied electrostatically prior to assembly, conforming to AWWA C-550-90. All valves up to and including 36-inch diameter shall have a safe working pressure of 250 psi. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve. All valves shall be tested for leakage and distortion in strict accordance with the latest revision of AWWA Specification C-500.

Gate valves installed in meter vaults shall have a wheel in lieu of a square operating nut and shall also have a non-rising stem. The wheel shall have an arrow cut in the metal indicating the direction of opening. Flanges shall not be buried. An approved pit shall be provided for all flange connections.

Resilient seated tapping valves shall be furnished with the tapping flange having a raised face or lip designed to engage the corresponding recess in the tapping sleeve flange in accordance with MSS-SP60.

Tapping valves without the raised face on the tapping flange are not permitted since they do not assure the proper alignment required to prevent damage by a misaligned shell cutter. The interior of the waterway in the body shall be a full opening and capable of passing a full sized shell cutter equal to the nominal diameter of the valve.

All valves shall be manufactured in strict accordance with the latest specifications of the American Water Works Association (AWWA). Valves shall be manufactured by: Mueller Company, Clow Corporation, or American Darling Company. Certification shall be furnished to the Fayetteville Public Works Commission by the manufacturer that all valves are in accordance with PWC standards. Where specified on the plans and approved by the Fayetteville Public Works Commission, resilient wedge gate valves may be furnished with spur gearing for valves installed in a vertical position and bevel gearing for valves installed in a horizontal position. All gate valves shall be installed in accordance with PWC standard details.

BALL VALVES

For all valves smaller than four (4) inches, ball valves shall be used. Ball valves shall be installed in accordance with PWC standard details.

Ball valves shall be all bronze construction, with tee head operator and having a removable disc. Ball valves shall have threaded connections, in accordance with PWC standard details. Ball valves shall be manufactured and tested in accordance with AWWA/ANSI C800. The valve shall be equipped with packing nut, gland, and packing material. Ball valves shall be of an approved type made from approved materials conforming to ASTM Specifications and shall also meet the approval of the Public Works Commission. The turn required to travel from fully closed to fully open on the ball valve shall be 90 degrees.

VALVE BOXES

Valve boxes shall be "slip-type" made of close-grained, gray cast iron metal painted with a protective asphaltic coating. Construction shall be in three pieces as follows: The lower of base pieces, which shall be flanged at the bottom, the upper part which shall be flanged on the lower end, and of such size as to telescope over the lower part, the upper end being constructed in the form of a socket to receive the cap or cover; and the cover or cap shall have cast on the upper surface, in raised letters, the word "WATER". All valve boxes shall be equal in quality and workmanship to those manufactured by Sigma Corporation (VB-462), Tyler Union (6855 Series), Star Pipe Products (VB-0004), or an approved equal. The valve box shall be installed in accordance with PWC standard details. The valve box shall have a 3/8-inch hole drilled in the upper part four (4) to six (6) inches from the top of the box to accommodate a ¼-inch x 1-1/2-inch galvanized bolt for securing tracer wire.

Valve box protector rings shall be installed to protect valve boxes located outside pavement. The ring shall be constructed and installed in accordance with PWC standard details.

FIRE HYDRANTS

All fire hydrants shall be dry barrel, traffic type and conform to the latest revision of AWWA Specification C-502 except as listed below or as otherwise directed by the Public Works Commission. All working parts shall be bronzed. The size of the fire hydrants (designated by the nominal diameter of the valve opening) shall not be less than four and one-half (4 ½) inches. All hydrants shall be able to deliver a minimum of 1,000 gallons per minute with a friction loss of not more than five (5) pounds per square inch (psi) total head loss through the hydrant. Hydrants shall be of compression type (opening shall be of such design that when the barrel is broken off the hydrant valve will remain closed and reasonably tight against leakage). All hydrants shall be mechanical joint to accommodate the spigot end of six (6) inch Pressure Class 150, AWWA Standard, ductile iron pipe. The installation of the fire hydrant shall be in accordance with PWC standard details. Bosses (6") may be substituted for tees in pipe sizes exceeding 24 inches in diameter, with prior approval from PWC. The boss shall be welded to the bottom of the main to provide effective flushing of the system.

All hydrants shall be furnished with two (2) two and one-half (2 ½) inch nozzles and one (1) four and one-half (4 ½) inch pumper nozzle. Outlets shall have American National Standard fire hose coupling thread, in accordance with the City of Fayetteville standard, and shall be provided with nozzle caps securely chained to the body of the hydrant. The base of the hydrant shall have two (2) cast lugs suitable for use in strapping the hydrant to the connecting pipe. The operating nut shall be pentagonal in shape, finished with a slight taper to one and one-half (1 ½) inches from point to flat to conform to the standard wrench used by the Fayetteville Public Works Commission. All hydrants shall open left or counter-clockwise. Hydrants shall be suitable for working pressure of 150 psi and a test pressure of twice the working pressure. Fire hydrants shall be specific models manufactured by Mueller Company (Model Centurian 200), Clow Corporation (Medallion), American Darling (Model Mark 73-1) or approved equal. The interior of the hydrant shoe shall be coated with a four (4) mil thickness FDA approved epoxy coating.

COMBINATION AIR VALVES ASSEMBLY

Combination air valves shall be of the single housing style that combines the operation features of both an air/vacuum and air release valve. The combination air valve shall have a two (2) inch inlet and one (1) inch outlet connections and an orifice diameter to be determined by the Design Engineer for each project for a maximum working pressure of 300 psi. The assembly shall be equipped with a two (2) inch cut-off valve as shown on the PWC standard detail. The combination air valve body shall be constructed of 316 stainless steel or reinforced nylon with the only exception being the Buna-N Rubber seat and gasket. Valves shall be as manufactured by Crispin (Model UX20), ARI (D-020), or approved equal. Combination air valves shall be installed in accordance with PWC standards.

WATER DISTRIBUTION PIPE

DUCTILE IRON PIPE

The raw material from all ductile iron pipe and fittings shall have an average minimum content consisting of 90% recycled iron and steel. Ductile iron pipe and fittings shall be manufactured in the United States of

America in accordance with ANSI/AWWA A21.51/C151. The manufacturer of the ductile iron pipe shall be a member of the Ductile Iron Pipe Research Association (DIPRA).

All ductile iron pipe shall be designated as "Pressure Class", unless otherwise specified. The pipe furnished shall have a minimum thickness calculated in accordance with ANSI A 21.50 (AWWA C-150), with a factor of safety of two (2); a working pressure of 150 psi to 350 psi, plus 100 psi water hammer allowance; and AASHTO H-20 live truck load with 2.5 feet of cover. In no case shall "Pressure Class" pipe's nominal thickness be less than the following:

SIZE	PRESSURE CLASS	NOMINAL THICKNESS (In.)
4"	350	0.25
6"	350	0.25
8"	350	0.25
10"	350	0.26
12"	350	0.28
16"	250	0.30
24"	250	0.37

PUSH-ON JOINTS

Push-on joints shall be as specified and installed in accordance with AWWA C-600 and shall conform to AWWA Standard C-111. Push on joints, rubber gaskets and lubricant shall conform to ANSI A21.11. Pressure rating shall not be less than 200 psi unless otherwise specified. All ductile iron pipe shall be lined with standard thickness cement mortar lining and asphaltic seal coat in accordance with ANSI A21.4 (AWWA C-104). The pipe shall have an outside asphaltic coating as specified in AWWA Standard C-151.

RESTRAINED JOINTS

Factory Restrained Joints

Factory restrained joint pipe shall be utilized for all pipe greater than 12-inches in diameter, unless otherwise approved by the Fayetteville Public Works Commission. Factory restrained joint pipe shall be furnished for the locations shown on the approved drawings. The pipe, joints, and gaskets shall be in accordance with ANSI/AWWA Standards as specified for ductile iron pipe. Factory restrained joints shall be rated for a working pressure of 350 psi for sizes up to 12-inches and 250 psi for larger sizes.

All factory restrained joint pipe shall have the restraints internal to the pipe (i.e., "boltless"). All restrained joint ductile iron pipe and fittings larger than 12-inches shall be as manufactured by U.S. Pipe's TR-Flex, Griffin Pipe Products SNAP-LOK, American Cast Iron Pipe Company's Flex-Ring Joint, or approved equal. The method of restraining the valves to the factory restrained ductile iron pipe shall be reviewed and approved by PWC on a case by case basis. The valves shall have the same working pressure as the pipe.

Flanged Joints

Flanges shall be specifically designed for each application. The flange pipe shall be in accordance with ANSI/AWWA C-115/A21.15. Threads for threaded flange pipe shall be in accordance with ANSI B2.1, shop fabricated as outlined by AWWA 115 with serrated faces furnished on the pipe, completely factory installed. Welding of flanges to the body of the pipe will not be acceptable.

Ductile iron fittings and flanges shall be in accordance with ANSI/AWWA C-110/A21.10 with a minimum working pressure of 250 psi. Gaskets shall be full faced SBR rubber per ANSI/AWWA C-111/A21.11 with a minimum 1/8 inch thickness. Linings and coatings shall be as previously outlined for all ductile iron pipe and fittings.

Mechanical Joints

Mechanical joints shall be as specified and installed in accordance with AWWA C-600 and shall conform to AWWA Standard C-111. Mechanical joints shall be of the stuffing box type and shall conform to ANSI A21.11 for four (4) inch pipe through 12-inch pipe. Mechanical joints, rubber gaskets and lubricant shall conform to ANSI A21.11. Pressure rating shall not be less than 200 psi unless otherwise specified.

Special accessories such as mechanical joint retainer glands or mega-lugs are acceptable on pipe 12-inches and less in diameter, upon approval from the Fayetteville Public Works Commission. Mega-lug and/or grip-ring restraint mechanisms will not be an acceptable method of restraint for pipe, fitting and/or valves on sizes larger than 12-inches in diameter. For mains larger than 12-inches and at locations specified by the Fayetteville Public Works Commission, factory restrained joints shall be utilized, in accordance with these Specifications.

Field Lok Gaskets

Special accessories such as US Pipe's Field-LOK gasket, Ford’s Uni-Ring, or Romac’s Grip-Ring are acceptable on pipe 12-inches and less in diameter, upon approval from the Fayetteville Public Works Commission. Mega-lug and/or grip-ring restraint mechanisms will not be an acceptable method of restraint for pipe, fitting and/or valves on sizes larger than 12-inches in diameter. For mains larger than 12-inches and at locations specified by the Fayetteville Public Works Commission, factory restrained joints shall be utilized, in accordance with these Specifications.

FITTINGS

Mechanical Joint

All fittings shall be ductile iron and shall be manufactured in accordance with AWWA Standard C-110 (ANSI A21.11). Compact fittings shall be mechanically restrained, ductile iron in accordance with ANSI A 21.53 (AWWA C-153) for four (4) inch through 12 inch sizes only. Where thrust blocking is utilized, fittings shall be full body ductile iron in accordance with ANSI A 21.53 (AWWA C110).

All ductile iron fittings shall be lined with standard thickness cement mortar lining and asphaltic seal coat in accordance with ANSI A21.4 (AWWA C-104). All fittings shall have an outside asphaltic coating as specified in AWWA Standard C-151 and C-110, respectively.

Factory Restrained

Factory restrained joint fittings shall be utilized for all pipe greater than 12-inches in diameter, unless otherwise approved by the Fayetteville Public Works Commission. Factory restrained joint fittings shall be furnished for the locations shown on the approved drawings. The fittings, joints, and gaskets shall be in accordance with ANSI/AWWA Standards as previously specified for ductile iron pipe. Factory restrained joints shall be rated for a working pressure of 350 psi for sizes up to 12-inches and 250 psi for larger sizes. All factory restrained joint fittings shall have the restraints internal to the fitting (i.e., "boltless"). All fittings shall be compatible with the factory restraint system. All restrained joint ductile iron fittings larger than 12-inches shall be as manufactured by U.S. Pipe's TR-Flex, Griffin Pipe Products SNAP-LOK, American Cast Iron Pipe Company's Flex-Ring Joint, or approved equal.

Bosses

Tangential welded on outlets (i.e., bosses) shall only be utilized on pipe 24-inches and larger, as approved by PWC. All bosses shall be factory welded; field fabrication is not allowed. The pipe shall be in accordance with these specifications. Bosses shall be of the size and location indicated on the approved drawings.

AERIAL CROSSINGS

For aerial crossings, the ductile iron pipe shall be thickness class, as specified on the plans and standard details. All thickness class pipe shall be in accordance with ANSI A21.51 and AWWA C-151, with a minimum working pressure of 200 psi.

For aerial crossings which are four (4) inches to 12 inches in diameter, Class 53 manufactured factory restrained joint or Class 53 flanged ductile iron pipe shall be used in accordance with the PWC standard details. No other means of restraint are allowed for aerial crossings. For aerial crossings larger than 12 inches, or as noted specifically on the plans, Class 53 flanged ductile iron pipe shall be used in accordance with the PWC standard details.

All aerial crossings shall be designed and installed in accordance with PWC standard details.

PIPE IN CASINGS

All ductile iron pipe (regardless of diameter) within casings shall be factory restrained, in accordance with these specifications and the applicable PWC standard details. The use of any other restraints (i.e., mega-lugs, grip-rings, etc.) shall not be utilized on pipe within casings.

All restrained joint ductile pipe in casings shall be in accordance with the PWC standard details.

TRENCHLESS APPLICATIONS

All ductile iron pipe (regardless of diameter) utilized for trenchless installations (i.e., horizontal directional drilling, pipe-bursting, etc.) shall be factory restrained, in accordance with these specifications and the applicable specification section for the trenchless technology. The use of any other restraints (i.e., mega-lugs, grip-rings, etc.) shall not be utilized.

PVC PIPE

Two (2) inch water main pipe shall be manufactured using Grade 1 PVC compound material as defined in ASTM D-1784 and shall be SDR21, pressure class 200 in accordance with ASTM D 2241. Fittings for two (2) PVC pipe shall be solvent weld Schedule 80 PVC. Brass FIP x pack joint for PVC fittings shall be used to transition from PVC to brass. The pipe shall be plainly marked with the manufacturer's name, size, material (PVC) type and grade or compound, NSF seal, date of manufacture, pressure rating and reference to appropriate product standards.

All PVC pipe (4-inches through 12-inches diameter) shall be manufactured using virgin compounds as defined in ASTM D-1784, with a 4,000 psi HDB rating and designated as PVC 1120 to be in strict accordance with AWWA C-900. The pipe shall be Class 150 and conform to the thickness requirements of DR18. The pipe shall be manufactured to withstand 755 psi quick burst pressure tested in accordance with ASTM D-1599 and withstand 500 psi for a minimum of 1,000 hours tested in accordance with ASTM D-1598. The pipe joints shall be of the integral bell type with rubber gaskets and shall conform to the requirements of ASTM D-3139 or ASTM F-477.

PVC fittings are not acceptable for water mains four (4) inches or greater. Fittings and specials shall be ductile iron, bell end in accordance with AWWA C-110, 150 psi pressure rating unless otherwise shown or specified. Ductile iron fittings to PVC pipe shall be adequately supported on a firm trench foundation. Ductile iron fittings and specials shall be cement mortar lined (standard thickness) in accordance with ANSI A21.4.

Mechanical restraining systems (i.e. mega-lug, grip-ring) shall not be used on PVC pipe.

TRACING WIRE

For the purpose of locating non-metallic pipes, a continuous "detectable" tracing wire shall be installed. The wire shall be a minimum 12 gauge, single strand, coated copper or copper clad steel wire that is suitable for underground use. Splices shall be accomplished utilizing a corrosion proof wire connector. The connectors shall "lock" the wires in place and contain a dielectric sealant to prevent corrosion. The connector shall be the "Snake Bite" connector manufactured by Copperhead Industries, LLC, or approved equal. The wire shall be buried continuously along the pipe. The wire shall be secured into valve boxes such that a direct/conductive metal detector may be used to trace the pipe location. Bolts shall be used to secure the wire and the attachment location shall be readily available from finished grade without special equipment.

POLYETHYLENE PLASTIC WATER TUBING

Polyethylene (PE) plastic water tubing shall be installed in accordance with PWC standard details. All services installed in new construction shall be one continuous run of pipe with no splices from the corporation stop to the meter. The PE water tubing shall meet the requirements of ASTM D2737, AWWA C901, and NSF Standards 14 and 61. Pipe dimensions shall meet Iron Pipe Size (IPS) standards.

The PE tubing material shall be high density polyethylene conforming to the minimum requirements of cell classification 445574E, as defined and described in ASTM D3350. The resin shall have a material designation code of PE4710 by the Plastic Pipe Institute.

The PE water tubing shall be SIDR 7, with a minimum pressure rating of 250 psi. Fittings for the PE water pipe shall be cast brass compression fittings, made to the PE water pipe dimension. All brass fittings shall have a 300 psi minimum pressure rating.

For the purpose of locating plastic water services during trenching, a continuous tracing wire shall be installed. The wire shall be a minimum 12 gauge, single strand, coated copper or copper clad steel wire that is suitable for underground use. The wire shall be buried along the water service lateral from the main to the meter box. The wire shall extend a minimum of 12 inches into the meter boxes.

COPPER WATER TUBING

Copper water tubing shall be installed in accordance with PWC standards. All services installed shall be one continuous run of pipe with no splices from the corporation stop to the meter.

Copper water tubing shall be Type K, soft copper manufactured in accordance with ASTM B88. The minimum pressure rating for the copper water pipe shall be 655 psi. Fittings for the copper water pipe shall be brass compression fittings, made to the copper water pipe dimensions. All brass fittings shall have a 300 psi minimum pressure rating.

TAPPING SLEEVES

Tapping sleeves shall be ductile iron mechanical joint or stainless steel and have a minimum working pressure of 150 psi for all tapping of mains up to and including 24-inch diameter with a branch less than or equal to 12-inches diameter. Branch diameter greater than 12-inches on a 16-inch diameter pipe and larger shall require full body ductile iron mechanical joint tapping sleeve.

Ductile iron mechanical joint tapping sleeves shall be as manufactured by Clow, M&H, Mueller, American, or an approved equal and shall be furnished with complete joint accessories. The mechanical joint sleeve shall be compatible with type and class of pipe being tapped. The outlet flange shall be class 125 per ANSI B16.1 compatible with approved tapping valves.

Stainless steel tapping sleeves shall be as manufactured by Romac, Smith-Blair, or approved equal, and shall be furnished with all accessories. The sleeve, lugs, bolts and nuts shall be 18-8 type 304 stainless steel, as provided by the manufacturer. The outlet flange shall be ductile iron or stainless steel. The gasket shall be a grid pattern design and shall provide full circumferential sealing around pipe to be

tapped. The sleeve shall include a 3/4 NPT test plug. All welds shall be passivated. The outlet flange shall be class D per AWWA C-207-ANSI 150 lb. drilling compatible with approved tapping sleeves.

The tapping sleeve and valve shall be in accordance with PWC standard details.

All tapping sleeves shall be hydrostatically pressure tested prior to the tap being accomplished. **Use of air to complete the pressure test is not acceptable.** The tapping sleeve shall be tested to 150 psi. The PWC Project Coordinator shall witness and approve the testing.

WATER SERVICE SADDLES

All water service saddles for use on two (2) inch PVC shall be one (1) inch brass saddles as manufactured by Ford, McDonald, or Mueller.

Water service saddles for one (1) and two (2) inch taps on four (4), six (6), eight (8), 12-inch and larger size PVC and asbestos-cement (AC) and also four (4) inch and larger size iron pipe shall be ductile iron with stainless steel strap(s), bolts, nuts and washers. Ford Models FS 101, FS 202; Romac Models 101S, 202S; or Smith-Blair Model 315.317 shall be used. Stainless steel straps must be pre-formed at the factory to the specified outside diameters of the pipe.

Water service saddles with a two (2) inch outlet shall be double strap.

Water service saddles for pipe sizes 12-inch through 24-inch shall be double strap.

Water service saddles for pipe sizes exceeding 24-inches shall be as specified by the PWC Water Resources Engineering Department.

INSTALLATION

GENERAL

Pipe installation shall be in strict accordance with Specification Section 02222 – Excavation and Backfilling for Utility Systems and as outlined herein.

PIPE INSTALLATION

Pipe installation shall be in accordance with the manufacturer's instructions. All pipes and fittings shall be handled to prevent damage to the protective coatings and linings.

All dust, dirt, oil, tar, or other foreign matter shall be cleaned from the jointing surfaces, and shall be lubricated with lubricant recommended by the manufacturer.

All pipe shall be installed in accordance with the approved drawings and cut sheets, unless otherwise directed by PWC.

All dead ends on new mains shall have a two (2) inch blow-off assembly as indicated on the approved drawings. The blow-off assembly shall be in accordance with PWC standard details.

For pipe sizes up to 12-inches, mechanical equipment should not be utilized to assemble the pipe. For pipe sizes over 12-inches, mechanical equipment may be utilized, in accordance with the pipe manufacturer's instructions. Any damage resulting from the use of mechanical equipment shall be replaced as directed by PWC.

Adjustments in grade by exerting force on the barrel of the pipe with excavating equipment shall not be allowed. The Contractor shall verify line and grade after assembling each joint.

When pipe installation is not in progress, the open ends of the pipe shall be closed by a water tight plug or other means approved by the PWC Project Coordinator. If water is present, the plug shall remain in place until the water is lowered to a level that allows for proper installation. No pipe shall be laid in water or where in the PWC Project Engineer's and/or PWC Project Coordinator's opinion trench conditions are unsuitable. Every precaution shall be taken to prevent material from entering the pipe while it is being installed.

ALIGNMENT AND GRADE

The Contractor shall be responsible for installing the pipe and appurtenances to proper line and grade.

All ductile iron pipe and fittings shall be installed in accordance with ANSI/AWWA C-110/A21.10. All C-900 pipe shall be installed in accordance with ASTM D-2774. The amount of deflection in the PVC or ductile iron pipe shall not exceed the applicable AWWA standards and the manufacturer's recommendations. If the required deflection exceeds the specified limitations or as determined by the Public Works Commission, mechanical joint bends shall be utilized.

Pipe passing through walls of NCDOT bridges, retaining walls, and other concrete structures shall be factory restrained joint ductile iron and be installed in casings/sleeves in accordance with NCDOT specifications. Annular space between walls and sleeves shall be filled with an approved cement mortar that meets NCDOT specifications. The annular space between the sleeve and the pipe shall be filled with an approved mastic.

Pipe passing through the walls of meter vaults, valve pits, and storm drainage structures shall be restrained joint ductile iron, as specified by PWC. Pipe shall be installed in a casing/sleeve if determined to be necessary. Annular space between walls and sleeves shall be filled with an approved cement mortar. Annular space between pipe and sleeves shall be filled with an approved mastic. Proposed conflict boxes with storm and water shall be reviewed by the PWC Water Resources Engineer and approved on a case by case basis.

All ductile iron pipe (regardless of diameter) within casings shall be factory restrained, in accordance with these specifications and the applicable PWC standard details. The use of mechanical restraints (i.e., mega-lugs, grip-rings, etc.) shall not be utilized on pipe within casings.

When pipe is field cut, the cut end shall be smooth and at right angles to the axis of the pipe. All sharp edges shall be removed. All field cut pipe shall be beveled. The beveled end of PVC pipe shall be removed, when installing into mechanical joint ductile iron fittings.

When connecting unlike (class, material, etc.) pipe, an approved PWC fitting shall be used. All pipe shall be installed in accordance with AWWA C-600 or C-605 as applicable, for buried lines and the manufacturer's recommendations. For mechanical joint pipe and fittings, all nuts shall be torqued to the manufacturer's recommendations.

Concrete thrust blocking shall be utilized on all PVC water mains. The concrete thrust blocking shall be in accordance with PWC standard details. When thrust blocking is to be utilized, backfilling shall not occur until the concrete has time to set. No hydrostatic pressure testing shall occur until the concrete thrust blocking has cured for a minimum of five (5) calendar days.

FIRE HYDRANTS

Fire hydrants shall be installed as shown on the approved drawings. Each fire hydrant shall be connected to the main with a six (6) inch branch line and shall have a minimum of 42-inches of cover. Fittings between the valve and fire hydrant may be utilized, with prior approval from PWC. The valve shall be located at the main unless otherwise approved by PWC. Hydrants shall be set plumb with pumper nozzle facing the roadway. The hydrant branch shall not be backfilled until inspected and approved by the PWC Project Coordinator. Fire hydrants shall be installed in accordance with PWC standard details.

HYDROSTATIC TESTS

All mains and laterals shall be subjected to a hydrostatic pressure test. Each valved section maybe tested individually.

The Contractor shall furnish all labor and material, including test pumps, taps, and corporations, necessary to complete the work. Any taps which are not to be utilized shall be killed out at the main. If any taps are to be used for irrigation laterals they shall be installed in accordance with PWC standard details. A PWC Project Coordinator shall be present and observe all valve operation by the Contractor. Under no circumstances shall a Contractor operate any PWC-owned valves unless it is an emergency.

The duration of the pressure test shall be at least one hour or longer, as directed by the PWC Project Coordinator. The hydrostatic pressure shall be 200 psi. The pipe to be tested shall be slowly filled with water and the specified test pressure shall be applied. Before applying the specified test pressure, all air shall be expelled from the pipe. If hydrants or blow offs are not located to properly expel the air, taps shall be made as approved by PWC.

Damaged or defective materials discovered as a result of the pressure test shall be removed and replaced with new material, and the test shall be repeated until the test results are satisfactory to the Public Works Commission.

All replacement, repair or retesting shall be accomplished by the Contractor at no additional cost to the Public Works Commission. All repairs shall be reviewed and approved by PWC prior to backfill. The use of couplings, fittings, sleeves, etc. shall be reviewed and approved by PWC prior to use. The main must successfully pass the hydrostatic test prior to sterilization.

STERILIZATION

Sterilization shall be in accordance with the requirements of NCDEQ, the North Carolina Rules Governing Public Water Supply, AWWA C651, and AWWA C655 (most recent editions). The Contractor shall furnish all chlorinating equipment, sterilization solution, materials, excavation, barricades, backfilling, and any taps and corporations necessary to complete the work. The Contractor shall fully cooperate with the PWC Project Coordinator, furnish any needed assistance, and schedule the testing.

Prior to performing the hydrostatic test, water mains, laterals, and appurtenances shall be flushed to remove air, sediment, contaminants, and/or foreign matter. After completion of a successful hydrostatic test, the water system shall be disinfected by the thorough dispersion of a chlorine solution. The chlorine level shall be between 50 parts per million (ppm) and 100 ppm throughout the water system. In no case shall the chlorine level exceed 300 ppm. If the chlorine level is over 300 ppm, the system shall be completely flushed and re-chlorinated. **In no case shall chlorine be introduced into the water system in a dry solid state.**

The chlorine solution shall remain in contact with the interior surfaces of the water system for a minimum period of 24 hours and shall result in not less than 10 ppm of chlorine throughout the system. Then the water system shall be flushed with water from the existing PWC water system until the chlorine solution is dispelled. The Contractor shall take all necessary measures to prevent downstream erosion caused by flushing the lines. All erosion/damages shall be repaired at no additional expense to the Public Works Commission. All environmental regulations governing the release and/or disposal of chlorinated testing water shall be met by the Contractor. AWWA C655 defines “highly chlorinated” water as water having more than four (4) ppm. Any water with a chlorine level greater than four (4) ppm shall be de-chlorinated by the Contractor prior to being released to the environment.

If any disruption to the disinfection process occurs, or if any repair procedure is necessary then the disinfection process shall start over.

After disinfection, the water supply shall not be accepted or placed into service until bacteriological tests results or representative water samples analyzed in the Public Works Commission’s laboratory are found to be satisfactory. The disinfection shall be repeated until tests indicate the absence of pollution for at least two (2) full days. The PWC Project Coordinator shall be responsible for taking the sample(s) and transporting them to the PWC laboratory.

If the initial sample taken after disinfection and flushing does not indicate that the water main is sterilized, the Contractor shall, in conjunction with the PWC Project Coordinator, flush the lines. Once flushing is complete, another sample will be taken to the Public Works Commission’s laboratory for analysis. Should this second sample also fail to indicate that the main is sterilized; the Contractor shall repeat the disinfection process. This process shall be repeated until the samples are satisfactory. The Contractor

shall fully cooperate with the PWC Project Coordinator, furnish any needed assistance, and schedule the testing.

DIVISION 2
SITE WORK

02730 SANITARY SEWER SYSTEMS

GENERAL

Sanitary sewer lines and all appurtenant items shall be constructed of materials specified or indicated on the drawings. The intent and purpose of these specifications is to require a complete and satisfactory installation in every respect and any defect in material or workmanship shall be cause for the replacement and correction of such defect as directed by the Public Works Commission.

RELATED SECTIONS

A. 02211 – Grading, Utilities
B. 02222 – Excavation and Backfilling for Utility Systems
C. 02732 – Sewage Force Mains

MATERIALS

SEWER MAINS

Prior to shipment each joint of pipe shall be stamped by an independent testing laboratory, certifying compliance with the specifications stated therein. Pipe sizes indicated shall be understood to be nominal inside diameter of the pipe. All sewer pipe materials shall be either PVC (as specified herein) or ductile iron (as specified herein), unless otherwise approved in writing by the Public Works Commission. Written approval shall be obtained prior to installation.

DUCTILE IRON PIPE

The raw material from all ductile iron pipe and fittings shall have an average minimum content consisting of 90% recycled iron and steel. Ductile iron pipe and fittings shall be manufactured in the United States of America in accordance with ANSI/AWWA A21.51/C151. The manufacturer of the ductile iron pipe shall be a member of the Ductile Iron Pipe Research Association (DIPRA).

All ductile iron pipe and fittings shall be in strict accordance with ANSI A21.51 and AWWA C151, Class 50 or Class 51, as applicable, in every respect. The working pressure shall be a minimum of 200 psi. Pipe shall be furnished in 18 or 20-foot lengths. All pipe joints used in open trench construction shall be furnished with "push-on" joints, unless otherwise indicated on the drawings or specified. All joints and fittings shall be in accordance with ANSI A21.11 and AWWA C111. All ductile iron interior surfaces shall be lined with two (2) coats of ceramic epoxy to produce a total minimum dry film thickness of 40 mils (Protecto401 or approved equal). The exterior pipe surfaces shall be protected with asphaltic coating as specified in AWWA C151 and C110. Specifications for the ceramic epoxy can be found in Specification Section 09802.

For aerial crossings which are 4 inches through 12 inches in diameter, manufactured restrained joint ductile iron pipe Class 53, or Class 53 flanged ductile iron pipe shall be utilized in accordance with the standard Public Works Commission detail for aerial crossings. Mega-lugs, field-lok, and gripper rings are not an allowable means of restraint for aerial crossings. For aerial crossings larger than 12 inches, or as noted specifically on the plans, flange joint ductile iron pipe, Class 53, shall be utilized in accordance with the standard Public Works Commission details. The location of flanges shall be specifically designed for each application. The flange pipe shall be in accordance with ANSI/AWWA C-115/A21.15. Threads for threaded flange pipe shall be in accordance with ANSI B2.1, shop fabricated as outlined by AWWA 115 with serrated faces furnished on the pipe, completely factory installed. Welding of flanges to the body of the pipe will not be acceptable. Ductile iron fittings and flanges shall be in accordance with ANSI/AWWA C-110/A21.10 with a minimum working pressure of 250 psi. Gaskets shall be full faced SBR rubber per ANSI/AWWA C-111/A21.11 with a minimum 1/8" thickness. Linings and coatings shall be as outlined for ductile iron pipe.

If the Public Works Commission determines that an expansion coupling is required, it shall be installed as indicated on the drawings. The expansion coupling shall not be buried.

For subsurface water crossings (i.e., streams, wetlands), restrained joint ductile iron pipe shall be utilized. No mechanical restraint systems (e.g., mega-lugs, field-lok gaskets, etc.) shall be utilized. The pipe shall be installed in a casing, in accordance with the approved Public Works Commission detail, unless otherwise specifically approved by the Public Works Commission.

PVC PIPE

PVC sewer pipe and fittings 4 inches thru 15 inches shall be in accordance with ASTM D-3034 with a standard dimension ratio (SDR) of 26 for sewer mains and laterals. Larger diameter pipe (18 inches through 27 inches) shall be in accordance with ASTM F-679, with a SDR of 26. Both pipe and fittings shall be made of PVC plastic having a cell classification of 12454 as specified in ASTM D-1784.

Pipe joining shall be push on elastomeric gasket joints only and the joints shall be manufactured and assembled in accordance with ASTM D-3212. Elastomeric seals shall meet the requirements of ASTM F-477. The pipe shall be furnished with integral bells and with gaskets that are permanently installed at the factory and in accordance with ASTM D-3212 and contain a steel reinforcing ring. PVC sewer pipe shall be made by continuous extrusion of prime green unplasticized PVC and contain identification markings as required by the applicable ASTM standard.

SEWER FITTINGS

Ductile Iron Push-on Fittings:

Ductile iron sewer fittings on PVC mains shall be deep bell, gasketed joint, and air test rated. Gasket groves shall be machined in the factory. Material shall be ductile iron, in accordance with ASTM A536, Grade 65-45-12 and ASTM F1336. Wall thickness shall meet the requirements of AWWA C153. Gaskets shall have a minimum cross sectional area of 0.20 square inches, and conform to ASTM F477.

All ductile iron fittings shall have an interior coating of Protecto 401, or approved equal. All ductile iron fittings on PVC pipe shall provide a flow line that provides a smooth transition between the materials. Ductile iron fittings shall be as manufactured by the Harrington Corporation (Harco), or approved equal.

Mechanical Joint Fittings:

Joints shall be installed in accordance with AWWA C-600 and shall conform to AWWA Standard C-111. Mechanical joints shall be of the stuffing box type and shall conform to ANSI A21.11 for four inch (4") pipe and larger. Fittings and specials shall be ductile iron and shall be manufactured in accordance with AWWA Standard C-110 (ANSI A21.11). Compact fittings shall be ductile iron in accordance with ANSI A 21.53 (AWWA C-153) for 4" thru 24" sizes only. Note: mechanical joint wyes are not included in the AWWA C-153 specification. Pressure rating shall be not less than 200 psi unless otherwise specified. All ductile iron fittings shall have an interior coating of Protecto 401, or approved equal. Mechanical joint fittings shall be utilized on ductile iron mains and ductile iron laterals. Mechanical joint fittings shall not be utilized on PVC mains, unless otherwise approved by the Public Works Commission.

PVC Fittings:

PVC fittings shall be manufactured in accordance with ASTM D-3034, F-1336, and F-679. Molded fittings shall be utilized in sizes from 4” to 8” (or larger, if available). Fabricated fittings shall only be utilized with prior approval from the Public Works Commission. Fabricated fittings are defined as those fittings that are made from pipe or a combination of pipe and molded components. All PVC fittings shall contain identification markings as required by the applicable ASTM standard. All PVC fittings shall be gasketed joint, except as indicated for interior drop structures. Plastic fittings shall be as manufactured by GPK Products, Inc., Plasti-Trends, the Harrington Corporation (Harco), or approved equal.

Ductile Iron Pipe Size x SDR26 Transition Adapter:

All ductile iron x PVC transition adapters shall be one (1) piece, bell x bell (gasket x gasket). Transition adapters shall range in size from four (4) inches through 12 inches. Transition adapters for pipe larger than 12-inches shall be as specified by the Public Works Commission. All transition adapters shall have a flow way tapered to allow a smooth transition between the ductile iron and PVC. Transition adapters shall be either PVC or ductile iron, in accordance with the following:

PVC – All PVC transition fittings shall be made from DR 18 C900 pipe stock. The C900 pipe stock shall meet the requirements of AWWA C900/C905, and have a minimum cell classification of 12454 as defined in ASTM D1784. The wall thickness shall meet or exceed DR 18. PVC transition fittings shall have SBR gaskets in accordance with ASTM F477. All six (6) inch and eight (8) inch adapters shall be molded. Molded fitting joints shall be 235 psi rated, in accordance with ASTM D3139, and shall have SBR rubber gaskets. Four (4) inch, ten (10) inch and 12 inch transition adapters shall have SBR Rieber style gaskets meeting ASTM F477. Joints shall be 235 psi rated, in accordance with ASTM D3139 for the C900 (ductile iron) bell, and in accordance with ASTM D3212 for the sewer (SRD26) bell. Molded C900 bell depths shall comply with AWWA C907. Fabricated (4-inch, 10-inch and 12-inch) bell depths and molded sewer (SDR26) bell depths shall be in accordance with ASTM F1336. PVC transition adapters shall be manufactured by the Harrington Corporation (Harco), GPK Products, or approved equal.

Ductile iron – Ductile iron transition fittings shall be deep bell, push-on joint, and air test rated. The ductile iron material shall comply with ASTM A536, Grade 65-45-12 or 80-55-06. The bell depth shall be in accordance with ASTM F1336. Gaskets shall be of SBR rubber, in accordance with ASTM F477. Transition gaskets are not allowed. All ductile iron transition fittings shall have an interior coating of Protecto401 or approved equal. Ductile iron transition fittings shall be manufactured by the Harrington Corporation (Harco) or approved equal.

Saddles:

Sewer service saddles may be utilized for sewer lateral installations. All sewer service saddles shall be ductile iron with stainless steel straps, bolts, nuts, and washers. The nuts shall be coated to prevent galling. The saddle body shall be ductile iron, in accordance with ASTM A536, Grade 65-45-12. The gasket material shall be SBR, in accordance with ASTM D2000. Saddles for PVC or DI laterals shall have an alignment flange. Sewer service saddles shall be as manufactured by Geneco, or approved equal. All stainless steel straps shall be pre-formed at the factory, to the specified outside diameters of the pipe.

SEWER LATERALS

Ductile iron laterals – For ductile iron mains, utilize mechanical joint fittings or an approved saddle with an alignment flange (Geneco or approved equal). For PVC mains, utilize an approved saddle with an alignment flange (Geneco or approved equal) or ductile iron fittings as specified above.

PVC laterals – utilize a saddle with an alignment flange (Geneco or approved equal) on PVC or ductile iron mains; utilize a mechanical joint tee with SDR 35 transition gaskets on ductile iron mains; or utilize PVC fittings as specified above on PVC mains.

The following table summarizes the materials to be utilized for sewer main to lateral connections:

	PVC Main	DI Main
DI Lateral	DI fitting or approved saddle	MJ fitting or approved saddle
PVC Lateral	PVC fitting or approved saddle	MJ fitting with transition gasket or approved saddle

Sewer laterals shall be in accordance with these Specifications and PWC standard details S.10, S.11, and S.12.

PRECAST CONCRETE MANHOLES

Pre-cast circular reinforced concrete manhole units shall be in accordance with ASTM C-478. The tongue and groove ends of the manhole sections shall be manufactured for jointing with rubber gaskets (i.e., con-seal). An eccentric cone shall be utilized on all manholes, unless otherwise approved by the Public Works Commission.

Manhole steps shall be placed in all manholes and shall be steel reinforced (½" grade 60) copolymer polypropylene plastic steps in accordance with ASTM C-478 for material and design. The steps shall be spaced 16" on center with serrated treads and wide enough to stand on with both feet.

Manhole frames and covers shall be made of gray cast-iron, and the iron shall possess a tensile strength of not less than 18,000 psi. Cast iron shall conform to ASTM Specification A 48-83 Class 35. The frame and cover shall be manufactured by the same manufacturer. All castings shall be in accordance with Public Works Commission standard details. Any defective castings shall be removed and replaced.

Any special linings and coatings that are specified for a manhole and installed at the production facility, in the field, or during repairs, shall be applied in accordance with the applicable special coatings specification and the manufacturer's specifications for that material.

Camlock ring and covers shall be in accordance with Public Works Commission standard details. Camlock bolt head shall be compatible with PWC standard tool for turning camlock mechanism. Camlock ring and covers shall be installed as indicated on the drawings, in accordance with PWC standard details.

SELECT BEDDING MATERIAL

Select bedding material shall be crushed stone (No. 57 or No. 5), in accordance with Public Works Commission standard details. Bedding material shall be provided for all pipe materials.

INSTALLATION

Pipe installation shall be in strict accordance with Specification Section 02222 – Excavation and Backfilling for Utility Systems and as outlined herein.

PIPE LAYING

Pipe installation shall be in accordance with the manufacturer's instructions. Proper equipment shall be utilized to perform the work in a manner satisfactory to PWC. All pipes and fittings shall be carefully lowered into the trench in such a manner to prevent damage to the protective coatings and linings. Under no circumstances shall pipe materials be dropped or dumped into the trench. Pipe shall be carried into position and not dragged.

All dust, dirt, oil, tar (other than standard coating), or other foreign matter shall be cleaned from the jointing surfaces, and the gasket, bell, and spigot shall be lubricated with lubricant recommended by the manufacturer.

The pipe shall be laid upgrade, beginning at the lower end with the tongue or spigot ends pointing in the direction of the flow to the correct line and grade, unless otherwise approved by PWC. The pipe section to be installed shall be aligned by batter board or laser beam with the last installed pipe section. Mechanical equipment should not be used to assemble the pipe. Pipe shall be assembled in accordance

with the pipe manufacturer's instructions. Any damage resulting from the use of mechanical equipment shall be replaced as directed by PWC.

Adjustments in grade by exerting force on the barrel of the pipe with excavating equipment shall not be allowed. The Contractor shall verify line and grade after assembling each joint.

At any time when pipe laying is not in progress, the open ends of the pipe shall be closed by a water tight plug or other means approved by the PWC Project Coordinator. If water is in the trench, the plug shall remain in place until the trench is pumped completely dry. No pipe shall be laid in water or where in the PWC Project Engineer's and/or PWC Project Coordinator's opinion trench conditions are unsuitable. Every precaution shall be taken to prevent material from entering the pipe while it is being installed.

ALIGNMENT AND GRADE

All pipe shall be installed to the required lines and grades. Structures shall be installed at the required locations. The lines and grades of the pipe will generally be indicated by stakes parallel to the line of the pipe. The Contractor shall be responsible for installing the pipe to proper line and grade.

Pipe shall be visually inspected by shining a light between structures and /or by closed circuit television inspection. Any defects discovered, including poor alignment, shall be corrected as directed by the Public Works Commission.

The bottom of the trench shall be excavated to a minimum of four inches (4") below the outside bottom of the pipe being installed to allow adequate placement and compaction of bedding material prior to installation.

Select bedding material shall be placed a minimum of four inches (4") and a maximum of six inches (6") under the pipe for full width of the trench and halfway up the pipe on the sides. Bedding material shall be placed in layers not exceeding six inches (6") loose thickness for compacting by vibratory mechanical tamps under the haunches and concurrently on each side of the pipe for the full width of the trench. The final result shall be "Class B" bedding for rigid pipe. If the existing material under the pipe bedding material is unsuitable, the unsuitable material shall be removed and replaced with select bedding material (No. 57 or No. 5 stone), as authorized and approved by the Public Works Commission Project Coordinator.

The same material pipe shall be utilized from manhole to manhole, unless otherwise approved by PWC. If the section of pipe between manholes is 250 feet or less, no transitions will be allowed (either all PVC or all ductile iron). Should the length between manholes exceed 250 feet, only one transition will be allowed. Use of a C900 x SDR 26 adaptor shall be used to accomplish the transition. A transition is defined as the use of one C900 x SDR26 adaptor. No more than one (1) adaptor shall be utilized in any given manhole to manhole segment.

All manholes shall be constructed to Public Works Commission's standards. Installation shall be in accordance with ASTM C-891 and PWC standards.

Manholes shall be constructed of precast reinforced concrete circular sections installed on a base riser section with integral floor and shall be cored to accommodate the various pipe connections, as indicated on the drawings. Pipe connections to a manhole shall be by gasketed flexible watertight connections (boot for small diameter and A Loc for larger diameter pipe) or as approved by the Public Works Commission. The manhole size shall be in accordance with the following table, unless otherwise specified:

Pipe Size	Manhole Diameter **
24" and less	48" *
27" - 36"	60"
42"	72"

* Where interior drop structures are required, use 60" diameter as required in the Public Works Commission standard details.
** Where multiple connections or acute angles are required, larger diameter manhole may be required as indicated on the plans.

The invert channel shall be constructed of brick and mortar, in accordance with Public Works Commission standard details. **Precast inverts are not allowed**. The invert channel shall be smooth and semicircular in shape conforming to the inside of the connecting sewer section. Changes in direction of flow shall be made with a smooth curve as large as a radius as the size of the manhole will permit without a decrease in flow velocity. Changes in size and grade of the channel shall be made gradually and evenly. The invert channel walls shall be constructed to three quarters (3/4) of the height of the crown of the outlet sewer and in such a manner not to obstruct maintenance, inspection or flow in the sewers. The inverts shall have a minimum slope of one (1) percent across the bottom of the manhole. A shelf shall be provided on each side of any manhole invert channel. Inverts in manholes with standing water will not be acceptable. The shelf shall be sloped not less than 1:12 (min) and no more than 2:12 (max). The bottom of the boot for the new sewer main or lateral shall be set one inch above existing shelf unless otherwise indicated.

When used in a paved street, the ring and cover shall be set in suitable mortar surrounded by a concrete collar in accordance with Public Works Commission standard details. When used in places other than in a paved street, the ring and cover shall be set to the grade shown on the plans or directed by the Public Works Commission. In unpaved areas cam-lock ring and cover shall be used. Camlock ring and cover shall be installed in accordance with Public Works Commission standard details.

The interior manhole riser joints, lift holes and grade adjustment rings shall be sealed with non-shrinking mortar to provide a watertight manhole. Lift holes sealed by the manufacturer with plastic caps do not require mortar seal. The hardened mortar shall be smooth to rub with no sharp edges. Use of grade rings with cam-lock ring and cover are not allowed, unless approved by the PWC Project Coordinator. **Use of grade rings is not allowed for above grade adjustments**.

All exterior manhole riser joints, including the joint at the cone, shall be sealed with an external rubber sleeve. The sleeve shall be made of stretchable, self-shrinking rubber, with a minimum thickness of 30

mils. The back side of each wrap shall be coated with a cross-linked reinforced butyl adhesive. The butyl adhesive shall be a non-hardening sealant, with a minimum thickness of 30 mils. The seal shall be designed to stretch around the manhole joint and then overlap to create a fused bond between the rubber and butyl adhesive. The application shall form a continuous rubber seal for the life of the application. The sealing system shall be as manufactured by Concrete Sealants, Inc. (Con-Seal), Sealing Systems, Inc., or approved equal. The wrap shall be a minimum of six (6) inches in width, and shall be centered on the joint. All manhole joints (including the cone section to the last riser) shall be wrapped and sealed. Care shall be taken to prevent damage to the wrap during backfill operations. The manhole surface shall be prepared in accordance with manufacturer's specifications, prior to installing the joint wrap.

Materials shall not enter the sewer line during construction of the manhole. The manhole shall be kept clean of any and all debris or materials. Any debris or material that entered the manhole shall be immediately removed. This condition shall be maintained until final acceptance of the work.

CONNECTION TO EXISTING MANHOLES OR LIFT STATIONS

All connections to existing manholes and/or lift stations shall be approved by the Public Works Commission. Where new mains are to be connected to existing active sanitary sewers, the active sewers shall remain in service. Unless otherwise indicated, where new lines are connected into existing manholes, all or such portion of the manhole invert as is necessary shall be removed and a new invert shall be constructed to accommodate both new and existing flows. All work shall conform to the requirements specified for new manholes. The existing structure connection shall be cored and a flexible watertight connection (i.e., boot) installed. The boot shall be installed in accordance with Public Works Commission standard details and requirements. The Contractor shall coordinate and cooperate with the Public Works Commission's Project Coordinator.

PIPE TO MANHOLE CONNECTOR (BOOT)

A watertight, flexible pipe-to-manhole connector shall be utilized on all pipe to manhole connections, for both new and existing manholes and pipes, unless otherwise specifically authorized in writing by the Public Works Commission.

The connector assembly shall be the sole element to provide a watertight seal of the pipe to the manhole or other structure. The connector shall consist of a rubber gasket, an internal compression sleeve, and one or more external take-up clamps. The connector shall consist of natural or synthetic rubber and Series 300 non-magnetic stainless steel. No plastic components shall be allowed.

The rubber gasket shall be constructed of synthetic or natural rubber, and shall meet or exceed the requirements of ASTM C-923. The connector shall have a minimum tensile strength of 1,600 psi. The minimum cross-sectional thickness shall be 0.275 inches.

The internal expansion sleeve shall be comprised of Series 300 non-magnetic stainless steel. No welds shall be utilized in its construction.

Installation of the connector shall be performed utilizing a calibrated installation tool furnished by the connector manufacturer. Installation shall require no re-tightening after the initial installation. Installation shall be done in accordance with the manufacturer's instructions.

The external compression take-up clamps shall be Series 300 non-magnetic stainless steel. No welds shall be utilized in its construction. The clamps shall be installed utilizing a torque-setting wrench furnished by the connector manufacturer. Installation shall be done in accordance with the manufacturer's instructions.

The Contractor shall utilize the proper size connector in accordance with the connector manufacturer's recommendations. All dead-end pipe stubs shall be restrained in accordance with ASTM C-923.

The finished connection shall provide a sealing to a minimum of 13 psi, and shall accommodate a minimum pipe deflection of seven (7) degrees without the loss of seal.

The pipe to manhole connector shall be PSX: Direct Drive as manufactured by Press-Seal, or approved equal.

INSIDE DROP MANHOLE STRUCTURE

Inside manhole drop structures shall be constructed and installed in accordance with Public Works Commission standard details.

CLEANING

Prior to final inspection, all sanitary sewer laterals, mains, and manholes newly installed on the collection system shall be flushed and cleaned. During the flushing operation, the downstream manhole shall be closed with a watertight plug to protect the existing sewer main. All water and debris shall be removed and properly disposed of by the Contractor. This condition shall be maintained until the Public Works Commission issues final acceptance for the project.

TESTING

Completed sewers shall be tested in accordance with the provisions outlined below. The Contractor shall furnish all equipment, labor, materials, and pay all costs associated with the tests performed. The Contractor shall schedule all testing with the Public Works Commission's Project Coordinator, a minimum of 48 hours in advance. The Contractor shall cooperate with the Public Works Commission's Project Coordinator and furnish any needed assistance necessary to complete the required testing.

For annexation and/or retrofit projects: No testing shall be conducted prior to successful completion of the compaction testing.

For all other projects: No testing shall be completed until all utilities are installed, prior to preparation of the road subgrade. The Contractor may elect to perform testing to satisfy them that the sewer utility is

installed properly prior to commencing installation of other utilities. However, such testing shall not be construed as acceptance by PWC.

The deflection/mandrel test shall not be performed until a minimum of thirty (30) calendar days after backfill operations are completed and the area graded to final contours. In lieu of waiting thirty (30) calendar days, the Contractor has the option to have an independent testing laboratory verify that compaction has been completed to achieve the maximum density as shown in the detail. The location and elevation of the compaction testing shall be determined reviewed and approved by the Public Works Commission's Project Coordinator. The Contractor shall provide the Public Works Commission with a copy of the density testing results.

Compaction testing shall be done in accordance with Specification Section 02222 – Excavation and Backfilling for Utility Systems.

Vacuum Testing Manholes:

All precast sanitary sewer manholes installed by the Contractor shall be vacuum tested for leakage. This test shall be done in accordance with ASTM C-1244 and in the presence of a Public Works Commission Project Coordinator. The Contractor shall be responsible for providing all the necessary labor, materials, equipment, testing apparatus, and all other incidentals necessary to complete the vacuum test. All testing equipment utilized shall be approved for use in vacuum testing manholes.

Each manhole shall be tested after assembly. All lift holes shall be plugged with an approved non-shrink grout. All lines, including laterals, entering the manhole shall be temporarily plugged. The Contractor should take care to ensure that the pipes and plugs are secure in place to prevent them being drawn into the manhole. The test head shall be placed directly on top of the concrete surface of the manhole following the manufacturer's recommendations, rather than to the cast iron seating ring.

Manholes may be tested either prior to backfill or post backfill at the contractor's option. For pre-backfill testing, a vacuum of 10 inches of Mercury (inches Hg) shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9 inches of Mercury (inches Hg). The manhole is acceptable if the time for the vacuum reading to drop from 10 inches of Mercury to 9 inches of Mercury meets or exceeds the values indicated below:

	Diameter of Manhole		
Manhole Depth	**4' Diameter**	**5' Diameter**	**6' Diameter**
10' or less	**25 sec**	**33 sec**	**41 sec**
11' to 15'	**38 sec**	**49 sec**	**62 sec**
16' to 20'	**50 sec**	**65 sec**	**81 sec**
21' to 25'	**62 sec**	**82 sec**	**101 sec**

25’ to 30’	**74 sec**	**98 sec**	**121 sec**

Vacuum testing backfilled manholes is not recommended in the presence of groundwater. Vacuum testing a backfilled manhole that is subjected to hydrostatic pressure may exceed the design limits of the flexible connecters and could lead to failure of the structure, joints, and/or connectors. Where groundwater is present a reduction in the vacuum pressure applied to the manhole will be required. The vacuum shall be reduced by 1 inch of Mercury for every 1 foot of hydrostatic head between 12 feet and 21 feet. A vacuum test should not be performed when the hydrostatic head exceeds 22 feet. See the chart below:

Hydrostatic Head (ft)*	12	13	14	15	16	17	18	19	20	21	22
Vacuum Pressure (in Hg)	10	9	8	7	6	5	4	3	2	1	**

*Hydrostatic head above the critical connector (critical connector is bottom most flexible connector)
**Do not perform vacuum test

If the manhole fails the initial test, the manhole shall be repaired by an approved method until a satisfactory test is obtained. All repair methods shall be approved by the Public Works Commission prior to being utilized. Retesting shall be performed until a satisfactory test is accomplished.

Mandrel Testing:

Deflection tests shall be performed on all PVC pipe installations. PVC pipe's maximum deflection after backfilling shall not exceed five (5) percent. The rigid ball or mandrel used for the deflection test shall have a diameter not less than 95 percent of the base inside diameter or average inside diameter of the pipe depending on the type of pipe manufactured and the applicable ASTM Standard. The PVC pipe shall be measured in compliance with ASTM D2122 “Standard Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings”. The Contractor shall supply all labor, equipment and materials necessary to perform the test in the presence of the Public Works Commission’s Project Coordinator. The test shall be performed without mechanical pulling devices. The mandrel shall be constructed so as to preclude any yield in diameter, and with a pull line on each end to facilitate withdrawal. If the deflection exceeds the allowable, the Contractor shall remove and replace the pipe.

Air Testing:

Air testing shall be performed on all mains and laterals to determine acceptability. The length of sewer subject to an air test shall be the distance between two adjacent manholes. The tests shall be conducted in accordance with the appropriate ASTM standard. The air test shall be coordinated with the Public Works Commission. The Contractor is required to supply all equipment, labor, materials and pay all costs associated with the test performed.

Air Test for PVC Pipe

The low pressure air test on PVC pipe shall be performed with satisfactory results in accordance with ASTM F1417 “Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using

Low-Pressure Air". The pipe, including lateral assemblies, shall be plugged and air added slowly until the internal pressure of the line is raised to 4.0 psi. After the pressure of 4.0 psi is obtained, regulate the air-supply so that the pressure is maintained between 3.5 and 4.0 psi for at least two (2) minutes, depending on air/ground temperature conditions. The pressure will drop slightly until equilibrium is obtained; however, a minimum of 3.5 psi is required. Once the 3.5 psi is maintained, the test will begin. If the pressure drops 1.0 psi within the time indicated below, the test fails.

Pipe Dia (in)	Minimum time (minutes)	Length for Min Time (ft)	Time for Longer Length (sec)
4	3:46	597	0.380L
6	5:40	398	0.854L
8	7:34	298	1.520L
10	9:26	239	2.374L
12	11:20	199	3.418L
15	14:10	159	5.342L
18	17:00	133	7.692L
21	19:50	114	10.470L
24	22:40	99	13.674L
27	25:30	88	17.306L
30	28:20	80	21.366L
33	31:10	72	25.852L
36	34:00	66	30.768L

The Contractor shall observe all safety precautions to include allowing no one in the manholes during testing, securing all plugs and providing additional plug bracing. The Contractor shall be required to furnish, install and remove after testing at no additional cost, a temporary glue cap/plug to be airtight for all cleanout stacks to accomplish air testing. The air pressure shall never exceed 8 psi. All gauges shall be accessible outside of the manholes.

HYDROSTATIC TESTS

After the ductile iron sewer pipe has been laid within the "protected" area and backfilled to finished grade, the pipe shall be subjected to a hydrostatic pressure test. All laterals within the "protected" area shall be ductile iron. All sewers subject to hydrostatic testing shall include (1) sewers entering or crossing streams, (2) sewers located less than 100 feet from any public or private water supply source including any WS-I waters or Class I or Class II impounded reservoirs, (3) where the minimum 18 inch vertical and 10 feet horizontal separation cannot be maintained between sewers and water mains (see NC DENR Regulations), or (4) as specified and/or indicated on the drawings. The Contractor will furnish all labor and material, including test pumps, plugs, and all other incidentals for making hydrostatic tests. Hydrostatic pressure testing shall be conducted on the completed main, including the laterals.

The duration of the pressure test shall be at least one hour or longer, as directed by the Public Works Commission. The hydrostatic pressure shall be 150 psi. Each section of pipe shall be slowly filled with water and the specified test pressure based on the elevation of the lowest point of the line or section under test and 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 Public Works Commission. Before applying the specified test pressure, all air shall be expelled from the pipe.

All joints showing visible leaks shall be made tight. Cracked or defective pipe, joints, laterals, and fittings discovered in consequence of the pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic test may be waived by the Public Works Commission in certain situations. The test shall be repeated until satisfactory to the Public Works Commission.

The results of the pressure tests shall be satisfactory as specified. All replacement, repair, or retesting shall be accomplished by the Contractor. All repairs shall be reviewed and approved by the Public Works Commission prior to backfill. The use of couplings, sleeves, etc. shall be reviewed and approved by the Public Works Commission prior to use.

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DIVISION 2
SITE WORK

02732 SEWAGE FORCE MAINS

GENERAL

Sewage force mains and all appurtenant items shall be constructed of materials as specified or indicated on the drawings. The intent and purpose of these specifications is to require a complete and satisfactory installation in every respect and any defect in material or workmanship shall be cause for replacement and correction of such defect as directed by the Public Works Commission and at no expense to the Public Works Commission. All materials and workmanship shall be in complete accordance with the standards and specifications of the Public Works Commission and subject to Public Works Commission inspection and approval.

RELATED SECTIONS

A. Section 02222 – Excavation and Backfilling for Utility Systems
B. Section 02660 – Water Distribution
C. Section 02730 – Sanitary Sewer System
D. Section 02736 – High Density Polyethylene Pipe
E. Section 02753 – Submersible Lift Stations
F. Section 02754 – Self-Priming Lift Stations
G. Section 09801 – Special Coatings – Anti-Microbial Admixture
H. Section 09802 - Special Coatings – Ceramic Epoxy

MATERIALS

PVC PIPE

In order to prevent the sanitary sewer force main from being mistaken for a water main, **all force main PVC pipe shall be green in color.**

Two (2) inch PVC pipe shall be manufactured using Grade 1 PVC compound material as defined in ASTM D-1784 and shall be SDR21, pressure class 200 in accordance with ASTM D 2241 or SDR-17 with a pressure rating of 250 psi, in accordance with ASTM D-2241. Fittings for two (2) inch PVC shall be solvent welded Schedule 80 PVC. The pipe shall be plainly marked with the manufacturer's name, size, material (PVC) type and grade or compound, NSF seal, pressure rating and reference to appropriate product standards.

All PVC pipe four (4) inches through 12 inches and couplings shall be manufactured using virgin compounds as defined in ASTM D-1784, with a 4000 psi HDB rating and designated as PVC 1120 to be in strict accordance with AWWA C-900. The pipe shall be Class 150 and conform to the thickness requirements of DR18. The pipe and fittings shall be manufactured to withstand 755 psi quick burst

pressure tested in accordance with ASTM D-1599 and withstand 500 psi for a minimum of 1,000 hours tested in accordance with ASTM D-1598. Couplings shall be compression, twin gasket type in accordance with ASTM D-3139 for push-on joints and ASTM F-477 for elastomeric seals (gaskets). PVC fittings are not acceptable for mains other than two (2) inch. The pipe joints shall be of the integral bell type with rubber gaskets shall conform to the requirements of ASTM D-3139 or ASTM F-477. Fittings and specials for mains four (4) inches and larger shall be ductile iron, bell end in accordance with AWWA C-110, 200-psi pressure rating unless otherwise shown or specified, except that profile of bell may have specials of the same material as the pipe with elastomeric-gaskets, all in conformance with the requirements of AWWA C-900. Ductile iron fittings to PVC pipe shall be adequately supported on a firm trench foundation. Fittings shall be for bell and spigot pipe or plain end pipe, or as applicable.

Mechanical restraining systems shall not be used on PVC pipe.

DUCTILE IRON PIPE

The raw material from all ductile iron pipe and fittings shall have an average minimum content consisting of 90% recycled iron and steel. Ductile iron pipe and fittings shall be manufactured in the United States of America in accordance with ANSI/AWWA A21.51/C151. The manufacturer of the ductile iron pipe shall be a member of the Ductile Iron Pipe Research Association (DIPRA).

All ductile iron pipe and fittings (six (6) inches and above) shall be in strict accordance with ANSI/AWWA C-150/A21.50 and ANSI/AWWA C-151/A21.51, Class 50 in every respect. Four (4) inch ductile iron pipe shall be Class 51. Joints shall be mechanical joint or push on joint as specified and installed in accordance with AWWA C-600 and shall conform to AWWA Standard C-111. Mechanical joints shall be of the stuffing box type and shall conform to ANSI A21.11 for four (4) inch pipe through 12-inch pipe. Push on joints, rubber gaskets and lubricant shall conform to ANSI A21.11. Fittings and specials shall be ductile iron and shall be manufactured in accordance with AWWA Standard C-110 (ANSI A21.11).

Compact fittings shall be mechanically restrained, ductile iron in accordance with ANSI A 21.53 (AWWA C-153) for four (4) inch through 12-inch sizes only. Where thrust blocking is utilized, fittings shall be full body ductile iron in accordance with ANSI A 21.53 (AWWA C110). Pressure rating shall be not less than 200 psi unless otherwise specified. All ductile iron interior surfaces shall be lined with two (2) coats of ceramic epoxy to produce a total minimum dry film thickness of 40 mils (Protecto401 or approved equal). The exterior pipe surfaces shall be protected with asphaltic coating as specified in AWWA C151 and C110. Specifications for the ceramic epoxy can be found in Specification Section 09802.

All pipe joints within an encasement shall be furnished with manufactured restrained joints, and as specified in the standard Public Works Commission detail for encasements.

For aerial crossings which are four (4) inches through 12 inches in diameter, manufactured restrained joint ductile iron pipe Class 53, or Class 53 flanged ductile iron pipe shall be utilized in accordance with the standard Public Works Commission detail for aerial crossings. Mega-lugs, field-lok, and gripper rings are not an allowable means of restraint for aerial crossings. For aerial crossings larger than 12 inches, or

as noted specifically on the plans, flange joint ductile iron pipe, Class 53, shall be utilized in accordance with the standard Public Works Commission details. The location of flanges shall be specifically designed for each application. The flange pipe shall be in accordance with ANSI/AWWA C-115/A21.15. Threads for threaded flange pipe shall be in accordance with ANSI B2.1, shop fabricated as outlined by AWWA 115 with serrated faces furnished on the pipe, completely factory installed. Welding of flanges to the body of the pipe will not be acceptable. Ductile iron fittings and flanges shall be in accordance with ANSI/AWWA C-110/A21.10 with a minimum working pressure of 250 psi. Gaskets shall be full faced SBR rubber per ANSI/AWWA C-111/A21.11 with a minimum 1/8" thickness. Linings and coatings shall be as outlined for ductile iron pipe.

If the Public Works Commission determines that an expansion coupling is required, it shall be installed as indicated on the drawings. The expansion coupling shall not be buried.

For subsurface water crossings (i.e., streams, wetlands), restrained joint ductile iron pipe shall be utilized. No mechanical restraint systems (e.g., mega-lugs, field-lok gaskets, etc.) shall be utilized. The pipe shall be installed in a casing, in accordance with the approved Public Works Commission detail, unless otherwise specifically approved by the Public Works Commission.

Transition between ductile iron pipe and HDPE shall be accomplished utilizing mechanical restraints as approved by PWC.

HDPE PIPE

All high density polyethylene (HDPE) pipe and fittings shall be in accordance with PWC Standard Specification Section 02736, most recent edition.

COMBINATION AIR RELIEF AND VACUUM VALVE ASSEMBLIES

All sewer force mains shall have automatic air release valves installed as indicated on the plans, and in accordance with Public Works Commission requirements. The automatic air release valve shall be a combination air release valve. Combination air release valves shall be heavy duty "universal" style, single body units, incorporating the functions of an air and vacuum valve within a single housing.

The tap size shall be a minimum of two (2) inches, however if a larger tap is needed it shall be sized accordingly. The valve body, cover flange, and all internal parts shall be 316 stainless steel. The air release orifice shall be as specified by the Design Engineer. The air release valve shall have a maximum working pressure of 200 psi.

All air and vacuum combination release valves shall be Crispin Model UX20, ARI D-020, H-Tec Model 986, or approved equal. All air release valves shall be installed in accordance with the manufacturer's recommendations.

Air relief and vacuum valve manholes shall be 60 inch diameter precast concrete units conforming to ASTM C-478. The combination air relief vacuum valve manhole shall be cast with an anti-microbial

admixture, in accordance with manufacturer's instructions. The manholes and valves shall be installed in accordance with the standard PWC detail. The force main shall consist of one full joint of PVC C-900 (DR18) pipe centered at the air relief valve and a minimum of four (4) feet deep.

Combination air relief and vacuum valves shall be installed using stainless steel double strap service saddles, a two (2) inch ball valve, and a two (2) inch x one (1) inch brass tee with a quick connect attachment as shown in the PWC standard detail.

Service saddles for two (2) inch taps on four (4) inch and larger size iron pipe shall be ductile iron with stainless steel double straps, bolts, nuts and washers

Ball valves shall be all bronze construction, with a handle operator. Ball valves shall be manufactured and tested in accordance with AWWA/ANSI C800. The valve shall be equipped with packing nut, gland, and packing material. Ball valves shall be of an approved type made from approved materials conforming to ASTM specifications and shall also meet the approval of PWC. The turn required to travel from fully closed to fully open on a ball valve shall be 90 degrees.

AIR RELEASE VALVE MANHOLE RING AND COVER

Cast iron manhole frames and covers shall conform to the drawings in all essentials of design with vent holes. The frames and covers shall have a combined weight of not less than 310 pounds and shall conform to ASTM A-48, Class 30 frame and Class 35 cover. Lettering on the cover shall conform to the City of Fayetteville Public Works Commission standards and shall be stamped or cast into all covers so as to be plainly visible. Unless otherwise shown on the drawings, the frames and covers shall be so set that the top of the cover will be flush with finished grade or as directed by PWC.

BY-PASS PUMPING ASSEMBLIES

By-pass pumping assemblies shall be installed in accordance with PWC standard detail S.21. The bypass pumping assembly shall be constructed of ductile iron pipe which meets the requirements of this specification.

INSTALLATION

Pipe installation shall be in strict accordance with Specification Section 02222 – Excavation and Backfilling for Utilities Systems, and as outlined herein.

PIPE LAYING

Pipe installation shall be in accordance with the manufacturer's instructions. Proper equipment shall be utilized to perform the work in a manner satisfactory to PWC. All pipes and fittings shall be carefully lowered into the trench in such a manner to prevent damage to the protective coatings and linings. Under no circumstances shall pipe materials be dropped or dumped into the trench. Pipe shall be carried into position and not dragged.

All dust, dirt, oil, tar (other than standard coating), or other foreign matter shall be cleaned from the jointing surfaces, and the gasket, bell, and spigot shall be lubricated with lubricant recommended by the manufacturer.

Mechanical equipment should not be used to assemble the pipe. Pipe shall be assembled in accordance with the pipe manufacturer's instructions. Any damage resulting from the use of mechanical equipment shall be replaced as directed by PWC.

Adjustments in grade by exerting force on the barrel of the pipe with excavating equipment shall not be allowed. The Contractor shall verify line and grade after assembling each joint.

At any time when pipe laying is not in progress, the open ends of the pipe shall be closed by a water tight plug or other means approved by the PWC Project Coordinator. If water is in the trench, the plug shall remain in place until the trench is pumped completely dry. No pipe shall be laid in water or where in the PWC Project Engineer's and/or PWC Project Coordinator's opinion trench conditions are unsuitable. Every precaution shall be taken to prevent material from entering the pipe while it is being installed.

ALIGNMENT AND GRADE

All pipe shall be installed to the required lines and grades. Structures shall be installed at the required locations. The lines and grades of the pipe will generally be indicated by stakes parallel to the line of the pipe. The Contractor shall be responsible for installing the pipe to proper line and grade.

Threaded PVC and cemented joints will not be permitted. The ends of push on joints shall be beveled to facilitate assembly. Pipe shall be marked to indicate when the pipe is fully seated and the gasket lubricated to prevent displacement. Care shall be exercised to insure that the gasket remains in proper position in the bell or coupling while marking the joint.

All pipe installations shall be properly restrained, utilizing either thrust blocks or approved restraint systems. The thrust blocking shall be in accordance with PWC standards, and as designed by the Engineer. The approved restraint system shall be installed in accordance with the manufacturer's instructions.

For the purpose of identification of buried pipes during future trenching or location, a continuous "detectable" identification wire shall be installed as well as green, "Sanitary Sewer Force Main" marking tape. The wire shall be a minimum 12 gauge single strand, coated copper wire or copper clad steel wire that is suitable for underground use. The wire shall be buried continuously along the pipe. The wire shall be "stubbed" into marker posts and air release valve manholes and secured such that a "direct"/conductive metal detector may be used to trace the pipe location.

The marker posts shall be Rhino TriView TracerPeds which are green with a "Sewer Force Main" warning decal (GD-5314K) and have internal terminals. The marker posts shall utilize the TriGrip Anchor system for direct bury installations. The identification wire shall be attached to the marker posts

in accordance with PWC standards. Tracing wire marker posts shall be located no more than 500 feet apart.

When the force main is located in unpaved areas such as easements the marker posts shall be installed along the centerline of the force main. When the force main is located in paved areas the marker posts may be offset from the centerline of the force main in a uniform manner. The wire shall be installed with all non-metallic pipelines.

The "Sanitary Sewer Force Main" marking tape shall be green and labeled to warn of the presence of the sewer main. The tape shall be manufactured for durability and resistance to the elements. The marking tape shall be installed with both PVC and ductile iron force mains.

CONNECTION TO EXISTING MANHOLES

Where new mains are to be connected to existing active sanitary sewers, the active sewers shall remain in service by the Contractor. Unless otherwise indicated, where new lines are connected into existing manholes, all or such portion of the manhole invert as is necessary in the opinion of the PWC Project Coordinator shall be removed and a new invert shall be constructed to accommodate both new and existing effluent pipes and flows. Where force mains enter manholes, pipe and fittings shall be restrained as indicated on the plans with the force main outlet directed toward invert out.

All work shall conform to the applicable requirements specified for new manholes including all necessary concrete works, brick work, cutting, shaping and pipe fitting. Existing manhole walls, inverts, and shelves shall be coated with cement mixed with an anti-microbial additive in accordance with Specification Section 09801. New manholes that contain a force main discharge shall be cast with an anti-microbial admixture, in accordance with Specification Section 09801. The Contractor shall coordinate and cooperate with the Public Works Commission Project Coordinator on all connections. Connections to any manhole shall be made using the core and boot method. If necessary, drop or slide structures shall be installed, in accordance with PWC standards.

HYDROSTATIC TESTS

After the pipe has been laid, the valves installed, the taps made and the system has been partially backfilled as specified, all newly laid pipe shall be subjected to a hydrostatic pressure test. Where any section of a force main is provided with concrete thrust blocking for fittings, the hydrostatic test shall not be made until at least five (5) days after installation of the blocking unless otherwise approved. The Contractor will furnish all labor and material, including test pumps, taps, and corporations, for making hydrostatic tests. Cost for said tests shall be included in the Proposal. A PWC Project Coordinator shall be present for all testing. The Contractor shall coordinate with the PWC Project Coordinator for disposing of the test water from the system.

The duration of the pressure test shall be at least one hour or longer, as directed by the PWC Project Coordinator. The hydrostatic pressure shall be 200 psi. The pipe shall be slowly filled with water and the specified test pressure based on the elevation of the lowest point of the line or section under test and 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 PWC Project Coordinator. Before applying the specified test pressure, all air shall be expelled from the pipe. If blow offs are not available at the high places, taps shall be made to provide blow offs.

The results of the pressure test shall be satisfactory as specified. All replacement, repair or retesting shall be accomplished by the Contractor at no additional cost to PWC. All materials and methods used to make repairs shall be approved by PWC. The PWC Project Coordinator shall be present while all repair work is taking place.

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DIVISION 2
SITE WORK

02750 WASTEWATER FLOW CONTROL (BYPASS PUMPING)

GENERAL

The intent and purpose of these specifications is to provide wastewater flow control, i.e., bypass pumping, of the sanitary sewer flows during the Contractor's operations. The Contractor shall furnish all labor, materials, accessories, equipment and tools for performing all operations required to bypass pump sewage around a manhole or sewer section in which work is to be performed.

The Contractor shall provide all pumps, piping, and other equipment to accomplish this task; perform all construction; obtain all permits; pay all costs; and perform complete restoration of all existing facilities to equal or better condition to the satisfaction of the Fayetteville Public Works Commission. The Contractor shall be responsible for the design, installation, operation, and maintenance of the temporary bypass pumping system. The Contractor shall provide sufficient documentation to the Fayetteville Public Works Commission to demonstrate that he, or his designated subcontractor, have the experience in the design, installation, and maintenance of temporary bypass pumping systems.

RELATED SECTIONS

A. Section 02305 – Pipe Bursting
B. Section 02500 – Traffic Control
C. Section 02730 – Sanitary Sewer System
D. Section 02760 – Television Inspection
E. Section 02766 – Sewer Line Cleaning
F. Section 02780 – Cured-in-Place Lining

REQUIREMENTS

The Contractor shall be responsible for all aspects of the bypass operation, including but not limited to: providing access to install, move, and maintain the pumps in the proper position, traffic control, installation and removal of bypass equipment, pump monitoring, testing of the bypass system, re-fueling, maintenance, notification of property owners (should access to private property be necessary), wastewater and fuel spill containment, and removal and replacement of manhole cones (if necessary). The bypass system (pumps and piping) shall be monitored by Contractor personnel at all times, when the bypass operation is in effect.

The Contractor shall have all materials and equipment on site to immediately respond to any emergencies or other event that could impact the bypass system (i.e., leak in the discharge piping, pump failure, flooding, etc.). The Contractor shall have sufficient support staff and equipment to mobilize to repair and/or service any equipment within one (1) hour of notification, 24 hours a day, seven (7) days a week. In the event of an emergency, the Contractor shall provide an immediate response and fully cooperate with the Fayetteville Public Works Commission.

The Contractor shall install the bypass pumps, equipment, and discharge lines to minimize impacts to the property owners, residents, and environment. The Contractor shall be responsible for determining the best

location for the bypass equipment, to include, but not limited to, the need for any special provisions to ensure access for the customers, preventing the pumps and manholes from flooding, etc. Such special provisions include, but are not limited to: installation of ramps, excavation and burial of the bypass lines, temporary fencing, sandbagging, construction of berms, raising the pumps, etc. The Contractor bears all responsibility for the maintenance and restoration of any trenches, ramps, access, etc. necessary for the temporary bypass pumping operation.

The Contractor shall take appropriate steps to ensure that all pumps, piping and hoses that carry raw sewage are protected from traffic. The Contractor shall identify the proposed methods to protect the temporary bypass pumping system from traffic as part of the detailed temporary bypass pumping plan. Traffic control shall be performed in accordance with these Contract Documents.

The bypass pumping system shall be monitored by Contractor personnel at all times (24 hours a day, 7 days a week), when the bypass operation is in effect. The Contractor's personnel shall be on-site at all times (24 hours a day, 7 days a week), and stationed at the primary bypass pumps. Depending on the location and system set-up, it may be necessary for the Contractor to station personnel at each of the various bypass pump locations. Unless otherwise approved by the Fayetteville Public Works Commission, one (1) person cannot monitor multiple bypass pump locations. All bypass pumps, regardless of their location (primary or on secondary lines), shall be equipped with an automatic dialer (or other similar device). The Contractor personnel shall immediately respond to any issue regarding the temporary bypass pumping system. All temporary bypass piping shall be periodically monitored (patrolled from pumps to discharge), but no less frequently than once every 12 hours. The bypass pumping equipment shall be automated and capable of functioning without the assistance of an operator.

SUBMITTALS

All submittals shall be provided in accordance with these Contract Documents, and the requirements outlined herein. The Contractor shall submit a detailed bypass pumping plan to the Fayetteville Public Works Commission for approval, prior to initiating the bypass operation. The Contractor shall submit this information far enough in advance to allow sufficient time to complete the necessary coordination, including but not limited to obtaining permits (i.e., encroachments), getting permission from property owners to cross and/or utilize their property, and gaining any necessary regulatory approvals. Failure to submit a complete and comprehensive bypass pumping plan in a timely manner shall not be cause for any extension of the Contract Time.

The detailed temporary bypass pumping plan shall include the following information:

- Method of monitoring the pumps to ensure proper operation, to include method of notifying personnel (Fayetteville Public Works Commission and Contractor) in the event of an emergency, activation of back-up pumps, etc.
- Method of monitoring upstream system levels to ensure surcharging does not result in back-ups into buildings, overflows, etc.
- The amount, if any, of any required surcharging.
- Method to initiate back-up pumps.
- Map showing general location of the pumps and bypass lines. This shall include means to maintain access to driveways, etc.
- Measures to secure the bypass system (lines, pumps, etc.) from traffic, vandalism, high stream flows, etc.

- Method of plugging (and securing the plug(s)) and type of plugs.
- Size and location of manholes or other access points for suction and discharge piping.
- Size of pipeline(s) or conveyance system(s) to be bypassed.
- Number, size, material, location, and method of installation of suction piping.
- Number, size, material, location, and method of installation of discharge piping.
- Bypass pump sizes, capacities, and number of each size to be provided on-site, including all primary, secondary, and spare pumping units.
- Calculations of static lift, friction losses, minimum inlet submergence, and flow velocity (pump curves showing pump operating range shall be submitted). Calculations shall be signed and sealed by a licensed Professional Engineer registered in the State of North Carolina. Calculations shall be provided for both the peak flow rate and a normal daily rate (see PUMPING AND BYPASSING section for sizing requirements).
- Measures to protect discharge manhole(s) or structure(s) from erosion and damage due to the bypass operation.
- Erosion control measures.
- Emergency contact information for the personnel responsible for the pump operation.
- Emergency contact information for Contractor personnel to respond in the event of an emergency.
- List of available resources (equipment, materials, personnel) and contact information for emergency response.
- Method to contain potential releases of sewer flow from air release valves.
- Contingency plan for responding to potential sewer spills caused by weather, vandalism, acts of God, etc. The plan shall include communication protocols, available resources, and the steps to be taken in the event of an emergency.

No bypass operations shall proceed until all bypass submittals have been reviewed and approved by the Fayetteville Public Works Commission.

COORDINATION

The Contractor shall fully coordinate their temporary bypass pumping operations with the Fayetteville Public Works Commission. It is the Contractor's responsibility to fully determine the scope and location of the temporary bypass pumping system. As outlined in these Contract Documents, the Fayetteville Public Works Commission may provide assistance with the building and maintenance of access roads, clearing of easements, etc. All coordination (to include location of the pumps and discharge lines) shall be fully discussed and agreed to prior to commencement of bypass operations.

The Contractor shall schedule a coordination meeting with the Fayetteville Public Works Commission and other personnel (Contractor, bypass sub-contractor, etc.) a minimum of three (3) business days prior to starting the temporary bypass pumping system. The purpose of this coordination meeting is to ensure that the Contractor and their sub-contractors have a good understanding of the requirements and expectations of operating the temporary bypass pumping system, discuss contingency plans (to include protocols for emergency contacts), identify location(s) of pumps, verify necessary materials (repair sleeves, containment devices, etc.) are on-site and available, and any other items necessary to ensure that the Fayetteville Public Works Commission has confidence that the appropriate personnel can operate and maintain the temporary bypass pumping system. Should, for any reason, the Fayetteville Public Works Commission deem that the Contractor and/or their sub-contractor is not prepared to operate and maintain the temporary bypass pumping system, the temporary bypass pumping system shall not be started. The Contractor shall take all necessary steps to address any concerns to the satisfaction of the Fayetteville Public Works Commission. Upon

completion of those actions, another coordination meeting shall be held, in order for the Fayetteville Public Works Commission to confirm that the Contractor and their sub-contractor is prepared to operate and maintain the temporary bypass pumping system. This process will be repeated until the Fayetteville Public Works Commission is satisfied that the Contractor and their sub-contractor are prepared to operate and maintain the temporary bypass pumping system. No additional contract time will be granted for this delay.

The temporary bypass pumping system shall run for a minimum of 24 hours, or longer as deemed by the Fayetteville Public Works Commission, prior to any activity occurring (cleaning, closed circuit television {CCTV}, etc.) within the main(s) being bypassed.

FLOW CONTROL PRECAUTIONS

Where the raw sewage flow will be blocked during the Work as a result of the temporary bypass pumping operation, the Contractor shall take all necessary precautions to protect the public health. No septic conditions shall be allowed due to Contractor's operations. The sewer system (mains, manholes, laterals, etc.) shall also be protected from damage. The following occurrences shall not be allowed:

1. No sewage shall be allowed to back up into any homes or buildings.
2. No sewage shall overflow any manholes, cleanouts or any other access to the sewers.
3. Users upstream of the project area shall be able to use all their water and sewer utilities without interruption or limitations.

If any of the above occur or are expected to occur, the Contractor shall take immediate action to alleviate one or all of the conditions. Additionally, the Contractor is required to observe the conditions upstream of the plug and be prepared to immediately increase bypass pumping or release the flows, as required. Any damage claims resulting from the Contractor’s failure to properly maintain sewer flows shall be the Contractor's responsibility.

All sump pumps, bypass pumps, trash pumps or any other type pump which pulls sewage or any type of material out of the sanitary sewer system shall discharge into another sanitary sewer manhole, or appropriate vehicle or container acceptable to the Fayetteville Public Works Commission. Under no circumstances shall untreated sanitary sewer be discharged, stored or deposited on the ground, swale, road or open environment. The Contractor shall not allow any flow of sewage onto private property, streets, or into creeks and drainage systems. Damage due to negligence of the Contractor, including, but not limited to, flooded dwellings, damaged property, damaged driveways, etc., shall be corrected immediately by the Contractor at no additional cost to the Fayetteville Public Works Commission.

PLUGGING AND BLOCKING

In some applications, the wastewater flow may be plugged and contained within the capacity of the collection system. This shall only be done when it has been determined the system can accommodate the surcharging without any adverse impact. The Contractor has the sole responsibility for determining whether the system can accommodate surcharging. If this option is selected, the Contractor shall be responsible for continuously monitoring the system to ensure no sewer spills or overflows occur.

A sewer line plug shall be inserted into the line at a manhole upstream from the section being surveyed or repaired. The plug shall be so designed that all or any portion of the operation flows can be released. The Contractor shall secure the plug, to prevent it from being dislodged and moving downstream. Flows shall be bypassed for the initial CCTV inspection and shall be bypassed throughout the duration of the work, to

include the final CCTV inspection. Flows shall be bypassed in accordance with the approved temporary bypass pumping plan. Upon acceptance of the work by the Fayetteville Public Works Commission, the temporary bypass pumping system shall be removed and flows restored.

PUMPING AND BYPASSING

The Contractor, when and where required, shall divert sewer flows for the sewer pipe rehabilitation process, cleaning, television inspection, pipe repairs, manhole replacement and/or rehabilitation, obstruction removals, or other related as required to complete the Work. The pumps and bypass lines shall be of adequate capacity and size to handle and prevent backup or overflow for all flows.

The temporary bypass pumping system shall be designed to maintain the flows necessary to meet the requirements of each particular location. The temporary sewer bypass system shall have the capacity to handle the flows outlined in these Contract Documents. The temporary sewer bypass system shall be sized to handle 2.5 times the average daily flow rate, or the specified peak flow – whichever is greater.

The Contractor shall be responsible for furnishing the necessary labor and supervision to set up, operate, and maintain the temporary bypass pumping system. A "set up" consists of the necessary pumps, conduits and other equipment to divert the flow of sewage, from the start to finish of work performed. Each "set-up", regardless of location, shall have Contractor personnel on-site at all times (24 hours a day, 7 days a week) and stationed at the pumps, unless otherwise approved by the Fayetteville Public Works Commission. The temporary bypass pumping system shall include:

- A minimum of one (1) redundant pump so that the temporary bypass pumping system is capable of transmitting the peak flow with the largest duty pump out of service.
- Pumps shall be provided with a means of automatic control via level sensing. Systems requiring manual starting and/or stopping shall not be allowed.
- All equipment (primary and secondary pumps) shall be equipped in a manner to keep noise to a maximum of 65 dBA at 30 feet.
- An automatic dialer (or similar) to immediately notify (in a sequential operation) Contractor and Fayetteville Public Works Commission personnel in the event of equipment failure. The automatic dialer shall be set to issue notifications prior to flow level reaching critical elevations and having a spill occur. All bypass pumps (regardless of location) shall be equipped with an automatic dialer (or similar).

The temporary bypass pumping system shall be provided in such a way as to maintain access for businesses and residences. The Contractor shall be responsible for determining the best location for the bypass equipment, and the need for any special provisions to ensure access for the residents and businesses. Such special provisions include, but are not limited to: installation of ramps, excavation and burial of the bypass lines, etc. The Contractor shall use bridges over the bypass lines, temporary lines under driveways, alternate routes, or other means to accomplish this item. The bypass plan submittal shall indicate the means of maintaining access. The Contractor bears all responsibility for the maintenance of any trenches, ramps, etc. necessary for the bypass operation.

Pumps, equipment, and bypass lines shall be continuously (24 hours a day, 7 days a week) monitored by on site Contractor personnel capable of starting, stopping, refueling and maintaining these pumps during the Work. The temporary bypass pumping system shall be provided with an automatic dialer (or other similar device) that will immediately notify (in a sequential operation) the Contractor and the Fayetteville Public Works Commission in the event of equipment failure. All bypass pumps (regardless of location) shall be

equipped with an automatic dialer. This automatic dialer (or similar) shall be set to issue notifications prior to flow levels reaching critical elevations and having a spill occur.

The automatic dialer shall be set to issue notifications through a sequential operation. Automatic dialers that are not set up for sequential notifications shall not be acceptable. The Contractor's personnel shall be the first to receive any notifications from the automatic dialer. The automatic dialer shall only notify the PWC personnel after all Contractor notifications have been ignored and/or not responded to. The Contractor shall properly adjust the level at which the automatic dialer initiates notification to provide adequate time for the sequential notification to occur. If the PWC personnel are notified by the automatic dialer, the PWC personnel shall assume that a spill is occurring or is imminent, and respond accordingly. The Contractor shall be responsible for all costs for the PWC to mobilize and respond to the notification, regardless if a spill occurred or not.

In some applications, it may be necessary to surcharge the system in order to ensure proper pump operation. This shall only be done when it has been determined the system can accommodate the surcharging without any adverse impact. The Contractor has the sole responsibility for determining whether the system can accommodate surcharging. In the event surcharging is necessary, the Contractor shall be responsible for continuously monitoring the system to ensure no sewer spills occur.

All bypass piping shall successfully pass a hydrostatic test prior to bypassing the sewer flows. The hydrostatic test pressure shall be no less than the expected discharge pressures, and shall be held for a minimum of one (1) hour. All testing shall be observed by the Fayetteville Public Works Commission. Testing shall be coordinated with the Fayetteville Public Works Commission a minimum of 24 hours in advance.

SPILL RESPONSE

The Contractor shall not discharge or pump any sewage, solids, or debris on the ground, streets, storm water system, ditches, or streams. Any sewage spills shall be immediately reported to the Fayetteville Public Works Commission Water Resources Construction Department, (910) 223-4716. After normal business hours, the Contractor shall contact the Fayetteville Public Works Commission Dispatch Center, (910) 678-7400 or (910) 323-0178. The Contractor shall take complete responsibility for all costs related to the clean-up of the spill, including any fines issued by the North Carolina Department of Environmental Quality (NC DEQ).

In the event that raw sewage (in any quantity) is spilled, discharged, leaked or otherwise deposited in the open environment, due to the Contractor's work, the Contractor is responsible for any cleanup of solids and disinfection of the area affected. This work will be performed at the Contractor's expense with no additional cost to the Fayetteville Public Works Commission. The Contractor is also responsible for complying with any and all regulatory requirements in regards to the size spill with no additional cost to the Fayetteville Public Works Commission. The Contractor shall cooperate fully with the Fayetteville Public Works Commission and the applicable State agencies in responding to and cleaning up the spill. Any work completed by the Fayetteville Public Works Commission in responding to a spill caused by the Contractor's operations shall be billed to the Contractor.

Where sewage has backed up into a property due to any aspect of the Contractor's operation, the Contractor shall immediately notify the Fayetteville Public Works Commission, inspect the property with the Fayetteville Public Works Commission and agree on remedial measures. The Contractor shall be responsible for all cleaning, repair and/or replacement of damaged property, temporary relocation of all occupants of the affected properties, if required, all to the satisfaction of the property owner. These actions shall be undertaken

immediately upon learning of the backup. Cleaning shall be performed by firms specializing in this type of work. All costs associated with the cleaning, repair, replacement of damages, occupant accommodations, insurance and spill remediation shall be borne by the Contractor. All remediation measures required as part of a spill response are part of acceptance of the project, and final payment shall not be made until such time all required measures are addressed and approved by the appropriate regulatory agency.

*** END OF SECTION ***

DIVISION 2
SITE WORK

02753 SUBMERSIBLE PUMP LIFT STATION

GENERAL

This section includes all pumps, piping; fittings, valves, structures and other appurtenances that form an integral part of a submersible pump lift station. All work shall be accomplished in a neat, workmanlike manner meeting the requirements of the City of Fayetteville Public Works Commission. PWC shall be supplied with shop drawings of all equipment and materials for approval prior to installation. The Contractor shall supply six (6) sets of O & M Manuals, for the lift station, including support literature, shop drawings and O & M instructions before final approval and acceptance of the operational station. The lift station start up shall be performed by a qualified factory representative capable of supervising PWC's personnel in proper operation and maintenance.

SUBMITTALS

Prior to fabrication, pump station equipment suppliers shall submit six (6) copies of submittal data for review and approval by PWC. Submittal shall include shop drawings, electrical ladder logic drawings, and support data as follows: Catalog cut sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor data, pump characteristic curves showing the design duty point capacity (GPM), head (FT), and hydraulic brake horsepower (BHP). Electrical components used in the motor and liquid level control shall be fully described. The electrical ladder logic drawings shall illustrate motor and liquid level control circuits to the extent necessary to validate function and integration of circuits to form a complete working system. Shop drawings for pre-engineered stations shall provide layout of mechanical equipment and contractor piping connections.

SUBMERSIBLE PUMPS

The pumps shall be non-clog, explosion proof, submersible units capable of passing a three-inch (3”) sphere. Pumps shall be specifically designed to handle raw, unscreened sanitary sewage and shall be selected to perform under following operating conditions:

Pump Performance	
Target Operating Point	gpm @ ft.
Maximum Pump Speed	RPM
Minimum Pump Efficiency	%

Pump discharge diameter shall be as noted on the plan drawings.

The pump shall be provided with an oil-filled cast iron, watertight enclosure sealed with O-rings. Heat sensors shall be attached to the windings and shall be wired for auto-shut off. The pump motor shall be provided with tandem seal arrangements incorporating two completely separate seals. Each seal shall be held in contact by its own spring system. The seal faces shall be tungsten carbide. The mechanical seal chamber shall be oil filled and equipped with a moisture detection device. The pump shall rotate on a minimum of two bearings permanently lubricated but capable of being re-greased, suitable for a minimum L10 bearing life of 40,000 hours.

All areas of the pump casing and volute, which are exposed to sewage, shall be constructed of cast iron meeting the requirements of ASTM A-48, Class 30.

The pumps shall be provided a rigid discharge base-elbow to support the total weight of the pumping unit. The base shall be bolted directly to the wet well floor with a 90° elbow having a 125-pound ANSI flange discharging vertically.

Pumps shall be Meyers or Fairbanks Morse.

IMPELLER

The impeller shall be two vane one piece, single suction, enclosed, non-clog, and ductile iron. The impeller shall be of a radial flow design with well-rounded leading vane edges and thick hydrofoil shape with large openings. The impeller shall be balanced and secured to a straight fit on the shaft by means of a key and fastener. The impeller waterways and clearance between the impeller periphery and volute cutwater shall be capable of passing a 3-inch sphere. The impeller is to be matched to a constant velocity equalizing pressure volute.

MOTORS

Each submersible solids handling pump shall be driven by a completely sealed, electric submersible squirrel cage induction motor with the following characteristics:

Motor Performance	
Horsepower	
Service Factor	
RPM	
Voltage / Phase	

The motor nameplate horsepower rating shall not exceed the brake horsepower requirements of the specified head and capacity conditions. The motor shall be UL listed for Class 1, Division 1, Group C and D explosion-proof hazardous locations. The windings and leads shall be insulated with moisture-resistant Class F insulation and shall be designed along with the motor, for

continuous duty. The motor shaft shall be one piece 416 stainless steel along with all appurtenant hardware. The rotor shall be dynamically balanced to meet NEMA vibration limits. Heavy duty lifting lugs shall be cast into the motor housing and shall be of adequate strength to lift the entire pump and motor assembly.

AUTOMATIC PUMP CONTROLS

1. General Requirements
    a. Refer to Chapter 9, Specification Section 13446 – Remote Telemetry, Lift Stations of PWC's Permit Design Manual for additional requirements.
    b. Refer to Chapter 9, Specification Section 16231 – Emergency Power Systems of PWC's Permit Design Manual for additional requirements.
    c. Refer to Chapter 9, Specification Section 16010 - Electrical of PWC's Permit Design Manual for additional requirements.
    d. Refer to applicable detail drawings contained within PWC's Permit Design Manual for additional requirements.
2. Functional Requirements
    a. The pump control panel shall be provided with an alarm horn, a remote mounted alarm light, and an alarm silence pushbutton. Remote Pump Control Panel Alarm Horn Disable/Enable contacts shall be provided from the RTU to control alarm horn actuation. The pump control panel shall annunciate all alarm and failure conditions on the inside dead front mounting panel. Only the High Wetwell Level Alarm shall cause the alarm horn and remote mounted alarm light to annunciate.
    b. Each pump shall be provided with a HAND-OFF-AUTO switch on the pump control panel. The pumps shall not run in the OFF position and run in HAND position. In AUTO position, the pumps shall operate as follows:
        i. On rising liquid level in the wetwell, a float switch shall start the lead pump. As the liquid level continues to rise, the second float switch shall start the lag pump. The pump(s) will continue to operate until the liquid level recedes to the level of a third float switch which shall stop all pumps. A fourth float switch shall actuate the high level alarm within the pump control panel, should the liquid level rise above the lag pump cut-on elevation. A fifth float switch shall be routed through the pump control panel to the RTU and shall actuate at the same level that the pump control panel's high level alarm float switch actuates.
        ii. The pumps shall automatically alternate between the lead and lag starts by means of an alternator relay in the pump control panel.
        iii. Remote RTU Control Enable and Start/Stop Command contacts shall be provided for each pump. When enabled, the RTU shall provide remote pump control of each pump

and override any automatic control functions excluding safety and equipment protection interlocks.

iv. On a restoration of power after loss event a timer(s) shall prevent simultaneous starting of pumps.

3. Pump Control Panel

a. A Pump Control Panel for each lift station shall be shipped to the site, completely pre-wired, pre-assembled and ready for service. The control panel enclosure shall be NEMA-4X stainless steel with a continuous hinged and pad-lockable door. The enclosure shall have a back mounting panel and a front inside hinged panel to make the control panel "dead-front" when outside door is open. The panel shall be UL508A and NEC 409 labeled and shall include the following as a minimum:

i. Multi-colored wires (or equivalent marking) shall be provided to facilitate trouble shooting. Refer to Division 16 – Electrical for wire color standards.

ii. Motor control shall be provided by a full voltage non-reversing (FVNR), reduced voltage auto-transformer (RVAT), or reduced voltage solid state starter (RVSS). Reduced voltage starters shall be capable of starting the motor under all expected load conditions. RVSS starters shall include a bypass contact in case of electronics failure. A combination type starter shall be provided for each pump motor, labeled "PUMP 1", "PUMP 2", etc. The starter for each motor shall be provided with under-voltage release and quick-trip ambient-compensated overload protection for each leg. Starter shall be Cutler-Hammer, Allen-Bradley, Square D, GE, or Siemens.

iii. Phase monitoring capability which shall override and stop the normal operation of the pumps.

iv. Automatic pump alternator relay as manufactured by TimeMark or equal.

v. Individual timers (0-999 sec.) for each pump to prevent pumps from starting at the same time on restoration of power after loss of power.

vi. A NEMA 3R transformer with a minimum rating of 3 KVA shall be provided mounted to the exterior of the pump control panel for supplying 120/240 VAC single phase loads. The transformer shall be provided with a secondary circuit breaker within the pump control panel. Branch circuit breakers shall be provided within the pump control panel for the follow loads as a minimum:

a) Pump controls

b) GFCI receptacle mounted on equipment rack (20A CB).

c) RTU control panel (15A CB)

d) Generator controls / battery charger

e) Generator heater

f) Spare 20A circuit breaker (800 watt minimum)

vii. The following controls shall be mounted on the exterior of the pump control panel:

a) Power Available white indicator light

b) NEMA 4X Alarm horn with adjustable volume. Alarm horn shall be by Edwards, Federal Signal, or equal.

viii. The following controls shall be mounted on the front inside panel of the pump control panel:

a) Hand-Off-Auto selector switch for each pump

b) Pump Running red indicator light for each pump

c) Pump Running Hours elapsed time meter for each pump. Meters shall be 6 digits with rear mounted reset.

d) Pump Motor Overload Alarm amber indicator light for each pump

e) Pump Motor High Temp Alarm amber indicator light for each pump

f) Moisture Intrusion Alarm amber indicator light for each pump (submersible pumps only)

g) High Wetwell Level Alarm amber indicator light

h) Loss of Phase Alarm amber indicator light

ix. The control panel shall have dry contact relay outputs to connect to the SCADA System RTU Panel. The outputs shall be as follows:

a) All pump off level

b) Lead pump on level

c) Lag pump on level

d) High level alarm

e) Loss of phase

f) Generator running

g) Pump 1 running

h) Pump 1 common failure

i) Pump 2 running

j) Pump 2 common failure

k) Pump 1 in auto

l) Pump 2 in auto

m) Refer to Specification 13446 Remote Telemetry, Lift Stations for signal interface requirements Pages 17 - 18), and Remote Telemetry Unit (RTU) Control Panel Construction Drawing (Sheet 4 of 4).

x. The pump control panel shall accept dry contacts (control inputs) from the SCADA System RTU. Refer to Specification 13446 Remote Telemetry, Lift Stations for signal interface requirements (Page 18), and Remote Telemetry Unit (RTU) Control Panel Construction Drawing (Sheet 4 of 4). The inputs shall be as follows:

a) Pump 1 start/stop command

b) Pump 1 RTU control enable

c) Pump 2 start/stop command

d) Pump 2 RTU control enable

e) Pump Control Panel alarm horn disable/enable

f) Spare

xi. All necessary internal wiring separation, relays, intrinsic safety barriers, etc. to provide an intrinsically safe operation for a Class I Division 1 Hazardous Area wetwell shall be provided. All signals provided to the RTU through the pump control panel from a hazardous area shall be provided with barriers eliminating the requirement for intrinsically safe wiring of that signal.

4. Standby Power Source: The generation unit and transfer switch shall provide control interface signals to the pump control panel and remote telemetry unit as specified therein.

a. Refer to Chapter 9, Specification Section 13446 – Remote Telemetry, Lift Stations of PWC's Permit Design Manual for additional requirements.

b. Refer to Chapter 9, Specification Section 16231 – Emergency Power Systems of PWC's Permit Design Manual for additional requirements.

c. Refer to Chapter 9, Specification Section 16010 - Electrical of PWC's Permit Design Manual for additional requirements.

d. Refer to applicable detail drawings contained within PWC's Permit Design Manual for additional requirements.

5. Appurtenances

a. Float switches shall be of the mercury-tube type, encapsulated in polyurethane or vinyl floats. The units shall be waterproof, shockproof, explosion-proof and equipped with

sufficient UV resistant submersible cable to extend to the control panel from the wetwell without splicing. Float switches shall be suspended in the wetwell on a suitable rack or rail of stainless steel construction. The float switch rack shall be easily accessible from outside the wetwell to eliminate "Confined Space" entry requirements for operation personnel. Float switches shall be unaffected by flows, etc., entering the wetwell. Any required weights shall be provided. Two sets of four (4) float switches shall be provided for duplex stations and two sets of five (5) provided for triplex stations. An additional High Level Alarm float connected to the RTU will be provided for a total of nine (9) or eleven (11) installed for duplex and triplex stations respectively. Each set shall be suspended separately in the wetwell, so that removal of either does not affect the operation of the other set. Both sets of float switches shall have their cables routed to the pump control panel and connected to terminals within the panel. The pump control panel will include a manual selector switch to allow alternation between the "primary" and "backup" sets of float switches. Each set of float switches shall provide for the following signals as a minimum:

i. All Pump Stop Level (provide two - Primary / Backup)

ii. Lead Pump Start Level (provide two - Primary / Backup)

iii. Lag Pump Start Level (provide two - Primary / Backup)

iv. Lag-Lag Pump Start Level – Triplex Stations only (provide two - Primary / Backup)

v. Pump Control Panel High Level Alarm (provide two - Primary / Backup)

vi. RTU High Level Alarm (One only)

Float switches provided shall be Meyers, Anchor Scientific (Roto-Float) or Conery (Model 2900).

b. A stainless steel equipment rack shall be provided to mount the electrical panels (e.g. meter base, main service disconnect, pump control panel, remote telemetry panel, etc.). The rack shall include a sun/rain shield and a concrete personnel pad. The pump control panel remote alarm light shall be mounted on the sun/rain shield at a location approved by PWC. The alarm light shall be a NEMA 4X red strobe light as manufactured by Edwards, Federal Signal, or equal. Refer to the detail drawings provided within PWC's *Permit Design Manual* for additional requirements.

c. The lift station site shall be provided with area lighting. The lighting shall meet the requirements of the local power company and should be sited as shown on the drawings.

PUMP REMOVAL / REPLACEMENT SYSTEM

The pump assembly shall be provided with a guide "rail" system to permit ease of installation and removal. The system shall consist of two - 2-inch diameter continuous stainless steel guide rail pipes and appropriate sized stainless steel cables. The guide rails shall align the pump with the discharge elbow as it is lowered into place. A rail guide bracket shall be used to support and align the rails at the top of the sump.

The pump shall be raised and lowered into position by a telescopic hoist assembly. The telescopic hoist shall extend a minimum of five-feet above the wet well access hatch when in the upright position and shall be secured by a pin-lock device. The hoist shall be located in a manner that permits the removal of either pump and shall allow full three hundred sixty degree rotation for direct loading into a service vehicle. The hoist shall be located on the wet well's slab, or located on its own foundation, provided the requirements of this specification are met. The hoist shall have a rated capacity of not less than 1,600 pounds. The stainless steel lifting cables shall be arranged to allow connection to the hoist for pump installation or removal.

VALVES AND PIPING

1. Ductile Iron Pipe and Fittings

   All piping in the lift station wetwell and valve vault shall be ductile iron, Class 53, AWWA/ANSI C115/A21.15. Flanges shall be Class 125, ANSI B16.1. Piping interior surfaces shall be coated with ceramic epoxy lining as specified in Section 09802 "Special Coatings – Ceramic". Exterior piping surfaces shall be shop primed. All flange gaskets shall be 1/8-inch full-face serrated rubber material.

2. Gate Valves

   Each pump shall be equipped with a resilient wedge gate valve to allow both pumps to be isolated from the force main. Valve shall pass 3" spherical solids. Gate valves shall be ductile iron body resilient wedge type rated for 250 psig working pressure gate valves and shall conform to AWWA C-515 and NSF 61. Valve body shall have flanged end connections drilled to 125 pound standard. Valves for aboveground use or installed inside vaults shall be NRS design with handwheel. Valves shall open by turning in a counterclockwise direction. The handwheel shall have an arrow cut in the metal, indicating the direction of opening. Valves shall have a clear waterway equal to the full nominal diameter of the valve. All valves shall be tested for leakage and distortion in strict accordance with the latest revision of AWWA Specification C-500. All gate valves shall be manufactured in strict accordance with the latest specifications of the AWWA. Valves shall be manufactured by: Mueller Company, Clow Corporation, American Darling Company, or approved equal. Certification shall be furnished to PWC by the manufacturer that all valves meet project specifications. Where specified on plans, resilient valves shall be supplied with gearing. Valves installed in a vertical position shall have spur gearing and bevel gearing for valves installed in a horizontal position.

Valve boxes shall be installed as specified in SECTION 02660, WATER DISTRIBUTION.

3. Check Valves

Each pump shall be equipped with a full flow type check valve with flanged ends and fitted with an external lever and spring. Each valve shall be capable of passing a 3" spherical solid. Valve clapper shall be cast iron, and shall swing completely clear of waterway when valve is full open. The seating shall be by a resilient field replaceable ring on the valve disc contacting a bronze or stainless seat ring in the valve body. Hinge pin shall be of 18 8 stainless steel construction and shall be utilized with bronze bushings and packing type seal. Valves shall be equipped with removable cover plate to permit entry or for complete removal of internal components without removing the valve from the line. Valve ends for use in above-ground or vault installations shall be flanged end connections drilled to 125 pound standard. Valve shall be rated at 175 psi water working pressure, 350 psi hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid shall not be acceptable.

4. By-Pass Pumping Valves and Piping

All Lift Stations shall have a By-Pass Pumping Assembly incorporated into the force main piping downstream from valve vaults or common header piping. By-Pass Pumping Assemblies shall be installed according to plan drawings and details with materials as specified in SECTION 02732, SEWAGE FORCE MAINS. Valve boxes shall be installed as specified in SECTION 02660, WATER DISTRIBUTION.

WET WELL/VALVE VAULT

The wet well and valve pit structures shall be precast concrete sections with a coal tar epoxy interior coating. The structures shall be manufactured and installed in accordance with ASTM C-890, ASTM C-891, ASTM C-913 and ASTM C-478. Joints between precast sections shall be sealed with one-inch diameter butyl rubber sealant conforming to SS-S-00210-A and AASHTO-198. Flexible rubber pipe wall penetrations and/or connections shall be in accordance with ASTM C-923. The wet well shall be watertight. The wet well base shall be manufactured specifically for direct mounting to an open top manhole and shall be provided with all mounting hardware and anchor bolts.

The minimum wet well diameter shall be six (6) feet, and the minimum valve vault shall be five (5) feet.

Access hatches shall be provided as shown on the drawings. Hatches shall be 3/16-inch aluminum checker plate with a stainless steel hardware frame. The frame shall be 1/4-inch thick

aluminum reinforcement cast into the concrete top. The hatch shall be designed for H-2O loading and shall provide for a latch with locking device.

The cable junction box shall be provided in an NEMA 3 or NEMA 4 enclosure mounted outside of the wet well.

SITE LIGHTING

The lift station site shall be provided with area lighting. The lighting shall meet the requirements of the local power company and should be sited as shown on the drawings.

SITE FENCING

The lift station site shall be fenced as shown on the drawings. Fencing shall be installed as specified in SECTION 02831, CHAIN LINK FENCING.

SITE ACCESS

Site access to the lift station shall be provided by a gravel access drive/parking area. The drive shall be a minimum of 10-feet wide and shall be oriented as shown on the plans. It shall consist of a minimum of 6 inches compacted ABC stone base. The drive shall be graded to drain and shall be installed in such a way as to minimize the runoff and erosion potential. Parking area shall be of sufficient size for a vactor truck to turn around during wet well cleaning.

WATER SERVICE

Each lift station site shall be provided with a source of water for routine maintenance purposes. If possible, a fire hydrant shall be located adjacent to the lift station site to facilitate filling of the wet well during lift station start up.

A one (1) inch water service with a standard PWC meter box, a reduced pressure backflow preventer, and a yard hydrant shall be installed at each lift station. The meter shall be installed inside the easement or right-of-way, in accordance with PWC standards. The meter box shall be in accordance with PWC standards. The reduced pressure backflow preventer shall be installed within 100’ of the tap on the main and inside the lift station fencing unless the distance exceeds 100’. A non-freeze 1" yard hydrant shall be provided, located as shown on the approved site plan. The yard hydrant shall be installed in accordance with the Yard Hydrant standard detail.

INSTALLATION

Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Immediately after off-loading, contractor shall inspect pumps and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all equipment serial numbers and parts lists with shipping documentation. Notify the appropriate manufacturer's representative of any unacceptable conditions noted with shipper.

Install, level, align, and lubricate pumps and all related equipment as required by the manufacturer. Equipment installation shall be in accordance with written instructions supplied by the respective manufacturer.

FIELD QUALITY CONTROL

Prior to acceptance by PWC, an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

After construction debris and foreign material has been removed from the wet well, the contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

The Contractor shall co-ordinate station start-up with pump manufacturers technical representative. The representative or factory service technician shall inspect the completed installation and calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.

OPERATION AND MAINTENANCE MANUALS

Installation shall be in accordance with written instructions provided by the pump equipment supplier. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.

Documentation shall be specific to the pump station and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied. Support data for all equipment supplied shall be provided by those supplying the equipment, and included into the O&M manual. Instructions shall include the following as a minimum:

a. Functional description of each major component, complete with operating instructions.
b. Instructions for operating pumps and pump controls in all modes of operation.
c. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.
d. Support data for all components shall be incorporated into the O&M Manual.
e. As-built electrical schematic diagram of the pump station circuits shall illustrate pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.
f. As-built mechanical layout drawing of the pump station and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.

QUALITY ASSURANCE

Upon request from PWC, pre-engineered pump station suppliers shall prove financial stability and ability to produce the pump system within the specified delivery schedules. Evidence of facilities, equipment and expertise shall demonstrate the manufacturer's commitment to long-term customer service and product support.

MANUFACTURER'S WARRANTY

The contractor shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.

All equipment, apparatus, and parts furnished shall be warranted for one (1) year, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O-rings, etc. The pump manufacturer shall be solely responsible for warranty of the

pumps and all related equipment. The pump shaft seal shall be warranted for a minimum of four (4) years from date of shipment. Should the seal fail within the first year, the manufacturer shall furnish a new seal, without charge to owner, F.O.B. factory. The warranty replacement cost for seals after the first year will be pro-rated as follows:

Failure Within	Percent New Price
2 years	25%
3 years	50%
4 years	75%

Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer without cost of parts or labor to the owner.

DIVISION 2
SITE WORK

02754 SELF-PRIMING LIFT STATION

GENERAL

This section includes all pumps, piping, fittings, valves, structures, and other appurtenances that form an integral part of a duplex self-priming sewage lift station. All work shall be accomplished in a neat, workmanlike manner meeting the requirements of the City of Fayetteville Public Works Commission. PWC shall be supplied with shop drawings of all equipment and materials for approval prior to installation. The Contractor shall supply six (6) sets of O&M Manuals for the lift station, including support literature, shop drawings, and O&M instructions before final approval and acceptance of the operational station. The lift station start up shall be performed by a qualified factory representative capable of supervising the Owner's personnel in proper operation and maintenance.

The Contractor shall furnish and install a base mounted, automatic pump system. The pump system shall be complete with all equipment specified herein; including factory assembled pumps mounted on individual pump bases. Pre-engineered modular pump stations shall be submitted to the Owner for approval prior to bidding. Principal items of equipment shall include two horizontal, self-priming, centrifugal sewage pumps, v-belt drives, motors, two swing check valves, two resilient wedge gate valves, pump motor control panel, and an automatic liquid level control system. The Contractor shall be responsible for providing and installing the automatic pump control system, telemetry, emergency generator and associated automatic transfer switch according to Owner's specifications.

SUBMITTALS

Prior to fabrication, pump station supplier shall submit six (6) copies of submittal data for review and approval by the Owner. Submittal shall include shop drawings, electrical ladder logic drawings, and support data as follows: Catalog cut sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor and v-belt drive data, pump characteristic curves showing the design duty point capacity (GPM), head (FT), net positive suction head required (NPSHr), and hydraulic brake horsepower (BHP). Electrical components used in the motor and liquid level control shall be fully described. The electrical ladder logic drawings shall illustrate motor and liquid level control circuits to the extent necessary to validate function and integration of circuits to form a complete working system. Shop drawings for pre-engineered stations shall provide layout of mechanical equipment and contractor piping connections.

SELF- PRIMING SEWAGE PUMPS

Pumps shall be horizontal, self-priming centrifugal type, designed specifically for handling raw, unscreened, domestic sanitary sewage and shall be capable of passing a three-inch (3") sphere. The manufacturer of the pumps shall have a quality management system in place and shall be ISO 9001 certified. Each pump shall be selected to perform under following operating conditions:

Pump Performance	
Pump Capacity (GPM)	
Motor Size (HP)	
Total Dynamic Head (FT)	
Available NPSH (FT)	
Max. Re-priming Lift (FT)	

Pumps shall be Gorman-Rupp or Pioneer. Pump motors shall be set for a 3 phase, 60 hertz, 240 volt electrical service.

REPRIME PERFORMANCE

Consideration shall be given to the sanitary sewage service anticipated, in which debris is expected to lodge between the primary check valve and its seat, resulting in the loss of the pump suction leg, and siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal, and the pump must be capable of automatic, unattended operation with an air release line installed. During unattended operation, the pump shall retain adequate liquid in the casing to insure automatic re-priming while operating at its rated speed in a completely open system. The need for a suction check valve or external priming device shall not be required.

Pumps must re-prime __ vertical feet at the required speed and impeller diameter. Re-prime lift is defined as the static height of the pump suction above the liquid, while operating with only one-half of the liquid remaining in the pump casing. The pump must re-prime and deliver full capacity within five minutes after the pump is energized in the re-prime condition. Re-prime performance must be confirmed with the following test set-up:

a. A check valve shall be installed down stream from the pump discharge flange. The check valve size shall be equal (or greater than) the pump discharge diameter.
b. A length of air release pipe shall be installed between the pump and the discharge check valve. This line shall be open to atmosphere at all times duplicating the air displacement rate anticipated at a typical pump station fitted with an air release valve.
c. No restrictions in the pump or suction piping will prevent the siphon drop of the suction leg. Suction pipe configuration for re-prime test shall incorporate a 2 feet minimum horizontal run, a 90 degree elbow and vertical run at the specified lift. Pipe size shall be equal to the pump suction diameter.

d. Impeller clearances shall be set as recommended in the pump service manual.
e. Repeatability of performance shall be demonstrated by testing five consecutive re-prime cycles. Full pump capacity (flow) shall be achieved within five minutes during each cycle.
f. Liquid to be used for re-prime test shall be water.

Upon request from PWC, certified re-prime performance test results, prepared by the manufacturer, and certified by a registered professional engineer, shall be submitted for approval prior to shipment.

PUMP CASING

Casing shall be cast iron Class 30 with integral volute scroll. Casing shall incorporate the following features:

a. Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.
b. Fill port cover plate, 3 1/2" diameter, shall be opened after loosening a hand nut/clamp bar assembly. In consideration for safety, hand nut threads must provide a slow release of pressure, and the clamp bar shall be retained by detente lugs. A Teflon gasket or viton o-ring shall prevent adhesion of the fill port cover to the casing.
c. Casing drain plug shall be at least 1 1/4" NPT to insure complete and rapid draining.
d. Liquid volume and recirculation port design shall be consistent with performance criteria listed above.

COVERPLATE

Cover plate shall be cast iron Class 30. Design must incorporate following maintenance features:

a. Retained by hand nuts for complete access to pump interior. Cover plate removal must provide ample clearance for removal of stoppages, and allow service of the impeller, seal or wear plate without removing suction or discharge piping.
b. A replaceable wear plate secured to the cover plate by weld studs and nuts shall be AISI 1015 HRS.
c. In consideration for safety, a pressure relief valve shall be supplied in the cover plate. Relief valve shall open at 75-200 PSI.
d. O-ring of Buna-N material shall seal cover plate to pump casing.

ROTATING ASSEMBLY

A rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, seal plate and bearing housing must be removable as a single unit without disturbing the pump casing or piping. Design shall incorporate following features:

a. Bearing housing shall be cast iron Class 30. Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Cavities must be cooled by the liquid pumped and lip seals will prevent leakage of oil. The bearing cavity shall have an oil level sight gauge and fill plug check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.
b. Impeller shall be austempered ductile iron, two-vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lock screw and conical washer. All internal passages and impeller vanes shall pass a 3" spherical solid. Smaller internal passages shall not be permitted.
c. Shaft shall be AISI 17-4 pH stainless steel.
d. Bearings shall be anti-friction ball or tapered roller type of proper size and designed to withstand all radial and thrust loads expected during normal operation. Bearings shall be oil lubricated from a dedicated reservoir. Pump designs, which use the same oil to lubricate the bearings and shaft seal, shall not be acceptable.
e. At a minimum, shaft seal shall be oil lubricated mechanical single-type with silicone carbide faces. For double-type seals the stationary and rotating seal faces shall be silicone carbide or tungsten titanium carbide alloy. Each mating surface shall be lapped to one-half light band flatness (5.8 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by virtue of a dual O-ring design; an external O-ring secures the stationary seat to the seal plate, and an internal O-ring holds the faces in alignment during periods of mechanical or hydraulic shock (loads which cause shaft deflection, vibration, and axial/radial movement). Elastomers shall be viton. Cage and spring to be AISI 316 stainless steel. Seal shall be oil lubricated from a dedicated reservoir. Seal shall be warranted in accordance with requirements listed under Manufacturer’s Warranty of this specification.
f. Adjustment of the impeller face clearance (distance between impeller and wear plate) shall be accomplished by external means. Stainless steel adjusting shims shall be used to move the entire rotating assembly as a unit when adjusting the working clearances. Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.
g. Spool flanges shall be one-piece cast iron, class 30 fitted to suction and/or discharge ports. Each spool shall have one 1-1/4" NPT and one 1/4" NPT tapped hole with pipe plugs for mounting gauges or other equipment.

MOTORS AND DRIVE UNIT

Pump motors shall be __ HP, horizontal ODP, ____ RPM, NEMA design B with cast iron frame with copper windings, induction type, with normal starting torque and low starting current characteristics, suitable for continuous service.

Power to pumps shall be transmitted by V-belt drive assemblies. The sheave/belt combination shall provide the speed ratio needed to achieve the specified pump operating conditions. Each drive assembly shall utilize at least two V-belts providing minimum a combined safety factor of 1.5. Single belt drives or systems with a safety factor of less than 1.5 are not acceptable. Computation of safety factors shall be based on performance data published by the drive manufacturer. Pump drives shall be enclosed on all sides by a guard constructed of fabricated steel or combination of materials including expanded, perforated, or solid sheet metal. No opening to a rotating member shall exceed 1/2 inch. Guards must be completely removable without interference from any unit component, and shall be securely fastened and braced to the unit base.

AUTOMATIC PUMP CONTROLS

1. General Requirements
    a. Refer to Chapter 9, Specification Section 13446 – Remote Telemetry, Lift Stations of PWC's Permit Design Manual for additional requirements.
    b. Refer to Chapter 9, Specification Section 16231 – Emergency Power Systems of PWC's Permit Design Manual for additional requirements.
    c. Refer to Chapter 9, Specification Section 16010 - Electrical of PWC's Permit Design Manual for additional requirements.
    d. Refer to applicable detail drawings contained within PWC's Permit Design Manual for additional requirements.
2. Functional Requirements
    a. The pump control panel shall be provided with an alarm horn, a remote mounted alarm light, and an alarm silence pushbutton. Remote Pump Control Panel Alarm Horn Disable/Enable contacts shall be provided from the RTU to control alarm horn actuation. The pump control panel shall annunciate all alarm and failure conditions on the inside dead front mounting panel. Only the High Wetwell Level Alarm shall cause the alarm horn and remote mounted alarm light to annunciate.
    b. Each pump shall be provided with a HAND-OFF-AUTO switch on the pump control panel. The pumps shall not run in the OFF position and run in HAND position. In AUTO position, the pumps shall operate as follows:
        i. On rising liquid level in the wetwell, a float switch shall start the lead pump. As the liquid level continues to rise, the second float switch shall start the lag pump. The pump(s) will continue to operate until the liquid level recedes to the level of a third

float switch which shall stop all pumps. A fourth float switch shall actuate the high level alarm within the pump control panel, should the liquid level rise above the lag pump cut-on elevation. A fifth float switch shall be routed through the pump control panel to the RTU and shall actuate at the same level that the pump control panel's high level alarm float switch actuates.

ii. The pumps shall automatically alternate between the lead and lag starts by means of an alternator relay in the pump control panel.

iii. Remote RTU Control Enable and Start/Stop Command contacts shall be provided for each pump. When enabled, the RTU shall provide remote pump control of each pump and override any automatic control functions excluding safety and equipment protection interlocks.

iv. On a restoration of power after loss event a timer(s) shall prevent simultaneous starting of pumps.

3. Pump Control Panel

a. A Pump Control Panel for each lift station shall be shipped to the site, completely pre-wired, pre-assembled and ready for service. The control panel enclosure shall be NEMA-4X stainless steel with a continuous hinged and pad-lockable door. The enclosure shall have a back mounting panel and a front inside hinged panel to make the control panel "dead-front" when outside door is open. The panel shall be UL508A and NEC 409 labeled and shall include the following as a minimum:

i. Multi-colored wires (or equivalent marking) shall be provided to facilitate trouble shooting. Refer to Division 16 – Electrical for wire color standards.

ii. Motor control shall be provided by a full voltage non-reversing (FVNR), reduced voltage auto-transformer (RVAT), or reduced voltage solid state starter (RVSS). Reduced voltage starters shall be capable of starting the motor under all expected load conditions. RVSS starters shall include a bypass contact in case of electronics failure. A combination type starter shall be provided for each pump motor, labeled "PUMP 1", "PUMP 2", etc. The starter for each motor shall be provided with under-voltage release and quick-trip ambient-compensated overload protection for each leg. Starter shall be Cutler-Hammer, Allen-Bradley, Square D, GE, or Siemens.

iii. Phase monitoring capability which shall override and stop the normal operation of the pumps.

iv. Automatic pump alternator relay as manufactured by TimeMark or equal.

v. Individual timers (0-999 sec.) for each pump to prevent pumps from starting at the same time on restoration of power after loss of power.

vi. A NEMA 3R transformer with a minimum rating of 3 KVA shall be provided mounted to the exterior of the pump control panel for supplying 120/240 VAC single phase loads. The transformer shall be provided with a secondary circuit breaker

within the pump control panel. Branch circuit breakers shall be provided within the pump control panel for the follow loads as a minimum:

a) Pump controls

b) GFCI receptacle mounted on equipment rack (20A CB).

c) RTU control panel (15A CB)

d) Generator controls / battery charger

e) Generator heater

f) Spare 20A circuit breaker (800 watt minimum)

vii. The following controls shall be mounted on the exterior of the pump control panel:

a) Power Available white indicator light

b) NEMA 4X Alarm horn with adjustable volume. Alarm horn shall be by Edwards, Federal Signal, or equal.

viii. The following controls shall be mounted on the front inside panel of the pump control panel:

a) Hand-Off-Auto selector switch for each pump

b) Pump Running red indicator light for each pump

c) Pump Running Hours elapsed time meter for each pump. Meters shall be 6 digits with rear mounted reset.

d) Pump Motor Overload Alarm amber indicator light for each pump

e) Pump Motor High Temp Alarm amber indicator light for each pump

f) Moisture Intrusion Alarm amber indicator light for each pump (submersible pumps only)

g) High Wetwell Level Alarm amber indicator light

h) Loss of Phase Alarm amber indicator light

ix. The control panel shall have dry contact relay outputs to connect to the SCADA System RTU Panel. The outputs shall be as follows:

a) All pump off level

b) Lead pump on level

c) Lag pump on level

d) High level alarm

e) Loss of phase

f) Generator running

g) Pump 1 running

h) Pump 1 common failure

i) Pump 2 running

j) Pump 2 common failure

k) Pump 1 in auto

l) Pump 2 in auto

m) Refer to Specification 13446 Remote Telemetry, Lift Stations for signal interface requirements Pages 17 - 18), and Remote Telemetry Unit (RTU) Control Panel Construction Drawing (Sheet 4 of 4).

x. The pump control panel shall accept dry contacts (control inputs) from the SCADA System RTU. Refer to Specification 13446 Remote Telemetry, Lift Stations for signal interface requirements (Page 18), and Remote Telemetry Unit (RTU) Control Panel Construction Drawing (Sheet 4 of 4). The inputs shall be as follows:

a) Pump 1 start/stop command

b) Pump 1 RTU control enable

c) Pump 2 start/stop command

d) Pump 2 RTU control enable

e) Pump Control Panel alarm horn disable/enable

f) Spare

xi. All necessary internal wiring separation, relays, intrinsic safety barriers, etc. to provide an intrinsically safe operation for a Class I Division 1 Hazardous Area wetwell shall be provided. All signals provided to the RTU through the pump control panel from a hazardous area shall be provided with barriers eliminating the requirement for intrinsically safe wiring of that signal.

4. Standby Power Source: The generation unit and transfer switch shall provide control interface signals to the pump control panel and remote telemetry unit as specified therein.

a. Refer to Chapter 9, Specification Section 13446 – Remote Telemetry, Lift Stations of PWC's Permit Design Manual for additional requirements.

b. Refer to Chapter 9, Specification Section 16231 – Emergency Power Systems of PWC's Permit Design Manual for additional requirements.

c. Refer to Chapter 9, Specification Section 16010 - Electrical of PWC's Permit Design Manual for additional requirements.

d. Refer to applicable detail drawings contained within PWC's Permit Design Manual for additional requirements.

5. Appurtenances

a. Float switches shall be of the mercury-tube type, encapsulated in polyurethane or vinyl floats. The units shall be waterproof, shockproof, explosion-proof and equipped with sufficient UV resistant submersible cable to extend to the control panel from the wetwell without splicing. Float switches shall be suspended in the wetwell on a suitable rack or rail of stainless steel construction. The float switch rack shall be easily accessible from outside the wetwell to eliminate "Confined Space" entry requirements for operation personnel. Float switches shall be unaffected by flows, etc., entering the wetwell. Any required weights shall be provided. Two sets of four (4) float switches shall be provided for duplex stations and two sets of five (5) provided for triplex stations. An additional High Level Alarm float connected to the RTU will be provided for a total of nine (9) or eleven (11) installed for duplex and triplex stations respectively. Each set shall be suspended separately in the wetwell, so that removal of either does not affect the operation of the other set. Both sets of float switches shall have their cables routed to the pump control panel and connected to terminals within the panel. The pump control panel will include a manual selector switch to allow alternation between the "primary" and "backup" sets of float switches. Each set of float switches shall provide for the following signals as a minimum:

   i. All Pump Stop Level (provide two - Primary / Backup)

   ii. Lead Pump Start Level (provide two - Primary / Backup)

   iii. Lag Pump Start Level (provide two - Primary / Backup)

   iv. Lag-Lag Pump Start Level – Triplex Stations only (provide two - Primary / Backup)

   v. Pump Control Panel High Level Alarm (provide two - Primary / Backup)

   vi. RTU High Level Alarm (One only)

   Float switches provided shall be Meyers, Anchor Scientific (Roto-Float) or Conery (Model 2900).

b. An equipment rack shall be provided to mount the electrical panels (e.g. meter base, main service disconnect, pump control panel, remote telemetry panel, etc.). The rack shall include a sun/rain shield and a concrete personnel pad. The pump control panel remote alarm light shall be mounted on the sun/rain shield at a location approved by PWC. The alarm light shall be a NEMA 4X red strobe light as manufactured by Edwards, Federal Signal, or equal. Refer to the detail drawings provided within PWC's *Permit Design Manual* for additional requirements.

c. The lift station site shall be provided with area lighting. The lighting shall meet the requirements of the local power company and should be sited as shown on the drawings.

LIFT STATION ENCLOSURE

Enclosures shall be as specified in Section 02755 – Fiberglass Reinforced Plastic Enclosures for Lift Stations or Section 02756 – Precast Concrete Enclosures for Lift Stations. Each separate

enclosure shall be placed over a single new pre-cast wet well with size and depth as shown on the drawings.

VALVES AND PIPING

1. Ductile Iron Pipe and Fittings

   All piping in the lift station wetwell and valve vault shall be ductile iron, Class 53, AWWA/ANSI C115/A21.15. Flanges shall be Class 125, ANSI B16.1. Piping interior surfaces shall be coated with ceramic epoxy lining as specified in Section 09802 "Special Coatings – Ceramic". Exterior piping surfaces shall be shop primed. All flange gaskets shall be 1/8-inch full-face serrated rubber material.

2. Gate Valves

   Each pump shall be equipped with a resilient wedge gate valve to allow both pump sets to be isolated from the force main. Valve shall pass 3" spherical solids. Gate valves shall be ductile iron body resilient wedge type rated for 250 psig working pressure gate valves and shall conform to AWWA C-515 and NSF 61. Valve body shall have flanged end connections drilled to 125 pound standard. Valves for aboveground use shall be NRS design with handwheel. Valves shall open by turning in a counterclockwise direction. The operating nut or wheel shall have an arrow cut in the metal, indicating the direction of opening. Valves shall have a clear waterway equal to the full nominal diameter of the valve. All valves shall be tested for leakage and distortion in strict accordance with the latest revision of AWWA Specification C-500. All gate valves shall be manufactured in strict accordance with the latest specifications of the American Water Works Association (AWWA). Valves shall be manufactured by: Mueller Company, Clow Corporation, American Darling Company, or approved equal. Certification shall be furnished to PWC by the manufacturer that all valves meet project specifications. Where specified on plans, resilient valves shall be supplied with gearing. Valves installed in a vertical position shall have spur gearing and bevel gearing for valves installed in a horizontal position.

3. Check Valves

   Each pump shall be equipped with a full flow type check valve with flanged ends and fitted with an external lever and spring. Each valve shall be capable of passing a 3" spherical solid. Valve clapper shall be cast iron, and shall swing completely clear of waterway when valve is full open. The seating shall be by a resilient field replaceable ring on the valve disc contacting a bronze or stainless seat ring in the valve body. Hinge pin shall be of 18 8 stainless steel construction and shall be utilized with bronze bushings and packing type seal. Valves shall be equipped with removable cover plate to permit entry or for complete removal of internal components without removing the valve from the line. Valve ends for use in above-ground or vault installations shall be flanged end connections drilled to 125 pound

standard. Valve shall be rated at 175 psi water working pressure, 350 psi hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid shall not be acceptable.

4. Air Release Valves

   An automatic air release valve shall be furnished for each pump designed to permit the escape of air to the atmosphere during initial priming or unattended re-priming cycles. Upon completion of the priming cycle or re-priming cycle, the valve shall close to prevent recirculation. Valves shall provide visual indication of valve closure, and shall operate solely on discharge pressure. Valves which require connection to the suction line shall not be acceptable. All valve parts exposed to sewage shall be constructed of cast iron, stainless steel, or similar corrosion resistant materials. Diaphragms, if used, shall be of fabric reinforced neoprene or similar inert material. A cleanout port, three inches in diameter, shall be provided for ease of inspection, cleanout, and service. Valves shall be field adjustable for varying discharge heads.

5. By-Pass Pumping Valves and Piping

   All Lift Stations shall have a By-Pass Pumping Assembly incorporated into the force main piping downstream from valve vaults or common header piping. By-Pass Pumping Assemblies shall be installed according to plan drawings and details with materials as specified in SECTION 02732, SEWAGE FORCE MAINS.

SUPPORT/RESTRAINT

All pipes connected to the pumps shall be supported according to good commercial practice to prevent piping loads from being transmitted to the pumps. All lift station piping shall be properly anchored for thrust restraint.

WETWELL

The wet well shall be constructed of pre-cast concrete sections and shall include a coal tar epoxy coating. All concrete shall have a minimum allowable compressive strength of 4,000 psi at 28 days (ACI 301, 3.2). Concrete shall reach a minimum of 80 percent of this design strength before weight supporting forms may be removed (ACI 301, 4.5.5). The structure shall be manufactured and installed in accordance with ASTM C890, ASTM C891, ASTM C913, and ASTM C478. Joints shall be sealed with pre-formed butyl rubber conforming to the requirements of ASTM C990.

Wet wells shall have a minimum diameter of six (6) feet.

Access hatches shall be provided as shown on the drawings. Hatches shall be 3/16-inch aluminum checker plate with a stainless steel hardware frame. The frame shall be ¼-inch thick

aluminum reinforcement cast into the concrete top. The hatch shall be designed for H-20 loading. If hatch is located outside of enclosure it shall be lockable.

SITE LIGHTING

The lift station site shall be provided with area lighting. The lighting shall meet the requirements of the local power company and should be sited as shown on the drawings.

SITE FENCING

The lift station site shall be fenced as shown on the drawings. Fencing shall be installed as specified in SECTION 02831, CHAIN LINK FENCING.

SITE ACCESS

Site access to the lift station shall be provided by a gravel access drive/parking area. The drive shall be a minimum of 10-feet wide and shall be oriented as shown on the plans. It shall consist of a minimum of 6 inches compacted ABC stone base. The drive shall be graded to drain and shall be installed in such a way as to minimize the runoff and erosion potential. Parking area shall be of sufficient size for a vactor truck to turn around during wet well cleaning.

WATER SERVICE

Each lift station site shall be provided with a source of water for routine maintenance purposes. If possible, a fire hydrant shall be located adjacent to the lift station site to facilitate filling of the wet well during lift station start up.

A one (1) inch water service with a standard PWC meter box, a reduced pressure backflow preventer, and a yard hydrant shall be installed at each lift station. The meter shall be installed inside the easement or right-of-way, in accordance with PWC standards. The meter box shall be in accordance with PWC standards. The reduced pressure backflow preventer shall be installed within 100’ of the tap on the main and inside the lift station fencing unless the distance exceeds 100’. A non-freeze 1" yard hydrant shall be provided, located as shown on the approved site plan. The yard hydrant shall be installed in accordance with the Yard Hydrant standard detail.

INSTALLATION

Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Immediately after off-loading, contractor shall inspect pumps and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all equipment serial numbers and parts lists with shipping documentation. Notify the appropriate manufacturer’s representative of any unacceptable conditions noted with shipper.

Install, level, align, and lubricate pumps and all related equipment as required by the manufacturer. Equipment installation shall be in accordance with written instructions supplied by the respective manufacturer.

FIELD QUALITY CONTROL

Prior to acceptance by Owner, an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

After construction debris and foreign material has been removed from the wet well, the contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

The Contractor shall co-ordinate station start-up with pump manufacturer's technical representative. The representative or factory service technician shall inspect the completed installation and calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.

OPERATION AND MAINTENANCE MANUALS

Installation shall be in accordance with written instructions provided by the pump equipment supplier. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.

Documentation shall be specific to the pump station and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied. Support data for all equipment supplied shall be provided by those supplying the equipment, and included into the O&M manual. Instructions shall include the following as a minimum:

a. Functional description of each major component, complete with operating instructions.
b. Instructions for operating pumps and pump controls in all modes of operation.
c. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.
d. Support data for all components shall be incorporated into the O&M Manual.

e. As-built electrical schematic diagram of the pump station circuits shall illustrate pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.

f. As-built mechanical layout drawing of the pump station and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.

QUALITY ASSURANCE

Upon request from PWC, pre-engineered pump station suppliers shall prove financial stability and ability to produce the pump system within the specified delivery schedules. Evidence of facilities, equipment and expertise shall demonstrate the manufacturer's commitment to long-term customer service and product support.

MANUFACTURER'S WARRANTY

The contractor shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.

All equipment, apparatus, and parts furnished shall be warranted for one (1) year, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O-rings, etc. The pump manufacturer shall be solely responsible for warranty of the pumps and all related equipment. The pump shaft seal shall be warranted for a minimum of four (4) years from date of shipment. Should the seal fail within the first year, the manufacturer shall furnish a new seal, without charge to owner, F.O.B. factory. The warranty replacement cost for seals after the first year will be pro-rated as follows:

Failure Within	Percent New Price
2 years	25%
3 years	50%
4 years	75%

Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer without cost of parts or labor to the owner.

DIVISION 2
SITE WORK

02755 FIBERGLASS REINFORCED PLASTIC (FRP) ENCLOSURES FOR LIFT STATIONS

PART 1 - GENERAL

1.1 REQUIREMENTS

Contractor shall furnish and install Fiberglass Reinforced Plastic (FRP) Enclosure(s) to shelter wastewater pumps, electrical switchgear and miscellaneous appurtenances as specified in Section 02740, SELF-PRIMING LIFT STATIONS. The enclosure(s) shall be transportable to the site and placed on concrete pad prepared in accordance with manufacturer's recommendations and the requirements of applicable sections of these specifications. Pre-engineered, factory built lift stations complete with Low-Profile FRP Enclosures may also be provided with prior PWC approval.

1.2 RELATED SECTIONS

Section 02740 - SELF-PRIMING LIFT STATIONS
Section 16010 – ELECTRICAL, LIFT STATIONS
Section 03301 – CONCRETE CONSTRUCTION, UTILITY

1.3 SUBMITTALS

Contractors shall within 30 calendar days after receiving Owner's Notice to Proceed, submit the following product data:

A. Materials list of items proposed to be provided under this Section.

B. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

C. Shop drawings showing plan, elevation and sectional views, materials of construction, and anchor details.

1.4 DELIVERY, STORAGE AND HANDLING

The fiberglass enclosure and the accessory items shall be carefully transported, stored, handled and set in place in a manner that will prevent distortion, misalignment or other damage to the units. During storage prior to installation and following installation, but prior to placing in service, the manufacturer's recommendations regarding handling shall be followed.

PART 2 – PRODUCTS

2.1 GENERAL MATERIAL AND EQUIPMENT REQUIREMENTS

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Engineer, reasonably convenient to the site.

2.2 FRP ENCLOSURES

Each separate FRP enclosure shall be secured to a concrete pad placed at grade and either wholly or partially over a single new pre-cast concrete wet well with size and depth as shown on the drawings. Enclosure outside dimensions shall be as specified in the following table:

Lift Station Designation	Structure Length	Structure Width	Roof Height at Peak

A. Provide a minimum of (4) four lifting eyes arranged on the corners to ease handling and installation onto a concrete pad furnished by the contractor.

B. FRP enclosure walls and roof shall be seamless, one-piece sprayed fiberglass panels laminated to form a structural composite as follows: 1/8" thick fiberglass outside surface, 1 ½" thick foam polyurethane core, 1/2" marine grade plywood, and 3/32" thick fiberglass inside surface.

C. Each wall panel shall be overlapped at the corner and form internal connection joint using stainless steel hardware. All panel joints shall be thoroughly sealed with silicone caulk. The FRP enclosure shall have a minimum R-10 insulation factor and shall be capable of withstanding 125 mph wind loads.

D. The wall sections shall be provided with vertical fiber-beam laminations located between the inner and outer skin of fiberglass to provide structural integrity and prevent de-lamination of the foam core and fiberglass skins. The vertical fiber beams shall be positioned no further than 10" apart.

E. All exterior surfaces shall be brick textured (green, or tan colored) with 18-20 mils of high quality gel coat, incorporating ultra-violet inhibitors.

F. All interior surfaces shall be sprayed with a white gel coat finish offering the same characteristics as the exterior surfaces.

G. The roof panel shall be a one-piece vaulted "hip" design, incorporating the same

materials of construction as the side walls without plywood. The roof shall be removable as a unit, allowing for complete access to the equipment with a crane. The pitch of the roof shall be sufficient for good moisture drainage, and withstand a minimum snow load of 30 pounds per square foot.

H. The FRP enclosure shall be provided with a 4.75” interior fiberglass base flange for mounting to the concrete slab by the installing contractor. The fully assembled enclosure shall be positioned on the concrete mounting pad and sealed with butyl tape. The interior base flange shall be drilled, positioned and fastened to the pad using Type 316 stainless steel expansion anchors on 24" maximum centers. Anchor bolts shall be provided by the contractor.

I. Furnish FRP enclosure factory wired except for service entrance conductors, system ground and as noted otherwise.

2.2.1 Doors and Hardware

A. Single Entrance Doors: The FRP enclosure shall be provided with one single entrance door, 3'-0" wide x 6'-8" high located on the structure as indicated on the plan drawings.

1) The door shall be constructed of laminated fiberglass and foam core materials and be completely compatible with the enclosure.
2) The door threshold shall be ½” high for easy stepover and transport of equipment through the doorway.
3) The door shall be hung with a minimum of (3) three 4” x 4” stainless steel ball bearing type hinges equipped with non-removable pins. The hinges shall be bolted through the doorjamb with stainless steel fasteners. Hinges shall be oriented in the full-mortised position with no fasteners exposed when door is closed.
4) The door shall be equipped with a three point closure system incorporating a door lever mechanism that may be padlocked in the closed position (padlocks furnished by PWC). The door shall be held tight to the enclosure at the top, side and bottom.
5) An adjustable door positioner and holder shall be provided at the top of the door which shall limit the door opening beyond 95 degrees.
6) Door shall be sealed with a weather tight neoprene gasket along the entire perimeter of the door.
7) Single door and all hardware shall be able to withstand 125 MPH winds.
8) A wall mounted drip molding shall be located above each door.

B. Double-Entrance Doors: The enclosure shall be provided with one double entrance door, 6'-0" wide x 6'-8" high located on the structure as indicated on the plan drawings.

1) Double hung door design shall incorporate 3-point locking hardware, door closer, and hinges on each section to allow complete access to the 6'-0" x 6'-8" full door opening without the need for a center sill.

2) Double door design shall adhere to the same material and workmanship specifications as described above for single door design.
3) Double door and all hardware shall be able to withstand 125 MPH winds.

2.2.2 Electrical Materials and Equipment

Electrical materials and equipment shall conform to the requirements in Section 16010 – ELECTRICAL, LIFT STATIONS.

A. Electrical Distribution: The enclosure shall be provided with two, duplex, GFCI receptacles, mounted 48" above finished floor. Receptacle shall be furnished with a corrosion resistant weatherproof cover. The receptacle shall be pre-wired to the electrical junction box. Circuit protection for the receptacles shall be provided within the pump control panel.

B. Interior Lighting: The enclosure shall be provided with, surface-mounted, vapor-tight, three (3) F32T8 lamp, fluorescent light fixtures providing a minimum of two (2) watts illumination per square foot. The enclosure shall be provided with a weatherproof wall switches mounted adjacent to both the single and double enclosure doors. The lighting shall be provided with conduit and wiring to the electrical junction box. Circuit protection for the lighting shall be provided within the pump control panel.

C. Exterior Lighting: The enclosure shall be provided with exterior security lighting mounted over both the single and double enclosure doors. The lighting fixtures shall be shielded to prevent "spillage" onto neighboring properties and shall be fitted with photocell sensors for dusk to dawn operation. Exterior lighting shall be provided with conduit and wiring to the electrical junction box. Circuit protection for the exterior lighting shall be provided within the pump control panel.

D. Exhaust Fan: The enclosure shall be provided with a thermostatically controlled, 120 VAC, exhaust fan with screen and weatherproof shutters shall be installed in the wall approximately opposite a fresh air intake vent. Manual on/off switches shall also be provided adjacent to both the single and double enclosure doors. The fan shall have a minimum capacity of 1600 CFM at free air and be capable of changing the air in the enclosure a minimum of six times per hour. The vent fan shall be pre-wired to the electrical junction box. Circuit protection for the vent fan shall be provided within the pump control panel.

E. Heater: A high capacity electric blower type heater shall be provided for the protection of the internal equipment. The heater shall maintain an inside/outside differential temperature of 30 degrees F while operating on the primary voltage supplied to the pump control panel. The heater shall be provided with an adjustable thermostat, and be wired through conduit to the electrical junction box. Circuit protection shall be provided within the pump control panel.

2.3 LOW-PROFILE FRP ENCLOSURES

Pre-engineered, factory built lift stations complete with Low-Profile FRP Enclosures may be provided with prior PWC approval. Low-profile FRP Enclosures shall contain and enclose all pumps and equipment, and be constructed to enhance serviceability by incorporating the following design characteristics:

A. Access panels shall be provided. Panels shall be sized and placed to permit routine maintenance operations through the panel openings of the enclosure. For these purposes, routine maintenance shall include pump and motor inspection, drive belt adjustment, and pump clean-out. Panels shall be secured with tamper-proof hardware.

B. Not less than two access panels shall be provided with a hinge and latch. Such panels shall provide access to frequently performed adjustments and inspections of the electrical controls. Hinges shall be the continuous type. Latches shall engage the enclosure at not less than two places, and shall be protected by a keyed lock.

C. One access panel shall contain a screened vent to maximize air flow for enclosure ventilation.

D. Station enclosure, less base, must be completely removable or able to be disassembled following the removal of reusable hardware. After removal or disassembly, no portion of the enclosure shall project above the surface of the base to interfere with maintenance operations or endanger personnel.

E. Removal or disassembly of the enclosure shall be accomplished by not more than two maintenance personnel without the use of lifting equipment.

2.3.1 Materials

Low-profile Enclosures for modular lift stations shall be manufactured of molded fiberglass reinforced orthophthalic polyester resins with a minimum of 30 percent fiberglass, and a maximum of 70 percent resin. Resin fillers or extenders shall not be used. Glass fibers shall have a minimum average length of 1-1/4 inches. Major design considerations shall be given to structural stability, corrosion resistance, and water-tight properties. The polyester laminates shall provide a balance of mechanical, chemical, and electrical properties to insure long life. They must be impervious to micro-organisms, mildew, mold, fungus, corrosive liquids, and gases which can reasonably be expected to be present in the environment surrounding the wet well.

All interior surfaces of the housing shall be coated with a polyester resin-rich finish. It shall provide:

A. Maintenance-free service.

B. Abrasion resistance.

C. Protection from sewage, greases, oils, gasoline, and other common chemicals.

The outside of the enclosure shall be coated with a suitable pigmented resin compounded to insure long, maintenance-free life.

2.3.2 Low-Profile FRP Enclosure Base

Station base shall be constructed of pre-cast, reinforced concrete, bonded inside a fiberglass form covering top and sides, and shall be designed to ensure adequate strength to resist deformation of structure during shipping, lifting, or handling. Base shall incorporate drainage provisions, and shall be provided with an opening of sufficient size to permit piping and service connections to the wet well. Station base shall incorporate anchor recesses for securing the pump station to the concrete pad supplied by the Contractor in accordance with the station plans. Color used shall de-emphasize the presence of dirt, grease, etc.

2.4 CONCRETE MATERIALS

Concrete materials including forms and reinforcement shall conform to Section 03301 – CONCRETE CONSTRUCTION, UTILITY

PART 3 - EXECUTION

3.1 FRP ENCLOSURE INSTALLATION

A. Locate FRP Enclosure as indicated on Drawings.

B. Block and shim as necessary to place at proper elevation plumb and level.

C. Snug down anchor bolt nuts and grout uneven places beneath enclosure base using non-shrink grout.

D. Install and make final electrical connections to all equipment shipped loose with water-tight flexible conduit and fittings.

3.2 CONCRETE

Construct concrete pad complying with the Project Drawings and applicable sections of these Specifications. Floor slab shall be a minimum of 6” thick, 4,000 psi @ 28 day minimum, steel reinforced concrete. Slab shall be level to within 1/8” in both directions, comply with local codes and standards, and shall be capable of supporting all imposed loads. Concrete forming, reinforcement, placement and curing shall conform to requirements in Section 03301 – CONCRETE CONSTRUCTION, UTILITY

3.3 ELECTRICAL

Installation of electrical equipment and materials shall conform to the requirements in Section 16010 – ELECTRICAL, LIFT STATIONS.

3.3 QUALITY ASSURANCE

Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

3.4 MANUFACTURER'S WARRANTY

The Fiberglass Enclosure shall be provided with a 5-year manufacturers warranty against defects in material and workmanship.

DIVISION 2
SITE WORK

02756 PRE-CAST CONCRETE ENCLOSURES FOR LIFT STATIONS

PART 1 - GENERAL

1.1 REQUIREMENTS

Contractor shall furnish and install Pre-cast Concrete Enclosure(s) to shelter wastewater pumps, electrical switchgear and miscellaneous appurtenances as specified in Section 02740, SELF-PRIMING LIFT STATIONS. The enclosure(s) shall be transportable to the site in modular wall and roof panel sections and assembled in place on a concrete slab prepared in accordance with manufacturer's recommendations and the requirements of applicable sections of these specifications.

1.2 RELATED SECTIONS

Section 02740 - SELF-PRIMING LIFT STATIONS
Section 16010 – ELECTRICAL, LIFT STATIONS
Section 03301 – CONCRETE CONSTRUCTION, UTILITY

1.3 CODES AND STANDARDS

The following Codes and Standards are incorporated by reference into this specification. The latest edition of these references shall be applicable.

A. ACI 318-99, "Building Code Requirements for Reinforced Concrete", American Concrete Institute.

B. ASCE 7-98, "Minimum Design Loads for Buildings and other Structures", American Society Of Civil Engineers

C. "Manual of Standard Practice", Concrete Reinforcing Steel Institute.

D. Local Codes and Standards for Project Location.

E. UL-752 Level 4 Bullet Resistance, certified by an independent structural engineer. (Pre-cast elements Only)

F. Fabricator must be producer member of the National Pre-cast Concrete Association (NPCA).

G. Building fabricator must have a minimum of five (5) years' experience manufacturing and setting transportable pre-cast concrete buildings.

In case of conflicting requirements between the specification and these referenced documents, the more stringent shall govern.

1.5 SUBMITTALS

Contractors shall within 30 calendar days after receiving Owner's Notice to Proceed, submit the following product data:

A. Materials list of items proposed to be provided under this Section.

B. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

C. Shop drawings showing plan, elevation and sectional views, materials of construction, and anchor details.

1.6 DELIVERY, STORAGE AND HANDLING

The pre-cast concrete enclosure panels and the accessory items shall be carefully transported, stored, handled and erected in a manner that will prevent damage. During storage prior to installation and following installation, but prior to placing in service, the manufacturer's recommendations regarding handling shall be followed.

PART 2 – PRODUCTS

2.1 GENERAL MATERIAL AND EQUIPMENT REQUIREMENTS

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacturer of such products and shall essentially duplicate items that have been in satisfactory use for at least 5-years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Engineer, reasonably convenient to the site.

2.2 PRE-CAST CONCRETE ENCLOSURES

Each separate enclosure shall be erected on a concrete slab placed at grade and either wholly or partially over a single new pre-cast concrete wet well with size and depth as shown on the drawings. Enclosure outside dimensions shall be as specified in the following table:

Lift Station Designation	**Structure Length**	**Structure Width**	**Roof Height at Peak**

2.2.1 Design Requirements

A. Seismic load performance category "C", Exposure Group I, III

B. Standard Roof Live Load - 40 psf.

C. Standard Floor Load – 250 psf.

D. Standard Wind Load – 44 psf (100 mph) (ASCE 7-93)

E. Floor: Floor shall include a ½" turn down edge on all four sides to prevent migration of water into building along bottom of wall panels.

F. Roof: Roof shall have a peak in center of 12-foot direction and shall slope 2" to each side. Roof shall extend a minimum of 3" beyond wall panels on all sides and include a ½" turn down edge with built in drip feature that caps all four walls to prevent migration of water into the building along top of wall panels. Roof shall have a smooth form edge on all four sides. The roof shall be removable as a unit, allowing for complete access to the equipment with a crane.

G. Roof, walls and floor panels shall be sealed at all joints. Wall panels shall set on top of floor panel with the exterior surfaces of the wall panels aligned flush with outside edges of floor panel so that no overhang is allowed.

2.2.2 Pre-cast Concrete Materials

A. Concrete: Steel reinforced, 5000 psi minimum 28-day compressive strength, air-entrained (ASTM C260), water reduced normal weight.

B. Reinforcing Steel: ASTM A615, grade 60, deformed bar unless otherwise indicated.

C. Post-tensioning Strand: 41K Polystrand CP50, .50, 270 KSI, 7-wire strand, greased plastic sheath, (ASTM A416). Roof and floor to be post-tensioned by a single, continuous tendon. Said tendon shall form a substantially rectangular configuration having gently curving corners and a corner where the tendon members are anchored. Tendons shall be greased and enclosed within sheathing. If post-tensioning is not used in the roof panel, the following guidelines must be followed to ensure a watertight roof design.

1) The entire pre-cast concrete roof panel surface must be cleaned and primed with a material that prepares the concrete surface for proper adherence to the coating material.
2) The entire pre-cast concrete roof panel surface shall be sealed with .045 EPDM continuous membrane cemented to the concrete with a compound designed for this purpose.

D. Caulking: All joints between panels shall be caulked on the exterior and interior surface of the joints. Caulking shall be Sonneborn "Sonolastic" NP-1 Limestone sealant or equal. Exterior caulk joint to be ½" x ½" square so that sides of joints are parallel for correct caulk adhesion.

E. Vents: Two extruded aluminum vents, clear anodized, with aluminum insect screen to be cast in rear wall. Vents shall be Sunvent FL 164, or equal.

F. Panel Connections: All panels shall be securely fastened together with ¼" thick steel brackets. Steel is to be of structural quality, hot-rolled carbon complying with ASTM A36 HR, prime coated after fabrication. All fasteners to be ½" diameter bolts complying with ASTM A307 for low-carbon steel bolts. Cast-in anchors used for panel connections to be Dayton-Superior #F-63, or equal.

2.2.3 Doors and Hardware

A. Single Entrance Doors: The pre-cast enclosure shall be provided with one single entrance door, 3'-0" wide x 6'-8" high located on the structure as indicated on the plan drawings.

1) The door shall comply with the Steel Door Institute "Recommended Specifications for Standard Steel Doors and Frames" (SDI-100) and as herein specified.
2) Door and frame are to be factory bonderized and primed.
3) The door threshold shall be ½" high for easy stepover and transport of equipment through the doorway.
4) The door and frame shall be complete with a stainless steel hasp and staple assembly intended for padlock use (padlocks furnished by PWC).
5) Single door and all hardware shall be able to withstand 125 MPH winds.
6) A wall mounted drip molding shall be located above each door.

B. Double-Entrance Doors: The enclosure shall be provided with one double entrance door, 6'-0" wide x 6'-8" high located on the structure as indicated on the plan drawings.

1) Double door and all hardware shall be able to withstand 125 MPH winds.
2) Double hung door design shall incorporate 3-point locking hardware, door closer, and hinges on each section to allow complete access to the 6'-0" x 6'-8" full door opening without the need for a center sill.
3) Double door design shall adhere to the same material and workmanship specifications as described above for single door design.

2.2.4 Finishes: The coating materials noted below are specified as the standard of quality. The usual "or equal" clause shall apply. No request for substitution will be considered which decreases the film thickness designated and/or the number of coats to be applied or which offers a change from the generic type of coating specified. Requests for substitution shall contain the full name of each product; descriptive literature and directions for use; its generic type, and its non-volatile content by volume. All materials shall be brought to the job site in the original sealed and labeled containers of the paint manufacturer and shall be subject to inspection by the Engineer on the job. Only new paint materials shall be used.

A. Interior of Building: Smooth steel form finish on all interior surfaces.

B. Exterior of Building:

1) Standard: Architectural, pre-cast, concrete Brick Finish: Finish must be imprinted in top face of panel while in form using an open grid impression tool. Finished brick size shall be 2-3/8" x 7-5/7" with vertical light broom finish. Joints between each brick must be 3/8" wide x 3/8" deep. Back of joint shall be concave to simulate a hand-tooled joint. Each brick face shall be coated with a silicone acrylic concrete stain as manufactured by H&C Concrete Care Products. Color shall be H&C #HC02 "Brick Red" unless specified otherwise. Stain shall be applied per manufacturer's recommendations. Joints shall be kept substantially free of stain to maintain a gray concrete color.

2) (Option): Washed brown riverstone aggregate finish on exterior wall surfaces. Aggregate must be seeded into top of panel while in form.

3) (Option): A Vertical Broom Finish shall be applied to exterior wall surfaces and shall be coated with a silicone acrylic concrete stain as manufactured by H&C Concrete Care Products. Color shall be H&C #HC25 "Concrete Gray" unless specified otherwise. Stain shall be applied per manufacturer's recommendations.

B. Doors and Frames

1) Standard: Door(s) and Frame(s) shall be top coated with one coat of Sherwin Williams #SW4025, "Anchor Gray" Industrial and Marine Coating (unless specified otherwise).
2) (Option): If either exterior finish option above is selected, then: Door(s) and Frame(s) shall be top coated with Sherwin-Williams #SW4001 "Bolt Brown" Industrial and Marine Coating (unless specified otherwise).

2.2.5 Electrical Materials and Equipment

Electrical materials shall conform to the requirements in Section 16010 – ELECTRICAL, LIFT STATIONS.

A. Electrical Distribution: Provide and install two, duplex, GFCI receptacles, mounted 48" above finished floor. Receptacle shall be furnished with a corrosion resistant weatherproof cover. The receptacles shall be wired to the electrical junction box. Circuit protection for the receptacles shall be provided within the pump control panel.

B. Interior Lighting: Provide and install surface-mounted, vapor-tight, three (3) F32T8 lamp, fluorescent light fixtures providing a minimum of two (2) watts illumination per square foot. A weatherproof wall switch mounted shall be mounted adjacent to the enclosure single door. Manual on/off switches shall also be provided and installed adjacent to both the single and double enclosure doors. The lighting shall be provided with conduit and wiring to the electrical junction box. Circuit protection for the lighting shall be provided within the pump control panel.

C. Exterior Lighting: Provide and install exterior security lighting fixtures mounted over both the single and double enclosure doors. The lighting fixtures shall be shielded to prevent "spillage" onto neighboring properties and shall be fitted with photocell sensors for dusk to dawn operation. Exterior lighting shall be provided with conduit and wiring to the electrical junction box. Circuit protection for the exterior lighting shall be provided within the pump control panel.

D. Exhaust Fan: Provide and install a thermostatically controlled, 120 VAC, exhaust fan with screen and weatherproof shutters shall be installed in the wall approximately opposite a fresh air intake vent. Manual on/off switches shall also be provided adjacent to both the single and double enclosure doors. The fan shall have a minimum capacity of 1600 CFM at free air and be capable of changing the air in the enclosure a minimum of six times per hour. The vent fan shall be wired to the electrical junction box. Circuit protection for the vent fan shall be provided within the pump control panel.

E. Heater: Provide and install a high capacity electric blower type heater for the protection of the internal equipment. The heater shall maintain an inside/outside differential temperature of 30 degrees F while operating on the primary voltage supplied to the pump control panel. The heater shall be provided with an adjustable thermostat, and be wired through conduit to the electrical junction box. Circuit protection shall be provided within the pump control panel.

2.3 CONCRETE MATERIALS

Concrete materials including forms and reinforcement shall conform to Section 03301 – CONCRETE CONSTRUCTION, UTILITY

PART 3 – EXECUTION

3.1 PRE-CAST CONCRETE ENCLOSURE INSTALLATION

A. Locate Pre-cast Enclosure as indicated on Drawings.

B. Erect enclosures using personnel experienced and trained in placement and securing of architectural pre-cast concrete units. Lift and handle pre-cast panels using lift points and embeds as shown on pre-cast shop drawings. Fill all lift holes with hydraulic cement.

C. Erection Tolerances: Erect within tolerances listed in PCI MNL 117, Appendix I or ACI 533R. Erect level, plumb, and true to line. Do not allow cumulative dimensional errors to develop. Adjustments such as shimming which would place additional stress on units will not be permitted. Adhere to dimensional tolerances in accordance with PCI recommendations. Erect and secure in a manner to prevent damage to units or units in place. Replace damaged units which cannot be successfully repaired.

D. Where two stage joint seal is required, sequence with sealant application to ensure that sealant, gaskets, and similar items required for interior side seal are installed concurrently with installation of pre-cast units.

3.2 CONCRETE

Construct concrete pad complying with the Project Drawings and applicable sections of these Specifications. Floor slab shall be a minimum of 6” thick, 4,000 psi @ 28 day minimum, steel reinforced concrete. Slab shall be level to within 1/8” in both directions, comply with local codes and standards, and shall be capable of supporting all imposed loads. Concrete forming, reinforcement, placement and curing shall conform to requirements in Section 03301 – CONCRETE CONSTRUCTION, UTILITY

3.3 ELECTRICAL

Installation of electrical equipment and materials shall conform to the requirements in Section 16010 – ELECTRICAL, LIFT STATIONS.

3.4 QUALITY ASSURANCE

Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

3.5 MANUFACTURER’S WARRANTY

The Pre-cast Concrete Enclosure shall be provided with a 5-year manufacturer's warranty against defects in material and workmanship.

DIVISION 2
SITE WORK

02762 MANHOLE LINING – POLYMERIC

GENERAL

The Contractor shall furnish all labor, materials, equipment and incidentals required and install the monolithic polymeric manhole lining system and appurtenances as specified herein. The lining system shall be used to rehabilitate the interior of all designated existing sewer manholes as indicated within these Contract Documents and as shown on the Contract Drawings. The installed lining system shall withstand all loading conditions and hydrostatic pressure.

The manhole lining system shall consist of a cementitious base coat applied to the cleaned and prepared manhole surfaces, followed by the polymeric lining system. The Contractor shall furnish all necessary materials, labor, and equipment necessary to properly prepare the surfaces and apply the polymeric lining system as specified herein. The lining system shall be compatible with the applied chimney seal. The chimney seal shall be in accordance with these Contract Documents.

The Contractor is responsible for properly preparing the existing manhole for lining prior to the installation of the lining system, including stopping all leaks, flow control, patching voids, removing steps/manhole rungs, cleaning (to include water blasting), removing rubble, root removal, debris removal, etc.

The Contractor is advised that the presence or absence of any leakage through the manhole walls as seen in the Contractor's independent inspection prior to bidding is dependent upon the ground water levels and conditions at the time of the inspections. The Contractor shall reflect his/her assumptions and judgments on leakage through the manhole walls based on this information in the unit prices bid. All leakage shall be stopped prior to installing the lining system. No additional payment will be made to the Contractor for repairing leaks not visible prior to bidding.

Cleaning, surface preparation, lining application, and thicknesses shall be as specified herein and shall meet or exceed the lining manufacturer's recommendations. When the manufacturer's minimum recommendations exceed the specified requirements, the Contractor shall comply with the manufacturer's minimum recommendations.

RELATED SECTIONS

A. Section 02500 – Traffic Control
B. Section 02730 – Sanitary Sewer System
C. Section 02750 – Wastewater Flow Control
D. Section 02765 – Manhole Chimney Seals

REFERENCE STANDARDS

This Section contains references to the governing standards and documents listed below. They are a part of this Section as specified and modified; the current version shall apply unless otherwise noted. In case of conflict between the requirements of this section and those of the listed documents, the more stringent of the requirements shall prevail.

A. American Concrete Institute (ACI)

a. ACI 224.1R – Causes, Evaluation and Repair of Cracks in Concrete Structures
b. ACI 301 – Specifications for Structural Concrete
c. ACI 308R – Guide to Curing Concrete
d. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures and Commentary
e. ACI 515 – A Guide to the use of Waterproofing, Dampproofing, Protective, and Decorative Barrier Systems for Concrete
f. ACI 546.R – Concrete Repair Guide
g. ACI 546.3R – Guide for the Selection of Materials for the Repair of Concrete

B. ASTM International (ASTM)

a. ASTM C 868 – Standard Test Method for Chemical Resistance of Protective Linings
b. ASTM C 1583/1583M – Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)
c. ASTM D 2794 – Standard Test Method for Resistance of Organic Linings to the Effects of Rapid Deformation (Impact)
d. ASTM D 4060 – Standard Test Method for Abrasion Resistance of Organic Linings by the Taber Abraser
e. ASTM D 4285 – Standard Test Method for Indicating Water or Oil in Compressed Air
f. ASTM D 4263 – Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
g. ASTM D 4414 – Standard Practice for Measurement of Wet Film Thickness by Notch Gages
h. ASTM D 4541 - Standard Test Method for Pull-off Strength of Coatings Using Portable Adhesion Testers
i. ASTM D 6944 Standard Test Method for Measuring Humidity with a Physchrometer
j. ASTM D 7682 – Standard Test Method for Replication and Measurement of Concrete Surface Profiles Using Replica Putty
k. ASTM F 1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
l. ASTM F 2170 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes
m. ASTM F 2414 – Standard Practice for Sealing Sewer Manholes Using Chemical Grouting
n. ASTM G 210 – Standard Practice for Operating the Severe Wastewater Analysis Testing Apparatus

C. International Concrete Repair Institute (ICRI)

a. Guideline No. 310.1R – Guide for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion
b. Guideline No. 310.2 – Selecting and Specifying Concrete Surface Preparation for Sealer, Linings, and Polymer Overlays

D. National Association of Corrosion Engineers International (NACE)

a. NACE Publication 6D-173 – A Manual for Painter Safety
b. NACE SP0188 – Standard Practice for Discontinuity (Holiday) Testing of Protective Linings
c. NACE SP0892 – Standard Practice for Coatings and Linings over Concrete for Chemical Immersion and Containment Service
d. NACE No. 6/SSPC-SP13 – Surface Preparation of Concrete

E. Occupational Safety and Health Administration (OSHA)

a. Safety and Health Standards (29 CFR 1910/1926)

F. The Society for Protective Coatings (SSPC)

a. SSPC-SP13/NACE No. 6 – Surface Preparation of Concrete
b. SSPC-Guide 12 – Guide for Illumination of Industrial Painting Projects

G. Standard Practice for the Rapid Evaluation of Coatings and Linings by Severe Wastewater Analysis Test (S.W.A.T.)

Unless otherwise specified, references to documents shall mean the documents in effect at the time of receipt of Bids. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents or the last version of the document before it was discontinued.

In case of conflicting requirements between this specification and these referenced documents, the more stringent shall govern.

SUBMITTALS

Submit, in accordance with Section 01300 – Submittals and Section 01000 – Special Conditions, letters, shop drawings, and product data showing materials of construction, installation equipment and details of installation for the monolithic lining system including:

1. Product Data Sheets: Copies of current technical data for each component specified and applied as outlined in this Section.

2. Safety Data Sheets: Copies of current SDS for any materials brought on-site including all clean-up solvents, repair or resurfacing mortars and lining materials.

3. Qualification Data: Approved Installer Training Certificates from manufacturer.

4. Performance Testing Reports: Copies of test data for the entire physical, chemical, and permeation properties listed herein and as outlined within this Section.

5. Installation Instructions: Manufacturer's written installation instructions for the materials specified in this Section.

6. Construction Details: Copies of manufacturer's computer generated standard lining details for specified materials, including: leading edge termination, metal embedment in concrete, joint detail, wall-to-slab detail, pipe termination detail, and any other detail at the request of the Public Works Commission.

GUARANTEE

The installed lining system shall be guaranteed by the Contractor and Manufacturer for a period of five (5) years from the date of final acceptance. During this period, all defects discovered in the lining, as determined by the Public Works Commission, shall be repaired or replaced in a satisfactory manner by the Contractor at no cost to the Public Works Commission. All proposed repairs shall be submitted, reviewed, and approved by the Public Works Commission prior to the Contractor completing any work.

QUALITY ASSURANCE

The supplier shall be responsible for the provisions of all test requirements specified in the above referenced ASTM Standards as applicable. In addition, all lining products to be installed under this Contract may be inspected at the plant for compliance with these specifications by an independent testing laboratory provided by the Public Works Commission. The Contractor shall require the manufacturer's cooperation in these inspections. The cost of plant inspection of all lining products and materials approved for this Contract shall be borne by the Public Works Commission.

Inspections of the lining products and materials may also be made by the Public Works Commission after delivery. The lining products and materials shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though samples may have been accepted as satisfactory at the place of manufacture. Lining materials rejected after delivery shall be marked for identification and shall be removed from the job at once.

The Contractor shall initiate and enforce quality control procedures in accordance with the applicable ASTM, National Association of Corrosion Engineers (NACE), the Society for Protective Coatings (SSPC) standards, and in accordance with the manufacturer's instructions.

Acceptable Manufacturers: A company with a minimum of five (5) years experience in manufacturing of, and providing technical service for chemical resistant systems equivalent to those specified herein.

The manufacturer of the lining system of manholes shall be a company that specializes in the design and manufacture of corrosion protection systems for manholes. The Contractor shall be completely trained in leak repair, surface preparation, installation of the lining system, and corrosion materials application on manholes. The lining system materials/products shall be suitable for installation in a severe hydrogen sulfide

environment without any deterioration.

The applicator shall be trained and certified by the manufacturer for the handling, mixing, application and inspection of the manhole lining system as described herein.

DELIVERY, STORAGE AND HANDLING

Care shall be taken in shipping, handling and placing to avoid damaging the lining products. Extra care may be necessary during cold weather construction. Any lining product or material damaged in shipment shall be replaced as directed by the Public Works Commission.

Any lining product showing deterioration, or which has been exposed to any other adverse storage condition that may have caused damage, even though no such damage can be seen, shall be marked as rejected and removed at once from the work.

While stored, the lining products shall be adequately packaged and protected. The lining products shall be stored in a manner as recommended by the manufacturer. The Contractor shall comply with the following:

1. Store the materials in sealed, original manufacturer's containers.
2. Store materials in a protected area out of direct sunlight.
3. Keep containers clean and undamaged.
4. Comply with manufacturer's published storage temperature and shelf life recommendations.
5. Protect all materials from freezing.

Deliver products to the job site in manufacturer's original, unopened containers bearing manufacturer's name and label and the following information

1. Product name.
2. Product description (generic product classification).
3. Manufacturer's lot number.
4. Color.

All materials shall be handled in accordance with their Safety Data Sheets (SDS) and the manufacturer's instructions.

PRODUCTS

The materials to be utilized in the lining of manholes shall be designed and manufactured to withstand the severe effects of hydrogen sulfide in a wastewater environment. The manufacturer of corrosion protection products shall have a minimum of 10 years experience in the production of the lining products utilized and shall have satisfactory installation record. All rehabilitation products shall be manufactured by a single manufacturer, or the Contractor shall provide documentation that the materials are compatible with each other.

All lining materials shall be approved by U.S. EPA for sewer system rehabilitation.

The lining system shall be compatible with the thermal condition of the existing sewer manhole surfaces. Surface temperatures will range from 20°F to 100°F.

Any polymeric lining system that cannot provide test results of ASTM G 210 will not be approved for this application. (ASTM G 210– Standard Practice for Operating the Severe Wastewater Analysis Testing Apparatus).

The polymeric lining system shall provide a minimum service life of 50 years.

INFILTRATION CONTROL MATERIAL

Infiltration control materials shall be rapid-setting, high early strength, hand applied cementitious material for stopping infiltrating water and making repairs to concrete, brick or other masonry constructed manholes. The material shall be non-shrinking, non-metallic and non-corrosive. It shall be formulated at the factory and supplied in factory sealed and labeled pre-measured containers. The material shall be compatible with the lining material to be used. The material shall have the following minimum characteristics:

1. Compressive strength (in accordance with ASTM C-109):
   - 1 hour 1,000 psi
   - 1 day 2,400 psi
   - 7 day 3,500 psi
   - 28 day 4,500 psi

2. Tensile strength (in accordance with ASTM C-109):
   - 1 day 175 psi
   - 7 day 250 psi
   - 28 day 350 psi

3. Bond Strength (in accordance with ASTM C-321)
   - 30 minutes 50 psi
   - 1 day 85 psi

4. Freeze-Thaw Durability (in accordance with ASTM C-666)
   - 100 cycles no loss

5. Set Time (in accordance with ASTM C-191-92)
   - Initial 30 to 60 seconds
   - Final 1 hour

6. Shrinkage (in accordance with ASTM C-157) – 0%

Infiltration control material shall be CEMTEC Hydraulic Cement by A.W. Cook Cement; Mainstay ML-10 by Madewell Products Corporation; PLS-505 by Protective Liner Systems; Quad-Plug by Quadex; or approved equal.

Chemical sealants or grouts used to seal active manhole leaks, to patch cracks, to fill voids and to

otherwise prepare the manhole surfaces for the lining installation shall be suitable for the intended purpose and shall be compatible with the lining system as certified by the manufacturer.

All leaks shall be stopped prior to the installation of the lining system.

PATCHING MATERIAL

Voids in the existing manhole walls, benches, or damaged inverts must be repaired prior to installing the lining system. The patching material shall be a rapid setting, high early strength, corrosion resistant hand mixed and hand applied cementitious material intended for filling voids and repairing inverts in concrete, brick or other masonry constructed manholes. It shall be formulated in the factory and supplied in factory sealed and labeled pre-measured containers. The material shall be compatible with the lining material to be used. The material shall have the following minimum characteristics:

1. Compressive strength (in accordance with ASTM C-109):
   - 1 day 3,500 psi
   - 7 day 4,900 psi
   - 28 day 5,500 psi

2. Tensile strength (in accordance with ASTM C-109):
   - 1 day 200 psi
   - 7 day 250 psi
   - 28 day 550 psi

3. Freeze-Thaw Durability (in accordance with ASTM C-666)
   - 100 cycles no loss

4. Set Time (in accordance with ASTM C-191-92)
   - Initial 15 to 20 minutes
   - Final 20 to 25 minutes

Patching material shall be CEMTEC Rapid Cure Vertical Grade by A.W. Cook Cement; Mainstay ML-72 by Madewell Products Corporation; Hyperform by Quadex; or approved equal.

All voids and other repairs shall be completed prior to the installation of the lining system.

CEMENTITIOUS BASE COAT

The cementitious base coat shall be a pumpable Portland based 100% pure calcium aluminate cement. The lining shall be installed via trowel or low-pressure application. The materials shall be suitable for all the specified design conditions.

The cementitious base coat shall be a system suitable for use as a trowel- or spray-applied monolithic surfacing in sewer manholes. The cementitious lining system shall be Mainstay ML-CA by Madewell Products Corporation; Aluminaliner by Quadex; CEMTEC Silatec CAM by A.W. Cook Cement; PLS-507 by Protective Liner Systems; or approved equal.

The cementitious base coat shall be applied to the following minimum total thicknesses for all lining systems:

1. **For block and cast concrete manholes in good condition, apply to a minimum thickness of one-half (0.5) inch.**
2. **For all brick manholes and for block or cast concrete manholes in poor condition, apply to a minimum thickness of one (1.0) inch.**

It is the Contractor's responsibility to determine the required thickness of the cementitious base coat, based on the manhole condition, groundwater conditions, etc. to ensure the long-term integrity of the installed lining system.

The cementitious base coat shall be installed on the walls of existing manholes, from the invert to the manhole frame, as further directed below. All cementitious lining shall be troweled to consolidate the material, and then brushed to provide a profile surface for application of the polymeric topcoat. The initial trowelling shall be done in an upward motion, to compress the material into voids. The Contractor shall ensure that the cement is not over-troweled. The cured cementitious base coat surface shall be continuous with proper sealing connections to all unsurfaced areas. The Contractor shall take all measures to ensure that the cementitious base coat properly cures. The use of curing compounds is prohibited.

The materials used in the cementitious base coat shall be mixed on site in accordance with the manufacturer's recommendations. Water shall only be added to the materials during the mixing process and prior to material pumping or spray application. No water shall be added at the nozzle.

The cementitious base coat, when cured, shall have the following minimum characteristics at 28 days as measured by the applicable ASTM standards referenced herein:

1. Density (when applied) – 135 pounds/cubic foot, plus/minus 5 pounds/cubic foot

2. Compressive strength (in accordance with ASTM C-109):
   1 day 2,800 psi
   28 day 8,000 psi

3. Bond Strength (in accordance with ASTM C-321)
   28 day 1,700 psi

4. Flexural Strength (in accordance with ASTM C-78)
   28 day 1,500 psi

5. Shrinkage (in accordance with ASTM C-157) – 0%

6. Freeze-Thaw Durability (in accordance with ASTM C-666)
   300 cycles no loss

The cured cementitious base coat shall be continuously bonded to all the brick, mortar, concrete, chemical sealant, grout, pipe and other surfaces inside the sewer manhole.

Where the manhole to be rehabilitated is subject to vehicular traffic, the cementitious lining shall be installed to no closer than one (1) inch below the bottom of the manhole frame so as to avoid transfer of impact loads to the new liner. Where the manhole to be rehabilitated is not subject to vehicular loads, the cementitious liner shall be continuous up to the manhole frame.

POLYMERIC LINING SYSTEM

Materials

The lining system top coat shall be a polymeric system suitable for use as a trowel- or spray-applied monolithic surfacing in sewer manholes. The polymeric lining system may be a two part 100% solids epoxy, epoxy mortar or polyurethane resin system. Accepted manufacturers are:

Epoxy Systems:	Mainstay DS-5 Epoxy by Madewell Products Corporation; PLS-614 by Protective Liner Systems; Raven 405 by Raven Lining Systems; Dura-Plate 5900 HB Epoxy by Sherwin-Williams; Dura-Plate 6100 HP Epoxy by Sherwin-Williams; or approved equal.
Epoxy Mortar:	Dura-Plate 5900 HB Epoxy Mortar by Sherwin-Williams; or approved equal.
Polyurethanes:	Sher-Flex by Sherwin-Williams; or approved equal.

The lining system top coat shall be a 100% solids, epoxy polymer protective barrier material specifically designed to protect concrete and steel surfaces in severe wastewater environments, including associated abrasive physical attack and chemical attack from sewer gases and organic acids generated by microbial sources.

Epoxy lining shall be capable of achieving the specified thickness in a single coat application.

The polymeric top coat materials shall be applied by low pressure spray or hand applied to the minimum dry film thickness of 150 mils.

The polymeric materials shall be suitable for sewer system service and chemically resistant to any chemicals or vapors normally found in domestic and/or commercial sewage. The polymeric material shall be compatible with the cementitious base coat material, as per manufacturer's recommendations.

Installation

The polymeric lining system shall be installed over the cementitious base coat previously applied on the inverts, benches, and walls of the designated manholes. The polymeric liner shall be applied only after the cementitious base coat has properly cured, in accordance with the manufacturer's instructions.

The Contractor shall saw-cut the existing walls, benches, and/or inverts in order to "tie-in" the polymeric lining.

The cured surface of the polymeric lining system shall be smooth and continuous with proper sealing connections to all unsurfaced areas. The sprayed-on liner shall be troweled to consolidate the product into the profile of the substrate or resurfacing mortar.

When cured, the monolithic polymeric lining system shall form a continuous, tight-fitting, hard, impermeable surfacing which is suitable for sewer system service and chemically resistant to any chemicals or vapors normally found in domestic sewage. The polymeric lining shall be continuously bonded to the cementitious base coat.

Where the manhole to be rehabilitated is subject to vehicular traffic, the polymeric lining system shall be installed to no closer than one (1) inch below the bottom of the manhole frame so as to avoid transfer of impact loads to the new liner. In those locations where the manhole is subject to vehicular traffic, a chimney seal shall be installed to "bridge" the gap between the manhole frame and the polymeric lining system. Where the manhole to be rehabilitated is not subject to vehicular loads, the polymeric lining system shall be continuous up to the manhole frame. **The polymeric lining system shall not be applied to the manhole frame.**

SPECTRASHIELD LINING SYSTEM

In addition to the above products and materials, the "Spectrashield" lining system as furnished by CCI Spectrum, Inc. is an approved equal. All products and materials for the "Spectrashield" lining system shall be in accordance with CCI Spectrum, Inc. requirements. Manhole preparation shall be in accordance with the following:

- Stop all active leaks and infiltration utilizing an approved infiltration control material
- Patch all voids in the manhole utilizing an approved patching material
- Install the "Spectrashield" lining system to build back the manhole profile (the minimum thickness shall be **500 mills**)

All work shall be in accordance with these Contract Documents and as directed by the Public Works Commission.

INSTALLATION

GENERAL

All work shall be in accordance with these Contract Documents and as directed by the Public Works Commission.

The Contractor shall take appropriate action to comply with all local, state and federal regulations including those set forth by OSHA, EPA, the Public Works Commission and any other applicable authorities.

Prior to conducting any work, the Contractor shall perform an inspection of the structure to determine any need for protection against hazardous gases or oxygen depleted atmosphere and the need for flow control or flow diversion.

The Contractor shall clean each sewer manhole and shall properly dispose of any resulting material. The Contractor shall take sufficient precautions prevent any debris from their operations to enter the sewer system.

All surface washing, abrasive blasting, waterjetting, grinding, patching, filling and preparation shall be completed by the Contractor in accordance with the lining system manufacturer's recommendations.

The Contractor shall notify all property owners who discharge sewage directly to the manhole being rehabilitated that their service will be discontinued while the lining system is being installed, cured and active pipe and service connections reopened. The Contractor shall notify individual property owners at least 48 hours in advance, giving the date, start time and estimated completion time for the work being conducted.

Application procedures shall conform to recommendations of the manufacturer, including materials handling, mixing, environmental controls during application, safety and spray equipment. Material shall not be applied during freezing weather conditions. No material shall be placed when the ambient air temperature is below 40°F, or when the temperature is anticipated to fall below 32°F in the next 24 hours.

Spray equipment shall be specifically designed to accurately ratio and apply the liner system.

SURFACE PREPARATION

Surface preparation methods may include high pressure water cleaning, hydro blasting, abrasive blasting, grinding, detergent water cleaning, and shall be suited to provide a surface compatible for installation of the liner system. Remove all dust, biological growths, grease, oil, paint or any other surface contaminants or coatings from all surfaces to be lined, including manhole walls, corbelling and manhole frame. The choice of surface preparation lies solely with the Contractor. The Contractor shall determine the required surface preparation method based upon the condition of the manhole, the presence of potential contaminants, access to perform the work, and the required condition of the surface to apply to specified lining system, as required by the manufacturer.

The surface preparation method shall produce a cleaned, abraded and sound surface with no evidence of laitance, loose concrete, brick or mortar, contaminants or debris, and shall display a surface profile suitable for application of the manhole lining system. The Contractor shall prepare the surface in accordance with the applicable NACE and/or SSPC recommendations for the specified lining system.

Coatings that cannot be removed shall be properly prepared (in accordance with these Specifications) to obtain and insure adequate bonding of the cementitious base coat material.

The Contractor shall conduct a visual inspection of each manhole after it is cleaned. All active infiltration leaks shall be plugged or sealed with an appropriate infiltration control material compatible with the cementitious base coat. The Contractor shall remove all loose mortar and rubble from existing walls, benches and inverts. Repairs to exposed rebar, defective pipe penetrations or inverts, etc. shall be repaired utilizing non-shrink grout or approved alternative method. The Contractor shall prepare manhole to receive the cementitious base coat as necessary by reshaping and repairing benches, inverts, and walls where required. All interior surfaces shall be prepared as recommended by the base coat lining manufacturer. Minimum requirements are as listed below.

1. All cracks and other voids must be repaired and filled with suitable non-shrinking cements, sealants or grouts, including all voids between the existing sewer pipes and manhole walls. Patching compounds shall be compatible with the proposed lining system. All patches shall be smooth and even with the manhole wall.
2. All existing manhole rungs/steps shall be removed and the void patched or cut off and ground smooth.
3. All surfaces shall be suitably prepared for the required bonding of the cementitious base coat as recommended by the manufacturer.

Concrete surfaces to be coated shall be free of curing compounds and form release agents, laitance and foreign particles that may inhibit bonding. Prior to the start of the protective coating system application, the Contractor shall pre-clean as required, and inspect the substrate in accordance with SSPC-SP13/NACE No. 6, Severe Service. Surface preparation procedures shall be in accordance with NACE SP0892, SSPC-SP13/NACE No. 6 and ICRI Guideline No. 310.2. Surface preparation shall expose aggregate and obtain a uniform surface texture resembling the minimum recommended concrete surface ICRI-CSP profile. The Contractor shall remove all dust, biological growths, grease, oil, paint or any other surface contaminants or coatings from all surfaces to be lined, including any metal work to be coated.

Existing Concrete Application: Existing concrete structures to receive the protective coating system must be capable of withstanding imposed loads. All oil, grease, waste and chemical contaminants shall be removed from the surface of the concrete prior to preparation in accordance with NACE SP0892 and SSPC-SP13/NACE No. 6. Concrete surfaces must be sound and capable of supporting the proposed polymeric lining system. Surface preparation requirement is to expose a sound, uniform surface texture confirming to the minimum recommended ICRI-CSP. The appropriate cementitious repair mortar or epoxy cementitious repair material shall be applied to the entire, prepared surface to level surface suitable for coating.

Commencement of the Work of this Section shall indicate that the substrate and other conditions of installation are acceptable to the Contractor, and will produce a finished product meeting the requirements of these Contract Documents. All defects resulting from accepted conditions shall be corrected by Contractor at his own expense.

All concrete surfaces shall be prepared to a minimum of SSPC-SP13 prior to installation of the polymeric lining system.

Level or grind concrete substrates to produce a uniform and smooth surface, including removal of all sharp edges, ridges, form fins, and other concrete protrusions.

FLOW CONTROL

It is the intent of these Contract Documents that the Contractor will utilize flow-through plugs or other means to complete the manhole rehabilitation without the use of a temporary sewer bypass system. All temporary flow-through plugs shall be removed upon the completion of each step of the rehabilitation process (cementitious base coat, polymeric top coat). The Contractor shall be responsible for ensuring that their flow control system does not result in any sanitary sewer being discharged to the environment.

If required to properly complete the lining, the Contractor shall provide temporary bypass pumping of sewage flows where and when the rehabilitation work is being performed. The temporary bypass pumping shall be in accordance with Specification Section 02750 – Wastewater Flow Control and these Contract Documents.

INFILTRATION CONTROL

After surface cleaning, any visible leaks or infiltration shall be stopped, prior to installation of any patching material or the cementitious base coat. Infiltration and leaks shall be stopped utilizing hydraulic cement or other "typical" methods (i.e., oakum). It is the intent of these Contract Documents that the Contractor will take all necessary steps to stop all but the very large leaks without the use of chemical grout. Should a significant, very large leak be encountered that would require significant effort, large quantities of chemical grout, and/or other extreme measures, the method and cost to stop that leak shall be mutually agreed upon by the Contractor and the Public Works Commission, prior to commencing work.

A complete, watertight seal shall be provided at pipe and manhole wall connections. The Contractor shall submit details of how the watertight connections will be made to the Public Works Commission for review and approval.

REPAIR OF BENCHES AND INVERTS

The Contractor shall complete any necessary repairs to the bench and/or invert of the manhole, prior to installation of the specified lining system. All repairs shall be completed in accordance with the requirements of the Public Works Commission, and as outlined herein.

The invert channel shall be constructed of brick and mortar, in accordance with Public Works Commission standard details. The invert channel shall be smooth and semicircular in shape conforming to the inside of the connecting sewer section. Changes in direction of flow shall be made with a smooth curve as large as a radius as the size of the manhole will permit without a decrease in flow velocity. Changes in size and grade of the channel shall be made gradually and evenly. A shelf shall be provided on each side of any manhole invert channel. Inverts in manholes with standing water will not be acceptable.

CEMENTITIOUS BASE COAT

The Contractor shall furnish and place the cementitious base coat in each manhole as and where directed by the Public Works Commission. The installation of the cementitious base coat shall be in complete accordance with the manufacturers' specifications.

Prior to placing the cementitious base coat, the Public Works Commission and the Contractor must inspect and approve the surface preparation work. The Contractor shall notify the Public Works Commission when the manholes are ready for inspection. The Contractor is responsible for ensuring proper installation conditions including surface preparation, temperature, and moisture.

All bottom and horizontal surfaces shall have the cementitious base coat material applied to the required thickness by hand troweling or spray-on methods. <u>All</u> cementitious lining shall be troweled to consolidate the material, and then brushed to provide a profile surface for application of the polymeric

topcoat. The initial troweling shall be done in an upward motion, to compress the material into voids.

All side vertical surfaces shall have the cementitious base coat applied to the required thickness in one pass or application. Non-vertical surfaces may be completed in multiple passes to prevent sloughing of material.

Temperature limitations must be handled as appropriate and as approved by the manufacturer.

POLYMERIC TOP COAT

The Contractor shall furnish and place the polymeric lining over the previously installed cementitious base coat and all other surfaces to be lined, and as may be directed by the Public Works Commission. The installation of the polymeric lining top coat shall be in complete accordance with the applicable provisions of the manufacturers' specifications.

The Contractor shall provide documentation that the mixing of materials is in accordance with the manufacturer's instructions.

Prior to placing the top coat, the Public Works Commission and the Contractor must inspect and approve the cementitious base coat. The Contractor shall notify the Public Works Commission when the manholes are ready for inspection. The Contractor is responsible for ensuring proper installation conditions including cementitious base coat conditions, temperature and moisture.

The Contractor shall saw-cut the existing walls, benches, and/or inverts in order to "tie-in" the polymeric lining.

All surfaces shall have the monolithic polymeric lining applied by a spray-on method or by hand troweled applications in multiple passes to gradually build up to the required thickness.

Temperature limitations must be handled as appropriate and as approved by the manufacturer.

SPECTRASHIELD LINING SYSTEM

Installation of the "Spectrashield" lining system, as furnished by CCI Spectrum, Inc. shall be in accordance with the manufacturer's requirements. Manhole preparation shall be in accordance with the requirements outlined in these Contract Documents.

FIELD QUALITY CONTROL

The Contractor to perform the quality control procedures listed below in conjunction with the requirements of this Specification Section.

A. Inspect all materials upon receipt to ensure that all are supplied by the approved Manufacturer.

B. Surface pH Testing: The pH of the concrete substrate will be measured using pH indicating papers. The pH testing is to be performed once every 50 square feet. Acceptable pH values shall be a minimum 9.0 as measured using color indicating pH paper with readable color calibrations and a

scale at whole numbers (minimum). Use Hydrion Insta-Check Jumbo 1-12, or approved equal. The paper shall be touched to the surface once using moderate gloved finger pressure. The surface shall not be wiped or moved laterally to disturb the surface during pH testing. Following the one touch, lift the paper vertically to not "wipe" the surface. Compare the color indicated with the scale provided and record the pH. Spot check any questionable areas with a 1% phenolphthalein solution. The phenolphthalein solution shall turn bright pink on concrete.

TESTING

During application of the polymeric top coat, the Contractor shall measure the thickness and uniformity of the material by the use of a wet film thickness gage meeting the requirements of ASTM D 4414. Measurements shall be completed in the presence of the Public Works Commission. The Contractor shall document all measurements for each manhole and submit the documentation to the Public Works Commission. The documentation shall be submitted with each pay application.

Field acceptance of the manhole lining system shall be based on the Public Works Commission's evaluation of the appropriate installation of the base coat and top coat per field inspections and on observation of the measurements of the wet film thickness. Acceptance shall also be based on the Public Works Commission's evaluation of the curing test data and final testing.

The polymeric lining top coat shall provide a continuous monolithic surfacing with uniform thickness throughout the manhole interior and be free of pinholes, slumps and drips. A visual inspection shall be conducted to ensure that no pinholes are in the monolithic coating. The visual inspection shall include terminations and transitions of the polymeric liner.

Once the lining system has fully cured, it shall be checked via high voltage spark detection, in accordance with NACE SP0188 and the manufacturer’s instructions. All defects shall be corrected at no cost to the Public Works Commission. The high voltage spark detection shall be done in accordance with:

1. The manhole environment shall be properly vented prior to testing to ensure hazardous conditions do not exist.
2. The high voltage spark detection equipment shall be set at 100 volts per one (1) mil of of applied film thickness, or as recommended by the manufacturer.
3. All detected holidays shall be marked and the area of the liner shall be repaired. The surface area around the defect in the liner shall first be abraded using an appropriate grit paper or other hand abrasion tool. After abrading and cleaning the area, the area shall be patched by hand application of the polymeric lining topcoat material. All repair procedures shall follow manufacturer’s recommended procedures.
4. All repaired areas shall be spark tested.

The Contractor is expected to perform preliminary spark testing prior to scheduling a final test with the Public Works Commission. Any defects noted during this preliminary testing shall be repaired in accordance with these specifications and the manufacturer’s recommended procedures.

ACCEPTANCE

The Public Works Commission shall complete a final inspection of each manhole, to include a visual

inspection to verify that no leakage through the manhole wall is occurring, the manhole has been rehabilitated in accordance with the Contract Documents, and witness the final spark test. The Public Works Commission shall visually inspect every manhole and shall observe the final spark testing for every manhole. The Contractor shall coordinate with the Public Works Commission to schedule the final inspection. Any deficiencies noted during the final inspection shall be repaired in accordance with these specifications and the manufacturer's recommended procedures.

Inspection by the Public Works Commission does not absolve the Contractor from their responsibility for quality control inspection and testing as specified in these Contract Documents or as required by the manufacturer's instructions.

There shall be no groundwater infiltration or other leakage through the manhole wall after it has been lined. If leakage is found, it shall be eliminated with an appropriate method as recommended by the liner manufacturer and approved by the Public Works Commission. Any leakage shall be sealed utilizing materials compatible with the lining system, in accordance with the manufacturer's directions, and as approved by the Public Works Commission. The repair materials shall have the same life expectancy of the installed lining system. All repair materials shall be properly cured in accordance with the manufacturer's instructions. The use of curing compounds is prohibited.

All pipe connections shall be open and clear.

There shall be no cracks, voids, pinholes, slumps, drips, uncured spots, dry spots, lifts, delaminations or other type defects in the lining. The polymeric lining shall provide a continuous monolithic surface with uniform thickness throughout the manhole.

If any defective lining is discovered after it has been installed, it shall be repaired or replaced in accordance with the manufacturer's recommendations and in a satisfactory manner to the Public Works Commission. This requirement shall apply for the entire guarantee period.

The Contractor shall demonstrate that the installed lining system does not interfere with the proper sealing and locking (as applicable) of the manhole cover. Upon completion of the spark testing, all manholes shall be locked (if so equipped). For those manholes within paved areas, the Contractor shall apply four (4) dollops of roofing tar to the frame, to eliminate the cover from rattling. The dollops shall be equally spaced around the frame. The Public Works Commission Project Coordinator shall verify that the manholes are secured (locked and/or tarred).

At the completion of the Work, the Contractor shall remove all materials and debris associated with the Work of this Section.

The Contractor shall clean all surfaces not designated to receive the specified lining system. The Contractor shall restore all other work in a manner acceptable to the Public Works Commission.

The installed lining system shall be protected from damage until Final Acceptance of the Work. Any damage to the installed lining system shall be repaired or replaced at the discretion of the Public Works Commission, at no additional cost to the Public Works Commission.

*** END OF SECTION ***

DIVISION 2
SITE WORK

02765 MANHOLE CHIMNEY SEALS

GENERAL

The Contractor shall furnish all labor, materials, equipment, and incidentals required and install the manhole chimney sealing system and appurtenances as specified herein. The internal manhole sealing system shall seal the manhole, from the top of cone up to, and including, the joint between the manhole cone (including all extensions to the chimney area) and the manhole ring. The Contractor shall furnish all necessary materials, labor, and equipment necessary to properly prepare the surface and apply the sealing system. Installation of the sealing system shall be in accordance with these Contract Documents and the manufacturer's recommendations.

All manhole chimney sealing systems shall be installed after the manhole has been relined, unless otherwise directed by the Public Works Commission.

The Contractor shall accurately field measure and size each individual manhole. The Contractor is responsible for performing any and all necessary field measurements, in order to ensure that the sealing system is properly installed in accordance with the requirements of these Contract Documents and the manufacturer.

RELATED SECTIONS

A. Section 02500 – Traffic Control
B. Section 02762 – Manhole Lining – Polymeric
C. Section 02763 – Manhole Lining – Cured-in-Place

REFERENCE STANDARDS

The following American Society for Testing and Materials (ASTM) standards are incorporated by reference into this specification. The latest edition of the reference shall be used.

A. ASTM D412-06ae2 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension
B. ASTM D2240-97e1 – Standard Test Method for Rubber Property - Durometer Hardness

In case of conflicting requirements between this specification and these referenced documents, this specification will govern.

SUBMITTALS

All submittals shall be provided in accordance with Section 01000 – Special Conditions and Section 01300 – Submittals.

GUARANTEE

All sealing systems installed shall be guaranteed by the Contractor for a period of five (5) years from the date of final acceptance. During this period, all defects discovered in the sealing system, as determined by the Public Works Commission, shall be repaired or replaced in a satisfactory manner by the Contractor at no cost to the Public Works Commission.

QUALITY ASSURANCE

The supplier shall be responsible for the provisions of all test requirements specified in the above referenced ASTM Standards as applicable. In addition, all products to be installed under this Contract may be inspected at the plant for compliance with these specifications by an independent testing laboratory provided by the Public Works Commission. The Contractor shall require the manufacturer's cooperation in these inspections. The cost of plant inspection of all products and materials approved for this Contract shall be borne by the Public Works Commission.

Inspections of the products and materials may also be made by the Public Works Commission after delivery. The products and materials shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though samples may have been accepted as satisfactory at the place of manufacture. Materials rejected after delivery shall be marked for identification and shall be removed from the job at once.

The manufacturer and/or applicator of the sealing system shall be a company that specializes in the design, manufacture or installation of corrosion protection systems for manholes. The applicator shall be completely trained in the installation of the sealing system in manholes. The sealing system shall be suitable for installation in a severe hydrogen sulfide environment without any deterioration to the liner.

The applicator shall be trained and certified by the manufacturer for the handling, mixing, application and inspection of the manhole sealing system as described herein.

DELIVERY, STORAGE AND HANDLING

Care shall be taken in shipping, handling and placing to avoid damaging the sealing system products. Extra care may be necessary during cold weather construction. Any sealing system product or material damaged in shipment shall be replaced as directed by the Public Works Commission.

Any sealing system product showing deterioration, or which has been exposed to any other adverse storage condition that may have caused damage, even though no such damage can be seen, shall be marked as rejected and removed at once from the work.

While stored, the sealing system products shall be adequately packaged and protected. The sealing system products shall be stored in a manner as recommended by the manufacturer.

PRODUCTS

SEALING SYSTEM

The materials to be utilized in the sealing of manhole chimneys shall be designed and manufactured to withstand the severe effects of hydrogen sulfide in a wastewater environment. Manufacturer of corrosion protection products shall have long proven experience in the production of the lining products utilized and shall have satisfactory installation record.

Equipment for installation of lining materials shall be high quality grade and be as recommended by the manufacturer.

The manhole seal shall be designed to prevent leakage of water into the manhole through the frame joint area and the area above the manhole cone including all extensions to the chimney area. Extensions shall include, but are not limited to: concrete adjustment rings, brick, and/or block material that may have been used to achieve grade.

The manhole seal shall remain flexible allowing for the repeated vertical or horizontal movements of the frame due to frost lift, ground movement or the thermal movement of pavements.

The manhole sealing material shall be made no less than 170 mils of corrosion resistant aromatic flexible urethane resin coating to be applied to the inside wall of the entire chimney area as described above.

The product shall have a minimum elongation of 800% and hardness (Durometer) of 75.

The installed sealing system shall have a minimum tensile and adhesion strengths of 1150 psi and 175 lb. l/in. respectively.

The manhole sealing system shall conform to the physical requirements of ASTM D- 412.

The lining product shall have an aromatic urethane primer resin on the complete surface.

The sealing system shall line the interior of the adjustment area from the cone/top of the manhole and onto the inside of the casting.

If the manhole has been relined prior to the seal installation the seal shall cover a minimum of 12 vertical inches, as measured from the casting.

PATCHING MATERIAL

Voids in the existing manhole walls must be repaired prior to installing the manhole chimney sealing system. The patching material shall be a rapid setting, high early strength, corrosion resistant hand mixed and hand applied cementitious material intended for filling voids and making repairs in concrete, brick or other masonry constructed manholes. It shall be formulated in the factory and supplied in factory sealed and labeled pre-measured containers. The material shall be compatible with the sealing system to be used. The material shall have the following minimum characteristics:

1. Compressive strength	ASTM C109	2,000 psi at 24 hours

2. Shrinkage	ASTM C 596	0 percent at 90 percent relative humidity
3. Set time	ASTM C 191-92	3 to 5 minutes

Product shall be Permacast-Patch as manufactured by Action Products Marketing Corp., Strong-Seal QSR by Strong Company, Preco-Patch by Fosroc Inc. or approved equal.

INSTALLATION

The Contractor shall remove all loose and protruding mortar and brick that would interfere with the sealing system's performance. Any protrusions on the casting shall be cut flush to the casting.

Any voids or repairs to the concrete, brick, or block manhole walls shall be repaired and filled with suitable non-shrinking cements, sealants, or grouts. The patching material shall be compatible with the chimney sealing system. All patches shall be smooth and even with the manhole wall. The Contractor shall allow the patching cement to completely sure prior to beginning installation of the chimney sealing system.

The Contractor shall prepare the surface by sandblasting and utilizing an acetone wet wipe to ensure a clean surface as required by the manufacturer. The substrate surface must be free of sand, loose debris, latencies, dust, oil, grease or chemical contamination. A blower or torch may be required to completely dry the substrate surface or as recommended by manufacturer.

All active, hydrostatic infiltration leaks shall be plugged or sealed with an appropriate grout compatible with the sealing system.

The Contractor shall properly mix the sealing system agents (if necessary), in accordance with the manufacturer's instructions.

The Contractor shall ensure that the casting and structure surfaces are clean and dry, prior to application of the primer. Primer shall be applied in accordance with the manufacturer's instructions.

Once the primer has dried in accordance with the manufacturer's instructions, the sealing system shall be applied to the entire chimney area, to include the frame joint area, the area above the manhole cone, and all extensions in the chimney area. The sealing system shall be installed in accordance with the manufacturer's instructions.

The chimney sealing system shall be as manufactured by Sealing Systems, Inc., or approved equal.

DIVISION 2
SITE WORK

02831 CHAIN LINK FENCING

GENERAL

Where shown on the plans there shall be installed a "chain link" fence with all necessary posts, braces, top rail, gates, fabric, extension arms, and three strand barbed wire.

The erected fence shall meet the following requirements:

> The enclosing fence shall have an overall fabric height of six feet (6') and an additional one foot (1') of three strand barbed wire, for a total height of seven (7'). The gates shall be seven feet (7') in overall height.

MATERIALS

Fabric: Fencing shall be chain link #9 gauge aluminized continuously woven wire 2" uniform square mesh without knots or ties, except for knuckling and barbing. Both the top and bottom edges of the fabric shall be barbed unless otherwise shown on the plans. The Contractor shall not piece together a number of short pieces of fence fabric.

Tensile Strength Test: Wire pickets of which this fabric is made to stand a tensile strength test of approximately 70,000 pounds per square inch based on the cross sectional area of the galvanized wire.

Framework: All posts and other appurtenances used in construction shall be hot-dipped, galvanized with a minimum of 1.8 oz. per square foot surface.

Line Posts: Hot dip galvanized "H" column (2" x 2 1/4") weight 4.1 pounds per linear foot, minimum carbon content 0.355. No used or open seam material will be permitted in posts or rails. (Alternate 2 1/2" O.D. galvanized pipe weight 3.65 pounds per linear foot or C-section line posts of the same dimension as H-post, 0.120 in wall thickness and fabricated from steel conforming to ASTM A-570, Grade E.) Intermediate posts shall be evenly spaced no more than 10 feet apart on center.

Top Rail: Hot dip galvanized pipe 1 5/8" O.D., weight 2.27 pounds per linear foot protected with outside sleeve type couplings at least 7 inches long. No used or open seam material will be permitted.

Terminal Posts: End, corner and pull posts hot dip galvanized pipe 3" O.D. - 5.79 pounds per linear foot. Gate posts hot dip galvanized pipe of "H" construction as specified.

Tension Wire: A bottom tension wire 7 gauge, alzd. (0.4 oz./s.f.), 6 inches above grade. Wire shall be fastened to fabric with aluminum rings at 24" on center and to each intermediate post.

Extension Arms: Hot dip galvanized. Line post arms of pressed steel malleable base; end, and corner post arms of malleable iron; gate posts to have ornamental top. Each extension arm to carry three strands of barbed wire approximately 12 inches out from fence line. Barbed wires to be securely fastened in by means of self-locking grooves. The barbed wire shall support a minimum of 400 lbs. vertical dead load from tip of arm. The barbed wire shall be 4-point pattern composed of two strands of No. 12 1/2 gauge galvanized wire.

Gates: Frame to be galvanized pipe 2.0 inches O.D. weighing 2.27 pounds per foot. Each frame to be equipped with 3/8-inch diameter adjustable truss rods. Gateposts and corner posts shall be 3 inches O.D. weighing 5.11 pounds per foot. Gates are to be manufactured using 2" aluminum tubing in lieu of the specified Schedule 40 steel pipe. Gateposts and corner posts shall be 6 5/8" O.D. for swing gates (greater than 20 feet in length and 4" O.D. for slide gates, weighing minimum of 5.11 pounds per foot. Corner fittings to be heavy pressed steel or malleable castings. Fabric to be same as in fence. Gates to be completed with malleable ball and socket hinges, catch, stops and rest. Hinges to permit gate to swing back against fence, 180 degrees if required. Latches shall be arranged for padlocking so that the padlock will be accessible from both sides of the gate regardless of the latching arrangement.

Braces: Brace material to be hot dip galvanized and same as top rail, to be spaced midway between top rail and ground, and to extend from terminal post to first adjacent line post. Braces to be securely fastened to post by suitable connections, and then trussed from line post back to terminal post with 3/8 inch round rod equipped with a turnbuckle for adjusting.

Fittings: Hot dip galvanized. All fittings to be malleable, cast iron or pressed steel.

Fabric-Bands: Fabric to be fastened to line post with (9 gauge) fabric bands spaced approximately 18 inches apart, and to top rail with wires (9 gauge) spaces approximately 24 inches apart.

Locks: Locks will be provided by the Owner.

INSTALLATION

General: Installation shall be made in a workmanlike manner by skilled workers experienced in the erection of this type of fence and in accordance with the manufacturer's recommendations. The fence shall be erected on a previously prepared surface to the lines and grades indicated on the plans.

Post Setting: All posts shall be set plumb and in alignment into a 36-inch concrete footing of proper size and shape so as to furnish sufficient support to withstand any strain or shock ordinarily brought to bear on a fence of this character. The concrete strength shall be 3000 psi (ASTM C-94) and the foundations a minimum of 9 inches in diameter for line post and 12 inches for terminal post.

Concrete shall be thoroughly compacted so as to be free of voids and finished in a dome. Straight runs shall not exceed 500 feet between brace posts. Concrete shall cure a minimum of 72 hours before any further work is done on the posts.

Fabric: The fabric and barbed wire shall be stretched to the proper tension as recommended by the manufacturer and securely fastened to the framework members to result in a straight fence line without sagging. The bottom of the fabric shall be held as uniformly as is practicable to the finished grade.

DIVISION 2
SITE WORK

02931 SOD

GENERAL

Restoration of existing lawn areas outside of the public right-of-way disturbed by construction activities shall be by installation of new sod. Restoration and sod shall be performed as soon as practical, but the time period between initial disturbance, the utility installation and sod placement shall not exceed 60 days. Sod is defined as blocks, squares, strips of turf grass and adhering soil used for vegetative planting. Sodding and preparation of the sod bed shall be performed by an experienced landscape subcontractor specializing in this type of operation unless otherwise approved by the Public Works Commission in writing.

The Contractor shall adhere to the standards set forth by the American Association of Nurseryman and the Associated Landscape Contractors of America. All personnel shall be appropriately trained with regard to the degree of involvement so to assure the Owner the highest level of workmanship. Sod species suitable in this area are hybrid bermuda, centipede and zoysia; however the sod placed for each individual's lawn shall be the same species of sod as existing. Sodding may be performed at any time of the year except frozen sod shall not be placed nor shall sod be placed on frozen ground. The Contractor shall adapt his operations to variations in weather or soil conditions as necessary for the successful establishment and growth of a vigorous, disease free and weed free sod lawn.

MATERIAL

Materials, equipment and products incorporated in the work shall be approved by the Public Works Commission. The Contractor shall submit a list of the proposed materials with samples, if required. Package materials should be delivered in unopened original containers showing weight, analysis and name of manufacturer. The Contractor shall protect the material from deterioration and/or damage

Sod shall contain 95 percent permanent grass; not more than five (5) percent weeds and undesirable grasses, good texture and free from obnoxious grasses, roots, stones and foreign materials. Sod shall be uniformly 1 ½ to 2 inches thick with a well developed fibrous root mat system in topsoil with clean cut edges. The sod shall be sufficiently dense and cut to the minimum required thickness such that if the sod is suspended by one corner, the sod will not tear apart. The sod shall be recently mowed to a height of not more than three (3) inches prior to harvest. The sod shall be supplied and maintained in a healthy condition as evidence by the grass being a normal green color in appearance, dense, and free from insects, pests, disease or injury. Sod shall be delivered to the job site within 24 hours after being cut and shall be installed within 24 hours after delivery. Any sod which is torn, broken or too dry will be rejected.

SOIL BED PREPARATION

Before landscape construction is to begin, the site shall be cleaned and disposed of brush, rubbish, stones, gravel and other foreign material within the area to be landscaped. Exposed ground surfaces disturbed during construction activities shall be graded to the original contours (allowing for the thickness of the sod) or as in the case of an altered contour such as a fill slope, graded as directed by the Public Works Commission to finish grade, or typical cross section. The sod bed shall be excavated to such a depth that after sod placement the top of the sod shall be flush with surrounding grade or contours. Rake areas to be sodded smooth, free from unsightly variations, bumps, ridges or depressions. Do not start work until conditions are satisfactory and do not work during inclement or impending inclement weather.

The surface area to receive sod shall contain a minimum of four (4) inches of good, fertile, friable, organic natural topsoil loam as a base for laying the sod. Topsoil shall be free of clumps, brush, sticks, weeds, stones, roots, trash or other objectionable material. Contractor shall insure all topsoil to be free of plants or plant parts of quackgrass, johnson grass, nut sedge, poison ivy or other noxious weeds. The Contractor shall furnish and supplement the existing topsoil at no additional costs to the Public Works Commission providing a minimum four (4) inch thickness as specified. Soil preparation shall not be performed in frozen or extremely wet conditions. The finished topsoil bed shall be uniform in grade, with a yard like appearance. All changes in grade shall have a smooth, rounded peaks and valleys.

The soil shall be scarified or otherwise loosened to a depth of not less than five (5) inches and all clods shall be broken. The top four (4) inches shall be worked into an acceptable smooth, friable and uniformly fine texture sod bed by use of soil pulverizes, drags, harrows or by other methods approved by the Public Works Commission. Commercial grade fertilizer (8% nitrogen, 8% phosphate, 8% potash) shall be applied at a rate of 20 pounds per 100 square feet, super-phosphate at 12 pounds per 1,000 square feet and lime (dolomite limestone containing not less than 85% total carbamates) shall be applied at a rate of 25 pounds per 1,000 square feet or at a rate recommended for the type of sod being placed. Apply soil amendments within 24 hours after raking topsoil base surface and not more than 48 hours prior to laying sod. Mix thoroughly a minimum depth into the upper four (4) inches of topsoil and lightly water to aid in dissipation. Sod placement shall not begin until the soil preparation is inspected and approved by the Public Works Commission. During application of soil amendment fertilizer etc., adequate precautions shall be taken to prevent damage to existing features such as traffic, structures, landscape, trees, vegetation, utilities or any other appurtenances. The Contractor shall be required to repair or clean any damages.

PLACING SOD

The Contractor and his landscape subcontractor shall coordinate the placing of the sod to begin

within 24 hours after the topsoil base preparation is completed and accepted by the Public Works Commission. Sod shall be brought to the site as near to the time of placing as possible. Store sod in the shade, and keep watered particularly in extreme hot and dry condition to insure vitality and to prevent the dropping off of soil during handling. During wet weather, the sod shall be allowed to dry sufficiently to prevent tearing. Handling shall be done in a manner which will prevent tearing, breaking, drying or other damage. Carefully place sod in rows with the longer side perpendicular to slopes and the ends staggered in each successive row in a brick-like pattern. Butt the ends and sides together tightly and do not overlap or stretch the sod. Do not leave any voids or gaps. Unavoidable gaps shall be closed with small pieces of torn or broken sod if kept moist and approved by the Public Works Commission. After the sod is laid, irrigate thoroughly to allow water to penetrate a minimum six (6) inches into the soil below the sod. Sod shall not be placed when the atmospheric temperature is below 32oF.

Tamp and roll completed sod installation with a manual roller or approved equipment to eliminate minor irregularities and to form close contact with the soil bed immediately after placing and watering. The type of rolling and tamping equipment to be used shall be submitted to the Public Works Commission for approval prior to construction. On steep slopes 3:1 (horizontal and vertical) or greater, in drainage ditches or any areas where sod slipping may occur, anchor sod with approved wooden stakes (½"x ¾" x 12") or staples spaced not over two (2) feet apart in any direction and/or in sufficient number to prevent slippage or displacement. The anchors shall be driven flush with the surface of the sod. The wide flat side of the stake shall be driven parallel to the slope. Staking shall be done concurrently with sod placement and prior to tamping. Sod shall be laid with the long horizontal edge of the strips parallel to the contour starting at the bottom of the slope. The edge of the sod shall be turned slightly in the ground at the top of a slope and a layer of earth placed over it and compacted so as to conduct the surface water over and onto the top of the sod. Upon completion of the above described work, the surface of the sodded areas shall coincide with the finished grade and not exceed ¼" plus or minus variation to adjoining grade or proposed contour. Extreme care shall be taken to prevent the installed sod from being torn or displaced.

MAINTENANCE

The Contractor shall, at no additional cost to the Public Works Commission, make whatever arrangements necessary to supply water of suitable quality and purity to sustain and encourage vigorous plant growth, and supply all equipment for proper delivery and application to planted areas. Water obtained from a PWC fire hydrant shall be metered and properly protected with an approved backflow prevention device. PWC must inspect and approved any connections to their water system to include the proposed water application and storage equipment. The Contractor shall not use private resident's water. The Contractor is solely responsible to provide watering of the sod. The method of application of water shall be approved by the Public Works Commission. Limit watering to early morning or late afternoon to enable to soil the absorb maximum amount of water.

Maintenance shall begin immediately after sodding operation. The Contractor shall maintain all sodded areas until sod is firmly established and as outlined below. Maintenance will include watering, fertilizer, pest control, soil amendments, disease control, erosion repair, mowing, protecting turf area from traffic (i.e. temporary fences, barriers, signs, etc.) and replacement of any dead or damaged sod.

Watering

- Water lawn areas once a day with a minimum ½ inch water for the first three (3) weeks after area sodded.
- After the three (3) week period, water twice a week with a ¾ inch of water each time unless a comparable amount of rainfall has occurred.
- Make weekly inspections to determine moisture content of soil and supplement the above watering schedule as needed.
- Excessive runoff puddling and wilting shall be prevented.

Fertilizer and Pest Control

- Evenly spread fertilizer composite at a rate of 40 pounds per 5,000 square feet or as recommended by the manufacturer. Fertilizer shall not be applied until two (2) weeks after initial placement of the sod or prior to the advent of winter dormancy.
- Treat areas of weed and insect infestation as recommended by the treatment manufacturer.

Mowing

- The Contractor shall do mowing operations, (in yards not being mowed by residents) until provisional acceptance.
- Mowing shall be done only when the grass is dry with a rotary type mower having a blade height set not lower than one and one half (1½) inches nor higher than three (3) inches.
- Mowing operations shall be conducted at intervals, which ensure grass height does not exceed four (4) inches between mowing.
- The Contractor shall complete at least one mowing operation before the work will be considered for acceptance.

The Contractor shall protect and not allow access of vehicular traffic into any newly sodded areas and shall repair any damaged turf to original grade. Maintenance shall continue for a period of 90 days after placement or until provisional acceptance by the Public Works Commission. A written record shall be furnished to the Owner of the maintenance work performed. At least two weeks shall elapse after chemical control is applied before a request of inspection.

ACCEPTANCE

Fifteen (15) days prior to the end of the 90 day maintenance period, the Contractor shall make a written request to the Public Works Commission for an inspection and provisional acceptance of

the sod. Failure to notify the Public Works Commission will not relieve the Contractor of the maintenance provisions required and the Contractor will continue to be responsible for the maintenance of the sod.

Replacement of dead sod shall be performed within seven (7) days after notification by the Public Works Commission and the maintenance period for these areas or individual lawns shall be extended for the 90 day maintenance period. Failure to replace dead sod within the specified seven (7) day period will result in the Public Works Commission having the work performed and deducting the cost from the Contract; however, the Contractor shall be responsible for the maintenance.

Final acceptance will be given upon satisfactory contract performance exhibited at final inspection and acceptance. Sodded areas are to be fully rooted prior to acceptance. The Owner shall be the sole judge as to whether or not the lawns are acceptable. Should any deficiencies be disclosed at final inspection, the Contractor shall make the necessary corrections in a timely manner and request re-inspection.

GUARANTEE

The Contractor shall guarantee a dense, vigorous stand of turf free of weeds, disease, pests or any dead areas more than one half of a square foot in size for a period of 90 days from initial placement or replacement whichever is greater. Total dead area shall not exceed one percent (1%) of total square footage for each individual resident's lawn.

DIVISION 2
SITE WORK

02933 LAWNS AND GRASSES (SEEDING)

GENERAL

All exposed ground surfaces that have been disturbed during construction shall be graded to original contours as practicable, shaped to drain, and free of trash and debris. Grassing shall be accomplished as soon as practicable after sections of work are completed. Seeding and/or planting shall be performed by an experienced subcontractor specializing in this type of operation, unless otherwise approved by the Public Works Commission in writing. Disturbed sections shall not exceed one mile, without prior approval by the Public Works Commission. Grassing shall be in accordance with the Contract Documents.

PREPARATION OF THE SOIL

The surface area to receive seed shall contain a minimum of four (4) inches of good, fertile, friable, organic natural topsoil loam as a base for spreading the seed. Topsoil shall be free of clumps, brush, sticks, weeds, stones, roots, trash or other objectionable material. Contractor shall insure all topsoil to be free of plants or plant parts of quackgrass, johnson grass, nut sedge, poison ivy or other noxious weeds. The Contractor shall furnish and supplement the existing topsoil at no additional costs to the Public Works Commission providing a minimum 4 inch thickness as specified. Soil preparation shall not be performed in frozen or extremely wet conditions. The finished topsoil bed shall be uniform in grade, with a yard like appearance. All changes in grade shall have a smooth, rounded peaks and valleys.

The topsoil shall be loosened and mixed to the depth of four inches (4"). Suitable equipment (cultipackers, harrows, drags) meeting the approval of the Public Works Commission shall be used. This operation shall be accomplished by cutting on one (1) foot centers parallel to the contour of the slopes. On slopes that are steeper than 2:1, both depth preparation and degree of smoothness may be reduced, if approved by the Public Works Commission, but in all cases the slope surface shall be scarified groove, trenched or punctured so as to provide a textural plane of cut forming pockets, ridges, or trenches in which seeding material can lodge. Soil preparation shall not be performed when the soil is frozen, extremely wet or in an otherwise unfavorable working condition. The soil shall be free of any substance that might inhibit plant growth. Assistance of the local agricultural agent is recommended.

Lime shall be applied at the rate of 1/2 tons per acre. 10-20-20 commercial fertilizer shall be applied at the rate of 1,000 pounds per acre and well worked in to the top four inches (4”) of top soil. If hydroseeding, use 500 pounds of 10-10-10 fertilizer on slopes steeper than 1/2 horizontal

to 1 vertical.

SEED MIXTURE AND SOWING THE SEED

Seed shall be seed certified to be the latest season's crop and shall be delivered in original sealed packages bearing the producer's guaranteed analysis for percentages of mixtures and pure live seed. The producer's seed label shall indicate it the minimum percent of pure live seed (which shall be 82.45 for Bermuda, 88 for Rye Grain), the minimum percent of germination in hard seed and maximum percent of weed seed (no more than 1 percent for Bermuda, 0.5 percent for Rye Grain). Seed shall be labeled in conformance with U.S. Department of Agriculture rules and regulations under the Federal Seed Act and applicable State seed laws. Seed that has become wet, moldy, or otherwise damaged will not be acceptable.

The following seed mixture shall be used:

	POUNDS OF SEED PER ACRE			
	K-31 Fescue	Grain Rye	Common Bermuda	Centipede
April 15 - Sept. 1	75	-	60 (hulled)	5
Aug. 15 - Nov. 15	120	-	25 (hulled)	5
Nov. 1 - April 1	120	120	25 (un-hulled)	5

Note: If there are differences in the seed mixture between the mixture stated in these specifications and that which is specified as part of an approved Erosion Control Plan, the seed mixture specified in the erosion control plan shall take precedence.

Where construction crosses a pasture that has been grassed, the Contractor shall re-seed the area with the same type of grass as found on the site. All highway rights-of-way, and private yards disturbed shall also be re-seeded or with the same type of grass previously found. The seed mixture specification shall be used as a guide and the Contractor is charged with the responsibility of seeding areas with the proper type of grass that matches the existing.

Seed shall be broadcast uniformly by hand or by approved sowing equipment. One half of the seed shall be sown in one direction and the remaining shall be sown at right angles to the first. Do not seed when the wind velocity exceeds five (5) miles per hour. Rake lightly into top 1/8 inch of the soil prior to compacting, with a roller not exceeding 100 pounds.

All seeded areas will be mulched with two (2) tons per acre of small grain straw or wood cellulose fiber spread uniformly, approximately 1/4 of ground should be visible to avoid

smothering seedlings. Asphalt emulsion (ASTM D-977 and ASTM D-2028) shall be used to anchor the straw applied at 150 gallons per ton of straw, or crimped to stabilize. Asphalt emulsion shall be required from November 1st to March 31st. The Contractor shall take sufficient precautions to prevent mulch from entering drainage structures through displacement by wind, water or other causes and promptly remove any blockage which may occur.

SPECIAL CONSIDERATIONS

Shrubbery shall be expertly removed and carefully preserved for replanting, unless otherwise directed by the Public Works Commission adequate earth ball shall be removed to guard against damage to the root system. Shrubbery shall be replanted only after all construction is complete. The excavation made for replanting shall be six inches (6") larger in every dimension than the root ball removed. This additional space shall be filled with a mixture of one half topsoil and one half peat moss. Care shall be taken to set the top of the ball slightly above or flush with the surrounding surface. Any shrubbery damaged or that dies shall be replaced with an equal or better plant material at the Contractor's expense.

MAINTENANCE

The Contractor shall protect and maintain grassed areas as necessary to establish a uniform turf composed of the grasses specified. The Contractor shall re-seed any bare areas and repair all eroded areas.

Watering of seeded areas will be required during periods of dry weather to promote maximum growth. The Contractor shall supplement natural rainfall to insure a minimum of one (1) inch of rainfall weekly.

Maintenance of lawns begins immediately after the area is planted and continues for the period required to establish acceptable lawns, but not less than sixty (60) days after initial seeding, or until provisional acceptance by Owner. Maintain seeded areas by watering, fertilizing, mowing, weeding and other operations such as rolling, re-grading, replanting, aerating, and mulching as required to establish an acceptable lawn free of eroded or bare areas.

ACCEPTANCE

Fifteen (15) days prior to the end of the sixty (60) day maintenance period, the Contractor shall make a written request to the Owner for an inspection and provisional acceptance of the seeded area. Failure to notify the Owner will not relieve the Contractor of the maintenance provisions required and the Contractor will continue to be responsible for the maintenance of the seeded area.

Replacement of dead seed area(s) shall be performed within seven (7) days after notification by the Public Works Commission and the maintenance period for these areas or individual lawns

shall be extended for an additional sixty (60) day maintenance period. Failure to replace seeded area(s) within the specified seven (7) day period will result in the Owner having the work performed and deducting the cost from the Contract; however, the Contractor shall be responsible for the maintenance.

Final acceptance will be given upon satisfactory contract performance exhibited at final inspection and acceptance. Seeded areas are to be fully rooted prior to acceptance. The Owner shall be the sole judge as to whether or not the lawns are acceptable. Should any deficiencies be disclosed at final inspection, the Contractor shall make the necessary corrections in a timely manner and request re-inspection.

Payment to the Contractor for seeding areas will be approved once the seed has been established and meets the requirements of this paragraph of this specification.

GUARANTEE

The Contractor shall guarantee a stand of turf is considered acceptable when a live vigorous stand of permanent grass is established with growing sprouts visible at the surface showing not less than 9 seedlings of permanent grass at least 2 inches long in each square foot, and where no gaps larger than 4 inches in diameter occur anywhere in the lawn area. Permanent grass is defined as Common Bermuda, Centipede, and Fescue.

DIVISION 2
SITE WORK

02934 SEEDING WETLANDS

GENERAL

All exposed ground surfaces that have been disturbed during construction shall be graded to original contours, reasonably smooth, and free of trash and debris. Grassing shall be accomplished as soon as practicable after sections of work are completed. Seeding shall be performed by an experienced subcontractor specializing in this type of operation, unless otherwise approved by the Engineer in writing. Disturbed sections shall not exceed one half mile, without prior approval by the Engineer. Grassing shall be in accordance with the following specifications:

PREPARATION OF THE SOIL

The topsoil shall be loosened and mixed to the depth of 4" to 8". Suitable equipment meeting the approval of the Engineer shall be used. The soil shall be free of clay lumps, brush, weeds, stones, roots, stumps or any other substance that might inhibit plant growth. Assistance of the local agricultural agent is recommended.

Provide agricultural lime at rate required to bring soil acidity to slightly acid - ph 6, according to soil test report.

Lime and fertilizer shall be applied uniformly and mixed with the soil during seedbed preparation. Apply 10-20-10 commercial fertilizers at the rate of 20-lbs./1000 s.f. for warm season mix and 10-20-10 commercial fertilizer at a rate of 20 lbs./1000 s.f. for cool season mix.

Apply 10-10-10 commercial fertilizers at the rate of 20-lbs./1000 s.f. for temporary cover crops. In addition, provide 15-lbs./1000 s.f. of superphosphate.

The following is for the warm season mix:

a. All warm grass seed shall be debearded or conditioned by brushing to create a product nearly the same as debearding. This does not apply to Switchgrass.

b. Disk two times to break-up crop residue and dirt clods prior to seeding.

c. Pack soil to create a firm seedbed with a cultipacker or roller.

d. If a rain shower should fall after the seedbed is prepared but before planting break-up any crust formation.
e. Seeding shall be installed to a depth of 1/4" utilizing a rangeland drill or conventional grass drills. It is extremely important that seed not be planted deeper than 1/2" depth. Do not disc

or harrow after seeding. This will put the seed too deep. A Brillion seeder will be acceptable.

The following seed mixture shall be used:

Dates	Types	Rate
April 1 - July 15	***Warm Season Mix*** Switchgrass, Cave-in-rock, Alamo	8 pls #/acre or 4 oz./1000 s.f.
	Smartweed; and	2 bulk #/acre or 1 oz./1000 s.f.
	Japanese Millet or Sorghum Sudan Grass Hybrids (Mow prior to maturity)	20-lb/acre or ½ lbs/1000 s.f.
July 16 - Sept 1	Temporary crop of Japanese Millet or Sorghum Sudan Grass Hybrids (To be followed by permanent mixture)	20-lb/acre or ½ lbs/1000 s.f.
Sept 2 - Nov 1	***Cool Season Mix*** Reed Canary Grass	12 bulk #/acre or 6 oz./1000 s.f.
	Smartweed	2 bulk #/acre or 1 oz./1000 s.f.
Nov 2 - March 31	Temporary Crop of Wheat (To be followed by permanent mixture	40 lbs/acre

All highway rights-of-way, and private yards disturbed shall also be re-seeded or sodded with the same type of grass previously found. The seed mixture specification shall be used as a guide and the Contractor is charged with the responsibility of seeding areas with the proper type of grass existing.

Seed shall be broadcast uniformly by hand or by approved sowing equipment. One half of the seed shall be sown in one direction and the remaining shall be sown at right angles to the first. Do not seed when the wind velocity exceeds 5 miles per hour. Rake lightly into top 1/8 inch of the soil prior to compacting, with a roller not exceeding 100 pounds.

All seeded areas will be mulched with 75 pounds to 100-lbs./1000 s.f. of clean wheat straw, spread uniformly, approximately 1/4 of ground should be visible to avoid smothering seedlings. If hydro-seeded, use virgin paper mulch only. The Contractor shall take sufficient precautions to prevent mulch from entering drainage structures through displacement by wind; water or other causes and promptly remove any blockage, which may occur.

MAINTENANCE AND GUARANTEE

The Contractor shall protect and maintain grassed areas as necessary to establish a uniform turf composed of the grasses specified. The Contractor shall re-seed any bare areas and repair all eroded areas.

Maintain seeded areas by watering, fertilizing, mowing, weeding, and other operations such as rolling, regrading, replanting, aerating, mulching as required to establish an acceptable lawn free of eroded or bare areas.

ACCEPTANCE

The Contractor shall guarantee a stand of turf is considered acceptable when a live vigorous stand of permanent grass is established with growing sprouts visible at the surface showing not less than 9 seedlings of permanent grass at least 2 inches long in each square foot, and where no gaps larger than 4 inches in diameter occur anywhere in the seeded area.

DIVISION 2
SITE WORK

03301 CONCRETE CONSTRUCTION (UTILITY)

GENERAL

Concrete construction specified in this section shall be applicable to all "site work" and is not intended to cover general building specifications. The concrete work shall include all furnishing, hauling, fine grading and subgrade, form work, etc. and all incidentals necessary for completion of the work as it pertains.

MATERIALS

Concrete

The Contractor shall furnish and place concrete in strict accordance with the requirements of ACI 318 (most recent edition). Ready-mixed concrete from an approved mixing plan shall be used throughout the work and conform to the requirements of ASTM C-94 for batch, mixing, and transporting. Concrete shall be in accordance with the following requirements:

A. Under Ground - Regular Weight Concrete

28-day compressive strength	3000 psi
Coarse aggregate	1 ½” max. size stone
Slump	2" minimum, 4" maximum
Air Entrainment	No requirement

B. Walls, Slabs, Sidewalks, Curb and Gutter - Regular Weight Concrete

28-day compressive strength	3000 psi
Coarse aggregate	3/4" max. size stone
Slump	2" minimum, 4" maximum
Air Entrainment	5 more or less 1

The Contractor shall submit for approval mix designs, designed and tested by an approved testing laboratory, following the requirements of ACI 318 for each class of concrete to be used on this project. Mix designs in excess of one year old shall be verified. The Contractor will be responsible for all costs involved in the mix design. Material suppliers and material proportions incorporated in the mix design and certification shall not change without written permission from the Public Works Commission.

Admixtures used to produce entrained or air shall be sulforated hydrocarbons or neutralized vinsol resins conforming to ASTM C-260. Calcium chloride, other accelerators, or "anti-freeze"

shall not be used without written approval by the Public Works Commission.

Reinforcing Steel

Reinforcing bars shall be new billet stock and shall conform to ASTM A-615, Grade 60. Bars shall be deformed to conform to ASTM A-305. The Contractor shall check and submit for approval four (4) sets of shop and erection drawings prepared by the fabricator. Reinforcement detailing and placement shall conform to ACI 318. All reinforcing bars shall be tied in place according to approved erection drawings, using bar supports and accessories conforming to ACI 315. Laps or splices shall conform to ACI 318, and consist of the following minimum dimensions:

Tension Splices	36 Bar Diameters
Compression Splices	30 Bar Diameters

All reinforcing bars shall be tagged and stored in such manner as to be readily available at the time needed. Tag mark substitutions will not be made.

Welded wire mesh fabric reinforcing shall conform to the requirements of ASTM A-185. Lap splices shall be at least one full mesh plus 2" staggered to avoid continuous laps in either direction and securely wired or clipped.

GRADING

The Contractor shall use every effort to observe any possible misalignments in line or grade of the installed forms and will call such to the attention of the Public Works Commission promptly. The Contractor is cautioned that he shall be responsible for any damage to utility lines caused by his negligence. The Public Works Commission or his representative shall then inspect the forms and if approved, pouring operations may begin. Where unstable material exists, the Contractor shall remove such material to a depth required to provide a stable subgrade at no additional cost to the Public Works Commission.

FORM WORK

Metal forms shall be used throughout the work except for short, odd length sections and in accordance with ACI 301 and ACI 347 (most recent editions). Earth cuts may be used as forms for unexposed vertical surfaces on footings, provided the soil and workmanship allow an accurate and curable excavation. Forms shall be kept in good condition at all times. Any forms which have become out of shape or otherwise unsuitable shall be removed from the work. Forms shall be of such section and design that they will adequately support the concrete and any construction equipment used in the work. Form sections shall be provided with interlocking joints to insure that the forms are tightly jointed together free from movement. Forms shall be held in place by metal pins, not less than eighteen (18) inches in length, with fastenings of metal and wedges to insure a correct, rigid setting.

Forms shall be of the dimension required for the designed cross-section shown on the plans. Built up sections to attain the required depth will not be permitted.

Forms shall be set true to the lines and grades established by the Design Engineer or as indicated on the plans.

Forms shall be held rigidly in position and shall be of sufficient strength to resist springing out of line when concrete is placed.

PLACING CONCRETE

Prior to placing concrete, the subgrade shall be moistened and the contact side of the forms shall be cleaned and coated with a heavy oil. The Contractor shall not place any concrete without the forms, reinforcing steel and subgrade being inspected and approved by the Design Engineer. Placing of concrete is to be in accordance with ACI 304 (most recent edition). Water shall be removed from the excavation before placing concrete and water shall be diverted to prevent washing over freshly deposited concrete.

Concrete shall be placed as not to disturb concrete already in place and in such a manner as to require the minimum amount of lateral movement. Concrete shall be deposited in the forms without segregation. A tremie shall be used when the fall exceeds five (5) feet. Care shall be taken not to upset any forms during the concrete pouring operations. Any concrete showing misalignment due to form movement shall be removed and replaced at no additional cost to the Public Works Commission.

All concrete shall be consolidated in accordance with ACI 309 (most recent edition). Mechanical vibrators shall be operated by experienced workmen. Spading and rodding may be required to supplement mechanical vibration. Consolidation shall be adequate to remove any voids and after removal of the forms, no honeycomb shall be present. Should any honeycomb be present, the Design Engineer shall determine if the honeycomb is of a minor nature, the voids may be filled with mortar as approved by the Design Engineer.

All concrete within forms shall be brought to true section by the use of an approved straight edge and shall be tamped with straight edge to bring mortar to the surface, after which it shall be floated smooth by means of wood floats. No steel floats will be permitted. After true surface of section has been obtained, and after initial set has taken place, the entire surface shall be brushed with a dampened brush. All joints and all exposed edges shall be rounded off with approved jointing and edging tools. The type of finish required will be specified in the specific item of work specified or indicated on the drawings. All exposed surfaces of retaining walls, structures, etc. shall be given a Class 2 finish with ¼ inch chamfered edges.

No more concrete shall be laid than can be properly finished and covered during the daylight, unless adequate artificial light satisfactory to the Design Engineer is provided.

Immediately after finishing operations have been completed, the entire surface of the concrete shall be sprayed with an approved curing compound. The use of liquid retarding agents shall conform to standards specified by current AASHTO or ASTM Specifications.

Cold weather concreting shall be in accordance with ACI 306 (most recent edition) and hot weather concreting shall be in accordance with ACI 305 (most recent edition). Concreting shall be done when weather conditions are favorable unless otherwise directed by the Design Engineer. Concrete operations shall be discontinued when the temperature of 40 degrees Fahrenheit is reached on a falling thermometer. No concreting shall be attempted when local weather bureaus indicate temperatures below freezing within the ensuing 24 hours unless proper precautions are made to protect concrete by covering with straw or other thermal insulation satisfactory to the Design Engineer. The Contractor shall be responsible for the quality and strength of the concrete laid during cold weather or hot weather and any concrete damaged by frost action or freezing shall be removed and replaced as directed by the Design Engineer and/or the Public Works Commission at the Contractor's expense.

Forms shall not be removed from the concrete for a minimum of 7 days, unless approved by the Design Engineer. The Contractor shall apply a curing compound or provide measures to maintain moisture for proper curing at his expense, if early form removal is approved. Immediately after the forms have been removed, all honeycomb areas shall be repaired (with one part cement and two parts sand) and earth backfill material shall be placed adjacent to the finished concrete and smoothed off to prevent an accumulation of standing water, subgrade saturation or under wash in the event of rain.

Both pedestrian and vehicle traffic shall be excluded from crossing the concrete for a period of 14 days by the erection and maintenance of suitable barricades. Contractor shall be responsible for any damage resulting from traffic within the 14 day period and he shall remove and replace any concrete damaged as directed by the Design Engineer and/or Public Works Commission.

MASONRY MATERIALS

Brick shall be in accordance with ASTM C-32 Grade MS laid in full beds of mortar with shove joints.

Concrete masonry blocks shall be in accordance with ASTM C-139. Blocks shall be at least 5", but not more than 8" in thickness nor less than 8" in length and of such shape that the joints can be effectively sealed and bonded with cement mortar.

Cement mortar for brick work shall be in accordance with ASTM C-270, Type M. Use Type IIA cement in accordance with ASTM C-150.

TESTING

The requirements of ACI318 (most recent edition) shall be used to control the evaluation of all concrete strengths. The strength is to be checked during construction by four (4) cylinders at the option and cost of the Public Works Commission, of which 1 shall be broken at 7 days, 2 at 28 days. If the specified strength is not achieved in 28 days, 1 reserved shall be stored and broken as specified by the Design Engineer. Cylinders shall be made and stored in accordance with ASTM C-13. Cylinders shall be for each day concrete is poured in excess of 10 cubic yards of each different type of concrete, as determined by the Design Engineer. All additional expenses required because of the failure of the materials to meet routine testing requirements, or poorly scheduled concrete deliveries, shall be borne by the Contractor.

DIVISION 2
SITE WORK

09801 ANTI-MICROBIAL ADMIXTURE

GENERAL

All reinforced concrete precast manholes shall include a liquid anti-microbial admixture to render the concrete uninhabitable for bacterial growth. The admixture shall be included in the fabrication of the manhole by an approved concrete precast manhole manufacturer. Coatings applied to the interior walls of the manhole shall not be acceptable.

Further, all field mixed mortar, utilized in concrete precast manholes, shall include the anti-microbial admixture. The intent and purpose of this specification is to render all concrete and/or mortar within sanitary sewer service uninhabitable for bacterial growth. Any defects shall be cause for the replacement and correction of such defect as directed by the Fayetteville Public Works Commission (PWC), at no expense to the Fayetteville Public Works Commission.

RELATED SECTIONS

A. 02730 – Sanitary Sewer Systems
B. 02732 – Sewage Force Mains

REFERENCES

A. ASTM C478 – Standard Specification for Precast Reinforced Concrete Manhole Sections
B. ASTM C1443 – Standard Specification for Precast Reinforced Concrete Pipe
C. ASTM C1577 – Standard Specification for Precast Reinforced Concrete Pipe

SUBMITTALS

All submittals shall be provided in accordance with the Contract Documents, and the requirements outlined herein. The Contractor shall submit, in accordance with the Contract Documents, product data, certifications, and product data, to include the following:

1. U.S. Environmental Protection Agency (EPA) registration number.
2. Documentation that the product has a minimum of 10 years of successful prevention of microbial induced corrosion in sanitary sewers.
3. Documentation that the precast facility is certified by the anti-microbial manufacturer.
4. Documentation from the precast facility stating that the correct amount and correct mixing procedure was followed for all anti-microbial concrete.

QUALITY ASSURANCE

A color identifier shall be applied to the interior of each concrete piece fabricated with the anti-microbial admixture. Each piece shall also be plainly stenciled with the name of the anti-microbial admixture on the exterior of each piece.

MATERIALS

All manholes shall conform to PWC standard specifications and details, unless otherwise approved in writing by the Fayetteville Public Works Commission. All concrete and mortar utilized in the construction of the manholes shall contain an anti-microbial admixture.

Anti-Microbial Admixture:

The liquid anti-microbial admixture shall be used in accordance with the manufacturer's recommendations. The amount of the admixture shall be included in the total water content of the concrete or mortar mix design. The admixture shall be added to the concrete or mortar mix water, to ensure even distribution of the admixture throughout the concrete or mortar mix. When properly prepared, the anti-microbial admixture shall render the concrete or mortar uninhabitable for bacterial growth.

The anti-microbial admixture shall be ConShield, ConBlock, or approved equal. The ConShield liquid anti-microbial admixture can be obtained from ConShield Technologies, Inc. or an approved precast facility. TheConBlock liquid anti-microbial admixture can be obtained from ConSeal Concrete Sealants, Inc., or an approved precast facility.

Field Repairs:

Field repairs to the precast concrete or mortar shall be in accordance with the admixture manufacturer's recommendations. All field repairs shall be completed in accordance with PWC requirements.

ACCEPTANCE

Acceptance of the concrete and mortar with the anti-microbial admixture shall be based on conformance with the requirements herein, the Fayetteville Public Works Commission's review of the installed manhole, and results of all testing.

DIVISION 2
SITE WORK

09802 SPECIAL COATINGS - CERAMIC EPOXY (PROTECTO401)

GENERAL

The interior surfaces of all ductile iron pipe and fittings shall be full coated with a ceramic epoxy lining. The ceramic epoxy lining shall be applied to ductile iron pipe free of any other interior lining material. The finish coat shall be applied to yield a minimum dry film thickness of 40 mils for a complete lining.

MATERIALS

The lining material shall be an amine cured novalac epoxy containing at least 20% by volume of ceramic quarts pigment.

The epoxy material shall meet the following minimum performance requirements:

Permeability Rating: 0.00 perms when tested according to ASTM E-96 Procedure A with a test duration of 30 days.

ASTM 6-95 Cathodic Disbandment: 1.5 volts at 77° F.

ASTM B-117 Salt Spray: 0.00 undercutting after one year.

Immersion Testing ASTM D-714	Duration
20% Sulfuric Acid	1 Year
25% Sodium Hydroxide at 140° F	1 Year
160° F Distilled Water	1 Year
120° F Tap Water	1 Year

The above requirements shall be verified and tested by an approved testing laboratory. Copies of the laboratory test showing that the lining conforms to the specifications shall be furnished to the Public Works Commission, certified by the Supplier.

APPLICATION OF LININGS

Surface Preparation: All interior barrel and joint surface areas which will be exposed to the sewer liquids and gases shall be prepared for lining by removing all laitance form oil and other loose, foreign or deleterious materials which would adversely affect the bond of the lining compound of the pipe surface. All areas to receive the protective coating shall be abrasive blasted using compressed air nozzles with sand or grit media. The entire surface to be lined shall be struck with blast media so

that all rust, loose oxides, etc., are removed from the surface. Any area where rust appears before lining must be re-blasted.

Qualification of Applicator and Workmen:

The lining shall be applied by a competent firm with a five year history of lining sewer pipe. The workmen employed by the applicator shall be experienced and competent in the application and inspection of the lining compound to be applied. The Public Works Commission shall have the right to require the applicator to furnish bonds covering proper performance and guaranteeing the payment of all obligations arising as a result of improper materials and workmanship.

Equipment: All application equipment shall be as recommended by the suppliers of the lining compound.

Application Technique: After the surface has been thoroughly prepared for application, the interior of the pipe shall be coated with the ceramic epoxy to a minimum dry film thickness of 40 mils. No lining shall take place when the substrate or ambient temperature is below 40° F. The surface must be dry and dust free. The number of coats of lining material applied shall be as recommended by the lining manufacturer, but in no case shall it be applied above the dry film thickness per coat recommended by the lining manufacturer. The time between coats shall be that specified by the lining manufacturer.

Repair: All damaged areas or test areas shall be repaired in accordance with the manufacturer's recommendation, so that the repaired areas are equal to the undamaged lined areas in all respects.

Inspection: All pipe linings shall be checked for thickness using a magnetic film thickness gauge, the thickness testing shall be done in accordance with the method outlined in SSPC-PA-2 film thickness rating. The interior linings shall also be tested for pinholes with a non-destructive 2,500 volt test. Any defects found shall be repaired as noted above.

Markings: Each joint, manhole unit, or pipe bend special shall be marked with the date of application of the coating system, the date of inspection, and the numerical sequence of application on that date.

Shipping and Handling: Equipment used to handle and transport the lined pipe shall be suitably designed and operated not to damage the lining. Any damage which does occur shall be repaired prior to the installation of the pipe in accordance with the manufacturer's recommendations, so the repaired area is equal to the undamaged lining in all respects.

DIVISION 2
SITE WORK

09804 SPECIAL COATINGS – EPOXY LINING (PERMOX OR TNEMEC)

GENERAL

The interior surfaces of all ductile iron pipe and fittings in sanitary sewer service shall be fully coated with a ceramic epoxy lining. The lining system shall be a two component, amine cured novalac epoxy. The ceramic epoxy lining shall be applied to ductile iron pipe free of any other interior lining material. The finish coat shall be applied to yield a minimum dry film thickness of 40 mils for a complete lining. Any defects in the lining shall result in the pipe or fitting being replaced, at no additional cost to the Public Works Commission.

RELATED SECTIONS

A. 02730 – Sanitary Sewer Systems
B. 02732 – Sewage Force Mains

REFERENCES

A. ASTM B 117 – Standard Practice for Operating Salt Spray (Fog) Apparatus
B. ASTM C 413 – Standard Test Method for Absorption of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
C. ASTM C 868 – Standard Test Method for Chemical Resistance of Protective Linings
D. ASTM D 714 – Standard Test Method for Evaluating Degree of Blistering of Paints
E. ASTM D 870 – Standard Practice for Testing Water Resistance of Coatings Using Water Immersion
F. ASTM D 1308 – Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes
G. ASTM D 1653 – Standard Test Methods for Water Vapor Transmission of Organic Coatings
H. ASTM D 2240 – Standard Test Method for Rubber Property – Durometer Hardness
I. ASTM D 2370 – Standard Test Method for Tensile Properties of Organic Coatings
J. ASTM D 2583 – Standard Test Method ofr Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
K. ASTM D 2794 – Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
L. ASTM D 4060 – Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
M. ASTM D 4400 – Standard Test Method for Sag Resistance of Paints Using a Multinotch Applicator
N. ASTM D 4541 – Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
O. ASTM G 8 – Standard Test Methods for Cathodic Disbonding of Pipeline Coatings
P. ASTM G 95 – Standard Test Method for Cathodic Disbondment Test of Pipeline Coatings
Q. ASTM G154 – Standard Practice for Operating Fluorescent Ultraviolet Lamp Apparatus for Exposure of Nonmetallic Materials

Unless otherwise specified, references to documents shall mean the documents in effect at the time of bid. If the referenced document(s) have been discontinued by the issuing organization, references to those documents shall mean the replacement documents or the last version of the document before it was discontinued.

Where conflicts exist between the standards and this specification, the more stringent shall apply.

MATERIALS

All ductile iron pipe and fittings shall be in accordance with the Public Works Commission standard specification 02730 – Sanitary Sewer Systems, Public Works Commission standard specification 02732 – Sewage Force Mains, and these Contract Documents.

The lining material shall be an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment (no silica fume, fly ash, or alumina dust). The lining shall be both coal tar (polycyclic aromatic hydrocarbons) free and hazardous air polluting solvents (HAPS) free. The lining system shall be 100% solids by volume.

The ceramic epoxy lining system shall be the Perma-Shield PL Series 431 as manufactured by Tnemec Company, Inc., Permox-CTF as manufactured by Permite Corporation, or approved equal.

The ceramic epoxy lining system shall meet the following minimum performance requirements:

A. Abrasion (ASTM D 4060, CS-17 wheel, 1,000 grams) – 76 mg loss
B. Adhesion (ASTM D 4541) – not less than 1,860 psi
C. Severe Wastewater Analysis Test (150oF, 500 ppm H2S, 4,000 ppm NaCl, 10% sulfuric acid, EIS Permeation Analysis) – Initial impedance of 11.2 (log-z). No blistering, cracking, checking, or loss of adhesion. Reduction in electrical impedance of 0.5 after 28 days of exposure.
D. Cathodic Disbondment (ASTM G 8, 1.5 V, Classification Group A) – no more than 0.000 inch disbanded equivalent circle diameter.
E. Dielectric Strength (ASTM D 149) – greater than 600 V per mil
F. Hardness (ASTM D 2240) – Shore D hardness of 79
G. Impact (ASTM D2794) – No visible cracking or delamination after 160 inch-pounds direct impact.
H. Chemical resistance by immersion testing, in accordance with ASTM D 714, as outlined in the following table:

20% Sulfuric Acid at 77^{o} F	2 years, no effect
25% Sodium Hydroxide at 140^{o} F	2 years, no effect
5% Sodium Chloride at 77^{o} F	2 years, no effect
Distilled Water at 160^{o} F	2 years, no effect

I. Salt Spray (ASTM B 117) – No blistering, cracking, rusting, or delamination of film. No rust creepage at scribe after 1,000 hours.
J. Sag Resistance (ASTM D 4400) – Not less than 90 mills wet film thickness.

K. Water Absorption (ASTM C 413) – 0.0 percent water absorption
L. Water Vapor Transmission (ASTM D 1653, Method B, Wet Cup, Condition C) – 1.25 g/m2 per 24 hour water vapor transmission and 0.09 perms water vapor permeance.

The above requirements shall be verified and tested by an approved testing laboratory. Copies of the laboratory test showing that the lining conforms to the specifications shall be furnished to the Public Works Commission upon written request and certified by the Supplier.

QUALITY ASSURANCE

The manufacturer of the specified coating system shall have a minimum of 10 years experience in manufacturing high performance epoxy coating systems. The epoxy coating material shall be from a single manufacturer.

Application of the ceramic epoxy lining system shall be in accordance with the manufacturer's requirements. Preparation of the ductile iron pipe to be lined shall be completed by an installer approved by the lining system manufacturer.

SUBMITTALS

In accordance with these Contract Documents, the Contractor shall submit the following:

1. Manufacturer's certification that the coatings comply with the specified requirements and are suitable for the intended application.
2. Product data sheet.
3. Material Safety Data Sheet.
4. Copies of test data for all the physical, chemical, and permeation properties listed within this specification.

WARRANTY

The ceramic epoxy lining manufacturer shall warranty its products as free from material defects for a period of five (5) years. The Public Works Commission will solely determine whether the pipe should be replaced if any defects are discovered in the lining within the warranty period. All costs to replace the pipe or fitting, including but not limited to, bypass pumping, excavation, and traffic control shall be the manufacturer's responsibility.

APPLICATION OF LININGS

Application of the ceramic lining system shall be completed by an installer approved by the manufacturer of the lining system.

Surface Preparation: All interior barrel and joint surface areas which will be exposed to the sewer liquids and gases shall be prepared for lining by removing all laitance, form oil and other loose, foreign or deleterious materials which would adversely affect the bond of the lining compound of the pipe surface. All areas to receive the protective coating shall be abrasive blasted using compressed air nozzles with

sand or grit media. The entire surface to be lined shall be struck with blast media so that all rust, loose oxides, etc., are removed from the surface. Any area where rust appears before lining must be re-blasted.

Qualification of Applicator and Workmen: The ceramic epoxy lining shall be applied by a competent firm with a ten (10) year history of lining sewer pipe. The workmen employed by the applicator shall be experienced and competent in the application and inspection of the lining compound to be applied. The Public Works Commission shall have the right to require the applicator to furnish bonds covering proper performance and guaranteeing the payment of all obligations arising as a result of improper materials and workmanship.

Equipment: All application equipment shall be as recommended by the suppliers of the lining compound.

Application Technique: After the surface has been thoroughly prepared for application, the interior of the pipe shall be coated with the ceramic epoxy to a minimum dry film thickness of 40 mils. No lining shall take place when the substrate or ambient temperature is below 40^{o}F. The surface must be dry and dust free. The number of coats of lining material applied shall be as recommended by the lining manufacturer, but in no case shall it be applied above the dry film thickness per coat recommended by the lining manufacturer. The time between coats shall be that specified by the lining manufacturer.

Repair: All damaged areas or test areas shall be repaired by the lining manufacturer prior to shipment, in accordance with the manufacturer's recommendation, so that the repaired areas are equal to the undamaged lined areas in all respects.

Inspection: All pipe linings shall be checked for thickness using a magnetic film thickness gauge. The thickness testing shall be done in accordance with the method outlined in SSPC-PA-2 film thickness rating. The interior linings shall also be tested for pinholes with a non-destructive 2,500 volt test. Any defects found shall be repaired as noted above. All ceramic epoxy lined pipe and fittings shall be visually inspected for any defects, including runs, sags, or debris within the lining. All repairs shall be performed by the manufacturer prior to shipment.

Markings: Each joint, manhole unit, or fitting shall be marked with the date of application of the coating system, the date of inspection, and the numerical sequence of application on that date.

Shipping and Handling: Equipment used to handle and transport the lined pipe shall be suitably designed and operated not to damage the lining. Any damaged pipe or fitting shall be replaced at no cost to the Public Works Commission.

INSTALLATION

Cutting Pipe: The Contractor shall cut the pipe without damaging the pipe or interior ceramic epoxy coating. All cuts shall be at right angles to the pipe axis. All cut ends shall be dressed with a power grinder to remove all sharp edges. The cut ends of push-on joint pipe shall be beveled in accordance with the pipe manufacturer’s instructions. All field cuts shall be coated and sealed prior to installation. Application of the lining shall be done in accordance with the ceramic epoxy lining manufacturer’s recommendations.

Handling: All ceramic epoxy lined pipe and fittings shall be handled only from the outside. No forks, chains, straps, hooks, cables, or other equipment shall be placed inside the pipe and fittings for lifting, positioning, or installation. The pipe and fittings shall not be dropped or unloaded by rolling. The pipe and fittings shall not strike sharp objects while moving or unloaded. Ductile iron pipe shall not be placed on grade utilizing hydraulic pressure from machinery or hammers. The use of nylon straps or other similar lifting devices are to be used.

Pipe Installation: All pipe and fittings shall be installed in accordance with PWC standard specifications 02222 – Excavation, Trenching, and Backfilling for Utility Systems, 02730 – Sanitary Sewer Systems, 02732 – Sewage Force Mains, and these Contract Documents.