Andy Beshear
GOVERNOR

TRANSPORTATION CABINET
200 Mero Street
Frankfort, Kentucky 40601

Rebecca Goodman
SECRETARY

May 13, 2026

CALL NO. 109
CONTRACT ID NO. 261122
ADDENDUM # 2

Subject: Rowan County, FD06 103 0032002-005
Letting May 21, 2026

(1) Revised – Omit Proposal Page 172 of 181
(2) Added - Specifications – Pages 1-253 of 253

Proposal revisions are available at http://transportation.ky.gov/Construction-Procurement/.

If you have any questions, please contact us at 502-564-3500.

Sincerely,

Rachel Mills, P.E.
Director
Division of Construction Procurement

RM:mr
Enclosures

SECTION 01025

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.01 WORK INCLUDED

The Contractor shall furnish all necessary labor, machinery, tools, apparatus, equipment, materials, equipment, service, other necessary supplies and perform all work, including all excavation, backfilling, & cleanup (without additional compensation, except where specifically set out in these specifications) at the unit or lump sum prices for the following items.

1.02 PROGRESS AND PAYMENTS SCHEDULES

A. Contractor shall submit to Engineer, for approval, a construction schedule within ten (10) days upon execution of the AGREEMENT. Construction schedule shall show work completed in dollars versus contract time. Schedule must be approved by ENGINEER prior to any payments being made.

B. Within ten (10) days after the date of formal execution of the CONTRACT AGREEMENT, the Contractor shall prepare and submit to the Engineer, for approval, a periodic estimate which depicts the Contractor's cost for completing the contract requirements and show by major unit of the project work, the Contractor's dollar value for the material and the labor (two separate amounts) to be used as a basis for the periodic payments. The Contractor's periodic estimate must be approved by the Engineer before any payments will be made on this contract.

C. The Engineer's decision as to sufficiency and completeness of the Contractor's construction schedule and periodic estimate will be final.

D. The Contractor must make current, to the satisfaction of the Engineer, the construction schedule and periodic estimate each time he requests a payment on this contract.

E. When the Contractor requests a payment on this contract, it must be on the approved periodic estimate and be current. Further, the current periodic estimate and construction schedule (both updated and revised) shall be submitted for review by the Engineer before monthly payments will be made by the Owner. The Contractor shall submit an electronic copy or six (6) current copies of each (periodic estimate and construction schedule) when requesting payment.

1.03 CONDITIONS FOR PAYMENT

A. The Owner will make payments for acceptable work in place and materials properly stored on-site. The value of payment shall be as established on the approved construction schedule and periodic estimate, EXCEPT the Owner will retain five percent (5%) of the work in place and a percentage as hereinafter listed for items properly stored or untested.

B. No payment will be made for stored materials unless a proper invoice from the supplier is attached to the pay request. Further, no item whose value is less than $1,000 will be considered as stored materials for pay purposes.

C. Payment for stored materials that are submitted with each monthly pay request will require documentation from the material supplier indicating that those items have been paid. Proof of payment for stored materials shall be in the form of “paid invoice” receipts or cancelled

checks. Failure to provide adequate documentation will result in delays in processing subsequent pay requests.

D. Payment for pipeline items shall be limited to eighty percent (80%) of the bid price until the pipeline items have been tested and clean up has been completed and accepted by the Engineer.

E. Payment for equipment items shall be limited to eighty-five percent (85%) of their scheduled value (materials portion only) until they are set in place. Eighty-five percent (85%) for stored materials and equipment shall be contingent on proper on-site storage as recommended by the manufacturer or required by the Engineer.

F. Payment for equipment items set in place shall be limited to ninety percent (90%) of their scheduled value until they are ready for operation and have been certified by the manufacturer. Ninety percent (90%) payment for installed equipment shall be contingent on proper routine maintenance of the equipment in accordance with the manufacturer's recommendations.

G. Payment for equipment items set in place and ready for operation shall be limited to ninety-five percent (95%) of their scheduled value until all acceptance tests have been completed and the required manufacturer's pre-startup operator's training has been completed.

H. Payment for the labor portion of equipment items will be subject only to the degree of completeness and the appropriate retainage.

I. The retainage shall be an amount equal to 5% of said estimate. The retainage on the equipment items shall be 5% as defined hereinbefore.

J. If at any time thereafter when the progress of the WORK is not satisfactory or determine that the Contractor is not making satisfactory progress, additional amounts may be retained.

1.04 DETERMINATION OF THE VALUE OF EXTRA (ADDITIONAL) OR OMITTED WORK

A. The value of extra (additional) or omitted work shall be determined in one or more of the following ways:

1. On the basis of the actual cost of all the items of labor (including on-the-job supervision), materials and use of equipment, plus a maximum 20% for added work or a minimum 20% for deleted work which shall cover the Contractor's general supervision, overhead and profit. In case of subcontracts, the sum of total overhead amounts of the subcontractors and Contractor, plus total profit amounts for the subcontracts and Contractor shall not exceed 25% of the cost. Subcontractors shall be limited to 15% and Contractors shall be limited to 10% for combined overhead and profit. The cost of labor shall include required insurance, taxes and fringe benefits. Contractor to provide detailed breakdown of all cost as justification of change in work. Equipment costs shall be based on current rental rates in the areas where the work is being performed, but in no case shall such costs be greater than the current rates published by the Associated Equipment Distributors, Chicago, Illinois.

2. By estimate and acceptance in a lump sum.

3. By unit prices named in the Contract or subsequently agreed upon.

B. Provided, however, that the cost or estimated cost of all extra (additional) work shall be determined in advance of authorization by the Engineer and approved by the Owner.

C. All extra (additional) work shall be executed under the conditions of the original Contract. Any claim for extension of time shall be adjusted according to the proportionate increase or decrease in the final total cost of the work unless negotiated on another basis.

D. Except for over-runs in contract unit price items, no extra (additional) work shall be done except upon a written change Order from the Engineer, and no claim on the part of the Contractor for pay for extra (additional) work shall be recognized unless so ordered in writing by the Engineer.

E. Change Orders to the construction contract must comply with DOW Procurement Guidance for Construction and Equipment Contracts. Contract requires cost, pricing, and certification for change orders exceeding $25,000 as required by DOW Procurement Guidance for Construction and Equipment Contracts.

PART 2 – PRODUCTS

2.01 15011 – S DIRECTIONAL BORE

Payment under this item is made whenever the plans or specifications specifically show directional boring is to be utilized in order to minimize the impact of open cut for the installation of force main or gravity sewer under streets, creeks, and etc. Payment under this item shall include the specified bore pipe, labor, and equipment. No separate payment shall be made for bore pipe installed in the bore whether used as a carrier pipe or an encasement of a separate carrier pipe. This item shall also include pipe anchors at each end of the bore when specified to prevent the creep or contraction of the bore pipe. Carrier pipe installed within a bore pipe shall be paid separately under pipe items. Payment under this item shall not be size specific and no separate bid items will be established for size variations. The bore pipe sizes to be included under this item shall be as shown on the plans and/or in the specifications. Any and all directional bores in each contract shall be paid under one directional bore bid item included in the contract regardless of size. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF).

2.02 15013 – S ENCASEMENT SPECIAL (PVC CASING ALL SIZES)

Includes all labor, equipment, excavation, PVC pipe, backfill, restoration, and etc., to construct the PVC encasement of the sewer or force main as shown on the plans, and in accordance with the specifications and standard drawings. Payment under this item shall be in addition to the carrier pipe as paid under separate bid items. Carrier pipe is not included in this bid item. Any and all PVC encasement shall be paid under one bid item included in the contract regardless of the size of the carrier pipe or as specified in the plans and specifications. No separate bid items will be established for size variations. Measurement of pay quantity shall be from end of pipe to end of pipe. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.03 15014 – S ENCASEMENT STEEL BORED RANGE 1

This item shall include the steel encasement pipe size as specified on the plans and in the specifications, casing spacers, end seals, labor, and equipment to bore and install the encasement in accordance with the plans and specifications, complete and ready for use. The size shall be the measured internal diameter of the encasement pipe. The sizes of encasement to be paid under the size ranges specified in the bid items shall be as follows:

Range 1 = All encasement sizes greater than 2 inches to and including 6 inches
Range 2 = All encasement sizes greater than 6 inches to and including 10 inches
Range 3 = All encasement sizes greater than 10 inches to and including 14 inches

Range 4 = All encasement sizes greater than 14 inches to and including 18 inches
Range 5 = All encasement sizes greater than 18 inches to and including 24 inches
Range 6 = All encasement sizes greater than 24 inches

(Encasement sizes of 2 inches internal diameter or less shall not be paid separately; but, shall be considered incidental to the carrier pipe.) Payment under this bid item shall not include the carrier pipe. Carrier pipe shall be paid under a separate bid item. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF).

2.04 15015 – S ENCASEMENT STEEL BORED RANGE 3

This item shall include the steel encasement pipe size as specified on the plans and in the specifications, casing spacers, end seals, labor, and equipment to bore and install the encasement in accordance with the plans and specifications, complete and ready for use. The size shall be the measured internal diameter of the encasement pipe. The sizes of encasement to be paid under the size ranges specified in the bid items shall be as follows:

Range 1 = All encasement sizes greater than 2 inches to and including 6 inches
Range 2 = All encasement sizes greater than 6 inches to and including 10 inches
Range 3 = All encasement sizes greater than 10 inches to and including 14 inches
Range 4 = All encasement sizes greater than 14 inches to and including 18 inches
Range 5 = All encasement sizes greater than 18 inches to and including 24 inches
Range 6 = All encasement sizes greater than 24 inches

(Encasement sizes of 2 inches internal diameter or less shall not be paid separately; but, shall be considered incidental to the carrier pipe.) Payment under this bid item shall not include the carrier pipe. Carrier pipe shall be paid under a separate bid item. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF).

2.05 15017 – S ENCASEMENT STEEL BORED RANGE 4

This item shall include the steel encasement pipe size as specified on the plans and in the specifications, casing spacers, end seals, labor, and equipment to bore and install the encasement in accordance with the plans and specifications, complete and ready for use. The size shall be the measured internal diameter of the encasement pipe. The sizes of encasement to be paid under the size ranges specified in the bid items shall be as follows:

Range 1 = All encasement sizes greater than 2 inches to and including 6 inches
Range 2 = All encasement sizes greater than 6 inches to and including 10 inches
Range 3 = All encasement sizes greater than 10 inches to and including 14 inches
Range 4 = All encasement sizes greater than 14 inches to and including 18 inches
Range 5 = All encasement sizes greater than 18 inches to and including 24 inches
Range 6 = All encasement sizes greater than 24 inches

(Encasement sizes of 2 inches internal diameter or less shall not be paid separately; but, shall be considered incidental to the carrier pipe.) Payment under this bid item shall not include the carrier pipe. Carrier pipe shall be paid under a separate bid item. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF).

2.06 15019 – S ENCASEMENT STEEL BORED RANGE 6

This item shall include the steel encasement pipe size as specified on the plans and in the specifications, casing spacers, end seals, labor, and equipment to bore and install the encasement in accordance with the plans and specifications, complete and ready for use. The size shall be the measured internal diameter of the encasement pipe. The sizes of encasement to be paid under the size ranges specified in the bid items shall be as follows:

Range 1 = All encasement sizes greater than 2 inches to and including 6 inches
Range 2 = All encasement sizes greater than 6 inches to and including 10 inches
Range 3 = All encasement sizes greater than 10 inches to and including 14 inches
Range 4 = All encasement sizes greater than 14 inches to and including 18 inches
Range 5 = All encasement sizes greater than 18 inches to and including 24 inches
Range 6 = All encasement sizes greater than 24 inches

(Encasement sizes of 2 inches internal diameter or less shall not be paid separately; but, shall be considered incidental to the carrier pipe.) Payment under this bid item shall not include the carrier pipe. Carrier pipe shall be paid under a separate bid item. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF).

2.07 15020 – S ENCASEMENT STEEL OPEN CUT RANGE 1

This item shall include the steel encasement pipe size as specified on the plans and in the specifications, casing spacers, end seals, labor, and equipment to open cut install the encasement in accordance with the plans and specifications, complete and ready for use. The size shall be the measured internal diameter of the encasement pipe. The size encasement to be paid under the size ranges specified in the bid items shall be as follows:

Range 1 = All encasement sizes greater than 2 inches to and including 6 inches
Range 2 = All encasement sizes greater than 6 inches to and including 10 inches
Range 3 = All encasement sizes greater than 10 inches to and including 14 inches
Range 4 = All encasement sizes greater than 14 inches to and including 18 inches
Range 5 = All encasement sizes greater than 18 inches to and including 24 inches
Range 6 = All encasement sizes greater than 24 inches

(Encasement sizes of 2 inches internal diameter or less shall not be paid separately; but, shall be considered incidental to the carrier pipe.) Payment under this bid item shall not include the carrier pipe. Carrier pipe shall be paid under a separate bid item. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF).

2.08 15022 – S ENCASEMENT STEEL OPEN CUT RANGE 3

This item shall include the steel encasement pipe size as specified on the plans and in the specifications, casing spacers, end seals, labor, and equipment to open cut install the encasement in accordance with the plans and specifications, complete and ready for use. The size shall be the measured internal diameter of the encasement pipe. The size encasement to be paid under the size ranges specified in the bid items shall be as follows:

Range 1 = All encasement sizes greater than 2 inches to and including 6 inches
Range 2 = All encasement sizes greater than 6 inches to and including 10 inches
Range 3 = All encasement sizes greater than 10 inches to and including 14 inches
Range 4 = All encasement sizes greater than 14 inches to and including 18 inches
Range 5 = All encasement sizes greater than 18 inches to and including 24 inches
Range 6 = All encasement sizes greater than 24 inches

(Encasement sizes of 2 inches internal diameter or less shall not be paid separately; but, shall be considered incidental to the carrier pipe.) Payment under this bid item shall not include the carrier pipe. Carrier pipe shall be paid under a separate bid item. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF).

2.09 15023 – S ENCASEMENT STEEL OPEN CUT RANGE 4

This item shall include the steel encasement pipe size as specified on the plans and in the specifications, casing spacers, end seals, labor, and equipment to open cut install the encasement in accordance with the plans and specifications, complete and ready for use. The size shall be the measured internal diameter of the encasement pipe. The size encasement to be paid under the size ranges specified in the bid items shall be as follows:

Range 1 = All encasement sizes greater than 2 inches to and including 6 inches
Range 2 = All encasement sizes greater than 6 inches to and including 10 inches
Range 3 = All encasement sizes greater than 10 inches to and including 14 inches
Range 4 = All encasement sizes greater than 14 inches to and including 18 inches
Range 5 = All encasement sizes greater than 18 inches to and including 24 inches
Range 6 = All encasement sizes greater than 24 inches

(Encasement sizes of 2 inches internal diameter or less shall not be paid separately; but, shall be considered incidental to the carrier pipe.) Payment under this bid item shall not include the carrier pipe. Carrier pipe shall be paid under a separate bid item. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF).

2.10 15027 – S FORCE MAIN AIR RLS/VAC VALVE 03 IN

This bid item description shall apply to all force main air release/vacuum valve installations of every size except those defined as "Special".
This item shall include the air release/vacuum valve, main to valve connecting line or piping, manhole/vault/structure, access casting or doors, tapping the main, labor, equipment, excavation, proper backfill and restoration required to install the air release/vacuum valve at the location shown on the plans or as directed in accordance with the specifications and standard drawings complete and ready for use. All air release/vacuum valves on a project shall be paid under one bid item regardless of size. No separate pay items will be established for size variations. Only in the case of the uniqueness of a particular air release/vacuum valve would a separate bid item be established. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.11 15057 – S FORCE MAIN PVC 02 INCH

This description shall apply to all PVC and ductile iron and polyethylene/plastic pipe bid items of every size and type, except those bid items defined as "Special". This item includes the pipe specified by the plans and specifications, all fittings (including, but not limited to, bends, tees, reducers, plugs, and caps), tracing wire with test boxes (if required by specification), polyethylene wrap (when specified), labor, equipment, excavation, bedding, restoration, testing, backfill, and etc., required to install the specified new pipe and new fittings at the locations shown on the plans, or as directed, in accordance with the specifications and standard drawings complete and ready for use. No additional payment will be made for rock excavation. This bid item includes material and placement of flowable fill under existing and proposed pavement, and wherever else specified on the plans or in the specifications. This item shall also include pipe anchors on polyethylene pipe runs as shown on the plans or required by the specifications to prevent the creep or contraction of the pipe.

Measurement of quantities under this item shall be through fittings, encasements, and directional bores (only when a separate carrier pipe is specified within the directional bore pipe). No separate payment will be made under pipe items when the directional bore pipe is the carrier pipe. Measurements shall be further defined to be to the center of tie-in where new pipe contacts existing pipe at the center of connecting fittings, to the outside face of vault or structure walls, or to the point of main termination at dead ends. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF).

2.12 15058 – S FORCE MAIN PVC 03 INCH

This description shall apply to all PVC and ductile iron and polyethylene/plastic pipe bid items of every size and type, except those bid items defined as "Special". This item includes the pipe specified by the plans and specifications, all fittings (including, but not limited to, bends, tees, reducers, plugs, and caps), tracing wire with test boxes (if required by specification), polyethylene wrap (when specified), labor, equipment, excavation, bedding, restoration, testing, backfill, and etc., required to install the specified new pipe and new fittings at the locations shown on the plans, or as directed, in accordance with the specifications and standard drawings complete and ready for use. No additional payment will be made for rock excavation. This bid item includes material and placement of flowable fill under existing and proposed pavement, and wherever else specified on the plans or in the specifications. This item shall also include pipe anchors on polyethylene pipe runs as shown on the plans or required by the specifications to prevent the creep or contraction of the pipe. Measurement of quantities under this item shall be through fittings, encasements, and directional bores (only when a separate carrier pipe is specified within the directional bore pipe). No separate payment will be made under pipe items when the directional bore pipe is the carrier pipe. Measurements shall be further defined to be to the center of tie-in where new pipe contacts existing pipe at the center of connecting fittings, to the outside face of vault or structure walls, or to the point of main termination at dead ends. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF).

2.13 15060 – S FORCE MAIN PVC 06 INCH

This description shall apply to all PVC and ductile iron and polyethylene/plastic pipe bid items of every size and type, except those bid items defined as "Special". This item includes the pipe specified by the plans and specifications, all fittings (including, but not limited to, bends, tees, reducers, plugs, and caps), tracing wire with test boxes (if required by specification), polyethylene wrap (when specified), labor, equipment, excavation, bedding, restoration, testing, backfill, and etc., required to install the specified new pipe and new fittings at the locations shown on the plans, or as directed, in accordance with the specifications and standard drawings complete and ready for use. No additional payment will be made for rock excavation. This bid item includes material and placement of flowable fill under existing and proposed pavement, and wherever else specified on the plans or in the specifications. This item shall also include pipe anchors on polyethylene pipe runs as shown on the plans or required by the specifications to prevent the creep or contraction of the pipe. Measurement of quantities under this item shall be through fittings, encasements, and directional bores (only when a separate carrier pipe is specified within the directional bore pipe). No separate payment will be made under pipe items when the directional bore pipe is the carrier pipe. Measurements shall be further defined to be to the center of tie-in where new pipe contacts existing pipe at the center of connecting fittings, to the outside face of vault or structure walls, or to the point of main termination at dead ends. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF).

2.14 15062 – S FORCE MAIN PVC 10 INCH

This description shall apply to all PVC and ductile iron and polyethylene/plastic pipe bid items of every size and type, except those bid items defined as "Special". This item includes the pipe specified by the plans and specifications, all fittings (including, but not limited to, bends, tees, reducers, plugs, and caps), tracing wire with test boxes (if required by specification), polyethylene wrap (when specified), labor, equipment,

excavation, bedding, restoration, testing, backfill, and etc., required to install the specified new pipe and new fittings at the locations shown on the plans, or as directed, in accordance with the specifications and standard drawings complete and ready for use. No additional payment will be made for rock excavation. This bid item includes material and placement of flowable fill under existing and proposed pavement, and wherever else specified on the plans or in the specifications. This item shall also include pipe anchors on polyethylene pipe runs as shown on the plans or required by the specifications to prevent the creep or contraction of the pipe. Measurement of quantities under this item shall be through fittings, encasements, and directional bores (only when a separate carrier pipe is specified within the directional bore pipe). No separate payment will be made under pipe items when the directional bore pipe is the carrier pipe. Measurements shall be further defined to be to the center of tie-in where new pipe contacts existing pipe at the center of connecting fittings, to the outside face of vault or structure walls, or to the point of main termination at dead ends. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF).

2.15 15069 – S FORCE MAIN TAP SLEEVE/VALVE RANGE 1

This item shall include
the specified tapping sleeve, valve, valve box, concrete pad around valve box (when required in specifications or plans), labor, and equipment to install the specified tapping sleeve and valve, complete and ready for use in accordance with the plans and specifications. The size shall be the measured internal diameter of the live pipe to be tapped. The size tapping sleeve and valve to be paid under sizes 1 or 2 shall be as follows:

Range 1 = All live tapped main sizes up to and including 8 inches
Range 2 = All live tapped main sizes greater than 8 inches

Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.16 15071 – S FORCE MAIN TIE-IN 02 INCH

This bid description shall be used for all force main tie-in bid items of every size except those defined as "Special". This item includes all labor, equipment, excavation, fittings, sleeves, reducers, couplings, blocking, anchoring, restoration, testing and backfill required to make the force main tie-in as shown on the plans and in accordance with the specifications complete and ready for use. This bid item shall include purge and sanitary disposal of any sewage from any abandoned segments of force main. Pipe for tie-ins shall be paid under separate bid items. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.17 15072 – S FORCE MAIN TIE-IN 03 INCH

This bid description shall be used for all force main tie-in bid items of every size except those defined as "Special". This item includes all labor, equipment, excavation, fittings, sleeves, reducers, couplings, blocking, anchoring, restoration, testing and backfill required to make the force main tie-in as shown on the plans and in accordance with the specifications complete and ready for use. This bid item shall include purge and sanitary disposal of any sewage from any abandoned segments of force main. Pipe for tie-ins shall be paid under separate bid items. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.18 15074 – S FORCE MAIN TIE-IN 06 INCH

This bid description shall be used for all force main tie-in bid items of every size except those defined as "Special". This item includes all labor, equipment, excavation, fittings, sleeves, reducers, couplings, blocking, anchoring, restoration, testing and backfill required to make the force main tie-in as shown on the plans and in accordance with the specifications complete and ready for use. This bid item shall include purge and sanitary disposal of any sewage from any abandoned segments of force main. Pipe for tie-ins shall be paid under

separate bid items. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.19 15076 – S FORCE MAIN TIE-IN 10 INCH

This bid description shall be used for all force main tie-in bid items of every size except those defined as "Special". This item includes all labor, equipment, excavation, fittings, sleeves, reducers, couplings, blocking, anchoring, restoration, testing and backfill required to make the force main tie-in as shown on the plans and in accordance with the specifications complete and ready for use. This bid item shall include purge and sanitary disposal of any sewage from any abandoned segments of force main. Pipe for tie-ins shall be paid under separate bid items. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.20 15081 – S FORCE MAIN TIE-IN SPECIAL (GRINDER LATERALS)

This bid description shall be used for all force main lateral tie-in bid items of every size. This item includes all labor, equipment, excavation, fittings, sleeves, reducers, couplings, blocking, anchoring, restoration, testing and backfill required to make the force main tie-in as shown on the plans and in accordance with the specifications complete and ready for use. This bid item shall include purge and sanitary disposal of any sewage from any abandoned segments of force main. Pipe for tie-ins shall be paid under separate bid items. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.21 15084 – S FORCE MAIN GATE VALVE

This description shall apply to all force main valves of every size required in the plans and specifications, except those bid items defined as "Special". Payment under this description is to be for gate or butterfly force main valves being installed with new force main. This item includes the valve as specified in the plans and specifications, polyethylene wrap (if required by specification), labor, equipment, excavation, anchoring (if any), valve box and valve stem extensions, backfill, concrete pad around valve box (if required by specification), restoration, testing, and etc., required to install the specified valve at the location shown on the plans in accordance with the specifications and standard drawings complete and ready for use. If required on plans and/or proposed adjoining DIP is restrained, force main valves shall be restrained. Force main valve restraint shall be considered incidental to the force main valve and adjoining pipe. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.22 15086 – S LATERAL CLEANOUT

This item shall be for payment for installation of a cleanout in a service lateral line. This item shall include furnishing and installation of a tee, vertical pipe of whatever length required, and threaded cap. The cleanout shall extend from the lateral to final grade elevation. The size of the cleanout shall be equivalent to the size of the lateral. The cleanout materials shall meet the same specification as those for the lateral. The cleanout shall be installed at the locations shown on the plans or as directed by the engineer. Only one pay item shall be established for cleanout installation. No separate pay items shall be established for size or height variances. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.23 15087 – S LATERAL LONG SIDE 04 INCH

This bid item description shall apply to all service lateral installations of every size up to and including 6 inch internal diameter, except those lateral bid items defined as "Special". This item includes the specified piping material, main tap, bends, clean outs, labor, equipment, excavation, backfill, testing, and restoration, at the locations shown on the plans or as directed, in accordance with the specifications and standard drawings, complete and ready for use. This bid item is to pay for service lateral installations where the ends of the lateral connection are on opposite sides of the public roadway. The new lateral must cross the centerline of the public roadway to qualify for payment as a long side lateral. The length of the service lateral is not to be

specified. Payment under this item shall not be restricted by a minimum or maximum length. The contractor shall draw his own conclusions as to the length of piping that may be needed. Payment under this item shall include boring, jacking, or excavating across the public roadway for placement. Placement of a service lateral across a private residential or commercial entrance alone shall not be reason to make payment under this item. Private or commercial entrances shall not be considered a public roadway in defining payment under this item. No additional payment will be made for rock excavation or for bedding required in rock excavation. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.24 15089 – S LATERAL SHORT SIDE 04 INCH

This bid item description shall apply to all service lateral installations of every size up to and including 6 inch, except those lateral bid items defined as "Special". This item includes the specified piping material, main tap tee, bends, clean outs, labor, equipment, excavation, backfill, testing, and restoration, at the locations shown on the plans or as directed, in accordance with the specifications and standard drawings, complete and ready for use. This bid item is to pay for lateral installations where both ends of the lateral connection are on the same side of the public roadway, or when an existing lateral crossing a public roadway will remain and is being extended, reconnected, or relocated with all work on one side of the public roadway centerline as shown on the plans. The length of the service lateral is not to be specified and shall not be restricted to any minimum or maximum length. Payment shall be made under this item even if the lateral crosses a private residential or commercial entrance; but, not a public roadway. Private or commercial entrances shall not be considered a public roadway in defining payment under this item. The contractor shall draw his own conclusions as to the length of piping that may be needed. No additional payment will be made for rock excavation or for bedding required in rock excavation. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.25 15090 – S LATERAL SHORT SIDE 06 INCH

This bid item description shall apply to all service lateral installations of every size up to and including 6 inch, except those lateral bid items defined as "Special". This item includes the specified piping material, main tap tee, bends, clean outs, labor, equipment, excavation, backfill, testing, and restoration, at the locations shown on the plans or as directed, in accordance with the specifications and standard drawings, complete and ready for use. This bid item is to pay for lateral installations where both ends of the lateral connection are on the same side of the public roadway, or when an existing lateral crossing a public roadway will remain and is being extended, reconnected, or relocated with all work on one side of the public roadway centerline as shown on the plans. The length of the service lateral is not to be specified and shall not be restricted to any minimum or maximum length. Payment shall be made under this item even if the lateral crosses a private residential or commercial entrance; but, not a public roadway. Private or commercial entrances shall not be considered a public roadway in defining payment under this item. The contractor shall draw his own conclusions as to the length of piping that may be needed. No additional payment will be made for rock excavation or for bedding required in rock excavation. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.26 15092 – S MANHOLE

Payment under this item is for the installation of new 4 foot interior diameter sanitary sewer manhole. Payment for manholes will be made at the contract unit price each in place complete and ready for use at the locations shown on plans in accordance with specifications and standard drawings. Manholes shall include concrete base, barrel sections, cone section or slab top, steps, excavation, backfilling, air testing, restoration, and cleanup in accordance with the specifications and standard drawings. Payment shall be made under this item regardless of whether the base is to be precast or cast-in-place (doghouse). All materials, except casting, shall be new and unused. An existing casting from an existing abandoned or removed manhole is to be reused and shall be considered incidental to this item. When a new casting is specified, or an existing casting is unavailable, it shall be paid as a separate bid item. Anchoring of casting, new or used, shall be considered incidental to this bid item. No additional compensation will be paid for manhole height variations.

No additional payment will be made for rock excavation. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.27 15098 – S MANHOLE SPECIAL (OPEN BOTTOM MANHOLE/DOGHOUSE MH)

Payment under this item is for the installation of new 4 foot interior diameter sanitary sewer manhole. Payment for manholes will be made at the contract unit price each in place complete and ready for use at the locations shown on plans in accordance with specifications and standard drawings. Manholes shall include concrete base, barrel sections, cone section or slab top, steps, excavation, backfilling, air testing, restoration, and cleanup in accordance with the specifications and standard drawings. Payment shall be made under this item regardless of whether the base is to be precast or cast-in-place (doghouse). All materials, except casting, shall be new and unused. An existing casting from an existing abandoned or removed manhole is to be reused and shall be considered incidental to this item. When a new casting is specified, or an existing casting is unavailable, it shall be paid as a separate bid item. Anchoring of casting, new or used, shall be considered incidental to this bid item. No additional compensation will be paid for manhole height variations. No additional payment will be made for rock excavation. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.28 15101 – S MANHOLE WITH DROP

Payment under this item is for the installation of new 4 foot interior diameter sanitary sewer manhole with drop. Payment for drop manholes will be made at the contract unit price each in place complete and ready for use at the locations shown on plans in accordance with specifications and standard drawings. Drop manholes shall include concrete base, barrel sections, drop materials, cone section or slab top, steps, excavation, backfilling, air testing, restoration, and cleanup. Payment shall be made under this item regardless of whether the base is to be precast or cast-in-place (doghouse). All materials, except casting, shall be new and unused. An existing casting from an existing abandoned or removed manhole is to be reused and shall be considered incidental to this item. When a new casting is specified, or an existing casting is unavailable, it shall be paid as a separate bid item. Anchoring of casting, new or used, shall be considered incidental to this bid item. No additional compensation will be paid for manhole height variations. No additional payment will be made for rock excavation. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.29 15104 – S PIPE DUCTILE IRON 08 INCH

This description shall apply to all PVC and ductile iron gravity sewer pipe bid items of every size and type 8 inches internal diameter and larger, except those bid items defined as "Special". This item includes the pipe specified by the plans and specifications, all fittings (including, but not limited to, tap tees and couplings for joining to existing similar or dissimilar pipes), polyethylene wrap (if required by specification), labor, equipment, excavation, bedding, restoration, pressure or vacuum testing, temporary testing materials, video inspection, backfill, and etc., required to install the specified new pipe and new fittings at the locations shown on the plans, or as directed, in accordance with the specifications and standard drawings complete and ready for use. This bid item shall include material and placement of flowable fill under existing and proposed pavement, and wherever specified on the plans or in the specifications. No additional payment will be made for rock excavation. Measurement of quantities under this item shall be through fittings and encasements to a point at the outside face of manhole barrels, or to the point of main termination at dead ends or lamp holes. Carrier pipe placed within an encasement shall be paid under this item and shall include casing spacers and end seals. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF).

2.30 15112 – S PIPE PVC 08 INCH

This description shall apply to all PVC and ductile iron gravity sewer pipe bid items of every size and type 8 inches internal diameter and larger, except those bid items defined as "Special". This item includes the pipe

specified by the plans and specifications, all fittings (including, but not limited to, tap tees and couplings for joining to existing similar or dissimilar pipes), polyethylene wrap (if required by specification), labor, equipment, excavation, bedding, restoration, pressure or vacuum testing, temporary testing materials, video inspection, backfill, and etc., required to install the specified new pipe and new fittings at the locations shown on the plans, or as directed, in accordance with the specifications and standard drawings complete and ready for use. This bid item shall include material and placement of flowable fill under existing and proposed pavement, and wherever specified on the plans or in the specifications. No additional payment will be made for rock excavation. Measurement of quantities under this item shall be through fittings and encasements to a point at the outside face of manhole barrels, or to the point of main termination at dead ends or lamp holes. Carrier pipe placed within an encasement shall be paid under this item and shall include casing spacers and end seals. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF).

2.31 15118 – S PIPE SPECIAL (NITRILE GASKETS FOR 15104)

This description shall apply to all ductile iron gravity sewer pipe w/ nitrile gaskets bid items of every size and type 8 inches internal diameter and larger. This item includes the pipe specified by the plans and specifications, all fittings (including, but not limited to, tap tees and couplings for joining to existing similar or dissimilar pipes), polyethylene wrap (if required by specification), labor, equipment, excavation, bedding, restoration, pressure or vacuum testing, temporary testing materials, video inspection, backfill, and etc., required to install the specified new pipe and new fittings at the locations shown on the plans, or as directed, in accordance with the specifications and standard drawings complete and ready for use. This bid item shall include material and placement of flowable fill under existing and proposed pavement, and wherever specified on the plans or in the specifications. No additional payment will be made for rock excavation. Measurement of quantities under this item shall be through fittings and encasements to a point at the outside face of manhole barrels, or to the point of main termination at dead ends or lamp holes. Carrier pipe placed within an encasement shall be paid under this item and shall include casing spacers and end seals. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF).

2.32 15155 – S CAP EXISTING MAIN

This item is to be used to pay for abandonment of existing sewer pipes. Payment under this time shall not be limited to size or scope. Payment under this item shall include all labor, equipment, and compacted fill or flowable fill for abandonment of the structure in place and restoration complete. No separate bid items will be established for size or structure variations. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.33 16000 – G DIRECTIONAL BORE

Payment under this item is made whenever the plans or specifications specifically show directional boring is to be utilized in order to minimize the impact of open cut for the installation of gas main under streets, creeks, etc. Payment under this item shall include the specified bore pipe, labor, and equipment. No separate payment shall be made for bore pipe installed in the bore whether used as a carrier pipe or an encasement of a separate carrier pipe. Carrier pipe installed within a bore pipe shall be paid separately under pipe items. Payment under this item shall be for all sizes and not be size specific. No separate bid items will be established for size variations. The bore pipe sizes to be included under this item shall be as shown on the plans and/or in the specifications. This bid item shall also include the cost of pre and/or post directional bore gas installation video inspection of adjacent sanitary and storm sewer mains, manholes, and laterals when the utility specifications associated with the contract require such video inspection. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.34 16001 – G ENCASEMENT SPECIAL (PVC CASING OF ANY SIZE)

Includes all labor, equipment, excavation, PVC pipe, backfill, restoration, and etc., to construct the PVC encasement of the gas main as shown on the plans, and in accordance with the specifications and standard drawings. Payment under this item shall be in addition to the carrier pipe as paid under separate bid items. Carrier pipe is not included in this bid item. Any and all PVC encasement shall be paid under one bid item included in the contract regardless of the size of the carrier pipe or as specified in the plans and specifications. No separate bid items will be established for size variations. Measurement of pay quantity shall be from end of pipe to end of pipe. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.35 16003 – G ENCASEMENT STEEL BORED RANGE 2

This item shall include the steel encasement pipe size as specified on the plans and in the specifications, casing spacers, end seals, vents, labor, and equipment to bore and install the encasement in accordance with the plans and specifications, complete and ready for use. The size shall be the measured internal diameter of the encasement pipe. The sizes of encasement to be paid under the size ranges specified in the bid items shall be as follows:

Range 1 = All encasement sizes greater than 2 inches to and including 6 inches
Range 2 = All encasement sizes greater than 6 inches to and including 10 inches
Range 3 = All encasement sizes greater than 10 inches to and including 14 inches
Range 4 = All encasement sizes greater than 14 inches to and including 18 inches
Range 5 = All encasement sizes greater than 18 inches to and including 24 inches
Range 6 = All encasement sizes greater than 24 inches

(Encasement sizes of 2 inches internal diameter or less shall not be paid separately; but, shall be considered incidental to the carrier pipe.) Payment under this bid item shall not include the carrier pipe. Carrier pipe shall be paid under a separate bid item. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.36 16005 – G ENCASEMENT STEEL BORED RANGE 4

This item shall include the steel encasement pipe size as specified on the plans and in the specifications, casing spacers, end seals, vents, labor, and equipment to bore and install the encasement in accordance with the plans and specifications, complete and ready for use. The size shall be the measured internal diameter of the encasement pipe. The sizes of encasement to be paid under the size ranges specified in the bid items shall be as follows:

Range 1 = All encasement sizes greater than 2 inches to and including 6 inches
Range 2 = All encasement sizes greater than 6 inches to and including 10 inches
Range 3 = All encasement sizes greater than 10 inches to and including 14 inches
Range 4 = All encasement sizes greater than 14 inches to and including 18 inches
Range 5 = All encasement sizes greater than 18 inches to and including 24 inches
Range 6 = All encasement sizes greater than 24 inches

(Encasement sizes of 2 inches internal diameter or less shall not be paid separately; but, shall be considered incidental to the carrier pipe.) Payment under this bid item shall not include the carrier pipe. Carrier pipe shall be paid under a separate bid item. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.37 16011 – G ENCASEMENT STEEL OPEN CUT RANGE 4

This item shall include the steel encasement pipe size as specified on the plans and in the specifications, casing spacers, end seals, vents, labor, and equipment to open cut and install the encasement in accordance with the plans and specifications, complete and ready for use. The size shall be the measured internal diameter of the encasement pipe. The size encasement to be paid under the size ranges specified in the bid items shall be as follows:

Range 1 = All encasement sizes greater than 2 inches to and including 6 inches
Range 2 = All encasement sizes greater than 6 inches to and including 10 inches
Range 3 = All encasement sizes greater than 10 inches to and including 14 inches
Range 4 = All encasement sizes greater than 14 inches to and including 18 inches
Range 5 = All encasement sizes greater than 18 inches to and including 24 inches
Range 6 = All encasement sizes greater than 24 inches

(Encasement sizes of 2 inches internal diameter or less shall not be paid separately; but, shall be considered incidental to the carrier pipe.) Payment under this bid item shall not include the carrier pipe. Carrier pipe shall be paid under a separate bid item. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.38 16015 – G PIPE POLYETHYLENE/PLASTIC 02 INCH

This description shall apply to all polyethylene/plastic and steel pipe bid items of every size and type to be used as gas main, except those bid items defined as "Special". This item includes the pipe specified by the plans and specifications, all fittings (including, but not limited to, bends, tees, reducers, plugs, and caps), tracing wire with test boxes (if required by specification), corrosion protective coatings of steel pipe and fittings, labor, equipment, excavation, bedding, restoration, pressure testing, backfill, etc., required to install the specified new pipe and new fittings at the locations shown on the plans, or as directed, in accordance with the specifications and standard drawings complete and ready for use. For steel pipe, this bid item shall include all cathodic protection anodes, lead wire, test boxes or stations, and any accessories. No additional payment will be made for rock excavation. This bid item shall include material and placement of flowable fill under existing and proposed pavement, and wherever else specified on the plans or in the specifications. This bid item shall also include the cost of pre and/or post directional bore gas installation video inspection of adjacent sanitary and storm sewer mains, manholes, and laterals when the utility specifications associated with the contract require such video inspection. Measurement of quantities under this item shall be through valves (including horizontal measurements through above grade valves), fittings, encasements, and directional bores (only when a separate carrier pipe is specified within the directional bore pipe). Measurements shall be further defined to be to the center of tie-in where new pipe contacts existing pipe at the center of connecting fittings, to the outside face of vault or structure walls, or to the point of main termination at dead ends. No separate payment will be made under pipe items when the directional bore pipe is the carrier pipe. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.39 16017 – G PIPE POLYETHYLENE/PLASTIC 04 INCH

This description shall apply to all polyethylene/plastic and steel pipe bid items of every size and type to be used as gas main, except those bid items defined as "Special". This item includes the pipe specified by the plans and specifications, all fittings (including, but not limited to, bends, tees, reducers, plugs, and caps), tracing wire with test boxes (if required by specification), corrosion protective coatings of steel pipe and fittings, labor, equipment, excavation, bedding, restoration, pressure testing, backfill, etc., required to install the specified new pipe and new fittings at the locations shown on the plans, or as directed, in accordance with the specifications and standard drawings complete and ready for use. For steel pipe, this bid item shall include all cathodic protection anodes, lead wire, test boxes or stations, and any accessories. No additional payment will be made for rock excavation. This bid item shall include material and placement of flowable fill

under existing and proposed pavement, and wherever else specified on the plans or in the specifications. This bid item shall also include the cost of pre and/or post directional bore gas installation video inspection of adjacent sanitary and storm sewer mains, manholes, and laterals when the utility specifications associated with the contract require such video inspection. Measurement of quantities under this item shall be through valves (including horizontal measurements through above grade valves), fittings, encasements, and directional bores (only when a separate carrier pipe is specified within the directional bore pipe). Measurements shall be further defined to be to the center of tie-in where new pipe contacts existing pipe at the center of connecting fittings, to the outside face of vault or structure walls, or to the point of main termination at dead ends. No separate payment will be made under pipe items when the directional bore pipe is the carrier pipe. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.40 16018 – G PIPE POLYETHYLENE/PLASTIC 06 INCH

This description shall apply to all polyethylene/plastic and steel pipe bid items of every size and type to be used as gas main, except those bid items defined as "Special". This item includes the pipe specified by the plans and specifications, all fittings (including, but not limited to, bends, tees, reducers, plugs, and caps), tracing wire with test boxes (if required by specification), corrosion protective coatings of steel pipe and fittings, labor, equipment, excavation, bedding, restoration, pressure testing, backfill, etc., required to install the specified new pipe and new fittings at the locations shown on the plans, or as directed, in accordance with the specifications and standard drawings complete and ready for use. For steel pipe, this bid item shall include all cathodic protection anodes, lead wire, test boxes or stations, and any accessories. No additional payment will be made for rock excavation. This bid item shall include material and placement of flowable fill under existing and proposed pavement, and wherever else specified on the plans or in the specifications. This bid item shall also include the cost of pre and/or post directional bore gas installation video inspection of adjacent sanitary and storm sewer mains, manholes, and laterals when the utility specifications associated with the contract require such video inspection. Measurement of quantities under this item shall be through valves (including horizontal measurements through above grade valves), fittings, encasements, and directional bores (only when a separate carrier pipe is specified within the directional bore pipe). Measurements shall be further defined to be to the center of tie-in where new pipe contacts existing pipe at the center of connecting fittings, to the outside face of vault or structure walls, or to the point of main termination at dead ends. No separate payment will be made under pipe items when the directional bore pipe is the carrier pipe. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.41 16022 – G PIPE SPECIAL (EXTRA DEPTH GAS MAIN INSTALLATION)

This description shall apply to all polyethylene/plastic and steel pipe bid items of every size and type to be used as gas main to be buried at extra depth. This item includes the pipe specified by the plans and specifications, all fittings (including, but not limited to, bends, tees, reducers, plugs, and caps), tracing wire with test boxes (if required by specification), corrosion protective coatings of steel pipe and fittings, labor, equipment, excavation, bedding, restoration, pressure testing, backfill, etc., required to install the specified new pipe and new fittings at the locations shown on the plans, or as directed, in accordance with the specifications and standard drawings complete and ready for use. For steel pipe, this bid item shall include all cathodic protection anodes, lead wire, test boxes or stations, and any accessories. No additional payment will be made for rock excavation. This bid item shall include material and placement of flowable fill under existing and proposed pavement, and wherever else specified on the plans or in the specifications. This bid item shall also include the cost of pre and/or post directional bore gas installation video inspection of adjacent sanitary and storm sewer mains, manholes, and laterals when the utility specifications associated with the contract require such video inspection. Measurement of quantities under this item shall be through valves (including horizontal measurements through above grade valves), fittings, encasements, and directional bores (only when a separate carrier pipe is specified within the directional bore pipe). Measurements shall be further defined to be to the center of tie-in where new pipe contacts existing pipe at the center of connecting

fittings, to the outside face of vault or structure walls, or to the point of main termination at dead ends. No separate payment will be made under pipe items when the directional bore pipe is the carrier pipe. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.42 16034 – G SERVICE LONG SIDE 3/4 INCH

This bid item description shall apply to all service line installations of every size bid up to and including 2 inch inside diameter, except those service bid items defined as "Special". This item includes the specified piping material, main tap, coupling for connecting the new piping to the surviving existing piping, encasement of 2 inches or less internal diameter (if required by plan or specification), labor, equipment, excavation, backfill, testing, and restoration, at the locations shown on the plans or as directed, in accordance with the specifications and standard drawings, complete and ready for use. This bid item is to pay for service installations where the ends of the service connection are on opposite sides of the public roadway and the service line crosses the centerline of the public roadway as shown on the plans. The length of the service line is not to be specified. Payment under this item shall not be restricted by a minimum or maximum length. The contractor shall draw his own conclusions as to the length of piping that may be needed. Payment under this item shall include boring, jacking, or excavating across the public roadway for placement. Placement of a service across a private residential or commercial entrance alone shall not be reason to make payment under this item. Private or commercial entrances shall not be considered a public roadway in defining payment under this item. This pay item does not include installation or relocation of meters. Meters will be paid separately. This bid item shall also include the cost of pre and/or post directional bore gas installation video inspection of adjacent sanitary and storm sewer mains, manholes, and laterals when the utility specifications associated with the contract require such video inspection. No additional payment will be made for rock excavation or for special bedding required in rock excavation. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.43 16039 – G SERVICE SHORT SIDE 3/4 INCH

This bid item description shall apply to all service line installations of every size up to and including 2 inch internal diameter, except those service bid items defined as "Special". This item includes installation of the specified piping material of the size specified on plans, encasement of 2 inches or less internal diameter (if required by plan or specification), main tap, coupling for connecting the new piping to the surviving existing piping, labor, equipment, excavation, backfill, testing, and restoration, at the locations shown on the plans or as directed, in accordance with the specifications and standard drawings, complete and ready for use. This bid item is to pay for service installations were both ends of the service connection are on the same side of the public roadway, or when an existing service crossing a public roadway will remain and is being extended, reconnected, or relocated with all work on one side of the public roadway centerline as shown on the plans. The length of the service line is not to be specified and shall not be restricted to any minimum or maximum length. Payment shall be made under this item even if the service crosses a private residential or commercial entrance; but, not a public roadway. Private or commercial entrances shall not be considered a public roadway in defining payment under this item. The contractor shall draw his own conclusions as to the length of piping that may be needed. This pay item does not include installation or relocation of meters. Meters will be paid separately. This bid item shall also include the cost of pre and/or post directional bore gas installation video inspection of adjacent sanitary and storm sewer mains, manholes, and laterals when the utility specifications associated with the contract require such video inspection. No additional payment will be made for rock excavation or for bedding required in rock excavation. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.44 16041 – G TIE-IN POLYETHYLENE/PLASTIC 02 INCH

This bid description shall be used for all polyethylene/plastic or steel gas main tie-in bid items of every size except those that include a temporary bypass or are defined as "Special". This item includes all labor, equipment, excavation, fittings, sleeves, reducers, couplings, restoration, testing and backfill required to make the gas main tie-in as shown on the plans, and in accordance with the specifications complete and ready for

use. Pipe for tie-ins shall be paid under separate bid items. No additional payment will be made for rock excavation. This bid item shall also include material and placement of flowable fill backfill under existing and proposed pavement, and wherever else specified on the plans or in the specifications. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.45 16043 – G TIE-IN POLYETHYLENE/PLASTIC 04 INCH

This bid description shall be used for all polyethylene/plastic or steel gas main tie-in bid items of every size except those that include a temporary bypass or are defined as "Special". This item includes all labor, equipment, excavation, fittings, sleeves, reducers, couplings, restoration, testing and backfill required to make the gas main tie-in as shown on the plans, and in accordance with the specifications complete and ready for use. Pipe for tie-ins shall be paid under separate bid items. No additional payment will be made for rock excavation. This bid item shall also include material and placement of flowable fill backfill under existing and proposed pavement, and wherever else specified on the plans or in the specifications. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.46 16044 – G TIE-IN POLYETHYLENE/PLASTIC 06 INCH

This bid description shall be used for all polyethylene/plastic or steel gas main tie-in bid items of every size except those that include a temporary bypass or are defined as "Special". This item includes all labor, equipment, excavation, fittings, sleeves, reducers, couplings, restoration, testing and backfill required to make the gas main tie-in as shown on the plans, and in accordance with the specifications complete and ready for use. Pipe for tie-ins shall be paid under separate bid items. No additional payment will be made for rock excavation. This bid item shall also include material and placement of flowable fill backfill under existing and proposed pavement, and wherever else specified on the plans or in the specifications. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.47 16049 – G VALVE POLYETHYLENE/PLASTIC 02 INCH

This description shall apply to all buried valves of every size and type required in the plans and specifications except those bid items defined as "Special". Payment under this description is to be for gas valves being installed with new main. This item includes the valve as specified in the plans and specifications, protective coating and corrosion protection, labor, equipment, excavation, valve box and valve stem extensions, backfill, restoration, testing, and etc., required to install the specified valve at the location shown on the plans in accordance with the specifications and standard drawings complete and ready for use. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.48 16051 – G VALVE POLYETHYLENE/PLASTIC 04 INCH

This description shall apply to all buried valves of every size and type required in the plans and specifications except those bid items defined as "Special". Payment under this description is to be for gas valves being installed with new main. This item includes the valve as specified in the plans and specifications, protective coating and corrosion protection, labor, equipment, excavation, valve box and valve stem extensions, backfill, restoration, testing, and etc., required to install the specified valve at the location shown on the plans in accordance with the specifications and standard drawings complete and ready for use. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.49 16052 – G VALVE POLYETHYLENE/PLASTIC 06 INCH

This description shall apply to all buried valves of every size and type required in the plans and specifications except those bid items defined as “Special”. Payment under this description is to be for gas valves being installed with new main. This item includes the valve as specified in the plans and specifications, protective coating and corrosion protection, labor, equipment, excavation, valve box and valve stem extensions, backfill, restoration, testing, and etc., required to install the specified valve at the location shown on the plans in accordance with the specifications and standard drawings complete and ready for use. Please refer to the Utility Company’s Specifications. If the Company does not have specifications, KYTC’s Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.50 16080 – G TIE-IN STEEL 06 INCH

This bid description shall be used for all polyethylene/plastic or steel gas main tie-in bid items of every size except those that include a temporary bypass or are defined as “Special”. This item includes all labor, equipment, excavation, fittings, sleeves, reducers, couplings, restoration, testing and backfill required to make the gas main tie-in as shown on the plans, and in accordance with the specifications complete and ready for use. Pipe for tie-ins shall be paid under separate bid items. No additional payment will be made for rock excavation. This bid item shall also include material and placement of flowable fill backfill under existing and proposed pavement, and wherever else specified on the plans or in the specifications. Please refer to the Utility Company’s Specifications. If the Company does not have specifications, KYTC’s Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.51 16607 – G CAP EXISTING MAIN

This bid item is in full payment for all efforts in abandonment of all gas mains and facilities shown to be abandoned on the plans, for removal of any sections of abandoned main that is in conflict with road construction, and for nitrogen purge and plug of any sections of main that are to remain. All work shall be done in accordance with the plans and specifications, and in accordance with all pipeline safety regulations. This bid item is for all work to abandon and purge gas main in the total project regardless of size or length. No adjustment in the unit bid price will be allowed if the scope of work described in this item should increase in this contract for any reason. Please refer to the Utility Company’s Specifications. If the Company does not have specifications, KYTC’s Specifications shall be referenced. This item is to be paid EACH (EA) when Complete.

2.52 14003 – W CAP EXISTING MAIN

This item shall include the specified cap, concrete blocking and/or mechanical anchoring, labor, equipment, excavation, backfill, and restoration required to install the cap at the location shown on the plans or as directed in accordance with the specifications. This item is not to be paid on new main installations. This pay item is only to be paid to cap existing mains. Caps on new mains are incidental to the new main. Any and all caps on existing mains shall be paid under one bid item included in the contract regardless of size. No separate bid items will be established for size variations. Please refer to the Utility Company’s Specifications. If the Company does not have specifications, KYTC’s Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.53 14004 – W DIRECTIONAL BORE

Payment under this item is made whenever the plans or specifications specifically show directional boring is to be utilized in order to minimize the impact of open cut for the installation of water main under streets, creeks, and etc. Payment under this item shall include the specified bore pipe, labor, and equipment. No separate payment shall be made for bore pipe installed in the bore whether used as a carrier pipe or an encasement of a separate carrier pipe. This item shall also include pipe anchors at each end of the bore when specified to prevent the creep or contraction of the bore pipe. Carrier pipe installed within a bore pipe shall be paid separately under pipe items. Payment under this item shall not be size specific and no separate bid items will be established for size variations. The bore pipe sizes to be included under this item shall be as shown on the plans and/or in the specifications. Any and all directional bores in each contract shall be paid

under one directional bore bid item included in the contract regardless of size. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.54 14007 – W ENCASEMENT STEEL BORED RANGE 2

This item shall include the steel encasement pipe size as specified on the plans and in the specifications, casing spacers, end seals, labor, and equipment to bore and install the encasement in accordance with the plans and specifications, complete and ready for use. The size shall be the measured internal diameter of the encasement pipe. The sizes of encasement to be paid under the size ranges specified in the bid items shall be as follows:

Range 1 = All encasement sizes greater than 2 inches to and including 6 inches
Range 2 = All encasement sizes greater than 6 inches to and including 10 inches
Range 3 = All encasement sizes greater than 10 inches to and including 14 inches
Range 4 = All encasement sizes greater than 14 inches to and including 18 inches
Range 5 = All encasement sizes greater than 18 inches to and including 24 inches
Range 6 = All encasement sizes greater than 24 inches

(Encasement sizes of 2 inches internal diameter or less shall not be paid separately; but, shall be considered incidental to the carrier pipe.) Payment under this bid item shall not include the carrier pipe. Carrier pipe shall be paid under a separate bid item. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.55 14008 – W ENCASEMENT STEEL BORED RANGE 3

This item shall include the steel encasement pipe size as specified on the plans and in the specifications, casing spacers, end seals, labor, and equipment to bore and install the encasement in accordance with the plans and specifications, complete and ready for use. The size shall be the measured internal diameter of the encasement pipe. The sizes of encasement to be paid under the size ranges specified in the bid items shall be as follows:

Range 1 = All encasement sizes greater than 2 inches to and including 6 inches
Range 2 = All encasement sizes greater than 6 inches to and including 10 inches
Range 3 = All encasement sizes greater than 10 inches to and including 14 inches
Range 4 = All encasement sizes greater than 14 inches to and including 18 inches
Range 5 = All encasement sizes greater than 18 inches to and including 24 inches
Range 6 = All encasement sizes greater than 24 inches

(Encasement sizes of 2 inches internal diameter or less shall not be paid separately; but, shall be considered incidental to the carrier pipe.) Payment under this bid item shall not include the carrier pipe. Carrier pipe shall be paid under a separate bid item. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.56 14009 – W ENCASEMENT STEEL BORED RANGE 4

This item shall include the steel encasement pipe size as specified on the plans and in the specifications, casing spacers, end seals, labor, and equipment to bore and install the encasement in accordance with the plans and specifications, complete and ready for use. The size shall be the measured internal diameter of the encasement pipe. The sizes of encasement to be paid under the size ranges specified in the bid items shall be as follows:

Range 1 = All encasement sizes greater than 2 inches to and including 6 inches
Range 2 = All encasement sizes greater than 6 inches to and including 10 inches
Range 3 = All encasement sizes greater than 10 inches to and including 14 inches

Range 4 = All encasement sizes greater than 14 inches to and including 18 inches
Range 5 = All encasement sizes greater than 18 inches to and including 24 inches
Range 6 = All encasement sizes greater than 24 inches

(Encasement sizes of 2 inches internal diameter or less shall not be paid separately; but, shall be considered incidental to the carrier pipe.) Payment under this bid item shall not include the carrier pipe. Carrier pipe shall be paid under a separate bid item. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.57 14010 – W ENCASEMENT STEEL BORED RANGE 5

This item shall include the steel encasement pipe size as specified on the plans and in the specifications, casing spacers, end seals, labor, and equipment to bore and install the encasement in accordance with the plans and specifications, complete and ready for use. The size shall be the measured internal diameter of the encasement pipe. The sizes of encasement to be paid under the size ranges specified in the bid items shall be as follows:

Range 1 = All encasement sizes greater than 2 inches to and including 6 inches
Range 2 = All encasement sizes greater than 6 inches to and including 10 inches
Range 3 = All encasement sizes greater than 10 inches to and including 14 inches
Range 4 = All encasement sizes greater than 14 inches to and including 18 inches
Range 5 = All encasement sizes greater than 18 inches to and including 24 inches
Range 6 = All encasement sizes greater than 24 inches

(Encasement sizes of 2 inches internal diameter or less shall not be paid separately; but, shall be considered incidental to the carrier pipe.) Payment under this bid item shall not include the carrier pipe. Carrier pipe shall be paid under a separate bid item. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.58 14022 – W FLUSH HYDRANT ASSEMBLY

This item shall include the flushing hydrant assembly, service line, tapping the main, labor, equipment, excavation, backfill, and restoration required to install the flush hydrant at the location shown on the plans and in accordance with the specifications and standard drawings, complete and ready for use. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.59 14023 – W FLUSHING ASSEMBLY

This item shall include the flushing device assembly, service line, meter box and lid, tapping the main, labor, equipment, excavation, backfill, and restoration required to install the flushing device at the location shown on the plans and in accordance with the specifications and standard drawings, complete and ready for use. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.60 14028 – W METER 3/4 INCH

This item is for payment for installation of all standard water meters of all sizes 2 inches ID or less as specified on the plans. This item shall include all labor, equipment, meter, meter box, casting, yoke, and any other associated material needed for installation of a functioning water meter in accordance with the plans and specifications, complete and ready for use. This item shall include connections to the new or existing water service line. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.61 14031 – W METER VAULT RANGE 2

This item is for payment for installation of an underground structure for housing of a larger water meter, fittings, and valves as required by the plans and specifications. This item shall include all labor, equipment, excavation, concrete, manhole castings or access doors, the specified meter(s) valve(s), all piping, and fitting materials associated with installing a functioning meter and vault in accordance with the plans, standard drawings, and specifications, complete and ready for use. The size shall be the measured internal diameter of the meter and piping to be installed. The size meter vault to be paid under size 1 or 2 shall be as follows:

Size Range 1 = All meter and piping sizes greater than 2 inches up to and including 6 inches
Size Range 2 = All meter and piping sizes greater than 6 inches

This item shall be paid EACH (EA) when complete. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced.

2.62 14036 – W PIPE DUCTILE IRON 06 INCH

This description shall apply to all PVC, ductile iron, and polyethylene/plastic pipe bid items of every size and type to be used as water main, except those bid items defined as "Special". This item includes the pipe specified by the plans and specifications, all fittings (including, but not limited to, bends, tees, reducers, plugs, and caps), tracing wire with test boxes (if required by specification), polyethylene wrap (when specified), labor, equipment, excavation, bedding, restoration, testing, sanitizing, backfill, and etc., required to install the specified new pipe and new fittings at the locations shown on the plans, or as directed, in accordance with the specifications and standard drawings complete and ready for use. No additional payment will be made for rock excavation. This bid item includes material and placement of flowable fill under existing and proposed pavement, and wherever else specified on the plans or in the specifications. This item shall include all temporary and permanent materials and equipment required to pressure test and sanitize mains including, but not limited to, pressurization pumps, hoses, tubing, gauges, main taps, saddles, temporary main end caps or plugs and blocking, main end taps for flushing, chlorine liquids or tablets for sanitizing, water for testing/sanitizing and flushing (when not supplied by the utility), chlorine neutralization equipment and materials, and any other items needed to accomplish pressure testing and sanitizing the main installation. This item shall also include pipe anchors, at each end of polyethylene pipe runs when specified to prevent the creep or contraction of the pipe. Measurement of quantities under this item shall be through fittings, encasements, and directional bores (only when a separate carrier pipe is specified within the directional bore pipe). Measurements shall be further defined to be to the center of tie-in where new pipe contacts existing pipe at the center of connecting fittings, to the outside face of vault or structure walls, or to the point of main termination at dead ends. No separate payment will be made under pipe items when the directional bore pipe is the carrier pipe. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.63 14039 – W PIPE DUCTILE IRON 12 INCH

This description shall apply to all PVC, ductile iron, and polyethylene/plastic pipe bid items of every size and type to be used as water main, except those bid items defined as "Special". This item includes the pipe specified by the plans and specifications, all fittings (including, but not limited to, bends, tees, reducers, plugs, and caps), tracing wire with test boxes (if required by specification), polyethylene wrap (when specified), labor, equipment, excavation, bedding, restoration, testing, sanitizing, backfill, and etc., required to install the specified new pipe and new fittings at the locations shown on the plans, or as directed, in accordance with the specifications and standard drawings complete and ready for use. No additional payment will be made for rock excavation. This bid item includes material and placement of flowable fill under existing and proposed pavement, and wherever else specified on the plans or in the specifications. This item shall include all temporary and permanent materials and equipment required to pressure test and sanitize mains including, but not limited to, pressurization pumps, hoses, tubing, gauges, main taps, saddles, temporary main end caps or plugs and blocking, main end taps for flushing, chlorine liquids or tablets for sanitizing, water for testing/sanitizing and flushing (when not supplied by the utility), chlorine neutralization equipment and materials, and any other items needed to accomplish pressure testing and sanitizing the main installation.

This item shall also include pipe anchors, at each end of polyethylene pipe runs when specified to prevent the creep or contraction of the pipe. Measurement of quantities under this item shall be through fittings, encasements, and directional bores (only when a separate carrier pipe is specified within the directional bore pipe). Measurements shall be further defined to be to the center of tie-in where new pipe contacts existing pipe at the center of connecting fittings, to the outside face of vault or structure walls, or to the point of main termination at dead ends. No separate payment will be made under pipe items when the directional bore pipe is the carrier pipe. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.64 14057 – W PIPE PVC 03 INCH

This description shall apply to all PVC, ductile iron, and polyethylene/plastic pipe bid items of every size and type to be used as water main, except those bid items defined as "Special". This item includes the pipe specified by the plans and specifications, all fittings (including, but not limited to, bends, tees, reducers, plugs, and caps), tracing wire with test boxes (if required by specification), polyethylene wrap (when specified), labor, equipment, excavation, bedding, restoration, testing, sanitizing, backfill, and etc., required to install the specified new pipe and new fittings at the locations shown on the plans, or as directed, in accordance with the specifications and standard drawings complete and ready for use. No additional payment will be made for rock excavation. This bid item includes material and placement of flowable fill under existing and proposed pavement, and wherever else specified on the plans or in the specifications. This item shall include all temporary and permanent materials and equipment required to pressure test and sanitize mains including, but not limited to, pressurization pumps, hoses, tubing, gauges, main taps, saddles, temporary main end caps or plugs and blocking, main end taps for flushing, chlorine liquids or tablets for sanitizing, water for testing/sanitizing and flushing (when not supplied by the utility), chlorine neutralization equipment and materials, and any other items needed to accomplish pressure testing and sanitizing the main installation. This item shall also include pipe anchors, at each end of polyethylene pipe runs when specified to prevent the creep or contraction of the pipe. Measurement of quantities under this item shall be through fittings, encasements, and directional bores (only when a separate carrier pipe is specified within the directional bore pipe). Measurements shall be further defined to be to the center of tie-in where new pipe contacts existing pipe at the center of connecting fittings, to the outside face of vault or structure walls, or to the point of main termination at dead ends. No separate payment will be made under pipe items when the directional bore pipe is the carrier pipe. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.65 14058 – W PIPE PVC 04 INCH

This description shall apply to all PVC, ductile iron, and polyethylene/plastic pipe bid items of every size and type to be used as water main, except those bid items defined as "Special". This item includes the pipe specified by the plans and specifications, all fittings (including, but not limited to, bends, tees, reducers, plugs, and caps), tracing wire with test boxes (if required by specification), polyethylene wrap (when specified), labor, equipment, excavation, bedding, restoration, testing, sanitizing, backfill, and etc., required to install the specified new pipe and new fittings at the locations shown on the plans, or as directed, in accordance with the specifications and standard drawings complete and ready for use. No additional payment will be made for rock excavation. This bid item includes material and placement of flowable fill under existing and proposed pavement, and wherever else specified on the plans or in the specifications. This item shall include all temporary and permanent materials and equipment required to pressure test and sanitize mains including, but not limited to, pressurization pumps, hoses, tubing, gauges, main taps, saddles, temporary main end caps or plugs and blocking, main end taps for flushing, chlorine liquids or tablets for sanitizing, water for testing/sanitizing and flushing (when not supplied by the utility), chlorine neutralization equipment and materials, and any other items needed to accomplish pressure testing and sanitizing the main installation. This item shall also include pipe anchors, at each end of polyethylene pipe runs when specified to prevent the creep or contraction of the pipe. Measurement of quantities under this item shall be through fittings, encasements, and directional bores (only when a separate carrier pipe is specified within the directional bore pipe). Measurements shall be further defined to be to the center of tie-in where new pipe contacts existing pipe at the center of connecting fittings, to the outside face of vault or structure walls, or to the point of main

termination at dead ends. No separate payment will be made under pipe items when the directional bore pipe is the carrier pipe. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.66 14059 – W PIPE PVC 06 INCH

This description shall apply to all PVC, ductile iron, and polyethylene/plastic pipe bid items of every size and type to be used as water main, except those bid items defined as "Special". This item includes the pipe specified by the plans and specifications, all fittings (including, but not limited to, bends, tees, reducers, plugs, and caps), tracing wire with test boxes (if required by specification), polyethylene wrap (when specified), labor, equipment, excavation, bedding, restoration, testing, sanitizing, backfill, and etc., required to install the specified new pipe and new fittings at the locations shown on the plans, or as directed, in accordance with the specifications and standard drawings complete and ready for use. No additional payment will be made for rock excavation. This bid item includes material and placement of flowable fill under existing and proposed pavement, and wherever else specified on the plans or in the specifications. This item shall include all temporary and permanent materials and equipment required to pressure test and sanitize mains including, but not limited to, pressurization pumps, hoses, tubing, gauges, main taps, saddles, temporary main end caps or plugs and blocking, main end taps for flushing, chlorine liquids or tablets for sanitizing, water for testing/sanitizing and flushing (when not supplied by the utility), chlorine neutralization equipment and materials, and any other items needed to accomplish pressure testing and sanitizing the main installation. This item shall also include pipe anchors, at each end of polyethylene pipe runs when specified to prevent the creep or contraction of the pipe. Measurement of quantities under this item shall be through fittings, encasements, and directional bores (only when a separate carrier pipe is specified within the directional bore pipe). Measurements shall be further defined to be to the center of tie-in where new pipe contacts existing pipe at the center of connecting fittings, to the outside face of vault or structure walls, or to the point of main termination at dead ends. No separate payment will be made under pipe items when the directional bore pipe is the carrier pipe. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.67 14060 – W PIPE PVC 08 INCH

This description shall apply to all PVC, ductile iron, and polyethylene/plastic pipe bid items of every size and type to be used as water main, except those bid items defined as "Special". This item includes the pipe specified by the plans and specifications, all fittings (including, but not limited to, bends, tees, reducers, plugs, and caps), tracing wire with test boxes (if required by specification), polyethylene wrap (when specified), labor, equipment, excavation, bedding, restoration, testing, sanitizing, backfill, and etc., required to install the specified new pipe and new fittings at the locations shown on the plans, or as directed, in accordance with the specifications and standard drawings complete and ready for use. No additional payment will be made for rock excavation. This bid item includes material and placement of flowable fill under existing and proposed pavement, and wherever else specified on the plans or in the specifications. This item shall include all temporary and permanent materials and equipment required to pressure test and sanitize mains including, but not limited to, pressurization pumps, hoses, tubing, gauges, main taps, saddles, temporary main end caps or plugs and blocking, main end taps for flushing, chlorine liquids or tablets for sanitizing, water for testing/sanitizing and flushing (when not supplied by the utility), chlorine neutralization equipment and materials, and any other items needed to accomplish pressure testing and sanitizing the main installation. This item shall also include pipe anchors, at each end of polyethylene pipe runs when specified to prevent the creep or contraction of the pipe. Measurement of quantities under this item shall be through fittings, encasements, and directional bores (only when a separate carrier pipe is specified within the directional bore pipe). Measurements shall be further defined to be to the center of tie-in where new pipe contacts existing pipe at the center of connecting fittings, to the outside face of vault or structure walls, or to the point of main termination at dead ends. No separate payment will be made under pipe items when the directional bore pipe is the carrier pipe. Please refer to the Utility Company's Specifications. If the Company does not have specifications, KYTC's Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.68 14062 – W PIPE PVC 12 INCH

This description shall apply to all PVC, ductile iron, and polyethylene/plastic pipe bid items of every size and type to be used as water main, except those bid items defined as “Special”. This item includes the pipe specified by the plans and specifications, all fittings (including, but not limited to, bends, tees, reducers, plugs, and caps), tracing wire with test boxes (if required by specification), polyethylene wrap (when specified), labor, equipment, excavation, bedding, restoration, testing, sanitizing, backfill, and etc., required to install the specified new pipe and new fittings at the locations shown on the plans, or as directed, in accordance with the specifications and standard drawings complete and ready for use. No additional payment will be made for rock excavation. This bid item includes material and placement of flowable fill under existing and proposed pavement, and wherever else specified on the plans or in the specifications. This item shall include all temporary and permanent materials and equipment required to pressure test and sanitize mains including, but not limited to, pressurization pumps, hoses, tubing, gauges, main taps, saddles, temporary main end caps or plugs and blocking, main end taps for flushing, chlorine liquids or tablets for sanitizing, water for testing/sanitizing and flushing (when not supplied by the utility), chlorine neutralization equipment and materials, and any other items needed to accomplish pressure testing and sanitizing the main installation. This item shall also include pipe anchors, at each end of polyethylene pipe runs when specified to prevent the creep or contraction of the pipe. Measurement of quantities under this item shall be through fittings, encasements, and directional bores (only when a separate carrier pipe is specified within the directional bore pipe). Measurements shall be further defined to be to the center of tie-in where new pipe contacts existing pipe at the center of connecting fittings, to the outside face of vault or structure walls, or to the point of main termination at dead ends. No separate payment will be made under pipe items when the directional bore pipe is the carrier pipe. Please refer to the Utility Company’s Specifications. If the Company does not have specifications, KYTC’s Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.69 14063 – W PIPE PVC 16 INCH

This description shall apply to all PVC, ductile iron, and polyethylene/plastic pipe bid items of every size and type to be used as water main, except those bid items defined as “Special”. This item includes the pipe specified by the plans and specifications, all fittings (including, but not limited to, bends, tees, reducers, plugs, and caps), tracing wire with test boxes (if required by specification), polyethylene wrap (when specified), labor, equipment, excavation, bedding, restoration, testing, sanitizing, backfill, and etc., required to install the specified new pipe and new fittings at the locations shown on the plans, or as directed, in accordance with the specifications and standard drawings complete and ready for use. No additional payment will be made for rock excavation. This bid item includes material and placement of flowable fill under existing and proposed pavement, and wherever else specified on the plans or in the specifications. This item shall include all temporary and permanent materials and equipment required to pressure test and sanitize mains including, but not limited to, pressurization pumps, hoses, tubing, gauges, main taps, saddles, temporary main end caps or plugs and blocking, main end taps for flushing, chlorine liquids or tablets for sanitizing, water for testing/sanitizing and flushing (when not supplied by the utility), chlorine neutralization equipment and materials, and any other items needed to accomplish pressure testing and sanitizing the main installation. This item shall also include pipe anchors, at each end of polyethylene pipe runs when specified to prevent the creep or contraction of the pipe. Measurement of quantities under this item shall be through fittings, encasements, and directional bores (only when a separate carrier pipe is specified within the directional bore pipe). Measurements shall be further defined to be to the center of tie-in where new pipe contacts existing pipe at the center of connecting fittings, to the outside face of vault or structure walls, or to the point of main termination at dead ends. No separate payment will be made under pipe items when the directional bore pipe is the carrier pipe. Please refer to the Utility Company’s Specifications. If the Company does not have specifications, KYTC’s Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.70 14070 – W PIPE POLYETHYLENE/PLASTIC 08 INCH

This description shall apply to all PVC, ductile iron, and polyethylene/plastic pipe bid items of every size and type to be used as water main, except those bid items defined as “Special”. This item includes the pipe specified by the plans and specifications, all fittings (including, but not limited to, bends, tees, reducers, plugs, and caps), tracing wire with test boxes (if required by specification), polyethylene wrap (when specified), labor, equipment, excavation, bedding, restoration, testing, sanitizing, backfill, and etc., required to install the specified new pipe and new fittings at the locations shown on the plans, or as directed, in accordance with the specifications and standard drawings complete and ready for use. No additional payment will be made for rock excavation. This bid item includes material and placement of flowable fill under existing and proposed pavement, and wherever else specified on the plans or in the specifications. This item shall include all temporary and permanent materials and equipment required to pressure test and sanitize mains including, but not limited to, pressurization pumps, hoses, tubing, gauges, main taps, saddles, temporary main end caps or plugs and blocking, main end taps for flushing, chlorine liquids or tablets for sanitizing, water for testing/sanitizing and flushing (when not supplied by the utility), chlorine neutralization equipment and materials, and any other items needed to accomplish pressure testing and sanitizing the main installation. This item shall also include pipe anchors, at each end of polyethylene pipe runs when specified to prevent the creep or contraction of the pipe. Measurement of quantities under this item shall be through fittings, encasements, and directional bores (only when a separate carrier pipe is specified within the directional bore pipe). Measurements shall be further defined to be to the center of tie-in where new pipe contacts existing pipe at the center of connecting fittings, to the outside face of vault or structure walls, or to the point of main termination at dead ends. No separate payment will be made under pipe items when the directional bore pipe is the carrier pipe. Please refer to the Utility Company’s Specifications. If the Company does not have specifications, KYTC’s Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.71 14073 – W PIPE POLYETHYLENE/PLASTIC SPECIAL

This description shall apply to all polyethylene/plastic pipe bid items of every size and type to be used as water main. This item includes the pipe specified by the plans and specifications, all fittings (including, but not limited to, bends, tees, reducers, plugs, and caps), tracing wire with test boxes (if required by specification), polyethylene wrap (when specified), labor, equipment, excavation, bedding, restoration, testing, sanitizing, backfill, and etc., required to install the specified new pipe and new fittings at the locations shown on the plans, or as directed, in accordance with the specifications and standard drawings complete and ready for use. No additional payment will be made for rock excavation. This bid item includes material and placement of flowable fill under existing and proposed pavement, and wherever else specified on the plans or in the specifications. This item shall include all temporary and permanent materials and equipment required to pressure test and sanitize mains including, but not limited to, pressurization pumps, hoses, tubing, gauges, main taps, saddles, temporary main end caps or plugs and blocking, main end taps for flushing, chlorine liquids or tablets for sanitizing, water for testing/sanitizing and flushing (when not supplied by the utility), chlorine neutralization equipment and materials, and any other items needed to accomplish pressure testing and sanitizing the main installation. This item shall also include pipe anchors, at each end of polyethylene pipe runs when specified to prevent the creep or contraction of the pipe. Measurement of quantities under this item shall be through fittings, encasements, and directional bores (only when a separate carrier pipe is specified within the directional bore pipe). Measurements shall be further defined to be to the center of tie-in where new pipe contacts existing pipe at the center of connecting fittings, to the outside face of vault or structure walls, or to the point of main termination at dead ends. No separate payment will be made under pipe items when the directional bore pipe is the carrier pipe. Please refer to the Utility Company’s Specifications. If the Company does not have specifications, KYTC’s Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.72 14085 – W SERV PE/PLST SHORTSIDE 3/4 INCH

This bid item description shall apply to all service line installations of every size up to and including 2 inch internal diameter, except those service bid items defined as “Special”. This item includes installation of the specified piping material of the size specified on plans, encasement of 2 inches or less internal diameter (if required by plan or specification), main tap, tapping saddle (if required), corporation stop, coupling for connecting the new piping to the surviving existing piping, labor, equipment, excavation, backfill, testing, disinfection, and restoration, at the locations shown on the plans or as directed, in accordance with the specifications and standard drawings, complete and ready for use. This bid item is to pay for service installations were both ends of the service connection are on the same side of the public roadway, or when an existing service crossing a public roadway will remain and is being extended, reconnected, or relocated with all work on one side of the public roadway centerline as shown on the plans. The length of the service line is not to be specified and shall not be restricted to any minimum or maximum length. Payment shall be made under this item even if the service crosses a private residential or commercial entrance; but, not a public roadway.
Private or commercial entrances shall not be considered a public roadway in defining payment under this item. The contractor shall draw his own conclusions as to the length of piping that may be needed. This pay item does not include installation or relocation of meters. Meters will be paid separately. No additional payment will be made for rock excavation or for bedding required in rock excavation. Please refer to the Utility Company’s Specifications. If the Company does not have specifications, KYTC’s Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.73 14089 – W TAPPING SLEEVE AND VALVE SIZE 1

This item shall include the specified tapping sleeve, valve, valve box, concrete pad around valve box (when required in specifications or plans), labor, and equipment to install the specified tapping sleeve and valve, complete and ready for use in accordance with the plans and specifications. The size shall be the measured internal diameter of the live pipe to be tapped. The size tapping sleeve and valve to be paid under sizes 1 or 2 shall be as follows:

Size 1 = All live tapped main sizes up to and including 8 inches
Size 2 = All live tapped main sizes greater than 8 inches

Please refer to the Utility Company’s Specifications. If the Company does not have specifications, KYTC’s Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.74 14090 – W TAPPING SLEEVE AND VALVE SIZE 2

This item shall include the specified tapping sleeve, valve, valve box, concrete pad around valve box (when required in specifications or plans), labor, and equipment to install the specified tapping sleeve and valve, complete and ready for use in accordance with the plans and specifications. The size shall be the measured internal diameter of the live pipe to be tapped. The size tapping sleeve and valve to be paid under sizes 1 or 2 shall be as follows:

Size 1 = All live tapped main sizes up to and including 8 inches
Size 2 = All live tapped main sizes greater than 8 inches

Please refer to the Utility Company’s Specifications. If the Company does not have specifications, KYTC’s Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.75 14092 – W TIE-IN 03 INCH

This bid description shall be used for all main tie-in bid items of every size except those defined as “Special”. This item includes all labor, equipment, excavation, fittings, sleeves, reducers, couplings, blocking, anchoring, restoration, disinfection, testing and backfill required to make the water main tie-in as shown on the plans, and in accordance with the specifications complete and ready for use. Pipe for tie-ins shall be paid under separate bid items. This item shall be paid EACH (EA) when complete.

2.76 14094 – W TIE-IN 06 INCH

This bid description shall be used for all main tie-in bid items of every size except those defined as “Special”. This item includes all labor, equipment, excavation, fittings, sleeves, reducers, couplings, blocking, anchoring, restoration, disinfection, testing and backfill required to make the water main tie-in as shown on the plans, and in accordance with the specifications complete and ready for use. Pipe for tie-ins shall be paid under separate bid items. This item shall be paid EACH (EA) when complete.

2.78 14095 – W TIE-IN 08 INCH

This bid description shall be used for all main tie-in bid items of every size except those defined as “Special”. This item includes all labor, equipment, excavation, fittings, sleeves, reducers, couplings, blocking, anchoring, restoration, disinfection, testing and backfill required to make the water main tie-in as shown on the plans, and in accordance with the specifications complete and ready for use. Pipe for tie-ins shall be paid under separate bid items. This item shall be paid EACH (EA) when complete.

2.79 14097 – W TIE-IN 12 INCH

This bid description shall be used for all main tie-in bid items of every size except those defined as “Special”. This item includes all labor, equipment, excavation, fittings, sleeves, reducers, couplings, blocking, anchoring, restoration, disinfection, testing and backfill required to make the water main tie-in as shown on the plans, and in accordance with the specifications complete and ready for use. Pipe for tie-ins shall be paid under separate bid items. This item shall be paid EACH (EA) when complete.

2.80 14103 – W VALVE 03 INCH

This description shall apply to all valves of every size required in the plans and specifications except those bid items defined as “Special”. Payment under this description is to be for gate or butterfly valves being installed with new main. This item includes the valve as specified in the plans and specifications, polyethylene wrap (if required by specification), labor, equipment, excavation, anchoring (if any), valve box and valve stem extensions, backfill, concrete pad around valve box (if required by specification), restoration, testing, disinfection, and etc., required to install the specified valve at the location shown on the plans in accordance with the specifications and standard drawings complete and ready for use. If required on plans and/or proposed adjoining DIP is restrained, valves shall be restrained. Valve restraint shall be considered incidental to the valve and adjoining pipe. This description does not apply to cut-in valves. Please refer to the Utility Company’s Specifications. If the Company does not have specifications, KYTC’s Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.81 14104 – W VALVE 04 INCH

This description shall apply to all valves of every size required in the plans and specifications except those bid items defined as “Special”. Payment under this description is to be for gate or butterfly valves being installed with new main. This item includes the valve as specified in the plans and specifications, polyethylene wrap (if required by specification), labor, equipment, excavation, anchoring (if any), valve box and valve stem extensions, backfill, concrete pad around valve box (if required by specification), restoration, testing, disinfection, and etc., required to install the specified valve at the location shown on the plans in accordance with the specifications and standard drawings complete and ready for use. If required on plans and/or proposed adjoining DIP is restrained, valves shall be restrained. Valve restraint shall be considered incidental to the valve and adjoining pipe. This description does not apply to cut-in valves. Please refer to the Utility Company’s Specifications. If the Company does not have specifications, KYTC’s Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.82 14105 – W VALVE 06 INCH

This description shall apply to all valves of every size required in the plans and specifications except those bid items defined as “Special”. Payment under this description is to be for gate or butterfly valves being installed with new main. This item includes the valve as specified in the plans and specifications, polyethylene wrap (if required by specification), labor, equipment, excavation, anchoring (if any), valve box and valve stem extensions, backfill, concrete pad around valve box (if required by specification), restoration, testing, disinfection, and etc., required to install the specified valve at the location shown on the plans in accordance with the specifications and standard drawings complete and ready for use. If required on plans and/or proposed adjoining DIP is restrained, valves shall be restrained. Valve restraint shall be considered incidental to the valve and adjoining pipe. This description does not apply to cut-in valves. Please refer to the Utility Company’s Specifications. If the Company does not have specifications, KYTC’s Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.83 14106 – W VALVE 08 INCH

This description shall apply to all valves of every size required in the plans and specifications except those bid items defined as “Special”. Payment under this description is to be for gate or butterfly valves being installed with new main. This item includes the valve as specified in the plans and specifications, polyethylene wrap (if required by specification), labor, equipment, excavation, anchoring (if any), valve box and valve stem extensions, backfill, concrete pad around valve box (if required by specification), restoration, testing, disinfection, and etc., required to install the specified valve at the location shown on the plans in accordance with the specifications and standard drawings complete and ready for use. If required on plans and/or proposed adjoining DIP is restrained, valves shall be restrained. Valve restraint shall be considered incidental to the valve and adjoining pipe. This description does not apply to cut-in valves. Please refer to the Utility Company’s Specifications. If the Company does not have specifications, KYTC’s Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.84 14107 – W VALVE 10 INCH

This description shall apply to all valves of every size required in the plans and specifications except those bid items defined as “Special”. Payment under this description is to be for gate or butterfly valves being installed with new main. This item includes the valve as specified in the plans and specifications, polyethylene wrap (if required by specification), labor, equipment, excavation, anchoring (if any), valve box and valve stem extensions, backfill, concrete pad around valve box (if required by specification), restoration, testing, disinfection, and etc., required to install the specified valve at the location shown on the plans in accordance with the specifications and standard drawings complete and ready for use. If required on plans and/or proposed adjoining DIP is restrained, valves shall be restrained. Valve restraint shall be considered incidental to the valve and adjoining pipe. This description does not apply to cut-in valves. Please refer to the Utility Company’s Specifications. If the Company does not have specifications, KYTC’s Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.85 14108 – W VALVE 12 INCH

This description shall apply to all valves of every size required in the plans and specifications except those bid items defined as “Special”. Payment under this description is to be for gate or butterfly valves being installed with new main. This item includes the valve as specified in the plans and specifications, polyethylene wrap (if required by specification), labor, equipment, excavation, anchoring (if any), valve box and valve stem extensions, backfill, concrete pad around valve box (if required by specification), restoration, testing, disinfection, and etc., required to install the specified valve at the location shown on the plans in accordance with the specifications and standard drawings complete and ready for use. If required on plans and/or proposed adjoining DIP is restrained, valves shall be restrained. Valve restraint shall be considered incidental to the valve and adjoining pipe. This description does not apply to cut-in valves. Please refer to the Utility Company’s Specifications. If the Company does not have specifications, KYTC’s Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.86 14109 – W VALVE 16 INCH

This description shall apply to all valves of every size required in the plans and specifications except those bid items defined as “Special”. Payment under this description is to be for gate or butterfly valves being installed with new main. This item includes the valve as specified in the plans and specifications, polyethylene wrap (if required by specification), labor, equipment, excavation, anchoring (if any), valve box and valve stem extensions, backfill, concrete pad around valve box (if required by specification), restoration, testing, disinfection, and etc., required to install the specified valve at the location shown on the plans in accordance with the specifications and standard drawings complete and ready for use. If required on plans and/or proposed adjoining DIP is restrained, valves shall be restrained. Valve restraint shall be considered incidental to the valve and adjoining pipe. This description does not apply to cut-in valves. Please refer to the Utility Company’s Specifications. If the Company does not have specifications, KYTC’s Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

2.87 14126 – W ENCASEMENT SPECIAL (PVC CASING ALL SIZES)

Includes all labor, equipment, excavation, PVC pipe, backfill, restoration, and etc., to construct the PVC encasement of the water main as shown on the plans, and in accordance with the specifications and standard drawings. Payment under this item shall be in addition to the carrier pipe as paid under separate bid items. Carrier pipe is not included in this bid item. Any and all PVC encasement shall be paid under one bid item included in the contract regardless of the size of the carrier pipe or as specified in the plans and specifications. No separate bid items will be established for size variations. Measurement of pay quantity shall be from end of pipe to end of pipe. Please refer to the Utility Company’s Specifications. If the Company does not have specifications, KYTC’s Specifications shall be referenced. This item shall be paid LINEAR FEET (LF) when complete.

2.88 14153 – W LEAK DETECTION METER

This item is for payment for installation of a water meter at main valve locations where shown on the plans for detection of water main leaks. The meter shall be of the size and type specified in the plans or specifications. This item shall include all labor, equipment, meter, meter box or vault, connecting pipes between main and meter, main taps, tapping saddles, casting, yoke, and any other associated material needed for installation of a functioning water meter in accordance with the plans and specifications, complete and ready for use. No separate payment will be made under any other contract item for connecting pipe or main taps. Any and all leak detection meters shall be paid under one bid item included in the contract regardless of size. No separate bid items will be established for size variations. Please refer to the Utility Company’s Specifications. If the Company does not have specifications, KYTC’s Specifications shall be referenced. This item shall be paid EACH (EA) when complete and ready for use.

2.89 20169EC – METER RECONNECTION

This item includes all labor, equipment, excavation, additional fittings, disinfection, testing, restoration, service tubing, and etc., to reconnect the existing water meter (whatever size exists), meter yoke, meter box, casting, and etc., in the location shown on the plans or as directed, in accordance with the specifications and standard drawings complete and ready for use. Any and all meter reconnections of 2 inches or less shall be paid under one bid item included in the contract regardless of size. Each individual reconnection shall be paid individually under this item; however, no separate bid items will be established for meter size variations of 2 inches ID or less. Please refer to the Utility Company’s Specifications. If the Company does not have specifications, KYTC’s Specifications shall be referenced. This item shall be paid EACH (EA) when complete.

PART 3 - EXECUTION

3.01 PAY ITEMS

A. The pay items listed herein before refer to the items listed in the Bid Schedule and cover all of the pay items under the base bid for this contract.

B. Any and all other items of work listed in the specifications or shown on the Contract Drawings for this contract shall be considered incidental to and included in those pay items.

3.02 QUANTITIES OF ESTIMATE

A. Wherever the estimated quantities of work to be done and materials to be furnished under this Contract are shown in any of the documents, including the Bid Proposal, they are given for use in comparing bids and the right is especially reserved except as herein otherwise specifically limited, to increase or diminish them as may be deemed reasonably necessary or desirable by the Owner to complete the work contemplated by this Contract, and such increase or diminution shall not give cause for claims or liability for damages. The Engineer will not be financially responsible for any omissions from the Contract Documents and therefore not included by the Contractor in his proposal.

B. Aerial photographs utilized for plan sheets in the Contract Documents are indicated at an approximate scale and shall not be scaled for quantity take-offs. The pipeline quantities listed in the Bid Schedule are given for use in comparing bids and may not be the actual quantities to be installed. It is the Contractor's responsibility to field verify the length and quantities of pipeline to be installed prior to the ordering of materials. Payment on unit price contracts are based on actual quantities installed. The Owner or Engineer will not be financially responsible for any shortage of pipe or overrun of pipe ordered for the pipeline quantities.

C. The actual quantities of all materials to be used for this project shall be field verified prior to the Contractor ordering the necessary materials. The quantity listed in the bid schedule is given for use in comparing bids and may increase or diminish as may be deemed necessary or as directed by the Owner. Any such increase or diminution shall not give cause for claims or liability for damages. The Engineer or Owner will not be financially responsible for any charges incurred for restocking of materials ordered.

- END OF SECTION -

SECTION 013323

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 - GENERAL

1.01 DESCRIPTION OF REQUIREMENTS

A. General: This section specifies procedural requirements for non-administrative submittals including shop drawings, product data, samples (when samples are specifically requested) and other miscellaneous work-related submittals. Shop drawings, product data, samples and other work-related submittals are required to amplify, expand and coordinate the information contained in the Contract Documents.

B. Refer to other Division-01 sections and other Contract Documents for Specifications on administrative, non-work-related submittals. Such submittals include, but are not limited to the following items:

1. Permits.
2. Payment applications.
3. Performance and payment bonds.
4. Insurance certificates.
5. Inspection and test reports.
6. Schedule of values.
7. Progress reports.
8. Listing of subcontractors.
9. Operating and Maintenance Manuals

C. Engineer prefers initial submittals be in electronic media along with one paper copy for review. Upon completion of the review process, Contractor shall print two (2) copies of complete submittal, including transmittal cover page and stamp page, and deliver to Engineer.

If Contractor does not have capability to submit electronic submittals, then Contractor shall submit a request to Engineer for waiver. In the event a waiver is granted, paper submittals shall be provided as directed by the Engineer.

D. Submittals shall be checked and reviewed by the Contractor and stamped with Contractor's review stamp before submission to the Engineer. The review of the submittals by the Engineer shall not be construed as a complete check but will indicate only that the general method of construction and detailing is satisfactory. Review of such submittals will not relieve the Contractor of the responsibility for any errors which may exist as the Contractor shall be responsible for the dimensions and design of adequate connections, details, and satisfactory construction of all work.

E. All Requests for Information (RFI) to Engineer shall be submitted electronically via e-mail to the Engineer.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-01 Specification sections, apply to work of this section.

B. Section 017823 - Operating and Maintenance Manuals.

1.03 DEFINITIONS

A. Shop drawings are technical drawings and data that have been specially prepared for this project, including but not limited to the following items:

1. Fabrication and installation drawings.
2. Setting diagrams.
3. Shopwork manufacturing instructions.
4. Templates.
5. Patterns.
6. Coordination drawings (for use on site).
7. Schedules.
8. Design mix formulas.
9. Contractor's engineering calculations.

Standard information prepared without specific reference to a project is not considered to be shop drawings.

B. Product data includes standard printed information on manufactured products that has not been specially-prepared for this project, including but not limited to the following items:

1. Manufacturer's product specifications and installation instructions.
2. Standard color charts.
3. Catalog cuts.
4. Roughing-in diagram and templates.
5. Standard wiring diagrams.
6. Printed performance curves.
7. Operational range diagrams.
8. Mill reports.
9. Standard product operating and maintenance manuals.

C. Samples, where specifically required, are physical examples of work, including but not limited to the following items:

1. Partial sections of manufactured or fabricated work.
2. Small cuts or containers of materials.
3. Complete units of repetitively-used materials.
4. Swatches showing color, texture and pattern.
5. Color range sets.
6. Units of work to be used for independent inspection and testing.

D. Miscellaneous submittals are work-related, non-administrative submittals that do not fit in the three previous categories, including, but not limited to the following:

1. Specially-prepared and standard printed warranties.
2. Maintenance agreements.
3. Workmanship bonds.
4. Survey data and reports.
5. Testing and certification reports.
6. Record drawings.
7. Field measurement data.

1.04 SUBMITTAL PROCEDURES

A. General: Refer to the General Conditions and Paragraph 1.1 hereinbefore for basic requirements for submittal handling.

B. Coordination: Coordinate the preparation and processing of submittals with the performance of the work. Coordinate each separate submittal with other submittals and related activities such as testing, purchasing, fabrication, delivery and similar activities that require sequential activity.

It is the Contractor's responsibility to make such field measurements as are needed to base submittals on actual field conditions to assure proper connection, fit, function and performance of all work and equipment in the execution of the contract work.

Coordinate the submittal of different units of interrelated work so that one submittal will not be delayed by the Architect/Engineer's need to review a related submittal. The Architect/Engineer reserves the right to withhold action on any submittal requiring coordination with other submittals until related submittals are forthcoming.

C. Coordination of Submittal Times: Prepare and transmit each submittal to the Architect/Engineer sufficiently in advance of the scheduled performance of related work and other applicable activities. Transmit different kinds of submittals for the same unit of work so that processing will not be delayed by the Architect/Engineer's need to review submittals concurrently for coordination.

D. Review Time: Allow sufficient time so that the installation will not be delayed as a result of the time required to properly process submittals, including time for resubmittal, if necessary. Advise the Architect/Engineer on each submittal, as to whether processing time is critical to the progress of the work and if the work would be expedited if processing time could be shortened.

1. Allow a longer time period where processing must be delayed for coordination with subsequent submittals. The Architect/Engineer will advise the Contractor promptly when it is determined that a submittal being processed must be delayed for coordination.
2. No extension of time will be authorized because of the Contractor's failure to transmit submittals to the Architect/Engineer sufficiently in advance of the work.

E. Submittal Preparation: Mark each submittal with a permanent label for identification. Provide the following information on the label for proper processing and recording of action taken.

1. Project name.
2. Date.
3. Name and address of Architect/Engineer.
4. Name and address of Contractor.
5. Name and address of subcontractor.
6. Name and address of supplier.
7. Name of manufacturer.
8. Number and title of appropriate specification section.
9. Drawing number and detail references, as appropriate.
10. Similar definitive information as necessary.

F. All submittals shall be referenced to the applicable item, section and division of the Specifications, and to the applicable drawing(s) or drawing schedule(s). Include only one item in a submittal.

G. The Contractor shall review and check submittals, and shall indicate his review by initials and date. Any submittal received without this evidence of review shall be returned to the Contractor without review.

H. If the submittals deviate from the Contract Drawings and/or Specifications, the Contractor shall advise the Engineer in writing of the deviation and the reasons therefore.

I. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from the Contractor to the Architect/Engineer, and to other destinations as indicated, by use of a transmittal form. Submittals received from sources other than the Contractor will be returned to the sender "without action".

J. Electronic Submittals: If the electronic method of submittals is agreed to by Contractor, Engineer, and Owner, the format and procedures will be determined and implemented prior to any submittals. Each item of the submittal documents shall be in .pdf format and shall be oriented so that they are read from upper left corner to lower right corner, with no rotation of said document being required after receiving it. The .pdf file shall be named so that it describes the item being submitted. All other requirements herein are part of the electronic submittal process with the exception of the duplicate copies. Contractor stamp indicating review and any comments or notes must be on the .pdf submittal.

1.05 SPECIFIC SUBMITTAL REQUIREMENTS

A. Shop drawings shall be prepared by a qualified detailer. Details shall be identified by reference to sheet and detail numbers shown on Contract Drawings. Where applicable, show fabrication, layout, setting and erection details.

Shop drawings are defined as original drawings prepared by the Contractor, subcontractors, suppliers, or distributors performing work under this Contract. Shop drawings illustrate some portion of the work and show fabrication, layout, setting or erection details of equipment, materials and components. The Contractor shall, except as otherwise noted, have prepared the number of reviewed copies required for his distribution plus three (3) which will be retained by the Engineer. Shop drawings shall be folded to an approximate size of 8-1/2" x 11" and in such manner that the title block will be located in the lower right-hand corner of the exposed surface.

B. Project data shall include manufacturer's standard schematic drawings modified to delete information which is not applicable to the project, and shall be supplemented to provide additional information applicable to the project. Each copy of descriptive literature shall be clearly marked to identify pertinent information as it applies to the project.

C. Where samples are required, they shall be adequate to illustrate materials, equipment or workmanship, and to establish standards by which completed work is judged. Provide sufficient size and quantity to clearly illustrate functional characteristics of product and material, with integrally related parts and attachment devices, along with a full range of color samples.

D. In the event the Engineer does not specifically reject the use of material or equipment at variance to that which is shown on the Drawings or specified, the Contractor shall, at no additional expense to the Owner, and using methods reviewed by the Engineer, make any changes to structures, piping, controls, electrical work, mechanical work, etc., that may be necessary to accommodate this equipment or material. Should equipment other than that on which design drawings are based be accepted by the Engineer, shop drawings shall be submitted detailing all modification work and equipment changes made necessary by the substituted item.

E. Additional information on particular items, such as special drawings, schedules, calculations, performance curves, and material details, shall be provided when specifically requested in the technical Specifications.

F. Submittals for all electrically operated items (including instrumentation and controls) shall include complete size, color coding, all terminations and connections, and coordination with related equipment.

G. Equipment shop drawings shall indicate all factory or shop paint coatings applied by suppliers, manufacturers and fabricators; the Contractor shall be responsible for insuring the compatibility of such coatings with the field-applied paint products and systems.

H. Fastener specifications of manufacturer shall be indicated on equipment shop drawings.

I. Where manufacturers brand names are given in the Specifications for building and construction materials and products, such as grout, bonding compounds, curing compounds, masonry cleaners, waterproofing solutions and similar products, the Contractor shall submit names and descriptive literature of such materials and products he proposes to use in this Contract.

J. No material shall be fabricated or shipped unless the applicable drawings or submittals have been reviewed by the Engineer and returned to the Contractor.

K. All bulletins, brochures, instructions, parts lists, and warranties package with and accompanying materials and products delivered to and installed in the project shall be saved and transmitted to the Owner through the Engineer.

1.06 REVIEW STATUS

A. Submittals will be returned, stamped with the following classifications: "Reviewed", "Furnish as Corrected", "Revise and Resubmit", "Rejected", or “Submit Specified Item”.

B. In some instances, corrections to dimensions or clarification notations will be required, in which case the drawings will be marked "Furnish as Corrected." These shop drawings will not be required to be resubmitted for further approval. If the supplier makes additional modifications after receiving a "Furnish as Corrected" disposition, the drawings must then be resubmitted for review.

C. If the shop drawing is returned with the notation “Revise and Resubmit”, the Contractor shall promptly make the revisions indicated and repeat the submittal approval procedure.

D. If the shop drawing is returned with the notation “Submit Specified Item”, this indicates that the submittal does not meet the specification, will not be reviewed, and is unacceptable. Upon return of a drawing so marked, the Contractor shall repeat the initial approval procedure, submitting acceptable materials or equipment.

E. The "Rejected" notation is used to indicate materials or equipment that are not acceptable and are not included in the project.

1.07 REMINDER OF CONTRACTOR RESPONSIBILITIES

A. Verify field measurements, field construction criteria, catalog numbers, and similar data.

B. Coordinate each submittal with requirements of work and of Contract Documents.

C. Notify Engineer, in writing at time of submission, of deviations in submittals from requirements of Contract Documents.

D. Begin no work, and have no material or products fabricated or shipped which requires submittals until return of submittals with Engineer's stamp and initials or signature indicating review.

E. Upon review and close-out of a submittal, Contractor shall print two (2) copies of complete submittal, including transmittal cover page and stamp page, and deliver to Engineer.

F. It is emphasized that the review of shop drawings by the Engineer is for general conformance to the Contract Drawings and Specifications, but subject to the detailed requirements of the Contract Drawings and Specifications. Although the Engineer may check submitted data in more or less detail, such checking is an effort to discover errors and omissions in the Contractor's drawings and to assist the Contractor in coordinating and expediting his work, but shall in no way relieve the Contractor of his obligation and responsibility to properly coordinate the work, and to Engineer the details of the work in such a manner, that the purpose and intent of the Contract will be achieved nor shall any such detailed checking by the Engineer be construed as placing on him or on the Owner, any responsibility for the accuracy, proper fit, functioning or performance of any phase of the work included in this Contract. The Contractor is responsible for confirmation and correlation of dimensions at the job site; for information that pertains solely to the fabrication processes or to the techniques of construction; for the coordination of the work of all trades; and for performance of his work in a safe and satisfactory manner.

PART 2 – PRODUCTS

(Not Applicable)

PART 3 – EXECUTION

(Not Applicable)

END OF SECTION

DIVISION 03

CONCRETE

SECTION 031100

CONCRETE FORMWORK

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Formwork for cast-in-place concrete, with shoring, bracing, and anchorage.

B. Openings for other affected work.

C. Form accessories.

D. Stripping forms.

1.02 RELATED WORK

A. SECTION 032100 – REINFORCEMENT BARS

B. SECTION 031500 – CONCRETE ACCESSORIES

C. SECTION 033000 – CAST-IN-PLACE CONCRETE

1.03 REFERENCES

A. ACI 301 - Specifications for Structural Concrete for Buildings.

B. ACI 347 - Recommended Practice for Concrete Formwork.

C. PS 1 - Construction and Industrial Plywood.

D. ACI 318 - Building Code Requirements for Reinforced Concrete.

E. Field Reference Manual, ACI Publication SP-15.

F. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.

1.04 SYSTEM DESCRIPTION

A. Design, engineer, and construct formwork, shoring, bracing to meet design and code requirements, so that resultant concrete conforms to required shapes, lines, dimensions, and tolerances.

1.05 QUALITY ASSURANCE

A. Construct and erect concrete formwork in accordance with ACI 301 and 347, latest revisions. Contractor shall maintain a copy of these standards, or Publication SP-15 in the field at all times.

PART 2 - PRODUCTS

2.01 FORM MATERIALS

A. Plywood; APA Plyform, Class 1; sound, undamaged sheets with straight edges.

B. Forms shall be sufficiently rigid to prevent displacement or sagging between supports, and so constructed that the concrete will not be damaged by their removal. The Contractor shall be entirely responsible for their adequacy.

C. For surfaces to be given rubbed finish, the form in contact with the concrete shall be made of plywood, metal, metal framed plywood faced, or other acceptable panel-type materials, to provide continuous straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize the number of joints. Forms shall not be pieced out by use of material different from those in the adjacent form or in such manner as will detract from the uniformity of the finished surface.

D. For surfaces other than those to be given rubbed finish forms shall be made of wood, metal, or other acceptable material. Wooden forms shall be constructed of sound lumber or plywood of suitable dimensions, free from knotholes and loose knots. Plywood shall be in reasonably good, condition. Metal forms shall be of an acceptable type for the work involved.

2.02 FORMWORK ACCESSORIES

A. Form ties to be encased in concrete shall not be made of through bolts or common wire, but shall be of a well-established type, so made and installed as to embody the following features:

1. After removal of the protruding part of the tie, there shall be no metal nearer than 1-1/2" to the face of the concrete.

2. That part of the tie which is to be removed shall be at least 1/2" in diameter, or if smaller, it shall be provided with a wood, metal, or plastic cone 1" long placed against the inside of the forms. Cones shall be carefully removed from the concrete after the forms have been stripped.

3. Ties which pass through walls of liquid retaining basins and all below grade structures which are to remain dry shall be provided with acceptable water stop, securely fastened to the ties.

B. Form Release Agent: Colorless material, which will not stain concrete, absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete. Acceptable products include Nox-Crete Form Coating Release Agent, Debond Form Coating by L&M Construction Chemicals Inc., or approved equal.

C. Fillets for Chamfered Corners: Provide ¾” chamfers constructed using wood strip. Chamfers are required along all concrete edges except along edges wall and slab penetrations.

D. Nails, spikes, lag bolts, through bolts, anchorages: Sized as required of strength and character to maintain formwork in place while placing concrete.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify lines, levels, and measurements before proceeding with formwork.

3.02 PREPARATION

A. Earth or rock forms for vertical surfaces are not permitted. The vertical surface of footings shall be formed unless approved otherwise by Engineer based on soil conditions.

3.03 ERECTION

A. Provide bracing to ensure stability of formwork. Strengthen formwork liable to be overstressed by construction loads.

B. Camber slabs and beams to achieve ACI 301 tolerances.

C. Forms for walls, columns, or piers shall have removable panels at bottom for cleaning, and inspection. Forms for thin sections (such as walls or columns) of considerable height shall be arranged with suitable openings so that the concrete can be placed in a manner that will prevent segregation and accumulations of hardened concrete on the forms or reinforcement above the fresh concrete, unless special spouts are used to place concrete, and so that construction joints can be properly keyed and treated.

D. Forms for exposed surfaces shall be built with 3/4" chamfer strips attached to produce smooth, straight chamfers at all sharp edges of concrete. See 2.02 above.

E. Before form material is reused, all surfaces that are in contact with the concrete shall be thoroughly cleaned, all damaged places repaired, and all projecting nails withdrawn.

3.04 TOLERANCES

A. ACI 117 shall be followed for forming tolerance limits.

3.05 APPLICATION OF RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's instructions. Apply prior to placing reinforcing steel, anchoring devices, and embedded items.

3.06 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for work embedded in or passing through concrete.

B. Coordinate work of other sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

C. Install accessories in accordance with manufacturer's instructions, level and plumb. Ensure items are not disturbed during concrete placement.

3.07 FORM REMOVAL

A. Do not remove forms and bracing until concrete has sufficient strength to support its own weight, construction and design loads, which may be imposed upon it. Remove load supporting forms when concrete has attained 75 percent of required 28-day compressive strength, provided construction is re-shored immediately, and the shoring remains until the concrete attains its 28-day compressive strength.

B. Reshore structural members due to design requirements or construction conditions to permit successive construction.

C. Remove formwork progressively so that unbalanced loads are not imposed on structure.

D. Do not damage concrete surfaces during form removal.

3.08 CLEANING

A. Clean forms to remove foreign matter as erection proceeds.

B. Ensure that water and debris drain to exterior through clean out ports.

C. During cold weather, remove ice and snow from forms. Do not use deicing salts. Do not use water to clean out completed forms, unless formwork and construction proceed within heated enclosure. Use compressed air to remove foreign matter.

-- END OF SECTION --

SECTION 031500

EXPANSION AND CONTRACTION JOINTS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Forming integral contraction and control joints in concrete.

B. Visually concealing expansion joints in concrete.

1.02 RELATED WORK

A. SECTION 031100 – CONCRETE FORMING.

B. SECTION 033000 – CAST-IN-PLACE CONCRETE.

PART 2 - PRODUCTS

2.01 INTEGRAL JOINT MATERIAL

A. Waterstop for Construction and Control Joints: Unless otherwise shown, waterstops shall be 6" wide, 3/16" minimum thickness, flat-ribbed, or dumbbell polyvinyl chloride (PVC), in accordance with Corps of Engineers Specifications CRD-C-572, latest revision, as manufactured by Vinylex Corp, W. R. Grace Company, Greenstreak, or equal. Split-ribbed waterstops may be used where appropriate.

B. Self Expanding Waterstops:

1. When approved by the Engineer, the Contractor may install self-expanding waterstop impregnated with sodium bentonite similar to Volclay Waterstop-RX. The manufacturer's recommended installation procedures shall be followed.

2. Self Expanding Waterstops shall not be used at expansion joints.

C. Joint Filler: ANSI/ASTM D994, bituminous impregnated fiberboard; closed cell polyethylene; self-expanding cork; of the sizes detailed and, in the locations, indicated on the Drawings. Bituminous impregnated fiberboard shall not be used to fill joints in liquid retaining structures. Where the application requires cementing the joint filler into place, a pressure sensitive adhesive recommended by the manufacturer shall be used.

2.02 SEALANTS

Joint Sealant Specified in Section 079100 and 079200.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Locate and form expansion control and contraction joints.

B. Waterstops shall be provided at all joints where indicated on the drawings. Waterstops shall also be provided in all joints, vertical and horizontal, in water containment and subterranean structures. Install waterstops continuous without displacing reinforcement. All joints between adjacent continuing and intersecting sections of waterstop including butt joints, tee joints, and other angled joints shall be heat fused to form a watertight seal. Waterstops shall not be lapped. Waterstops shall be securely wired in place to maintain proper position during placement of concrete.

C. Place formed construction joints in slabs or walls as detailed on the Drawings or as directed by Engineer. Set top screed to required elevations. Secure to resist movement of wet concrete.

D. Install joint fillers and sealants in accordance with manufacturer's instructions. Use primers of type recommended by joint filler and sealant manufacturer.

E. Apply sealants in accordance with Section 079100.

-- END OF SECTION --

SECTION 032100

REINFORCEMENT BARS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Reinforcing steel.

B. Shop Drawings.

1.02 RELATED WORK

A. SECTION 031100 – Concrete Forming.

B. SECTION 031500 – Concrete Accessories

C. SECTION 033000 – Cast-In-Place Concrete.

1.03 REFERENCES

A.	ASTM A-615	Deformed and Plain Billet - Steel Bars for Concrete Reinforcement.
B.	ASTM A-616	Rail Steel Deformed and Plain Bars for Concrete Reinforcement.
C.	ASTM A-617	Axle Steel Deformed and Plain Bars for Concrete Reinforcement.
D.	ACI 315	Details and Detailing of Concrete Reinforcement.
E.	ACI 315R Concrete	Manual of Engineering and Placing Drawings for Reinforced Structures.
F.	ASTM A-185	Welded Steel Wire Fabric for Concrete Reinforcement.
G.	ACI 301-96	Standard Specifications for Structural Concrete.
H.	ACI 117-90	Standard Specifications for Tolerances for Concrete Construction and Materials.

1.04 SUBMITTALS

A. Shop Drawings: The Contractor shall submit a complete set of shop drawings including schedules and bending drawings for all reinforcement used in the work in accordance with ACI 315, and ACI 315R. Review of drawings by the Contractor and the Engineer is required before shipment can be made. Splices shall be indicated on the shop drawings.

PART 2 - PRODUCTS

2.01 MATERIALS

A. The minimum yield strength of the reinforcement shall be 60,000 pounds per square inch. Bar reinforcement shall conform to the requirements of ASTM A-615. All bar reinforcement shall be deformed.

B. Smooth dowels shall be plain steel bars conforming to ASTM A-615, Grade 60.

C. Welded wire fabric shall conform to ASTM 185, welded steel wire fabric for concrete reinforcement.

D. Reinforcement supports and other accessories in contact with the forms for members, which will be exposed to view in the finished work, shall have approved high-density polyethylene tips so that the metal portion shall be at least one quarter of an inch from the form or surface. Supports for reinforcement, when in contact with the ground or stone fill, shall be precast concrete blocks.

2.02 FABRICATION

A. Reinforcement shall be bent cold. It shall be bent accurately to the dimensions and shapes shown on the plans and to within tolerances specified in the CRSI Manual of Standard Practice (latest edition).

B. Reinforcement shall be shipped with bars of the same size and shape, fastened securely with wire and with metal identification tags using size and mark.

PART 3 - EXECUTION

3.01 PLACING AND FASTENING

A. Before being placed in position, reinforcement shall be cleaned of loose mill and rust scale, dirt and other coatings that will interfere with development of proper bond.

B. Reinforcement shall be accurately placed in positions shown on the drawings and firmly held in place during placement and hardening of concrete by using annealed wire ties. Bars shall be tied as required to prevent displacement under foot traffic and during casting operations, and shall be placed within tolerances allowed in ACI 117. Unless otherwise indicated, all reinforcement shall be placed to provide the minimum concrete cover specified by ACI.

C. Distance from the forms shall be maintained by means of stays, blocks, ties, hangers, or other approved supports. (See paragraph 2.01 D) If fabric reinforcement is shipped in rolls, it shall be straightened into flat sheets before being placed.

D. Before any concrete is placed, the Engineer or his designee shall have inspected the placing of the steel reinforcement and given permission to deposit the concrete. Concrete placed in violation of this provision will be rejected and thereupon shall be removed.

E. Unless otherwise specified, reinforcement shall be furnished in the full lengths indicated on the plans. Splicing of bars, except where shown on the plans, will not be permitted without the approval of the Engineer. Where splices are made, they shall be staggered insofar as possible. Splices shall be Class B according the ACI 318. Mat dowels and hook bars shall extend into concrete in compliance with ACI 318 regarding development length.

F. Wire mesh reinforcement shall be continuous between expansion joints. Laps shall be at least one full mesh plus 2", staggered to avoid continuous lap in either direction and securely wired or clipped.

G. Dowels within pads and slabs on grade shall be installed at right angles to construction joints and expansion joints. Dowels shall be accurately aligned parallel to the finished surface, and shall be rigidly held in place and supported during placing of the concrete. One end of dowels shall be oiled or greased or dowels shall be coated with high-density polyethylene with a minimum thickness of 14 mils. At expansion joints, provide dowel caps with a minimum expansion capacity of ¾”

-- END OF SECTION --

SECTION 033000

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Provide all labor, materials, equipment and services required to furnish and install all cast-in-place concrete as indicated on the Drawings and specified herein.

B. All concrete construction shall conform to all applicable requirements of ACI 301 (latest), Specifications for Structural Concrete for Buildings, except as modified by the supplemental requirements specified herein.

C. All water holding structures shall be tested for leakage by the Contractor. The Contractor shall provide at his own expense all labor, material, temporary bulkheads, pumps, water measuring devices, etc.; necessary to perform the required tests. Each unit shall be tested separately and the leakage tests shall be made prior to backfilling and before equipment is installed. Testing water shall be from any potable, non-potable, or natural moving source such as a river or stream, but not from any still water source such as a lake or pond, and not from any wastewater source.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Earthwork: D31?

C. Precision Grouting: D3?

1.03 ACTION SUBMITTALS

The Contractor shall submit the following data for Engineer's review in accordance with DIVISION 01.

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternative design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at the Project site.

2. Submit copies of laboratory test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix must be suitable for the job conditions. This shall include at least 3 tests each for 7-day and 28-day compressive strengths for test cylinders made and cured in accordance with ASTM C192/C192M and tested in accordance with ASTM C39/C39M. Include mill test and all other tests for cement, fly ash, aggregates, and admixtures in the laboratory test reports. Provide maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a

graph of percentage retained versus sieve size. Submit test reports along with the concrete mix design. Obtain approval before concrete placement.

3. Use a qualified independent testing agency for testing for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

C. Slab, Wall, and Construction Joint Layout Drawings: The Contractor shall submit for review drawings separate from the steel reinforcing drawings, showing the location of all proposed construction joints and the sequence of concrete placements. Layout plans specifically detailing methods and sequences of concrete placements for concrete slabs and walls. Include proposed concrete screed equipment, location of waterstops, and/or any proposed deviations from joints indicated on the contract drawings. Indicate all proposed construction joints required to construct the structure. Location of construction joints is subject to approval of the Engineer.

D. Form Ties: Submit product data and dimensions and details of form ties for approval.

E. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement. Shop drawings shall conform to the latest edition ACI detail manual SP-66. Shop drawings shall be prepared under the direct supervision of a professional engineer licensed in the state in which the project is located and shall include plans, elevations, sections, details, and attachments to other work.

F. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements.

1. Cementitious materials.

2. Aggregates: Test results showing compliance with required standards, i.e. sieve analysis, aggregate soundness tests, petrographic analysis per ASTM C295/C295M, alkali-aggregate reactivity per ASTM C1260, mortar bar expansion testing per ASTM C1567, etc. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity. Submit Certification of Compliance for freeze-thaw resistant concrete aggregate.

3. Admixtures: Include the chloride ion content of each admixture and certification from the admixture manufacturer that all admixtures utilized in the design mix are compatible with one another and properly proportioned prior to mix design review by the Engineer.

   a. Fly Ash: Submit test results in accordance with ASTM C618 for fly ash. Submit test results performed within 6 months of submittal date. Submit manufacturer’s policy statement on fly ash use in concrete.

4. Curing Compounds.

5. Trial Batches: For each of the preliminary concrete mix designs and shall include slump per ASTM C143, air content per ASTM C231, unit weight per ASTM C138 and compressive strength tests.

6. Steel Reinforcement: Submit material test results.

7. Field Test of Fresh Concrete: Obtain at least one composite sample for each 50 cubic yd, or fraction thereof, of each concrete mixture placed in any one day. Test fresh concrete in accordance with ACI 301 for compressive strength, slump, and air content.

8. Submit copies of Delivery Tickets of concrete with field test reports. All field test reports and tickets shall be referenced in writing to the location that the subject concrete was placed.

G. Leakage Test Reports: All water holding structures shall be tested separately for leakage by Contractor.

H. Field Quality-Control Reports. Contractor shall submit a signed, dated checklist for each concrete placement that indicates that the forms, reinforcement, and embedded items were independently checked by his quality control person for proper installation prior to placing concrete.

I. Manufacturer Certification: Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities".

J. Testing Reports: For all required tests.

1.04 QUALITY ASSURANCE

A. Qualification Data: Comply with the following including all sub-references contained herein unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete".

2. ACI 318, "Building Code Requirements for Structural Concrete".

3. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials".

4. CRSI 10MSP, "Manual of Standard Practice"

5. ASTM E329, "Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction".

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products that complies with ASTM C94/C94M requirements for production facilities and equipment and is certified according to NRMCA CPMB 100.

C. Welding Procedure Qualifications: Must be in accordance with AWS D1.4/D1.4M.

D. Welder Qualifications: Provide certificates in accordance with AWS D1.4/D1.4M or under an equivalent qualification test approved in advance. Welders are permitted to do only the type of welding for which each is specifically qualified.

E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from a single source, and obtain admixtures from single source from single manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING/PROJECT CONDITIONS

A. Reinforcing Steel:

1. All reinforcing shall be neatly bundled and tagged for placement when delivered to the job site. Bundles shall be properly identified for coordination with mill test reports.

2. Reinforcing steel shall be stored above ground on platforms or other supports and shall be protected from the weather at all times by suitable covering. It shall be stored in an orderly manner and plainly marked to facilitate identification.

3. Reinforcing steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.

4. The surfaces of all reinforcing steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed. Where there is a delay in depositing concrete, reinforcing shall be re-inspected and, if necessary, recleaned.

B. Joint Sealers:

1. Do not proceed with installation of joint sealers when ambient and substrate temperature conditions are outside the limits permitted by the joint sealer manufacturer. Do not install joint sealers when joint substrates are wet due to rain, frost, condensation or other causes.

2. Do not proceed with installation of joint sealers when joint widths are less than allowed by joint sealer manufacturer for application indicated.

PART 2 - PRODUCTS

2.01 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed, ASTM A706 Grade 60 where required to be welded.

B. All bar reinforcing shall be from domestic mills and shall have the manufacturer’s mill marking rolled into the bar which shall indicate the producer, size, type, and grade.

C. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs. Dowels shall be installed at right angles to construction joints and expansion joints. Dowels shall be accurately aligned parallel to the finished surface, and shall be rigidly held in place and supported during placing of the concrete. One end of dowels shall be oiled or greased or dowels shall be coated with high density polyethylene with a minimum thickness of 14 mils.

2.02 ANCHOR RODS

A. Unheaded Anchor Rods: ASTM F1554, Grade 36.

1. Configuration: Straight, threaded each end with three sets nut and washer each as indicated.

2. Nuts: ASTM A563 heavy-hex carbon steel.

3. Washers: ASTM F436, Type 1, hardened carbon steel plus A 36 plate washers where indicated.

4. Finish: As indicated.

2.03 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice", of greater compressive strength than concrete and as follows:

1. Reinforcement supports and other accessories in contact with the forms for members which will be exposed to view in the finished work shall be of stainless steel or shall be plastic. Supports for reinforcement, when in contact with the ground or stone fill, shall be precast stone concrete blocks or plastic. Particular attention is directed to the requirement of Paragraph 3.3.2.4 of ACI Standard 301. These requirements apply to all reinforcement, whether in walls or other vertical elements, inclined elements or flatwork.

2. Particular care shall be taken to bend tie wire ends away from exposed faces of beams, slabs and columns. In no case shall ends of tie wires project toward or touch formwork.

B. Concrete blocks (dobies), used to support and position bottom reinforcing steel shall have the same or higher compressive strength as specified for the concrete in which it is located.

C. Mechanical couplers shall develop a tensile strength which exceeds 125 percent of the yield strength of the reinforcing bars being spliced at each splice. The reinforcing steel and coupler used shall be compatible for obtaining the required strength of the connection.

2.04 FORMWORK

A. Formwork shall conform to ACI SP-4.

B. Forms for exposed concrete surfaces shall be exterior grade, high-density overlay plywood, steel, or wood forms with smooth tempered hard-board form-liners.

C. All forms shall be smooth surface forms unless otherwise specified.

D. Forms and falsework shall be designed for total dead load, plus all construction live loads as outlined in ACI 347. Design and engineering of formwork and safety considerations during construction shall be the responsibility of the Contractor.

E. Forms shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. The maximum deflection of facing materials reflected in concrete surfaces exposed to view shall be 1/600 of the span between structural members.

F. Form-Release Agents: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

G. Formulate form-release agent with rust inhibitor for steel form-facing materials.

H. Form Ties: Shall be one of the following:

1. Taper ties that can be removed from the concrete wall after the forms have been stripped, and that have an elastomeric plug seal to place in the hole after the tie is removed.

2. Snap ties that remain in the wall and he ends can be snapped off at least 1½ inches below the surface of the concrete. Snap ties shall have integral water stops.

3. She-bolts with ends at least 1½ inches below the surface of the concrete.

4. Coil ties with ends at least 1½ inches below the surface of the concrete.

I. Form Ties for water-retaining structures shall have integral waterstops.

J. Flat or strap ties are not permitted.

2.05 HYDRAULIC CEMENT

A. Portland Cement: ASTM C150, Type I/II. Type III may only be used with Engineer's written approval.

B. When potentially reactive aggregates are to be used in the concrete mix, cement shall meet the following requirements:

1. For concrete mixed with only Portland Cement, the total alkalis in the cement (calculated as the percentage of NA2O plus 0.658 times the percentage of K20) shall not exceed 0.40%.

2. For concrete mixed with Portland Cement and an appropriate amount of fly ash the total alkalis in the Portland Cement (calculated as the percentage of NA20 plus 0.658 times the percentage of K20) shall not exceed 0.85%.

3. When non-reactive are used in the concrete mix, total alkalis in the cement shall not exceed 1.0%.

4. The proposed Portland Cement shall not contain more than 8% tricalcium aluminate and more than 12% tetra-calcium aluminoferrite.

C. Different types of cement shall not be mixed nor shall they be used alternately except when authorized in writing by the Engineer. Different brands of cement or the same brand from different mills may be used alternately. A resubmittal will be required if different cements are proposed during the Project.

D. Cement shall be stored in a suitable weather-tight building so as to prevent deterioration or contamination. Cement which has become caked, partially hydrated, or otherwise damaged will be rejected.

2.06 FLY ASH

A. Fly Ash: ASTM C618, Class F with a maximum LOI of 6%, a maximum free carbon content of 3.0% and a maximum available alkali content (as Na_2O) of 1.5%.

B. Where reactive aggregates are used in concrete mix, the fly ash constituent shall be between 15% and 25% of the total weight of the combined Portland Cement and fly ash.

C. For concrete to be used in environmental concrete structures, i.e. process structures or fluid containing structures, the inclusion of fly ash in the concrete mix is mandatory.

2.07 WATER

A. Water: ASTM C94/C94M

B. Water used for mixing concrete shall be clear, potable, and free from deleterious substances such as objectionable quantities of silty organic matter, alkali, salts, and other impurities.

2.08 AGGREGATES

A. Normal-Weight Aggregates: ASTM C33.

B. Fine aggregate (sand) in the various concrete mixes shall consist of natural or manufactured sand, clean and free of deleterious substances, and conforming to ASTM C33.

C. Coarse aggregates shall consist of hard, clean, durable gravel, crushed gravel or crushed rock. Coarse aggregate shall be size #57 or #67 conforming to ASTM C33.

1. Supplier shall certify that coarse aggregate source has a demonstrated history of not causing alkali silica reaction in concrete.

D. Provide aggregates from a single source.

E. Aggregates shall be tested for gradation by sieve analysis tests in conformance with ASTM C136.

F. Aggregates shall be tested for soundness in accordance with ASTM C88. The loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using magnesium sulfate.

G. Non-reactive aggregates shall meet the following requirements:

1. Fine and coarse aggregates shall be tested and evaluated for alkali-aggregate reactivity in accordance with ASTM C1260. The fine and coarse aggregates shall be evaluated separately and in combination, which matches the Contractor’s proposed mix design proportioning. All results for the separate and combination testing shall have a measured expansion less than 0.008 percent at 16 days after casting. Should the test data indicate an expansion of 0.08 percent or greater, the aggregate shall be rejected or additional testing using ASTM C1260 and ASTM C1567 shall be performed. The additional testing using ASTM C1260 and ASTM C1567 shall be performed using the low alkali Portland cement in combination with Class F fly ash. Class F fly ash shall be used in the range of 25 to 40 percent of the total cementitious material by mass.

2. A petrographic analysis in accordance with ASTM C295 shall be performed to identify the constituents for the fine and coarse aggregate. Non-reactive aggregates shall meet the following limitations:

a. Optically strained, microfractured, or microcrystalline quartz, 5.0% maximum.

b. Chert or chalcedony, 3.0% maximum.

c. Tridymite or cristobalite, 1.0% maximum.

d. Opal, 0.5% maximum.

e. Natural volcanic glass in volcanic rocks, 3.0% maximum.

3. Proposed concrete mix including proposed aggregates shall be evaluated by ASTM C1567. Mean mortar bar expansions at 16 days shall be less than 0.08%. Tests shall be made using exact proportion of all materials proposed for use on the job in design mix submitted.

H. All aggregates shall be considered reactive unless they meet the requirements above for non-reactive aggregates. Aggregates with a lithology essentially similar to sources in the same region found to be reactive in service shall be considered reactive regardless of the results of the tests above.

I. Contractor shall submit form certifying that all aggregates used for this Project meet the Tennessee Department of Highways' requirements for freeze-thaw resistance.

J. Contractor shall submit a new trial mix to the Engineer for approval whenever a different aggregate or gradation is proposed.

2.09 ADMIXTURES

A. Air-Entraining Admixture: ASTM C260.

B. Air entraining agent shall be added to all concrete unless noted otherwise. Air content of concrete, when placed, shall be within the ranges given in the concrete mix design.

C. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.

2. Retarding Admixture: ASTM C494/C494M, Type B.

3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.

4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.

5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.

6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

D. The admixture manufacturer, when requested, shall provide a qualified concrete technician employed by the manufacturer to assist in proportioning concrete for optimum use. He shall also be available when requested to advise on proper addition of the admixture to the concrete and on adjustment of the concrete mix proportions to meet changing job conditions.

E. Admixtures containing calcium chloride, thiocyanate or more than 0.05 percent chloride ions are not permitted.

F. The addition of admixtures to prevent freezing is not permitted.

G. The use of admixtures to retard setting of the concrete during hot weather, to accelerate setting during cold weather, and to reduce water content without impairing workability will be permitted if the following conditions are met:

1. The admixture shall conform to ASTM C494, except that the durability factor for concrete containing the admixture shall be at least 100 percent of control, the water content a maximum of 90 percent of control and length change shall not be greater than control, as defined in ASTM C 494.

2. Where the Contractor finds it impractical to employ fully the recommended procedures for hot weather concreting, the Engineer may at his discretion, require the use of a set retarding admixture for mass concrete 2.5 feet or more thick for all concrete whenever the temperature at the time concrete is cast exceeds 80oF. The admixture shall be selected by the Contractor subject to the review of the Engineer. The admixture and concrete containing the admixture shall meet all the requirements of these Specifications. Preliminary tests of this concrete shall be required at the Contractor's expense.

2.10 CLASSES OF CONCRETE AND USAGE

A. Structural concrete of the various classes required shall be proportioned by either Method 1 or Method 2 of ACI 301 to produce the following 28-day compressive strengths:

1. Selection of Proportions for Class A Concrete:

a. 4,500 psi compressive for strength at 28 days.

b. Type I/II cement plus supplementary cementitious materials.

c. Max. water-cementitious materials ratio = 0.45.

d. Min. cement content = 564 lbs.

e. Nominal max. size coarse aggregate = No. 67 (3/4" max.) or No. 57 (1" max.). Walls with architectural treatment shall use #67 stone.

f. Air content = 6% plus or minus 1% by volume for exterior concrete, except interior smooth finished slabs shall have 2% plus or minus 1% by volume.

g. Fly Ash = 25% maximum.

h. Slump = 3" - 4" when tested in accordance with ASTM C 143/C 143M. Slump shall not exceed 8 inches when high-range water-reducers are used.

2. Selection of Proportions for Class B Concrete:

a. 3,500 psi compressive strength at 28 days.

b. Type I/II cement plus supplementary cementitious materials.

c. Max. water-cementitious materials ratio = 0.50.

d. Min. cement content = 470 lbs. (5.0 bags)/cu. yd. concrete.

e. Nominal max. size coarse aggregate = No. 67 (3/4" max.) or No. 57 (1" max). Walls with architectural treatment shall use No. 67 (3/4" max.).

f. Air content = 6% plus or minus 1% by volume if exposed to freezing and thawing.

g. Slump = 3" - 4" when tested in accordance with ASTM C 143/C 143M. Slump shall not exceed 8 inches when high-range water-reducers are used.

B. Concrete shall be used as follows:

1. Class A concrete for all concrete work except as noted below.

2. Class B non-structural concrete for fill concrete, thrust blocks, and where indicated on the Drawings.

2.11 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type I, Class B, dissipating.

2.12 RELATED MATERIALS

A. Bonding Agents: ASTM C1059-C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

B. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements.

C. Expansion Joint Filler: Preformed, compressible, resilient, non-waxing, non-extruding strips of plastic foam of material and size, shape and density to control sealant depth and otherwise contribute to producing optimum sealant performance. Provide either flexible, open cell polyurethane foam or non-gassing, closed-cell polyethylene foam, unless otherwise indicated, subject to approval of sealant manufacturer.

D. Joint Sealants: ASTM C920, Type M, Class 25, Use T, M, A, I. Use non-sag type on vertical surfaces.

E. Polyvinyl Chloride (PVC) Waterstops:

1. PVC waterstops for construction joints shall have width and shape as indicated on the drawings with a minimum thickness at any point of 3/8 inches.

2. Waterstops for expansion joints shall have width and shape as indicated on the drawings with a minimum thickness at any point of 3/8 inches.

3. The required minimum physical characteristics for this material are:

   a. Tensile Strength = 1750 psi (ASTM D638)

   b. Ultimate Elongation = not less than 280% (ASTM D638)

4. No reclaimed PVC shall be used for the manufacturing of the waterstops. The Contractor shall furnish certification that the proposed waterstops meet the above requirements.

5. Waterstops shall be securely wired into place to maintain proper position during placement of fresh concrete, as shown on the Drawings. Care shall be taken in the installation of the waterstop and the placing of the concrete to avoid "folding" while concrete is being placed, and to prevent voids in the concrete surrounding the waterstop.

F. Chamfer strips shall be one (1) inch radius with leg, polyvinyl chloride strips by Gateway Building Products, Saf-T-Grip Specialties Corp., Vinylex Corp., or equal.

PART 3 - EXECUTION

3.01 STEEL REINFORCEMENT

A. General: Comply with CRSI’s “Manual of Standard Practice” for placing reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

D. Reinforcement bars shall not be straightened or re-bent in a manner that will injure the material. Heating of bars is not permitted.

E. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.

3.02 FORMWORK

A. No falsework or forms shall be used which are not clean and suitable. Deformed, broken or defective falsework and forms shall be removed from the work.

B. Forms shall be smooth and free from surface irregularities. Joints between the forms shall be sealed to eliminate any irregularities. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to a practical minimum.

C. Forms shall be true to line and grade, and shall be sufficiently rigid to prevent displacement and sagging between supports. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly-placed concrete.

D. Forms shall be mortar tight so as to prevent the loss of water, cement and fines during placing and vibrating of the concrete.

E. All forms shall be constructed in such a manner that they can be removed without hammering or prying against the concrete. Forms shall not be disturbed until the concrete has attained sufficient strength. Forms shall be removed in such manner as not to impair safety and serviceability of the structure. Care shall be taken to prevent chipping of corners or other damage to concrete when forms are removed. Exposed corners and other surfaces which may be damaged by ensuing operations shall be protected from damage by boxing, corner boards or other approved means until construction is completed.

F. Forms shall be coated with an approved release agent before initial pour and between subsequent pours, in accordance with the manufacturer's printed instructions. Form boards shall not be wet prior to placing concrete.

3.03 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.

2. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

4. Construction joints shall be positioned so as not to adversely affect the structural performance.

5. All joints in water bearing structures shall have a waterstop. All joints below grade in walls or slabs which enclose an accessible area shall have a waterstop.

C. Expansion Joints: All expansion joints in water-bearing structures shall have a center-bulb type waterstop. All expansion joints below grade in walls or slabs which enclose an accessible area shall have a center-bulb type waterstop.

D. Contraction Joints in Slabs: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

E. Isolation Joints in Slabs: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated:

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.

2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

F. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.04 CONCRETE MIXING

A. All concrete shall be machine mixed. Hand mixing of concrete will not be permitted. The Contractor may supply concrete from a ready-mix plant or from a site mixed plant. In selecting the source for concrete production, the Contractor shall carefully consider its capability for providing quality concrete at a rate commensurate with the requirements of the placements so that well bonded, homogenous concrete, free of cold joints, is assured.

B. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

2. Any truck delivering concrete to the job site, which is not accompanied by a delivery ticket showing the following information will be rejected and such truck shall immediately depart from the job site:

a. Date and truck number

b. Ticket number

c. Mix designation of concrete

d. Cubic yards of concrete

e. Cement brand, type, and weight in pounds

f. Weight in pounds of fine aggregate

g. Weight in pounds of coarse aggregate

h. Air entraining agent, brand, and weight in pounds and ounces

i. Admixtures, brand and weight in pounds and ounces

j. Water, in gallons, stored in attached tank

k. Water, in gallons, maximum that can be added without exceeding design water/cement ratio

l. Time of loading

m. Time of delivery to job (by truck driver)

C. Project Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94. Mix concrete materials in appropriate drum-type batch machine mixer.

1. Scales for weighing concrete ingredients shall be accurate when in use within +/- 0.04 percent of their total capacities. Standard test weights shall be available to permit checking scale accuracy.

2. The concrete shall be mixed in a batch mixer capable of thoroughly combining the aggregates, cement, and water into a uniform mass within he specified mixing time, and of discharging the concrete without harmful segregation. The mixer shall bear a manufacturer's rating plate indicating the rate capacity and the recommended revolutions per minute and shall be operated in accordance within.

3. The interior of the mixer shall be free of accumulations that will interfere with mixing action. Mixing blades shall be replaced when they have lost 10% if their original height.

4. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at lease 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.

5. For mixer capacity larger than 1 cu. Yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd.

6. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

7. Concrete shall be mixed only in quantities for immediate use and within the time and mixing requirements of ASTM C94.

3.05 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. If concrete is placed by pumping, no aluminum shall be used in any parts of the pumping system which contact or might contaminate the concrete. Aluminum chutes and conveyors shall not be used.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation:

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.

2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

F. All construction joints shall be prepared for bonding by roughening the surface of the concrete in an acceptable manner which will expose the aggregate uniformly and will not leave laitance, loosened particles of aggregate or damaged concrete at the surface. Joints in walls and columns shall be maintained level. Concrete shall be placed in layers not over 18 inches deep and each layer shall be compacted by mechanical internal-vibrating equipment supplemented by hand spading, rodding and tamping as directed. Vibrators shall not be inserted into lower courses that have begun to set.

G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

I. All construction joints shall be prepared for bonding by roughening the surface of the concrete in an acceptable manner which will expose the aggregate uniformly and will not leave laitance, loosened particles of aggregate or damaged concrete at the surface. Horizontal joints in walls and columns shall be maintained level. Concrete shall be placed in layers not over 18 inches deep and each layer shall be compacted by mechanical internal vibrating equipment supplemented by hand spading, rodding and tamping as directed. Vibrators shall not be inserted into lower courses that have begun to set.

3.06 FINISHES

A. Exposed to Public View Concrete Surfaces:

1. For all exterior exposed to public view concrete surfaces, including the outside surfaces of tanks, form faces shall be smooth and forms shall be true-to-line and grade. Surfaces produced by forms shall require only minor dressing to arrive at true surfaces. Do not reuse forms with surface wear, tears, or defects that lessen the quality of the surface. Thoroughly clean and properly coat forms before reuse.

2. All formed exposed to view concrete surfaces shall have a "smooth rubbed finish". Exterior vertical surfaces shall be rubbed to one foot below grade. Interior exposed to public view vertical surfaces of liquid containers shall be rubbed to one (1) foot below the minimum liquid level that will occur during normal operations.

B. All vertical surfaces in liquid containing structures shall have a "smooth form" finish.

1. All "smooth form" concrete vertical surfaces shall be a true plane within 1/4 inch in ten (10) feet as determined by a ten (10) foot straightedge placed anywhere on the surface in any direction. Abrupt irregularities shall not exceed 1/8 inch.

C. Basin, flume, conduit and tank floors shall have a "smooth troweled" finish unless shown otherwise on Drawings.

D. Weirs and overflow surfaces shall be given a hard "smooth troweled" finish.

E. Exterior platforms, steps and landings, shall be given a "broom" finish. "Broom" finish shall be applied to surfaces which have been steel-troweled to an even, smooth finish. The troweled surface shall then be broomed with a fiber-bristle brush in the direction transverse to that of the main traffic.

3.07 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Foundations: Provide foundations as shown on Drawings.

1. Unless otherwise directed by the Engineer, the vertical surfaces of footings shall be formed. Excavations and reinforcement for all footings shall have been inspected by the Engineer before any concrete is placed.

D. The installation of underground and embedded items shall be inspected before slabs are placed. Pipes and conduits shall be installed below the concrete unless otherwise indicated. Fill required to raise the subgrade shall be placed as specified in Section 02300 "Earthwork". Porous fill not less than 6 inches in compacted thickness shall be installed under all slabs, tank bottoms, and foundations. The fill shall be leveled and uniformly compacted to a reasonably true and even surface. The surfaces shall be clean, free from frost, ice, mud and water. Waterproof paper, polyethylene sheeting of nominal 4-mil minimum thickness, or polyethylene-coated burlap shall be laid over all surfaces receiving concrete.

E. Concrete Walks and Curbs:

1. Subgrade shall be true and well compacted at the required grades. Spongy and otherwise unsuitable material shall have been removed and replaced with approved material. Concrete walks shall be placed upon porous fill covered with waterproof paper, polyethylene sheeting of nominal 4-mil minimum thickness or polyethylene-coated burlap.

2. Concrete walks shall be not less than 4 inches in thickness. Walks shall have contraction joints every 5 linear feet in each groove in the top surface of the slab to a depth of at least one-fourth the slab thickness with a jointing tool. Transverse expansion joints shall be installed at all returns, driveways, and opposite expansion joints in adjacent curbs. Where curbs are not adjacent, transverse expansion joints shall be installed at intervals of approximately forty (40) feet. Sidewalks shall receive a "broomed" finish. Scoring shall be in a transverse direction. Edges of the sidewalks and joints shall be edged with a tool having a radius not greater than 1/6 inch. Sidewalks adjacent to curbs shall have a slope of 1/4 inch per foot toward the curb. Sidewalks not adjacent to curbs shall have a slope of 1/4 inch per foot. The surface of the concrete shall show no variation in cross section in excess of 1/4 inch in 5 feet. Concrete walks shall be reinforced with 6 x 6-W1.4xW1.4 welded wire reinforcement.

3. Concrete curbs shall be constructed to the section indicated on the Standard Detail, and all horizontal and vertical curves shall be incorporated as indicated or required. Forms shall be steel as approved by the Engineer. At the option of the Contractor, the curbs may be precast or cast-in-place. Cast-in-place curbs shall be divided into sections 8 to 10 feet in length using steel divider plates. The divider plates shall extend completely through the concrete and shall be removed. Precast curbs shall be cast in lengths of 4 to 5 feet. All exposed surfaces of concrete shall be finished smooth. All sharp edges and the edges of joints and divisions shall be tooled to 1/4-inch radius. Steel reinforcement shall be installed where the curb crosses pipe trenches or other insecure foundations. Such reinforcement shall consist of two (2) No. 4 deformed bars near the bottom of the curb and shall extend at least 24 inches beyond the insecure area. Transverse expansion joints shall be installed at all curb returns and at intervals of approximately 40 feet.

F. Column base plates, bearing plates for beams and similar structural members, machinery and equipment bases shall, after being plumbed and properly positioned, be provided with full bearing with non-shrink grout. Concrete surfaces shall be rough, clean, free of oil, grease, and laitance and shall be moistened thoroughly immediately before grout is placed. Metal surfaces shall be clean and free of oil, grease and rust. Mixing and placing shall be in conformance with the material manufacturer's printed instructions. After the grout has set, exposed surfaces shall be cut back one (1) inch and covered with a parge coat of mortar consisting of one (1) part Portland cement, two (2) parts sand and sufficient water to make the mixture placeable. Parge coat shall have a smooth dense finish. Exposed surfaces of grout and parge coat shall be water cured with wet burlap for seven (7) days.

G. Grout fill which is formed in place by using rotating equipment as a screen, such as clarifiers and similar types of equipment, shall be mixed in proportions and consistencies as required by the manufacturer or supplier of the equipment.

H. Unless otherwise shown or directed, all pumps, other equipment, and items such as lockers, motor control centers and the like, shall be installed on concrete bases. The

bases shall be constructed to the dimensions shown on the plans or as required to meet plan elevations. Where no specific plan elevations are required, the bases shall be 6 inches thick and shall extend 3 inches outside the metal equipment base. In general, the concrete bases shall be placed up to 2 inches below the metal base. The equipment shall then be properly shimmied to grade and the 2- inch void filled with non-shrink grout.

I. Manhole or access steps shall be plastic, constructed of copolymer polypropylene meeting the requirements of ASTM D2146 for Type II, Grade 16906 material. Step shall be reinforced with ASTM A615, Grade 60, #4 deformed steel reinforcing bar, be 9" deep, 14" wide, provided with notched tread ridge, foot retainer lugs on each side of tread and penetration stops for press fit installation. Plastic steps shall be PS2-PF as manufactured by M.A. industries, Inc., Peachtree City, Georgia. Steps shall be installed by drilling 1" diameter holes, minimum 3-3/4 inches deep into the wall and then driving steps into hole to the penetration stop, resulting in a press fit condition.

J. All existing contact surfaces with new patch shall be coated with moisture insensitive epoxy bonding adhesive, Sikadur Hi-Mod, Concresive LPL Liquid by BASF Construction Chemicals, or approved equal. Patch shall consist of base pour of 4,000 psi structural concrete, then a topping of non-shrink natural aggregate grout, Masterflow 713, Sonogrout by BASF Construction Chemicals, or approved equal, mixed and placed in accordance with manufacturer's instructions, to the thicknesses shown on Drawings. Coat base pour with epoxy bonding adhesive prior to placing grout course.

3.08 WATERTIGHTNESS TESTING

A. The structures which are intended to contain liquids and/or will be subjected to exterior hydrostatic pressures shall be so constructed that, when completed and tested, there shall be no loss of water and no wet spots shall show.

B. The structure shall not be tested before all elements of the structure which resist any portion of the retained liquid pressure are in place and the concrete has attained its specified compressive strength.

C. Unless otherwise specified, coating shall not be applied until after the hydrostatic tightness testing is complete. Liners that are mechanically locked to the surface during the placement of the concrete shall be installed before the hydrostatic tightness testing. Interior liners shall be visually examined for deficiencies and must pass integrity testing. Deficiencies shall be repaired.

D. The concrete surfaces and concrete joints shall be thoroughly inspected for potential leakage points. Areas of potential leakage hall be repaired before filling the containment structure with water.

E. All openings, fittings, and pipe penetrations in the structure shell shall be inspected at both faces of the concrete, if practical. Defective or cracked concrete shall be repaired prior to testing. All structural penetrations and inlets/outlets shall be securely sealed to prevent the loss of water from the structure during the test. All structural penetrations shall be monitored before and during the test to determine the watertightness of these appurtenances. If the structure is to be filled using the inlet/outlet pipe, positive means shall be provided to check that water is not entering or leaving though this pipe once the structure is filled to the test level. Leakage at these inlet/outlets shall be repaired prior to testing. No allowance shall be made in the test measurements for uncorrected known points of leakage.

F. No backfill shall be placed against the walls or on the wall footings of the structure to be tested unless otherwise specified.

G. The groundwater level shall be brought to a level below the top of the base slab and kept at that elevation or at a lower elevation during the test.

H. As soon as practicable, after the completion of the structures, the Contractor shall fill them with water and if leakages develop or wet spots show, the Contractor shall empty such structures and correct the leakage in an approved manner. Any cracks which appear in the concrete shall be dug out and suitably repaired. Temporary bulkheads over pipe openings in walls shall be provided as required for the testing.

I. The allowable loss of water for tightness tests shall not exceed 0.050% of the test water volume in 24 hours.

J. After repairs, if any are required, the structures shall be tested again and further repaired if necessary, until satisfactory results are obtained. All work in connection with these tests and repairs shall be at the expense of the Contractor.

K. If any leaks, in excess of the specified amount, are not remedied by the Contractor within four weeks of notification by the Engineer, regardless of whether the cause of these leaks is or is not determined, the Engineer shall have the authority to have these leaks repaired by others. The cost of repairs, by others, shall be deducted from monies due or to become due to the General Contractor.

L. Waterstops shall be placed in other locations as indicated on the Drawings and as required to assure the watertightness of all containers of liquids. Special shop fabricated ells, tees and crosses shall be provided at junctions. Waterstops shall be extended at least 6 inches beyond end of placement in order to provide splice length for subsequent placement. In slabs and tank bottoms, water stops shall be turned up to be made continuous with waterstops at bottom of walls or in walls.

M. Joints between pipe (except cast iron wall pipe) and cast-in-place concrete walls shall be sealed by means of a groove cast completely around the pipe; the groove shall be filled with a quick setting hydraulic compound similar and equal to Waterplug as made by BASF Construction Chemicals mixed and applied in accordance with the manufacturer's instructions.

3.09 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.

    b. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

    c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

    a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

3.10 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer’s written instructions.

1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.11 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one-part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.03 inch-wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and

mixture as original concrete except without coarse aggregate. Place, compact, and finish blending with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of damaged or defective concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used subject to Engineer's approval.

END OF SECTION

SECTION 034000

PRECAST CONCRETE

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Provide all labor, materials, equipment and services required to furnish and install all precast concrete vaults and other precast structures & appurtenances as shown on the Drawings and specified herein.

B. Delegated Design: Design utility structures, including comprehensive engineering analysis by a qualified professional engineer, licensed in the state in which the project using performance requirements and design criteria indicated.

1.02 SUBMITTALS

The Contractor shall submit the following data for Engineer's review in accordance with the submittal specifications.

A. Delegated Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data, calculations, and erection drawings signed and sealed by the qualified professional engineer responsible for their preparation.

B. Product Data: For each type of product indicated included but not limited to standard precast units, proprietary precast units, embedded items, and accessories.

C. Design Data: Submit calculations prepared under the direct supervision of a professional engineer supporting the structural design, including resistance to buoyancy, uplift and wheel loads in accordance with requirements and references indicated. The calculations shall be sealed by a professional engineer licensed in the state in which the project is located.

D. Test Reports: Submit test reports for the following:
   1. Material certifications and/or laboratory test reports, including mill tests and all other test data, for Portland cement, blended cement, pozzolans, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this Project.
   2. Test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Such tests may include compressive strength, flexural strength, plastic or hardened air content, freeze thaw durability, abrasion and absorption. Clearly detail in the specification’s special tests for precast concrete or cast-in items.
   3. Sufficient documentation, when the use of self-consolidating concrete (SCC) is proposed, showing a minimum of 30-days production track records demonstrating that SCC is appropriate for casting of the product.
   4. In-plant QA/QC inspection reports, upon the request of the Project Representative.

E. Shop Drawings: Submit shop drawings for standard precast units and custom-made precast units prepared under direct supervision of a professional engineer licensed in the state in which the project is located. Shop drawings shall include:
   1. The criteria and loads used in the design of the precast components.
   2. All materials used, their specifications and their design strengths.
   3. Layout, piecemark, dimensions, reinforcing, and connection details of each precast member, including openings.
   4. Details and instructions for lifting, rigging, erection, and installation of each precast component.
   5. Lists and descriptions of all loose accessory materials supplied.

6. Instructions on secondary pours (in the field) when required.
7. Seal of Professional Engineer, licensed in the state the project is located in, under whose direct personal supervision the drawings were prepared.

F. Quality Control Procedures: Submit certificate from the NPCA QC Manual that the precast concrete utility structures and vault manufacturer participates in their QA/QC program.

G. Manufacturer's Installation Instructions.

1.03 QUALITY ASSURANCE

A. Manufacturer of precast concrete utility structures and vaults shall be quality certified by NCPA. Inspect manufacture of utility structures and vaults in accordance with ASTM C1037.

B. Installer of precast concrete utility structures and vaults shall have a record of at least three (3) years of successful installation of similar products on similar projects.

C. Inspection of earthwork, compaction and backfill shall be in accordance with the earthwork specifications.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver precast units to the site in accordance with the delivery schedule to avoid excessive build-up of units in storage at the site. Upon delivery to the jobsite, all precast concrete units will be inspected by the Project Representative for quality and final acceptance.

B. Store units off the ground or in a manner that will minimize potential damage.

C. Handle, transport, and store products in a manner to minimize damage. Lifting devices or holes shall be consistent with industry standards. Perform lifting with methods or devices intended for this purpose as indicated on Shop Drawings.

PART 2 - PRODUCTS

2.01 PRECAST STRUCTURES FOR UTILITY STRUCTURES AND VAULTS

A. Circular precast utility structures and vaults shall conform to ASTM C478. Non-circular vaults and structures shall conform to ASTM C857. Access hatch and pipe penetrations shall be cast in the top slab.

B. Manhole frames and covers shall have a clear opening of 22 inches and shall be made of cast iron conforming to ASTM A48/A48M Class 30. Casting shall be smooth, clean and free from blisters, blowholes and shrinkage. Castings shall be dipped twice in a preparation of asphalt or coal tar and oil applied at a temperature of not less than 144 degrees F and not more than 155 degrees F so as to form a tenacious coating.

C. Structural design of precast concrete utility structures and vaults is hereby delegated. A licensed professional engineer in the State of the Project shall approve all designs.

D. All precast concrete structures shall be designed to resist the lateral soil pressures and fluid pressures in accordance with ASTM C857.

E. All precast concrete structures have integral flanges at the base to engage enough soil resistance to resist the buoyant force from full submergence.

F. All precast concrete structures shall be designed to support HL-93 or HS25-44-wheel loads in accordance with the AASTHO HB-17 anywhere on the top surface of the structure.

G. Joints: Joints shall be watertight and shall be sealed with one of the following:
1. Rubber gaskets conforming to ASTM C443.
2. Pre-formed flexible butyl type joint sealant conforming to AASHTO M198.
   a. Hamilton Kent "Kent Seal No. 2"
   b. K.T. Snyder Company "Rub'r Nek"
   c. Press Seal Gasket "E Z Stik"

H. Corrosion Control: Follow recommendations outlined in ACPA 01-110 when hydrogen sulfide is indicated as a potential problem. See the geotechnical report.

PART 3 - EXECUTION

3.01 FABRICATION

A. Fabricate precast concrete utility structures and vaults in accordance with NPCA QC Manual.

3.02 INSTALLATION

A. Install precast concrete utility structures and vaults in accordance with ASTM C891 and the manufacturer's instructions.
B. Lift precast components at designated lifting points in accordance with the manufacturer's instructions and other applicable safety standards.
C. Precast concrete utility structures and vaults shall bear on a minimum 4-inch thick bedding / base / drainage course of free-draining granular material. See Division 31 for bedding / base / drainage course materials.
D. Do no bear precast concrete utility structures and vaults on uneven subgrade or grade with high points from rock pinnacles or boulders or rock ledges.
E. Install precast concrete utility structures and vaults in proper location, with the proper alignment and level.
F. Backfill around the precast concrete utility structures and vaults in accordance with Division 31 specifications.

3.03 JOINTS

A. Joints shall be sealed with an approved sealant as specified in Part 2, and shall be mortared or grouted.
B. When making joints with mastic compound prime and seal all joints with primer supplied with the joint compound.
C. Joints shall be watertight.
D. Pipe Connections into Precast Structures:
    1. Precast Openings:
        a. Pipe shall be sealed in the precast section pipe opening with a resilient connector meeting the requirements of ASTM C923. Resilient connector shall be "Dura-Seal III" by Dura-Tech, Dayton, Ohio; "A-Lok" by A-LOK Products, Inc.; or approved equal.
        b. Resilient connector shall be cast integrally into the wall of the precast section at the time of manufacture. There shall be no mortar placed around the connector on the outside of the manhole and no mortar shall be placed around the top half of the connector on the inside of the manhole when completing the invert work.
    2. Cored Openings:
        a. Pipe shall be sealed in cored precast section pipe opening with a resilient mechanical connector meeting the requirements of ASTM C923. Resilient connector shall be "NPC Kor-N-Seal I" (with stainless steel wedge) by Trelleborg Pipe Seals Milford, Inc.; "PSX: Direct Drive" by Press-Seal Gasket Corporations; interlocking link pipe seal; or approved equal. All fasteners and hardware shall be Type 304 stainless steel.
        b. There shall be no mortar placed around the connector on the outside of the structure and no mortar shall be placed around the top half of the connector on the inside of the structure when completing the invert work.

3.04 LEAKAGE TESTING

A. Leakage tests shall be made and observed by the Project Representative's representative for all precast utility structures and vault structures. The test shall be the watertightness (exfiltration) test as described herein.

B. After each structure has been assembled in place, including wall piping, all lifting holds shall be filled with an approved non-shrink, non-metallic grout. Upon completion, each precast structure shall be tested to determine watertightness. The leakage test shall be made prior to placing any fill material and prior to application of interior/exterior wall coatings if specified. If the groundwater table has been allowed to rise above the bottom of the utility structures or vault, it shall be lowered for the duration of the test. All pipes and other openings into the structures shall be suitably plugged and the plugs braced to prevent blow out.

C. The structure shall be filled with potable water to the maximum level. The test shall consist of measuring the liquid level over the next 24 hours to determine if any change has occurred. If a change is observed and exceeds the maximum allowance, the test shall be extended to a total of five days. If at the end of five days the average daily change has not exceeded the maximum allowance, the test shall be considered satisfactory.

D. The liquid volume loss for a period of 24 hours shall not exceed one-twentieth of one percent of the structure capacity, 0.0005 x structure volume. If the liquid volume loss exceeds this amount, it shall be considered excessive, and the structure shall be repaired and retested.

E. Damp spots will not be permitted at any location on the structure wall. Damp spots are defined as spots where moisture can be picked up on a dry hand. All such areas shall be repaired as necessary.

F. Damp spots or standing water on the footing may occur upon structure filling and are permissible within the allowable volume loss. Measurable flow in this area is not permissible and must be corrected.

G. It shall be the Contractor's responsibility to uncover the structure as necessary and to disassemble, reconstruct, or replace it as directed by the Project Representative. The structure shall then be retested.

H. No adjustment in the leakage allowance will be made for unknown causes such as leaking plugs, absorptions, etc. It will be assumed that all loss of water during the test is a result of leaks through the joints or through the concrete. Furthermore, the Contractor shall take any steps necessary to assure the Project Representative that the water table is below the bottom of the utility structures throughout the test.

3.05 CLEAN UP

A. Upon completion of installation of the precast structures and appurtenances, the Contactor shall remove all debris and surplus construction materials resulting from the Work. The Contractor shall grade the ground around and adjacent to the construction area in a uniform and neat manner to the final grade lines.

END OF SECTION

SECTION 03 60 00

PRECISION GROUTING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Provided all labor, material, equipment and services required for grouting of equipment, machinery, structural steel, handrails, anchor bolts and other items or work for which grouting is specified or required. All unnecessary holes, openings and cracks in existing concrete shall be filled and patched.

B. The object of these Specifications is to obtain grout which can be mixed to a flowable consistency (i.e., thinner than plastic consistency), placed in leakproof forms, with a minimum of strapping, without bleed water exceeding specification requirements. The requirement of 24-hour presoak of existing concrete is of prime importance and must be adhered to.

1.02 DESCRIPTION OF WORK

A. High strength, precision support of machine bases and soleplates, setting anchor bolts.

B. Work includes providing a non-shrink, ready-to-use, fluid precision grout material; proportioned, pre-mixed and packaged at the factory; delivered to the job site to place with only the addition of water; forming, placing and curing as specified in this section.

1.03 RELATED WORK

A. SECTION 033000 – CAST-IN-PLACE CONCRETE.

B. Review all divisions and sections for equipment, machinery and other items to be grouted.

1.04 QUALITY ASSURANCE

Comply with the following codes, standard, test and recommended practices for foundation concrete as apply to precision grouting.

A. ACI 304 "Guide for Measuring, Mixing, Transporting and Placing Concrete".

B. ACI 305 "Hot Weather Concreting".

C. ACI 306 "Cold Weather Concreting".

D. ACI 347 "Guide to Formwork for Concrete".

E. ASTM C-91 - Standard Test Method for Time of Set of Hydraulic Cement by Vicat Needle.

F. ASTM C-827 - Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.

G. Manufacturer's Information on Use of Grout.

H. Corps of Engineers CRD C-621 Corps of Engineers Specification for Nonshrink Grout.

I. ASTM C 109 "Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.

1.05 SUBMITTALS

A. The Contractor shall submit to the Engineer prior to installation, manufacturer's literature and certified test data that material complies with the requirements of these specifications.

PART 2 - PRODUCTS

2.01 GROUT

Cement-based grouts must have a minimum 15-year history of use and meet the following performance requirements at maximum water content. They must not contain expansive cement or metallic particles such as aluminum powder or iron fillings.

A. Plastic Volume Change: The grout shall show no shrinkage (0.0%) and a maximum 4.0% expansion from time of placement until final set when tested according to ASTM C-827.

B. Hardened Volume Change: The grout shall show no shrinkage (0.0%) and a maximum 0.2% expansion in the hardened state when tested according to CRD C-621.

C. Compressive Strength: The grout shall show a minimum of 28-day compressive strength of 5,000 psi when tested according to ASTM C 109, restrained.

D. Creep: The grout shall show creep equal to or less than .6 in./in. x 10^{-3} at 70EF for a minimum of one year when tested according to CPR Creep Test (extrapolated data is not acceptable).

E. Working Time: The grout shall show a consistency greater than 125% for a minimum 45 minutes when tested according to applicable consistency sections of ASTM C 827 at 15 minutes intervals.

F. Tests: Upon request of the Engineer, the Cylinder Plate Test shall be run on any field shipments.

2.02 WATER

A. Water shall be potable.

PART 3 - EXECUTION

3.01 INSPECTION

A. Inspect concrete surfaces to receive grout and verify that they are free of ice, frost, dirt, grease, oil, curing compounds, paints impregnations and all loose material or foreign matter likely to affect the bond or performance of the grout.

B. Newly placed concrete shall have been placed and cured sufficiently to attain its design strength.

C. Inspect baseplates for rust, oil, and other deleterious substances.

3.02 PREPARATION

A. In order to ensure proper bond to the baseplate and the concrete, all grease, oil, dirt, curing compounds, laitance and other deleterious materials must be completely removed from the concrete and bottom of baseplate.

B. Roughen the surfaces by chipping, sandblasting or other mechanical means to assure bond of the grout to the existing concrete. Loose or broken concrete shall be removed.

C. After concrete surfaces have been washed clean, they shall then be saturated with water for 24 hours prior to placement of cement-based grout.

D. Upon completion of saturation period excess water shall be removed with clean compressed air prior to grouting.

E. Formwork shall be compatible with proposed method of placing grout. Design for rapid, continuous and complete filling of space to be grouted.

1. Build strong, tight forms braced so they will not leak or buckle under weight of fluid grout. On placing side, slant form at 45 degrees angle and pour grout directly on slanted face. On other sides, place form and pour grout directly on slanted face. On other sides, place form 1/2" or more from edge of baseplate and 1" or more higher than underside of the plate.

2. Caulk forms with grouting material being used on inside or a sand-cement mortar outside to prevent leakage and loss of "head". Use expanded polystyrene or other means to caulk between foundation and portions of the baseplate and equipment to seal off areas where grout is not desired.

3.03 INSTALLATION

A. Preparation of grout shall be in paddle-type mortar mixer suitable mechanical mixer. DO NOT MIX BY HAND. Mix according to the manufacturer's recommendations.

B. Mix grout adjacent to area being grouted, have sufficient manpower and equipment available for rapid and continuous mixing and placing. Do not add cement, sand or pea gravel, additives.

C. Avoid a consistency that produces bleeding. Mix materials for a minimum of 3 minutes and not more than 5 minutes and place immediately. Do not retemper. Do not use mixing water with a temperature above 80 degrees F (27 degrees C).

D. Grout shall be placed under environmental conditions acceptable to manufacturer's standards for the product.

E. Placing: Grout may be drypacked, flowed, vibrated or pumped into place. All grouting shall take place from one side of the plate to the other to avoid trapping air.

F. Cutback: Just before the grout has reached its final set, the grout shall be cut back to the lower edge of the bearing or column base plate. A 45-degree angle or vertical cutback shall be used.

G. Curing: The grout shall be kept moist for a minimum of three days. The method needed to protect the grout will depend on temperature, humidity and wind. Wet burlap, a soaker hose, sun shading, ponding and in extreme conditions a combination of methods shall be employed.

H. Field service representative of the manufacturer shall be available during initial planning for installation to suggest recommended procedures and at start of placement for further suggestions. A minimum of three (3) days notice shall be given by the Contractor to the manufacturer prior to use of the product.

-- END OF SECTION --

DIVISION 27

DATA COMMUNICATION

SECTION 272100

DATA COMMUNICATIONS NETWORK EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Description of Work

The work to be accomplished under this section shall consist of furnishing the equipment necessary for a complete control system to function as specified herein and as shown on the drawings.

B. Scope of Work

The Contractor shall furnish and install all materials, labor, tools, equipment, supplies and services required to furnish and/or modify the existing system for a complete, stand alone INSTRUMENT & CONTROL/SUPERVISORY CONTROL AND DATA ACQUISITION (I&C/SCADA) system. Contractor to provide a system to operate within the existing SCADA system in operation of the OWNER.

C. System Integrator Shall Supply:

1. Shop drawings prior to installation.
2. All the paper works and fees necessary to obtain a license in the name of the Owner.
3. All labor for installation and start-up of the system.
4. All equipment required by schedule.
5. All ancillary equipment, hardware, software, and appurtenances needed for proper installation and operation of equipment.
6. Provide spare parts and maintenance tools as described below.
7. Operations and maintenance manuals as detailed below.
8. 120VAC power at all sites.
9. Pressure sensing taps for all sensing points in the system.
10. Meter pits for sensing tank levels or line pressures in the system

D. Owner Shall Supply:

1. Access and easements as needed for all sites.

1.02 QUALITY ASSURANCES

A. Manufacturer’s Qualifications

The system specified herein shall be the product of a manufacturer who can demonstrate at least ten (10) years of satisfactory experience in furnishing and installing comparable radio telemetry/control systems for water and wastewater installations.

The manufacturer of this system shall maintain a 24-hour available inventory of all replaceable modules to assure the Owner of prompt maintenance service and a single source of responsibility. The manufacture and shall certify this to the Engineer in writing at the time of bidder pre-qualification.

B. Prebid Approval

All “unapproved” manufactures are required to submit a pre-bid per SECTION 012500 – PRODUCTS AND SUBSTITUTIONS. Submissions that fail to include a complete submittal as detailed shall be deemed unresponsive. The Consulting Engineer and the Owner shall be the sole judge as to whether the alternate equipment is considered an approved equal. Approval of an alternate system by the Engineer will not relieve the alternate system of strict adherence to these specifications. The pre-bid submittal shall include the following:

1. Block diagrams for the various sites in the proposed system,
2. Sample electrical drawings for typical sites
3. A product performance data sheet shall be included for each proposed component in the system (i.e. antennas, radios, coaxial cables & arrestors, remote unit equipment, central terminal unit equipment, power supplies, time delays and relays, and the various sensors required).
4. Radio path study for each radio path in the system.
5. An installation list with the names and phone numbers of both the Owner and Consulting Engineer for at least ten projects of similar size and complexity.
6. A "statement of compliance" detailing paragraph by paragraph his compliance or exceptions to these specifications.

Bidders shall satisfy themselves that the necessary radio frequency can be obtained. The radio path study provided by each bidder shall utilize either:

1. Computer generated techniques utilizing USGS terrain information to plot the path profiles for each radio path with elevation samples not more that 2000-foot increments.

2. Actual field measurements to determine the necessary antenna heights, transmitter power, and antenna gains required to insure a 20db fade margin as detailed in Section 2.02 of these specifications.

   A physical path analysis shall be made using temporary equipment installations and an IFR 1000 or equal equipment to measure actual path margins. The bidder shall include in his bid, all the calculations used to extrapolate the measured data. The bidder is expected to obtain the necessary temporary FCC license for the study.

C. Codes & Standards

The control system and its components shall comply will all applicable requirements of the following:

1. Electrical Code Compliance (National & Local)
2. NEMA Compliance
3. IEEE Compliance
4. EIA Compliance
5. FCC Compliance

D. System Integrator

The equipment shall be as supplied by Micro-Comm, Inc of Olathe, Kansas. This is the equipment now used by the district throughout their entire system.

1.03 SUBMITTALS

Complete submittal shall be provided to the engineer for approval prior to equipment fabrication.

The submittal data shall include the following:

A. Product Data

Provide product data sheets for each instrument and component supplied in the system. The data sheets shall show the component name as used on reference drawings, manufacturer's model number or other product designator, input and output characteristics, scale or ranges selected, electrical or mechanical requirements, and materials compatibility.

B. Shop Drawings

Provide drawings for each panel showing the wiring diagrams for control circuits and interconnections of all components. The drawings shall include wiring diagrams for all remote devices connected to the panel.

C. Panel Layout Drawings

A front panel and sub-panel layout shall be included as part of each control panel drawing. Components shall be clearly labeled on the drawing.

D. Installation Drawings

Typical installation drawings applicable to each site in the system shall be included.

1.04 MAINTENANCE INFORMATION

A. Maintenance Data Manuals

Submit maintenance manuals and "as built" drawings on all items supplied with the system. The manuals and drawings are to be bound into one or more books as needed. In addition to "as built" engineering submittal data and drawings, the manual shall include:

1. Trouble Shooting Guides.
2. Maintenance and calibration data for all adjustable items.

1.05 JOB CONDITIONS

All instruments and equipment shall be designed to operate under the environmental conditions where they are to perform their service. The equipment shall be designed to handle lightning and transient voltages as normal environmental hazards. The environmental conditions are as follows:

A. Outdoor

The equipment will be exposed to direct sunlight, dust, rain, snow, ambient temperatures from -20 to +120 degrees F, relative humidity of 10 to 100 percent, and other natural outdoor conditions. The installations shall be hardened to with stand normal vandalism.

B. Indoor

The equipment will be capable of operating in ambient temperatures of +32 to +130 degrees F and relative humidity of 20 to 100 percent.

1.06 DELIVERY, STORAGE & HANDLING

All items shall be stored in a dry sheltered place, not exposed to the outside elements, until ready for installation. All items shall be handled with appropriate care to avoid damage during transport and installation.

1.07 SEQUENCING & SCHEDULING

A. Coordination

The Systems Integrator shall coordinate with other electrical and mechanical work including wires/cables, raceways, electrical boxes and fittings, controls supplied by others, and existing controls, to properly interface installation and commissioning of the control system.

B. Sequence

Sequence installation and start-up work with other trades to minimize downtime and to minimize the possibility of damage and soiling during the remainder of the construction period.

PART 2 - PRODUCTS

2.01 DISTRIBUTED CONTROL OPERATION DESCRIPTION

A. General

The control system shall use "smart-programmable" Remote Terminal Units (RTUs) to provide a "distributed intelligence" type control system. The software programs used at all locations shall be stored in non-volatile EEPROM or Flash type memories that are field re-programmable using software detailed later in these specifications. The system shall be "self-initializing" and not require operator intervention after power interruptions, transients from lightning storms, or component changes. All units in the system shall include "watch-dog" circuitry to insure automatic restarts of the system. Each remote site in the system shall be assigned a unique digital address.

The control system shall support peer-to-peer (i.e. RTU to RTU) communications to provide completely automatic control. In the event a Central Unit is not in operation, the RTUs shall be capable of operation without software or hardware modifications. Each Water Tower remote shall be able to automatically communicate with its respective Booster Pump Station remotes with level data and discrete data. Each pump station remote shall be able to generate its own pump stop/start commands to maintain its water tower's level. All sites in the system shall have a "Telemetry Control" lamp to indicate that the site is functioning normally and in communication with the Central Unit or its respective water tower.

2.02 VHF (154-173 MHz) Radio Channel Data Operation

A. General

The control system shall be specifically designed for radio channel data communications. All of the equipment required for operation of the system shall be directly owned by the Owner and included as part of this contract. Systems using third party repeaters, trunking masters, or leased equipment will not be allowed.

B. Communications

The control system shall operate in a half-duplex mode over a single VHF (154 - 173MHz)

radio frequency using "point-to-point" communication techniques. The RTUs shall monitor for the channel to avoid data collisions with other RTUs during peer-to-peer communications. The system shall be capable of sharing the radio channel with other radio telemetry systems.

All data transmitted shall be in digital word form using FSK (frequency shift keying) transmission. All transmissions shall include the address of the sender and the receiver, and be subject to check sum, parity, and framing error checks, to insure a minimum data reliability of 1 error in 1,000,000,000 bits. Any transmissions that fail the data checking will be retried until correct. No data correction methods will be allowed. A plug-in RS232C data port shall be provided at all locations in the system to allow the use of a standard data terminal to view data exchanges between the sites and to provide a means of extensive de-bugging.

The system shall provide a complete data update at least once every (2) minutes with some functions updating faster as required by local system conditions.

C. Radio Channel Operation

The system shall be capable of operation on the narrow band splinter frequencies of the Private Land Mobile Radio Services within the Federal Communications Commissions (FCC) rules and regulations regarding these telemetry channels. The manufacture shall guarantee operation under co-channel conditions with other radio systems without interference to this system. FSK tones, data baud rates, transmitter output power, transmitter deviation, antenna gain, and antenna height shall be chosen to comply with the FCC requirements Part 90 - Subpart 90.35 and 90.238 for the Industrial/Business frequency pools. The radio system shall specifically meet the operating requirement that the sum of the highest FSK frequency and the amount of deviation shall not exceed 1.7 kHz for 3F2 emission (or 2.8 kHz for 6F2 emission) as detailed by the FCC for the specific frequency assigned.

The overall system design and operation shall provide a 20db pad over the minimum required for operation on all primary data paths (primary paths may include data relays) to insure a 98% reliability of communications. Remote sites required to support peer-to-peer back-up control shall provide 30db of pad to ensure operation under all weather conditions and provide a 99.9% communications reliability. The 20db and 30db pad requirements and FCC rule compliance shall be demonstrated (at no additional cost) to the Engineer at his request. The testing shall be accomplished using an IFR AM/FM 1000S communications analyzer or equal equipment.

D. FCC Licensing

The system manufacturer/supplier shall be responsible for collecting all information, generating all paper work, and paying all fees required obtaining a license on behalf of the Owner.

2.03 Radio Transceivers & Accessories

A. General

The radio transceivers shall be standard "un-modified" mobile two-way that can be tuned, aligned, and repaired at any two-way radio shop. Interface to external data modems shall be through the front panel microphone jack. The radios shall be synthesized and fully field programmable and include a built-in time-out timer to disable the transmitter after 0-60 seconds. The units shall be tuned to FCC specifications for the specific frequency assigned. The radio equipment shall be FCC type approved and the system capable of

operation on the narrow band splinter frequencies (154 or 173MHz) in the Industrial/Business radio service.

B. VHF Radio Transceiver (154Mhz or 173Mhz)

The system manufacturer shall supply a 5-watt VHF radio transceiver to insure a high level of quality and reliability. The radios shall be adjustable to 4 watts output power as may be required by the FCC for ERP (Effective Radiated Power) restrictions. All connections to the radio shall be plug-in. The VHF radio transceiver shall have the following specifications:

Transmitter:

RF output power	5 watts minimum (adjustable to 4)
Spurs & Harmonics	16 dBm (25uW) (or –50dBc)
Frequency stability	±0.00025% (-30 to +60 degrees C)
Emission	6F2 (2.5kHz DEV max) or 3F2 (1.2kHz DEV max)
FM hum and noise	-40 dB

Receiver:

Sensitivity	.35uV @ 12 dB SINAD (.5uV @ 20db quieting)
Selectivity	-65 dB
Spurious image rejection	-50 dB
Intermodulation	-65 dB
Frequency stability	±0.00025% (-30 to +60 degrees C)
Receive bandwidth	*6kHz (or 3kHz) as required to match the transmitter

* The receiver bandwidth shall be reduced to match the transmit bandwidth of the transmitter and provide a minimum adjacent channel rejection of -50db.

The radio transceivers shall be Motorola Radius SM50-M33 or DTS.

C. Antenna & Coaxial Cable

The radio antennas at all locations shall be a five element Yagi, constructed with 3/8" diameter aluminum rod elements and 1-1/16” diameter aluminum pipe element support with a type N coaxial connector. The antenna shall have a minimum 8.0db forward gain with a 20.0db front-to-back ratio. The antenna shall be wind rated for a 100-MPH wind speed. The VHF antennas shall be MC-Yagi, Decibel Products DB292, or Celwave PD390S. The UHF antennas shall be MC-Yagi or Celwave PD688S.

Antennas shall be cabled to the transmitter enclosure connection by an RG/8U low loss (less than 1.8db per 100ft @ 100MHz) coaxial cable with cellular polyethylene (foam) dielectric. The coaxial cable shall have a braided copper shield coverage of 97% and a long-life weather resistant polyvinyl chloride jacket. The antenna coaxial cable connection shall be a constant impedance weatherproof Type N connector, taped with a weather resistant electrical tape to insure a lifetime watertight assembly. The coaxial cable shall be Belden 8214 or Amphenol TWB 4001 cable.

D. Antenna Lightning Protection

Coaxial connection to remote and central unit enclosures shall be by means of a coaxial type bulkhead lightning arrestor. The units shall be rated at 1 kilowatt with a minimum 500V and maximum 2000V-breakdown voltage. Coaxial lightning arrestors shall be a PD-593 or PolyPhaser IS-B50LN-C1.

E. Antenna Mounting Systems

Antennas shall be mounted at a height above ground that is consistent with FCC rules and regulations and provides adequate signal fade margin as described earlier. Antennas must be a minimum of 15 feet above ground and mounted as follows:

1. **Water Tanks:** The antenna shall be mounted on the ladder or the water tower catwalk railing at a height consistent with FCC requirements. The coaxial cable shall be secured to the ladder or obstruction lighting conduit. A 3/4" rigid conduit with a weather-head shall be provided from the transmitter to the ladder on the tower.

2. **Antenna Tower:** A bracketed antenna tower shall be supplied at the booster pump station, lift station, meter vault, valve vault locations. The tower shall be assembled from 10' sections built on a 18" equilateral triangle design. Tower sections shall be constructed of 1-1/4" steel tubing with continuous solid steel rod "zigzag" cross bracing electrically welded to the tubing. The entire 10' sections shall be Hot-Dip Galvanized after fabrication for long life. The antenna tower shall be a 50’ in height or at an adequate height to provide reliable communication.

2.04 Instrumentation & Accessories

A. General

All items in the control system (electronic cards, power supplies, radios, time delays, relays, etc.) shall be of plug- in construction, make use of a plug-in wiring harness, use plug-in terminal blocks, and be interchangeable without recalibration. To ensure field repair-ability by non-technical personnel, equipment that must be un-wired for replacement will not be accepted.

The following instrumentation devices and techniques shall be used as specifically called for in the RTU input/output sections of this specification.

B. Power Supplies

The DC power supplies shall provide ±0.1% line and load regulation with ±10% input variations. They shall have a temperature coefficient of ±0.02% per degree C. The input/output isolation shall be 100 Mohms DC (900Volts AC) with output transient response of 50 microseconds maximum. The power supplies shall be sized to operate the remote unit equipment with or without the back-up battery in place. Power Supplies shall be a Power One Series MAP130, Sola SLS.

C. Battery Back-up Operation

The remote units indicated shall be supplied with battery back-up operation. The rechargeable batteries shall be the sealed solid gelled electrolyte types, designed for float or standby service. Unless noted otherwise in the RTU descriptions, batteries shall be sized to maintain 24-hour service at water tower remotes and 8-hour service at booster pump stations and other remotes. The remote shall include a charging module to recharge the battery when power is resumed, maintain the charge between outages, and provide a low voltage cut-off to protect the battery from excessive discharge during prolonged outages. All discrete, analog, and pulse inputs (i.e. switch closures, pressure, level, flows, etc.) shall continue to function on battery back-up. Batteries shall be Globe Gel/Cell.

D. Single Phase 120VAC Power Line Lightning Protection

Every site in the system shall be equipped with AC line filtering and lightning protection. The equipment shall provide 2-stage lighting/transient protection including inductive and capacitive filtering and MOV over-voltage protection.

E. Alternative Power Supply – Solar Panels

The CONTRACTOR shall install a solar panel(s) to provide adequate power to operate RTU in lieu of running new 120VAC electric line with written approval from OWNER & ENGINEER. The Solar Panel(s) shall have the ability to operate for a minimum of 10 days with heavily overcast conditions.

The Solar Panel(s) shall be installed on an adjustable (15° to 75°) aluminum frame mounted on the tank or service pole (provided by CONTRACTOR). Stainless Steel mounting hardware shall be supplied. The Solar Panel(s) shall be designed to withstand up to 100 mph winds and ambient temperatures of -20° to 140° F. Solar Panel(s) shall have proper lightening protection.

1. The solar equipment shall have the following specifications:

SOLAR CELLS	
Voltage	15VDC @ 2 amps
Nominal Rated Power	90W or as needed for the RTU
Conversion Efficiency	At minimum 15%
BATTERIES	
Storage Capacity	10 days of operation during heavily overcast conditions.
Type	Marine deep charging
Recharge Time	Shall not exceed 72 hours (Low voltage cut out to full charge)

F. Time Delays & Relays

All hardware time delays used in the system shall be of plug-in construction with DIN rail mounted sockets and have pilot duty contacts rated for 3 amps resistive @ 240VAC (or 0.8 amps inductive) loads. The time delays shall have switch selectable ranges from .1-1c, .2-10, 1.2-60, and 12-600 seconds. The time delays shall provide a ±0.2% repeat accuracy. The time delays shall have both "timing" and "timed" LED indicators. Time delays and relays shall be IDEC series GT5Y and RY4S.

G. Level & Pressure Transducers

Level & pressure transducers shall be of the all solid-state two-wire transmitter type with a 4-20mA output from a 10.5-24VDC excitation. The units shall be powered from the RTU power supply. The transducers shall have a combined error (linearity and hysteresis) of ±0.25% full scale and be temperature compensated to ±2.5% per 100 degrees Fahrenheit. Zero and span adjustments shall be standardized so that transducers are interchangeable without recalibration. All exposed or wetted parts shall be series 316 stainless steel, PVC, or Buna-N. The units shall be capable of a three times full scale over pressure with-out damage or change of calibration.

The transducers shall be mounted at the sensing point and wired to the enclosure. The transducers shall have a 1/4" or 1/2" NPT process pressure connection. Transducers for above ground mounting shall have a 1/2" conduit connection for cable entry. Transducers at water towers (and other outside locations) shall be mounted below grade and below frost line to prevent freezing. Below grade mounted units shall have factory signal cabling and be suitable for a minimum of 100' submerged duty.

Level transducers for clear-wells and wet-wells shall be suspended in the clear-well or wet-well and supplied with sufficient factory installed cable to access a "clean/dry area" junction box. The suspension cable shall have a polyethylene jacket and internal venting to provide

for atmospheric sensing of the non-process side of the diaphragm. The sensors shall have a multi-ported pressure-sensing end that protects the diaphragm while sensing the level of viscous liquids or slurries. The cable connection in wet-well applications shall have a non-fouling guard to prevent buildup of foreign materials.

Pressure/Level transducers shall be Micro-Comm L5N series, Consolidated A300 Model 221GEE, or Ametek Model 57S.

H. Entry Alarm

Unauthorized entry alarms at remote sites shall be accomplished through a perimeter alarm system powered from the common 12VDC-power supply. The system shall include the necessary structure entrance magnetic door switches. Should an intruder enter the structure without acknowledging his presence, an entry alarm will be sent to the Central Unit. The entry alarm shall have an adjustable time delay (0-60 seconds) to allow authorized personnel time to acknowledge their presence when entering the structure and provide a re-arming delay when leaving the structure. The RTU door mounted key switch shall be constructed so that the key can only be removed in the "armed" position. The alarm system shall be Micro-Comm SEAS series, Tandy Safe House 49-450.

2.05 Remote Terminal Unit Equipment

A. General

The Remote Terminal Units (RTUs) shall be "smart" Programmable Logic Control units at all locations. The core software program used at all locations shall be identical and stored in non-volatile FLASH type ROM memories that can be upgraded in the field by the owner using configuration software supplied as part of this contract. The core RTU software shall provide the basic operational logic including communication with other sites in the system. In the event a CTU is add the RTUs shall respond to control commands from the CTU, and provide back-up peer-to-peer control in the event of a CTU failure.

Program and configuration data shall normally be stored in battery-back or flash type memory for use by the CPU. In addition, this data shall also be stored in a plug-in operator interchangeable EEPROM memory module. This module shall be fully enclosed with no exposed electrical leads, similar to the Allen-Bradley M11 memory module, providing protection against damage due to handling and static electricity. The module shall be programmed via the CPU and without the use of external adapters. The RTUs shall include "watch-dog" circuitry and be "self-initializing" without operator intervention. In the event that the program or configuration data is corrupted, the CPU shall reload the program and configuration data from the EEPROM memory module.

The RTUs shall be fully online programmable while the RTU continues to communicate with the rest of the system and performs its assigned control tasks. The RTUs shall support “fill-in-the-blank” type configuration for basic operation and to set-up common features such as COM port set-up, peer-to-peer data collections, local back-up control set points, input and output setup, output on/off time delay settings, front panel display setup, etc. The RTU shall also support a process script language or ladder logic type programming for site-specific customizations including special input and output manipulations, local sequential control, and math functions. The RTU shall support both mathematical and PID control algorithms. Both the fill-in-the-blank configuration and programming shall be stored in the operator removable program module.

The supplier shall provide a licensed copy of the RTU configuration and programming software along with the necessary communications cables to the owner. The software shall be Windows 95/98/NT compatible. Training on the use of the software shall be

provided as part of the system training.

B. Construction

The RTU shall use modular construction. The base unit shall be composed of the power supply, CPU, communications modules, and basic inputs and outputs. The unit shall have expandable inputs and outputs via either a card rack design or integrated high-performance serial I/O bus. All terminations on the RTU or expanded I/O shall use removable, NEMA-style “finger-safe” terminal blocks on the controller and I/O.

The RTU shall be capable of being powered from AC, DC, or solar sources. DC and solar powered RTUs shall have an integral battery charging circuit that protects the external battery from over and under voltage conditions and provides automatic charging of the battery after power failures. The back-up power supply shall provide for the necessary 12VDC to run the radio and 24VDC to power external sensors while on battery power or recharging. Back-up batteries shall be rechargeable sealed lead-acid type batteries as manufactured by PowerSonic or equal. The back-up battery shall provide for 24 hours of back-up operation at water tower remote units and 3 hours at all other sites.

The RTU shall support multiple communications ports. The first shall be used primarily for CTU-RTU and RTU-RTU communications. It shall support baud rates of 110-9600 baud and have a plug-in standard 25 pin sub-D connector that provides both full RS232 interface and radio modem interface for use with either "data" radios or standard business band type radios (i.e. radios without internal modems). This port shall also have a 9 pin sub-D connector to allow monitoring of the communications activity. The second communications port shall provide for multi-drop type communications with operator interfaces, external inputs and outputs (I/O), and programming terminals. The port shall provide for both 2 and 4 wire RS485 interface with data rates to 9600 baud. The communications ports shall include LED’s to show the status of all control lines.

The RTU shall provide for sufficient installed and configured spare inputs and outputs (I/O) to meet the site requirements as detailed and provide for 25% spares of each type. The unit shall have a minimum of 8 discrete inputs (DI), (4) analog inputs (AI), and (1) high speed pulse input (PI). The analog and pulse inputs shall provide for sensor excitation with separate fuses for each input. The fuses may be the self-resetting type. The RTU inputs, outputs, and operator interface shall be as follows:

1. **Discrete Outputs -** The discrete outputs shall be isolated relay outputs rated at 5.0A continuous @ 240VAC. LEDs on the front of the RTU base unit or expansion module shall indicate the status of each output point. Interposing relays shall be provided if the voltage or current of the external load on a contact exceed the 5.0A 240VAC ratings. Each output shall be provided with operator settable software ON and OFF time delays

2. **Discrete Inputs -** The discrete inputs shall be optically isolated and provide for 24VDC excitation to remote sensors and switches. LEDs on the front of the input module shall indicate the status of each input point.

3. **Analog Inputs -** The analog inputs shall provide filtered and scalable analog to digital conversion of input signals. The analog inputs shall be switch selectable from 0-5VDC to 0-20mADC and provide a minimum of 0.3% resolution and 0.5% accuracy over the temperature range of 0-70degrees C. The RTU shall provide separately fused 24VDC excitations to the remote sensors.

4. **Analog Outputs -** The analog inputs shall provide a 0-5VDC signal to RTU panel mounted devices or 4-20mA isolated signals if sent to other panels as specified.

5. **Pulse Inputs** - The high-speed counter/pulse inputs shall provide for pulse rates up to 1KHz direct from flow meter transmitter heads without interposing equipment. The pulse input shall include fused 12VDC excitation to the meter transmitter.

6. **Power Supply -** Each RTU assembly shall include an integral power supply. Power supplies shall be designed for 12VDC or 24VDC input power and suitable for use in battery back-up operations.

7. **Keypad & Display Unit -** The optional keypad & display unit shall have a 4x20 back-lighted LCD display to display the status of all local inputs and the tank level of the associated control water tower level. The 5x5 keypad shall provide for operator input of set points and timer settings. The operator interface shall be menu driven and provide for dedicated keys for cursor position and input functions. The operator interface shall provide for up to 50 screens of data display. The keypad & display unit shall be supplied and mounted on the front of the RTU enclosure if detailed in the specific RTU I/O requirement list. The keypad & display unit shall maintain the Nema 4 rating of the RTU enclosure.

C. Enclosures

The remote unit enclosures for indoor mounting shall meet all the requirements for NEMA Type 12 enclosures. The enclosures body shall be made of a minimum 14-gauge steel with continuously welded seems and be furnished with external mounting feet. The enclosure door shall be made of a minimum 16-gauge steel with have a 14-gauge steel hinge. Enclosures larger than 16x14 shall have a rolled lip on 3 sides of the door for added strength. The door opening shall have a rolled edge on 4 sides to protect the door gasket. The door gasket shall be heavy neoprene and attached to the door with oil resistant adhesive. Sub-panels shall be 14-gauge steel for 16x14 enclosures and 12 gauge for larger enclosures. The enclosure finish shall be gray polyester powder coating inside and out over phosphatized surfaces. The subpanels shall be finished in white. Nema 12 enclosures shall be Hoffman “CH” or “CONCEPT” wall mount enclosures.

Remote site installations requiring equipment to be mounted outside shall have a double box enclosure with the remote unit enclosure mounted inside a lockable NEMA 3R enclosure. The double enclosure shall be required to control vandalism, provide complete weather protection, reduce the heating effects of the sun, and prolong the life of the equipment. The NEMA 3R enclosure shall be constructed of 14-gauge galvanized steel, with a drip shield top and seems free sides front and back, and a stainless-steel hinge pin. The enclosure finish shall be gray polyester powder coating inside and out over phosphatized surfaces. The NEMA 3R enclosure shall be Hoffman Bulletin A-3.

The remote unit enclosures mounted in damp corrosive areas (such as concrete meter vaults) shall be NEMA Type 4X rated enclosures. The enclosures shall be made of molded fiberglass polyester and be furnished with external mounting feet. The door shall have a seamless foam-in-place gasket and corrosion-resistant hinge pin and bails. Sub-panels shall be 14-gauge steel for 16x14 enclosures and 12 gauge for larger enclosures. The enclosure finish shall be a light gray inside and out. The subpanels shall be finished in white. Nema 4X enclosures shall be Hoffman “Fiberglass Hinged Cover”.

D. Local Control Functions

In general, the RTU's shall be programmed to provide generic control functions as detailed earlier and to work in concert with the CTU. The integrator shall be responsible to meet with the owner and the engineer to develop the automatic control strategy required for the system.

PART 3 - EXECUTION

3.01 System Startup

The manufacturer shall supply "Factory" personnel for start-up service as needed to insure satisfactory operation. Subsequent trips to the job site to correct defects shall be made at no charge to the Owner during the warranty period.

3.02 Training

The system manufacturer shall supply "factory" personnel to conduct an on-site training session; a minimum of one day of training is required.

3.03 Substantial Completion

The Engineer will grant substantial completion only after completion of the start-up and initial training phase of the project. The Engineer shall make an inspection of the system to determine the status of completion. Substantial completion will be awarded only when the system is providing usable service to the Owner. If the system is commissioned in phases, the Contractor may request substantial completion for the completed phases.

3.04 Water Tower Requirements – NOT USED

3.05 Booster Station Requirements – NOT USED

3.06 Lift Station Requirements – NOT USED

3.07 Valve Vault Requirements – NOT USED

3.08 Meter Vault Requirements

The RTU panel and instruments shall be shipped to the job site for installation by the General/Electrical Contractor. The General/Electrical Contractor shall be responsible for the installation of the new RTU enclosure, all conduit and wiring to the associated devices, and all instrumentation installation. The General/Electrical Contractor shall be responsible for mounting a 10' long X 1-1/2" diameter mast secured to the side of the equipment rack or on a 20' power pole with 3/4" rigid conduit and a weather-head run to the RTU enclosure.

Supplier of RTU shall be responsible for all FCC licensing fees for adding this RTU to the SCADA system.

A. CTU Communications Method:

The CTU shall communicate with these RTUs via VHF radio communications as detailed previously.

B. Front Panel Display Requirements:

2. Keypad & Display assembly to display all inputs and output status

C. Discrete Outputs:

3. Valve CALL (Valve provided by valve supplier)

4. (4) Spares

D. Discrete Inputs:

5. Valve Open/Close Indication (Valve limit switches provided by valve supplier)
6. Valve Vault Flooding (Float switch provided by Micro-Comm)
7. Power Failure
8. (8) Spares

E. Analog Inputs:

3. Flow Rate/Total (4-20mA signal from Flow meter supplied by others)
4. (4) Spares

F. Pulse Inputs

2. Flow Rate/Total (pulse signal from Flow meter supplied by others)

3.09 Central Unit Modifications

The Proposed RTU(s) information to be added to the existing Central Unit. The new RTU(s) site information shall be displayed, monitored and controlled via the existing SCADA view software program.

- END OF SECTION -

DIVISION 31

EARTHWORK

SECTION 311000

SITE CLEARING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Clear site within construction limits of plant life.

B. Remove grass and topsoil in area of access road and foundation.

C. Remove root system of trees and shrubs.

D. Remove surface debris

1.02 RELATED WORK

A. SECTION 312317 - Rock Removal.

B. SECTION 312213 - Rough Grading.

1.03 REGULATORY REQUIREMENTS

A. Conform to applicable local codes and ordinances for disposal of debris.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 CLEARING

A. Clear areas required for access to site and execution of work.

B. Remove trees, shrubs, brush, and other vegetable matter such as snags, bark, and refuse.

3.02 PROTECTION

A. The Contractor shall not cut or injure any trees or other vegetation outside the easement lines and outside the areas to be cleared, as indicated on the Drawings, without written permission from the Engineer. The Contractor shall be responsible for all damage done outside these lines.

3.03 GRUBBING

A. From areas to be grubbed, the Contractor shall remove completely all stumps, remove to a depth of at least 24 inches below subgrade elevation all roots larger than 1 1/2 in. in diameter, and remove to a depth of 12 in. all roots larger than 1/2 in. in diameter. Such depths shall be measured from the existing ground surface, the proposed finished grade or subgrade, whichever is lower.

3.04 STRIPPING

A. All stumps, roots, foreign matter, topsoil, loam, and unsuitable earth shall be stripped from the ground surface. The topsoil and loam shall be utilized insofar as possible, for finished surfacing. Loam shall not be taken from the site.

3.05 DISPOSAL

A. All material resulting from clearing and grubbing and not scheduled for reuse or stockpiling shall become the property of the Contractor and shall be suitably disposed of off site, unless otherwise directed by the Engineer, in accordance with all applicable laws, ordinances, rules and regulations.

B. Such disposal shall be performed as promptly as possible after removal of the material and shall not be left until the final period of cleaning up.

3.06 FENCES

A. Wherever fences need to be removed to provide access to the work or are damaged during the progress of work, they shall be restored or repaired to as good a condition as existed prior to construction at the Contractor's expense.

-- END OF SECTION --

SECTION 311400

STRIPPING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This Section includes the requirements for stripping designated area(s) as shown on the Contract Drawings. The work shall consist of the excavation and removal of all topsoil, organic and other unsuitable matter at the location(s) and to the stripping limits required by the work shown on the Contract Drawings.

1.02 REFERENCES

Not Used.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

A. The area(s) designated for stripping shall be stripped to a depth of six (6) inches.

B. Stripped material shall be stockpiled at designated areas for later use or removed from the site.
Stripped material stockpiles shall be enclosed by silt fence.

C. Objectionable materials encountered during the stripping operation shall be removed from the site and be legally disposed of.

D. The Contractor shall be responsible for compliance with all Federal, State and local laws and regulations relative to disposal by removal, and for obtaining all necessary permits and payment of fees for removal or disposal.

- END OF SECTION -

SECTION 312000

EARTHWORK

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Extent of earthwork is indicated on the Drawings.

1. Preparation of subgrade for pavements is included as part of this work.

2. Engineered fill for support of building or basin slabs is included as part of this work.

3. Backfilling of tanks, basins, basements and trenches within building line is included as part of this work.

B. Excavation for Mechanical/Electrical Work: Excavation and backfill required in conjunction with underground mechanical and electrical utilities, and buried mechanical and electrical appurtenances is included as work of this Section.

C. Definition: "Excavation" consists of removal of all material encountered to subgrade elevations and subsequent disposal or reuse of materials removed.

1.02 REFERENCES

A. Materials and installation shall be in accordance with the latest revisions of the following codes, standards, and specifications, except where more stringent requirements have been specified herein:

1. American Society for Testing and Materials (ASTM)

a. A328 Specification for Steel Sheet Piling

b. D698 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3) (600 kN-m/m^3)

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

d. D1760 Specification for Pressure Treatment of Timber Products

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

1.03 DEFINITIONS

A. Excavation (or Trenching)

1. Grubbing, stripping, removing, storing and re-handling of all materials of every name and nature necessary to be removed for all purpose’s incidental to the construction and completion of all the work under construction.

2. All sheeting, sheet-piling, bracing and shoring, and the placing, driving, cutting off and removing of the same.

3. All diking, ditching, fluming, coffer-damming, pumping, bailing, draining, well pointing, or otherwise disposing of water.

4. The removing and disposing of all surplus materials from the excavations in the manner specified.

5. The maintenance, accommodation and protection of travel and the temporary paving of highways, roads and driveways.

6. The supporting and protecting of all tracks, rails, buildings, curbs, sidewalks, pavements, overhead wires, poles, trees, vines, shrubbery, pipes, sewers, conduits or other structures or property in the vicinity of the work, whether over- or underground or which appear within or adjacent to the excavations, and the restoration of the same in case of settlement or other injury.

7. All temporary bridging and fencing and the removing of same.

B. Earth

1. All materials such as sand, gravel, clay, loam, ashes, cinders, pavements, muck, roots or pieces of timber, soft or disintegrated rock, not requiring blasting, barring, or wedging from their original beds, and specifically excluding all ledge or bedrock and individual boulders or masonry larger than one-half cubic yard in volume.

C. Backfill

1. The refilling of excavation and trenches to the line of filling indicated on the Contract Drawings or as directed using materials suitable for refilling of excavations and trenches; and the compacting of all materials used in filling or refilling by rolling, ramming, watering, puddling, etc., as may be required.

D. Spoil

1. Surplus excavated materials not required or not suitable for backfills or embankments.

E. Embankments

1. Fills constructed above the original surface of the ground or such other elevation as specified or directed.

F. Limiting Subgrade

1. The underside of the pipe barrel for pipelines

2. The underside of footing lines for structures

G. Excavation Below Subgrade

1. Excavation below the limiting subgrades of structures or pipelines.

2. Where materials encountered at the limiting subgrades are not suitable for proper support of structures or pipelines, the Contractor shall excavate to such new lines and grades as required.

1.04 RELATED WORK

A. Dewatering is included in elsewhere in this specification.

B. SECTION 312500 – EROSION & SEDIMENTATION CONTROLS.

C. DIVISION 32 – EXTERIOR IMPROVEMENTS

D. DIVISION 33 – UTILITIES.

1.05 QUALITY ASSURANCE

A. Codes and Standards: Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

B. Testing and Inspection Service: The Owner shall engage the services of a qualified geotechnical engineering, inspection, and testing firm for quality control testing during earthwork operations.

1.06 SUBMITTALS

A. Test Reports - Excavating: Copies of all test reports and field reports shall be made available to the Owner and the Engineer.

B. The Contractor shall provide access to site areas, borrow pits and other areas for testing. The Contractor shall also indicate the need for tests to be performed. The Contractor may prepare any tests necessary for the conduct of his work.

1.07 JOB CONDITIONS

A. Site Information:

1. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that the Owner will not be responsible for interpretation or conclusions drawn therefrom by Contractor. Data are made available for convenience of Contractor.

2. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.

3. A geotechnical investigation has been carried out at the site and a report is available upon request. The Contractor shall obtain a copy of this report and shall read, understand follow all the recommendations and requirements contained therein.

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

C. Use of Explosives: SEE SECTION 02228

D. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.

1. Operate warning lights as recommended by authorities having jurisdiction.

2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS - DEFINITIONS

A. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, natural or crushed sand.

B. Drainage Fill: Washed, uniformly graded mixture of crushed stone or crushed gravel conforming to No. 57 of Kentucky Department of Highways Standard Specifications.

C. Backfill and Non-Structural Fill Materials: Satisfactory soil materials free of debris, waste, frozen materials, vegetable, and other deleterious matter. No. 57 stone is also used as backfill material at selected structures.

D. Granular Structural Fill: Granular structural fill shall be used in areas where indicated in this specification. Granular structural fill shall consist of a crushed stone conforming to gradation requirements of Kentucky Department of Highways and having less than 5% passing the No. 200 sieve. Placing and compaction of the granular structural fill shall be in general accordance with Kentucky Department of Highways Standard Specifications and this specification.

2.02 FILTER FABRIC

A. Material shall be non-woven polyester or polypropylene geotextile having an equivalent opening size no finer than U.S. Standard Sieve No. 200 and no coarser than a U.S. Standard Sieve No. 140.

B. An acceptable product is Typar 3601 manufactured by the Dupont Corporation. Other equivalent products shall be submitted to the Engineer for review and approval prior to usage.

PART 3 - EXECUTION

3.01 EXCAVATION

A. Excavation includes excavation to subgrade elevations including excavation of earth, rock, bricks, wood, cinders, and other debris. All excavation of materials shall be included in the lump sum portion of the work and will be UNCLASSIFIED AND NO ADDITIONAL PAYMENT WILL BE MADE REGARDLESS OF TYPE OF MATERIAL ENCOUNTERED.

B. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be at Contractor's expense.

1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position, when acceptable to the Engineer.

2. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification.

3. All material which slides, falls or caves into the established limits of excavations due to any cause whatsoever, shall be removed and disposed of at the Contractor's expense and no extra compensation will be paid the Contractor for any materials ordered for refilling the void areas left by the slide, fall or cave-in.

C. Additional Excavation: When excavation has reached required subgrade elevations, notify the Geotechnical Engineer who will make an inspection of conditions. The surface of the excavated area shall be "proof rolled" with a loaded truck or other heavy construction equipment.

1. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavation deeper and replace excavated material as directed in writing by the Engineer.

2. Removal of unsuitable material and its replacement as directed will be paid on basis of Contract conditions relative to changes in work.

D. Stability of Excavations:

1. Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.

2. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

E. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross-braces, in good serviceable condition.

1. Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.

2. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.

3. Provide permanent steel sheet piling or pressure crested timber sheet piling wherever subsequent removal of sheet piling might permit lateral movement of soil under adjacent structures. Cut off tops as required and leave permanently in place. In the event the Owner directs the Contractor to leave shoring materials in place, the Owner will reimburse the Contractor for the reasonable cost of leaving such materials in place.

F. Dewatering: It is anticipated that dewatering may be required at excavations.

G. Material Storage:

1. Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.

2. Dispose of excess soil material and waste materials offsite at no additional cost to the Owner.

H. Excavation for Structures

1. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 feet and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.

2. In excavating for footings and foundations, take care not to disturb bottom of excavation. All loose material shall be removed from the excavation just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other work.

3. Protruding rock formations that would interfere with uniform footing bearing shall be removed such that the structure will bear upon uniform engineered fill at least 24 inches thick.

I. Excavation for Pavements: Cut surface under pavements to comply with cross-sections, elevations, and grades as shown.

J. Trench Excavation:

1. The Contractor shall include in his lump sum bid all trenching and backfill necessary for installation of all pipe as planned and specified. Trenching shall include clearing and grubbing of all trash, and debris encountered in the trenching. The Contractor shall dispose of such material offsite at no extra cost to the Owner.

2. All existing facilities shall be protected from danger or damage while pipelines are being constructed and backfilled, and from damage due to settlement of the backfill.

3. In the event any existing structure is damaged, repair and restoration shall be made at once and backfill shall not be replaced until this is done. Restoration and repair shall be such that the damaged structure is equal to or better than its original condition and can serve its purpose as completely as before. All such restoration and repair shall be done without extra cost to the Owner.

4. Trenches must be dug to lines and grades shown on the Drawings. Hand trenching may be required in areas where machine trenching would result in undue damage to existing structures and facilities.

5. Sheeting and shoring of trenches shall be provided at the expense of the Contractor where necessary to protect life, property and the new or existing structures from damage or to maintain maximum permissible trench widths at top of pipe. All necessary materials, including, but not limited to, sheeting, sheet piling, trench jacks, braces, shores and stringers, shall be used to hold trench wall. Sheeting and shoring may be withdrawn as the trenches are being backfilled, after backfill has been tamped over top of the pipe at least 18-inches. If removal before backfill is completed to surface endangers adjacent structures, such as buildings, pipelines, street paving, and sidewalks, then the sheeting and shoring shall be left in place until such danger has passed, and then pulled if practical. Voids caused by sheeting withdrawal shall be backfilled and tamped. If not withdrawn, sheeting shall be cut off at least 18-inches below final surface grade, so there is no obstruction at the ground level. In the event the Owner directs the Contractor to leave shoring materials in place, the Owner will reimburse the Contractor for the reasonable cost of leaving such materials in place.

6. Where subgrade of trench has insufficient stability to support the pipeline and hold it to its original grade, the Engineer may order stabilization by various means.

Exclusive of dewatering normally required for construction, and instability caused by neglect of the Contractor, the payment necessary for stabilization shall be negotiated.

7. The location of the pipelines and their appurtenances as shown are those intended for the final construction. However, conditions may present themselves before construction on any line is started that would indicate desirable changes in location. The Owner reserves the right to make reasonable changes in line and structure locations without extra cost, except as may be determined by extra units of materials and construction actually involved. The Owner is under no obligation to locate pipelines, so they may be excavated by machine.

8. The Contractor shall only have sufficient trench open ahead of the pipe laying work as necessary for the prosecution of the work, that day. Dig trenches to the uniform width required for the particular item to be installed, sufficiently wide to provide ample working room. Provide a minimum of 9" clearance on both sides of pipe or conduit.

   a. Excavate trenches to depth indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations. Beyond building perimeter, keep bottoms of trenches sufficiently below finish grade to avoid freeze-ups.

   b. Where rock is encountered, carry excavation 6-inches below required elevation and backfill with a 6-inch layer of crushed stone or gravel prior to installation of pipe.

   c. For pipes or conduit 3-inches or less in nominal size and for flat-bottomed, multiple-duct conduit units, excavate to subbase depth indicated or, if not indicated, then to 4-inches below bottom of work to be supported.

   d. For pipes or conduit 6-inches or larger in nominal size, and mechanical/electrical work indicated to receive subbase, excavate to subbase depth indicated or, if not otherwise indicated, to 6-inches below bottom of work to be supported.

   e. Except as otherwise indicated, excavate for exterior water piping (water, drainage) so top of piping is no less than 3-feet 6-inches below finish grade.

   f. Grade bottom of trenches as indicated, notching under pipe bells to provide solid bearing for entire body of pipe.

   g. Encase pipe with concrete (full encasement) where trench excavations pass within 18 inches of column or wall footings and which are carried below bottom of such footings, or which pass under wall footings. Place concrete to level of bottom of adjacent footing(s).

   h. Concrete is specified in Division 3.

   i. Do not backfill trenches until tests and inspections have been made and backfilling authorized by the Engineer. Use care in backfilling to avoid damage or displacement of pipe systems.

   j. For piping or conduit less than 3-feet 6-inches below surface of roadways, furnish and install steel casing pipe, minimum wall thickness of 5/16", of

sufficient diameter to carry the pipe or conduit to at least two feet beyond outside edge of pavement.

K. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F (1°C).

3.02 REMOVAL OF WATER

A. General

1. The Contractor shall at all times provide and maintain proper and satisfactory means and devices for the removal of all water entering the excavations, and shall remove all such water as fast as it may collect, in such manner as shall not interfere with the prosecution of the work or the proper placing of pipes, structures, or other work.

2. Unless otherwise specified, all excavations which extend down to or below the static groundwater elevations shall be dewatered by lowering and maintaining the groundwater beneath such excavations at all times when work thereon is in progress, during subgrade preparation and the placing of the structure or pipe thereon.

3. Water shall not be allowed to rise over or come in contact with any masonry, concrete or mortar, until at least 24 hours after placement, and no stream of water shall be allowed to flow over such work until such time as the Engineer may permit.

4. Where the presence of fine-grained subsurface materials and a high groundwater table may cause the upward flow of water into the excavation with a resulting quick or unstable condition, the Contractor shall install and operate a well point system to prevent the upward flow of water during construction.

5. Water pumped or drained from excavations, or any sewers, drains or water courses encountered in the work, shall be disposed of in a suitable manner without injury to adjacent property, the work under construction, or to pavements, roads, drives, and water courses. No water shall be discharged to sanitary sewers. Sanitary sewage shall be pumped to sanitary sewers or shall be disposed of by an approved method.

6. Any damage caused by or resulting from dewatering operations shall be the sole responsibility of the Contractor.

B. Work Included

1. The construction and removal of cofferdams, sheeting and bracing, and the furnishing of materials and labor necessary therefor.

2. The excavation and maintenance of ditches and sluiceways.

3. The furnishing and operation of pumps, well points, and appliances needed to maintain thorough drainage of the work in a satisfactory manner.

C. Well Point Systems

1. Installation

a. The well point system shall be designed and installed by or under the supervision of an organization whose principal business is well pointing and

which has at least five consecutive years of similar experience and can furnish a representative list of satisfactory similar operations.

b. Well point headers, points and other pertinent equipment shall not be placed within the limits of the excavation in such a manner or location as to interfere with the laying of pipe or trenching operations or with the excavation and construction of other structures.

c. Detached observation wells of similar construction to the well points shall be installed at intervals of not less than 50 feet along the opposite side of the excavation from the header pipe and line of well points, to a depth of at least 5 feet below the proposed excavation. In addition, one well point in every 50 feet shall be fitted with a tee, plug and valve so that the well point can be converted for use as an observation well. Observation wells shall be not less than 1-½ inches in diameter.

d. Standby gasoline or diesel-powered equipment shall be provided so that in the event of failure of the operating equipment, the standby equipment can be readily connected to the system. The standby equipment shall be maintained in good order and actuated regularly not less than twice a week.

2. Operation

a. Where well points are used, the groundwater shall be lowered and maintained continuously (day and night) at a level not less than 2 feet below the bottom of the excavation. Excavation will not be permitted at a level lower than 2 feet above the water level as indicated by the observation wells.

b. The effluent pumped from the well points shall be examined periodically by qualified personnel to determine if the system is operating satisfactorily without the removal of fines.

c. The water level shall not be permitted to rise until construction in the immediate area is completed and the excavation backfilled.

3.03 BACKFILL AND FILL

A. General:

1. All material to be used as backfill material shall be tested and approved by the Geotechnical Engineer prior to backfilling excavations.

2. With the exception of the organic and inorganic debris, and topsoil, the on-site soil removed from the excavations could be used as non-structural fill or backfill material provided the moisture content of the soil is within acceptable limits. However, offsite borrow material may be required for use as non-structural fill. The use of off-site borrow material shall not result in additional compensation for the Contractor.

3. Place acceptable backfill material in maximum 6-8" lifts (loose thickness) to required subgrade elevations, for each area classification listed below.

a. In excavations, use satisfactory excavated or borrow material.

b. Under slabs, use drainage fill material for a minimum depth of 6-inches. Below drainage fill use satisfactory excavated or borrow material.

B. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Acceptance of construction below finish grade.

2. Inspection, testing, approval, and recording locations of underground utilities.

3. Removal of concrete formwork.

4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.

5. Removal of trash and debris.

C. Compaction:

1. Control soil compaction during construction providing minimum percentage of density specified for each area classification indicated below.

a. Fill under slab-on-grade shall be compacted to 98% Standard Proctor Density, ASTM D698, at a moisture content between 2 percent below to 3 percent above the optimum moisture content.

b. Granular structural fill under foundation elements, i.e., footings and base slabs for tanks and basins shall be compacted to 98% Standard Proctor Density, ASTM D698, at a moisture content between 2 percent below to 3 percent above the optimum moisture content.

2. Moisture Control

a. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface or subgrade, or layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operations. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

b. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

c. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by dicing, harrowing, or pulverizing until moisture content is reduced to the optimum moisture for compaction.

3. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

D. Backfilling Trenches:

1. Backfilling shall be accomplished as soon as practical after pipe has been laid and jointing and alignment approved. Packing of crushed rock between joints shall be uniform and progress as the pipe laying progresses. This is in order to avoid danger

of misalignment from slides, flooding or other causes. The Engineer shall be given a maximum of 24 hours for inspection before backfilling.

2. The backfill over the pipe shall be in accordance with the details shown on the Drawings for bedding and backfilling pipe.

3. In case maximum permissible trench widths (as designated by the pipe manufacturer) are exceeded, the Contractor shall furnish crushed rock backfill to a minimum of 12-inches over the top of pipe at no extra cost to the Owner.

4. If additional earth is required for back filling, it must be obtained and placed by the Contractor.

5. In the case of street, highway, railroad, sidewalk and driveway crossings; or within any roadway paving; or about manholes, valve and meter boxes; the backfill must be mechanically tamped in not over 6-inch layers, measured loose. Alternate method of compacting backfill shall be used, if refill material is in large hard lumps (crushed rock excepted) which cannot be consolidated without leaving voids.

6. Where traffic on streets, driveways, railroads, sidewalks and highways requires temporary surfacing, backfilling shall terminate 4-inches below original ground level and 4-inches to 6-inches of dense graded aggregate shall be placed on the trench. Backfill shall be maintained easily passable to traffic at original ground level, until acceptance of project or replacement of paving or sidewalks.

7. The Contractor shall protect all sewer, gas, electric, telephone, water, and drain pipes or conduits from damage while pipelines are being constructed and backfilled, and from danger due to settlement of trench backfill.

8. No extra payment shall be made for backfilling of any kind, except as specified hereinbefore. Backfilling shall be included as a part of the lump sum bid. No extra payment will be made to the Contractor for supplying outside materials for backfill.

9. On completion of the project, all backfill shall be dressed; holes filled; and surplus material hauled away. All permanent walks, street paving, roadway, etc., shall be restored and repaved to match existing pavement thickness over a width equal to the trench width plus 2 feet. A compacted subbase of 12" of KDOT DGA crushed stone with less than 5% passing the No. 200 sieve shall be added under concrete pavements (10" under asphalt concrete pavement).

3.04 GRADING

A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.

B. Grading Outside Building Lines:

1. All materials used for backfill around structures shall be of a quality acceptable to the Engineer and shall be free from large or frozen lumps, wood and other extraneous material. All spaces excavated and not occupied by footings, foundations, walls or other permanent work shall be refilled with earth up to the surface of the surrounding ground, unless otherwise specified, with sufficient allowance for settlement. In making the fills and terraces around the structures, the

fill shall be placed in layers not exceeding 8-inches in depth and shall be kept smooth as the work progresses. Each layer of the fill shall be compacted. Sections of the fill immediately adjacent to buildings or structures shall be thoroughly compacted by means of mechanical tamping or hand tamping as may be required by the conditions encountered. All fills shall be placed so as to load structures symmetrically.

2. As set out hereinbefore, rough grading shall be held below finished grade and then the topsoil, which has been stockpiled, shall be evenly spread over the surface. The grading shall be brought to the levels shown on the Drawings. Final dressing shall be accomplished by hand work or machine work, or a combination of these methods as may be necessary to produce a uniform and smooth finish to all parts of the regrade. The surface shall be free from clods greater than 2-inches in diameter. Excavated rock may be placed in the fills, but it shall be thoroughly covered. Rock placed in fills shall not be closer than 12-inches from finished grade.

3. Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes, and as follows:

   a. Walks: Shape surface of areas under walks to line, grade, and cross-section, with finish surface not above or 1.0 inch below required subgrade elevation.
   b. Pavements: Shape surface of areas under pavement to line, grade, and cross-section, with finish surface not more than 1.0 in. below required subgrade elevation.

C. Grading Surface of Fill Under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1.0 in. above or 1.0 in. below required subgrade elevation when tested with a 10-ft. straightedge.

D. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or standard proctor density for each area classification.

E. Slope Protection and Erosion Control: Conform to the requirements of Section 02270 for permanent slope protection and erosion control.

3.05 FIELD QUALITY CONTROL

A. Quality Control Testing During Construction:

1. Allow the Geotechnical Engineer to inspect and report to the Engineer on findings and approve subgrades and fill layers before further construction work is performed.

2. Perform field density tests in accordance with ASTM D 1556 (sand cone method), ASTM D 2167 (rubber balloon method), or ASTM D 2992 (nuclear density method), as applicable and at a frequency necessary to be reasonably assured that adequate compaction is achieved.

B. If in the opinion of the Engineer, based on testing service reports and inspection, subgrade or fills which have been placed are below specified density, provide additional compaction and testing at no additional expense to the Owner.

3.06 MAINTENANCE

A. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

B. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.07 DISPOSAL OF EXCESS NON-ORGANIC SOIL AND ROCK

A. General: All excess excavated material shall become the property of the Contractor and shall be disposed by him outside the project limits. It is the Contractor's responsibility to locate a suitable waste area off-site, obtain necessary permits or use of the waste area and be in compliance with applicable laws and regulations.

- END OF SECTION -

SECTION 312213

ROUGH GRADING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Remove topsoil and stockpile for later reuse.

B. Grade and rough contour site.

1.02 RELATED WORK

A. Geotechnical investigation report is available upon request.

B. SECTION 312213 – ROUGH GRADING
C. SECTION 312000 – EARTHWORK.

1.03 PROJECT RECORD DOCUMENTS

A. Submit document.

B. Accurately record location of utilities remaining, rerouted utilities, new utilities by horizontal dimensions, elevations or inverts, and slope gradients.

1.04 PROTECTION

A. Protect trees and other features remaining as portion of final landscaping.

B. Protect bench marks, existing structures, fences, roads, sidewalks and other features not designated for demolition.

C. Protect above or below grade utilities which are to remain.

D. Contractor shall be responsible for repairing any damage to those items not designated for demolition or removal in a manner satisfactory to the Owner at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Topsoil: Excavated material, graded free of roots, rocks larger than one inch, subsoil, debris, and large weeds.

B. Subsoil: Excavated material, graded free of lumps larger than 12 inches, rocks larger than 12 inches, and debris.

PART 3 - EXECUTION

3.01 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Identify known below grade utilities. Stake and flag locations.

C. Identify and flag above grade utilities.

D. Maintain and protect existing utilities remaining which pass through work area.

E. Upon discovery of unknown utility or concealed conditions, discontinue affected work; notify Engineer.

3.02 TOPSOIL EXCAVATION

A. Excavate topsoil from areas to be further excavated, and stockpile in area designated on site by the Engineer.

B. Do not excavate wet topsoil.

C. Stockpile topsoil to depth not exceeding 8 feet.

3.03 SUBSOIL EXCAVATION

A. Excavate subsoil from indicated areas and stockpile in area designated on site. Excess subsoil may be reused according to DIVISION 31.

B. Do not excavate wet subsoil.

C. Stockpile subsoil to depth not exceeding 8 feet.

D. When excavation through roots is necessary, perform work by hand and cut roots with a sharp axe.

3.04 TOLERANCES

A. Top Surface of Subgrade: Plus or minus three inches.

- END OF SECTION -

SECTION 312316

EXCAVATION

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Structure excavation.

B. Shoring excavations.

1.02 RELATED WORK

A. Geotechnical Report in these specifications.

B. SECTION 014500 - Quality Control.

C. SECTION 312317 - Rock Removal.

D. SECTION 312213 - Rough Grading.

E. SECTION 312333 – Trenching & Backfilling.

1.03 REGULATORY REQUIREMENTS

A. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods required to prevent cave-in or loose soil from falling into excavation.

B. Underpin adjacent structures which may be damaged by excavation work, including service utilities and pipe chases.

C. Notify Engineer of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.

D. Protect bottom of excavations and soil adjacent to and beneath foundations from frost.

E. Grade excavation top perimeter to prevent surface water run-off into excavation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Subsoil: Excavated material, graded free of lumps larger than 12 inches, rocks larger than 12 inches, and debris.

B. # 57’s or # 9’s: Mineral aggregate graded 1/4 inch to 5/8 inch, free of soil, subsoil, clay, shale, or foreign matter.

PART 3 - EXECUTION

3.01 PREPARATION

Identify required liens, levels, contours, and datum.

3.02 EXCAVATION

A. Excavate subsoil required for structure foundations, construction operations, and other work. All excavation shall be unclassified excavation.

B. Contractor is responsible to adequately brace open cuts and protect workmen and equipment from cave-in.

C. Remove lumped subsoil, boulders, and rock up to 1/3 cu. yd., measured by volume. Remove larger material under Section 312317.

D. Correct unauthorized excavation at no cost to Owner.

E. Fill over-excavated areas under structure bearing surfaces in accordance with direction by Engineer.

F. Stockpile excavated material in area designated on site.

3.03 FIELD QUALITY CONTROL

Provide for visual inspection of rock surfaces under provisions of Section 014500.

- END OF SECTION -

SECTION 312317

ROCK REMOVAL

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes removal to the widths and depths shown on the Contract Drawings or as directed by the Engineer, including the loosening, removing, transporting, storing and disposal of all materials requiring blasting, barring, or wedging for removal from their original beds, and backfill of rock excavations with acceptable materials

B. Use of explosives for rock removal shall be used only with prior permission from both the Engineer and Owner. **Blasting will NOT be permitted in this project.**

C. Rock removal is part of and incidental to unclassified excavation. No separate payment shall be made for rock removal.

1.02 SUBMITTALS

A. In addition to those submittals identified in the General Provisions, the following items shall be submitted:

1. Before any blasting operations begin the Contractor shall obtain all permits and licenses required.

1.03 DEFINITIONS

A. Rock

1. All pieces of ledge or bedrock, boulders or masonry larger than one-half cubic yard in volume.

2. Any material requiring blasting, barring, or wedging for removal from its original bed.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 BLASTING (Use of explosives for rock removal shall be used only with prior permission from both the Engineer and Owner.)

A. General

1. Handling of explosives and blasting shall be done only by experienced persons.

2. Handling and blasting shall be in accordance with all Federal, State and local laws, rules and regulations relating to the possession, handling, storage and transportation and use of explosives.

3. All blasts in open cut shall be properly covered and protected with approved blasting mats.

4. Charges shall be of such size that the excavation will not be unduly large and shall be so arranged and timed that adjacent rock, upon or against which pipelines or structures are to be built, will not be shattered.

5. Blasting will not be permitted within 25 feet of pipelines or structures.

6. All existing pipes or structures exposed during excavation shall be adequately protected from damage before proceeding with the blasting.

7. NFPA 495 - Code for Manufacture, Transportation, Storage and Use of Explosive Materials.

8. Commonwealth of Kentucky Department of Mines and Minerals, Laws and Regulations Governing Explosives and Blasting.

B. Repair of Damages Due to Blasting

1. Any injury or damage to the work or to existing pipes or structures shall be repaired or rebuilt by the Contractor at his expense.

2. Whenever blasting may damage adjacent rock, pipes or structures, blasting shall be discontinued and the rock removed by drilling, barring, wedging or other methods.

C. Explosives

1. At no time shall an excessive number of explosives be kept at the site of the work. Such explosives shall be stored, handled and used in conformity with all applicable laws and regulations.

2. Accurate daily records shall be kept showing the amounts of explosives on hand, both at the site and at any storage magazine, the quantities received and issued, and the purpose for which issued.

3. The Contractor shall be responsible for any damage or injury to any persons, property or structures as a result of his handling, storage or use of explosives.

D. Rock Clearance in Trenches

1. Ledge rock, boulders and large stones shall be removed from the sides and bottom of the trench to provide clearance for the specified embedment of each pipe section, joint or appurtenance; but in no instance shall the clearance be less than 6 inches. Additional clearance at the pipe bell or joint shall be provided to allow for the proper make-up of the joint.

2. At the transition from an earth bottom to a rock bottom the minimum bottom clearance shall be 12 inches for a distance of not less than 5 feet.

E. Rock Clearance at Structures

1. Concrete for structures shall be placed directly on the rock and the excavation shall be only to the elevations and grades shown on the Contract Drawings.

3.02 EXCAVATION AND BACKFILL

A. Rock removal and backfilling shall be performed in accordance with the applicable provisions of the Section entitled "Earthwork".

B. The rock excavated which cannot be incorporated into the backfill material, as specified, shall be disposed of as spoil and shall be replaced with the quantity of acceptable material required for backfilling.

-END OF SECTION-

SECTION 312333

TRENCHING, BACKFILLING AND COMPACTING

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes excavation and backfill as required for pipe installation or other construction in the trench, and removal and disposal of water, in accordance with the applicable provisions of the Section entitled "Earthwork" unless modified herein.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 EXCAVATION

A. The trench excavation shall be located as shown on the Contract Drawings or as specified. Under ordinary conditions, excavation shall be by open cut from the ground surface. Where the depth of trench and soil conditions permit, tunneling may be required beneath cross walks, curbs, gutters, pavements, trees, driveways, railroad tracks and other surface structures. No additional compensation will be allowed for such tunneling over the price bid for open cut excavation of equivalent depths below the ground surface unless such tunnel excavation is specifically provided for in the Contract Documents.

B. Trenches shall be excavated to maintain the depths as shown on the Contract Drawings or as specified for the type of pipe to be installed.

C. The alignment and depth shall be determined and maintained by the use of a string line installed on batter boards above the trench, a double string line installed along side of the trench or a laser beam system.

D. The minimum width of trench excavation shall be 6-inches on each side of the pipe hub for 21-inch diameter pipe and smaller and 12-inches on each side of the pipe hub for 24-inch diameter pipe and larger.

E. Trenches shall not be opened for more than 300 feet in advance of pipe installation nor left unfilled for more than 100 feet in the rear of the installed pipe when work is in progress without the consent of the Engineer. Open trenches shall be protected and barricaded as required.

F. Bridging across open trenches shall be constructed and maintained where required.

3.02 SUBGRADE PREPARATION FOR PIPE

A. Where pipe is to be laid on undisturbed bottom of excavated trench, mechanical excavation shall not extend lower than the finished subgrade elevation at any point.

B. Where pipe is to be laid on special granular material the excavation below subgrade shall be to the depth specified or directed. The excavation below subgrade shall be refilled with special granular material as specified or directed, shall be deposited in layers not to

exceed 6 inches and shall be thoroughly compacted prior to the preparation of pipe subgrade.

C. The subgrade shall be prepared by shaping with hand tools to the contour of the pipe barrel to allow for uniform and continuous bearing and support on solid undisturbed ground or embedment for the entire length of the pipe.

D. Pipe subgrade preparation shall be performed immediately prior to installing the pipe in the trench. Where bell holes are required they shall be made after the subgrade preparation is complete and shall be only of sufficient length to prevent any part of the bell from becoming in contact with the trench bottom and allowing space for joint assembly.

3.03 STORAGE OF MATERIALS

A. Traffic shall be maintained at all times in accordance with the applicable Highway Permits. Where no Highway Permit is required at least one-half of the street must be kept open for traffic.

B. Where conditions do not permit storage of materials adjacent to the trench, the material excavated from a length as may be required, shall be removed by the Contractor, at his cost and expense, as soon as excavated. The material subsequently excavated shall be used to refill the trench where the pipe had been built, provided it be of suitable character. The excess material shall be removed to locations selected and obtained by the Contractor.

1. The Contractor shall, at his cost and expense, bring back adequate amounts of satisfactory excavated materials as may be required to properly refill the trenches.

C. If directed by the Engineer, the Contractor shall refill trenches with select fill or other suitable materials and excess excavated materials shall be disposed of as spoil.

3.04 REMOVAL OF WATER AND DRAINAGE

A. The Contractor shall at all times provide and maintain proper and satisfactory means and devices for the removal of all water entering the trench, and shall remove all such water as fast as it may collect, in such manner as shall not interfere with the prosecution of the work.

B. The removal of water shall be in accordance with the Section entitled "Earthwork".

3.05 PIPE EMBEDMENT

A. All pipe shall be protected from lateral displacement and possible damage resulting from superimposed backfill loads, impact or unbalanced loading during backfilling operations by being adequately embedded in suitable pipe embedment material. To ensure adequate lateral and vertical stability of the installed pipe during pipe jointing and embedment operations, a sufficient amount of the pipe embedment material to hold the pipe in rigid alignment shall be uniformly deposited and thoroughly compacted on each side, and back of the bell, of each pipe as laid.

B. Concrete cradle and encasement of the class specified shall be installed where and as shown on the Contract Drawings or ordered by the Engineer. Before any concrete is placed, the pipe shall be securely blocked and braced to prevent movement or flotation. The concrete cradle or encasement shall extend the full width of the trench as excavated

unless otherwise authorized by the Engineer. Where concrete is to be placed in a sheeted trench it shall be poured directly against sheeting to be left in place or against a bond-breaker if the sheeting is to be removed.

C. Embedment materials placed above the centerline of the pipe or above the concrete cradle to a depth of 12 inches above the top of the pipe barrel shall be deposited in such manner as to not damage the pipe. Compaction shall be as required for the type of embedment being installed.

3.06 BACKFILL ABOVE EMBEDMENT

A. The remaining portion of the pipe trench above the embedment shall be refilled with suitable materials compacted as specified.

1. Where trenches are within the ditch-to-ditch limits of any street or road or within a driveway or sidewalk, or shall be under a structure, the trench shall be refilled in horizontal layers not more than 8 inches in thickness, and compacted to obtain 95% maximum density, and determined as set forth in the Section entitled "Earthwork".

2. Where trenches are in open fields or unimproved areas outside of the ditch limits of roads, the backfilling may be by placing the material in the trench and mounding the surface.

3. Hand tamping shall be required around buried utility lines or other subsurface features that could be damaged by mechanical compaction equipment.

B. Backfilling of trenches beneath, across or adjacent to drainage ditches and water courses shall be done in such a manner that water will not accumulate in unfilled or partially filled trenches and the backfill shall be protected from surface erosion by adequate means.

1. Where trenches cross waterways, the backfill surface exposed on the bottom and slopes thereof shall be protected by means of stone or concrete rip-rap or pavement.

C. All settlement of the backfill shall be refilled and compacted as it occurs.

-END OF SECTION-

SECTION 312500

EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. The Contractor shall do all work and take all measures necessary to control soil erosion resulting from construction operations, shall prevent the flow of sediment from the construction site, and shall contain construction materials (including excavation and backfill) within his protected working area so as to prevent damage to adjacent property.

B. The Contractor shall not employ any construction method that violates a rule, regulation, guideline or procedure established by Federal, State or local agencies having jurisdiction over the environmental effects of construction. The Contractor shall be responsible for obtaining all associated permits.

C. Pollutants such as chemicals, fuels, lubricants, bitumen, raw sewage and other harmful waste shall not be discharged into or alongside of any body of water or into natural or man-made channels leading thereto.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Temporary Slope Protection and Erosion Control:

Bales may be hay or straw, and shall be reasonably clean and free of noxious weeds and deleterious materials. Filter fabric for sediment traps shall be of suitable materials acceptable to the Engineer.

B. Permanent Slope Protection and Erosion Control:

On slopes 2H:1V and steeper, and where shown on the drawings place Type A Dumped Rock Fill with a 24-inch minimum thickness over non-woven geotextile filter fabric.

PART 3 - EXECUTION

3.01 METHODS OF CONSTRUCTION

A. The Contractor shall use any of the acceptable methods necessary to control soil erosion and prevent the flow of sediment to the maximum extent possible. These methods shall include, but not be limited to, the use of water diversion structures, diversion ditches and settling basins.

B. Construction operations shall be restricted to the areas of work indicated on the Drawings and to the area which must be entered for the construction of temporary or permanent facilities. The Engineer has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and fill operations and to direct the Contractor to provide immediate permanent or temporary pollution

control measures to prevent contamination of the wetlands and adjacent watercourses. Such work may involve the construction of temporary berms, dikes, dams, sediment basins, slope drains, and use of temporary mulches, mats, or other control devices or methods as necessary to control erosion.

C. Excavated soil material shall not be placed adjacent to the wetlands or watercourses in a manner that will cause it to be washed away by high water or runoff. Earth berms or diversions shall be constructed to intercept and divert runoff water away from critical areas. Diversion outlets shall be stable or shall be stabilized by means acceptable to the Engineer. If for any reason construction materials are washed away during the course of construction, the Contractor shall remove those materials from the fouled areas as directed by the Engineer.

D. For work within easements, all materials used in construction such as excavation, backfill, roadway, and pipe bedding and equipment shall be kept within the limits of the easements.

E. The Contractor shall not pump silt-laden water from trenches or other excavations into the wetlands, or adjacent watercourses. Instead, silt-laden water from his excavations shall be discharged within areas surrounded by baled hay or into sediment traps to ensure that only sediment-free water is returned to the watercourses. Damage to vegetation by excessive watering or silt accumulation in the discharge area shall be avoided.

F. Prohibited construction procedures include, but are not limited to, the following:

1. Dumping of spoil material into any streams, wetlands, surface waters, or unspecified locations.

2. Indiscriminate, arbitrary, or capricious operation of equipment in wetlands or surface waters.

3. Pumping of silt-laden water from trenches or excavations into surface waters, or wetlands.

4. Damaging vegetation adjacent to or outside of the construction area limits.

5. Disposal of trees, brush, debris, paints, chemicals, asphalt products, concrete curing compounds, fuels, lubricants, insecticides, wash water from concrete trucks or hydro-seeders, or any other pollutant in wetlands, surface waters, or unspecified locations.

6. Permanent or unauthorized alteration of the flow line of any stream.

7. Open burning of debris from the construction work.

G. Any temporary working roadways required shall be clean fill approved by the Engineer. In the event fill is used, the Contractor shall take every precaution to prevent the fill from mixing with native materials of the site. All such foreign fill materials shall be removed from the site following construction.

3.02 EROSION CHECKS

The Contractor shall furnish and install baled hay or straw erosion checks in all locations indicated on the Drawings, surrounding the base of all deposits of stored excavated material outside of the disturbed area, and where indicated by the Engineer. Checks, where indicated on the Drawings, shall be installed immediately after the site is cleared and before trench

excavation is begun at the location indicated. Checks located surrounding stored material shall be located approximately 6 ft. from that material. Bales shall be held in place with two 2 in. by 2 in. by 3 ft. wooden stakes. Each bale shall be butted tightly against the adjoining bale to preclude short circuiting of the erosion check.

- END OF SECTION -

DIVISION 32

EXTERIOR IMPROVEMENTS

SECTION 321216

ASPHALT PAVING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The hot-mix asphalt paving work includes the construction of an aggregate base course, asphalt base and wearing courses as specified herein. This work is to replace paving disturbed by the construction and any damages to paving by Contractor's operations, as well as new pavement and driveways, within the limits shown on the plans.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. The general provisions of the Contract, including General Conditions and General Requirements apply to the work specified in this section.

B. SECTION 312000 – EARTHWORK

1.03 APPLICABLE STANDARDS

A. All references in this section to the Standard Specifications shall refer to the most recent Edition of Standard Specifications for Road and Bridge Construction with all amendments thereto as published by the Kentucky Transportation Cabinet (KYTC).

1.04 SUBMITTALS

A. Job-Mix Designs: For each job mix proposed for the Work.

B. Comply with the requirements of Section 013323.

1.05 QUALITY ASSURANCE

A. Hot Mix Asphalt Producer Qualifications: Engage a firm experienced in producing hot-mix asphalt similar to that indicated for this Project and with a record of successful in-service performance.

B. Producer firms shall be qualified through the Kentucky Transportation Cabinet as an approved Asphalt Mix Producing Firm.

C. Testing and inspection: The Contractor shall retain a qualified testing laboratory for testing and inspection.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp. Comply with the provisions of KYTC Standard Specifications for temperature requirements.

B. Grade Control: Establish and maintain required lines and elevations.

PART 2 – PRODUCTS

2.01 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Aggregate Base Course: Dense Graded Aggregate Base (DGA) complying with Section 302 and 805 of the Standard Specifications.

C. Coarse Aggregate: Sound, angular crushed stone, or crushed gravel, complying with Standard Specifications Section 805.

2.02 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO MP 1, Performance Graded Binder PG 64-22 for general applications.

B. Tack Coat: Comply with provisions in KYTC Standard Specifications Section 406.

2.03 MIXES

A. Hot-Mix Asphalt: Hot-laid, hot-mix asphalt plant mixes meeting the requirements of the Standard Specifications of the Kentucky Transportation Cabinet (KYTC) or Asphalt Institute (AI) MS-2 and complying with the following requirements:

1. Base Course: Produce KYTC mixture designation Class 2 Base. There shall be no restrictions on polish resistant aggregates (utilize KYTC Type “D” aggregates). Recycled Asphalt Pavement (RAP) may be utilized in accordance with Standard Specifications Section 409.

2. Surface Course: KYTC mixture designation Class 2 Surface. The mixture gradation may pass through the restricted zone and there shall be no restriction on polish resistant aggregates (utilize KYTC Type “D” aggregates). Recycled Asphalt Pavement (RAP) may be utilized in accordance with Standard Specifications Section 409.

B. Hot-Mix Asphalt: Hot-laid, hot-mix asphalt plant mixes designed according to procedures established by the Kentucky Transportation Cabinet (KYTC) and complying with the following requirements.

1. Provide mixes complying with composition, grading, and tolerance requirements Standard Specifications for the following nominal, maximum aggregate sizes:

a. Base Course: Mixture with a nominal maximum aggregate size of 0.75 inch with a minimum Voids in the Mineral Aggregate (VMA) of 12 percent.

b. Surface Course: Mixture with a nominal maximum aggregate size of 0.38 inch with a minimum VMA of 14 percent.

PART 3 - EXECUTION

3.01 INSPECTION

A. Pavement installer must examine the areas excavated and backfilled and conditions under which pavement is to be constructed. Notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until satisfactory embankments and subgrade have been established to a uniform line, properly shaped and compacted.

B. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.

C. Proof-roll subbase using loaded dump trucks or heavy rubber-tired construction equipment to locate areas that are unstable or that require further compaction.

D. Proceed with paving only after unsatisfactory conditions have been corrected.

E. Repairs to Base Course: Fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact flush with adjacent surface.

F. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.02 AGGREGATE BASE COURSES

A. Place aggregate base course on subgrades free of mud, frost, snow, or ice in accordance with Section 302 of the Standard Specifications.

B. On prepared subgrade, place base course as follows:

1. Shape base course to required crown elevations and cross-slope grades.
2. Place base course that exceeds 9 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
3. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry unit weight according to ASTM D698 or in accordance with Section 302.03.04 of the Standard Specifications.

3.03 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

B. Tack Coat: Comply with provisions in Standard Specifications Section 406. Apply to the surface of concrete surfaces, existing asphalt surfaces and, when necessary, to newly constructed asphalt surfaces.

3.04 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Comply with applicable provisions of KYTC Standard Specifications Section 403 for delivery, placement, spreading and compaction of the mixture.

1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent.

3.05 FIELD QUALITY CONTROL

A. Thickness Tolerances: Compact each course to produce the thickness indicated within the following tolerances:

1. Aggregate and asphalt base Course: Plus or minus 1/2 inch.
2. Asphalt surface course: Plus or minus 1/4 inch.
3. Provide a minimum fall of 2% to facilitate drainage unless otherwise indicated on the Drawings.

B. Surface Smoothness: Compact each course to produce a surface smoothness with the following tolerances as determined using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Aggregate base course: 3/8 inch.
2. Asphalt base course: 1/4 inch.
3. Asphalt surface course: 1/8 inch.
4. Crowned surfaces: Test with crowned template centered and at a right angle to crown. Maximum allowable variance from template is 1/4 inch.

C. In-Place Density: Filed density test of in-place compacted aggregate base will be determined by nuclear method in accordance with ASTM D 2940. Field density of in-place compacted pavement will be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726. Test will be made for every 1,000 square yards or less of installed pavement.

D. Core Sampling: If required to confirm either thickness tolerances or compaction of asphalt courses, core samples shall be taken and tested according to ASTM D 3549 for thickness and ASTM D 1188 or ASTM D 2726 for compaction. Determination of need for core samples will be made by the Engineer.

- END OF SECTION -

SECTION 321540

CRUSHED STONE SURFACING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish and install crushed stone for miscellaneous uses as shown on the Drawings, as called for in the Specifications.

B. Sizes, types, and quality of crushed stone are specified in this Section, but its use for replacement of unsuitable material, pavement base, and similar uses is specified in detail elsewhere in the Specifications. The Engineer may order the use of crushed stone for purposes other than those specified in other Sections, if, in his opinion, such use is advisable. Payment for same will be subject to negotiation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. When referred to in these Specifications, crushed stone shall be Number 57 graded in accordance with the Kentucky Department of Highways, Standard Specifications, latest edition, unless otherwise noted.

B. When referred to in these Specifications, dense graded aggregate (DGA) shall be crushed stone classified by the Kentucky Department of Highways, Standard Specifications, latest edition, and conforming to the following requirements:

Sieve Size	Percent Passing
1 Inch	100
3/4 Inch	70 - 100
1/2 Inch	50 - 80
#4	30 - 65
#10	17 - 50
#40	8 - 30
#200	2 - 10

PART 3 - EXECUTION

3.01 INSTALLATION

A. Crushed stone shall be placed and compacted in accordance with the Kentucky Department of Highways, Standard Specifications.

B. Crushed stone shall be placed in those areas as shown on the Drawings.

-- END OF SECTION --

SECTION 321623

SIDEWALKS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and services required for constructing concrete sidewalks where shown on the Drawings and as specified herein,

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. SECTION 312000 – EARTH MOVING

PART 2- PRODUCTS

2.01 CRUSHED STONE

A. Stone for sidewalk base shall be No. 57 aggregate, or equal.

2.02 CONCRETE

A. Concrete for sidewalks shall be 3000 psi concrete.

2.03 REINFORCEMENT

A. The minimum yield strength of the reinforcement shall be 60,000 pounds per square inch. Bar reinforcement shall conform to the requirements of ASTM A615. All bar reinforcement shall be deformed.

B. Wire-mesh reinforcement shall be continuous between expansion joints. Laps shall be at least one full mesh plus 2", staggered to avoid continuous lap in either direction, and securely wired or clipped with standard clips.

2.04 PREMOLDED EXPANSION JOINT FILLER

A. Pre-molded expansion joint filler shall be closed cell polyethylene foam type, Sonneborn Sonoflex F, Williams Products Expand-O-Foam, or equal. Seal joint with one-part self. leveling polyurethane sealant, Sonneborn Sonolastic SL 1, or equal, maximum 3/8” deep. Prepare and prime joints per manufacturer’s instructions.

PART 3- EXECUTION

3.01 BASE

A. Following finished grading, a base course of crushed stone shall be placed to a compacted thickness of four (4) inches. Immediately prior to placing concrete, crushed

stone base shall be thoroughly wetted, or the concrete placed on a layer of heavy building paper.

3.02 SURFACE

A. Concrete paving shall consist of 4 or 6 inches (as noted) of 3,000 psi reinforced concrete, struck off to accurately placed screens and worked with a float until mortar appears on the top. After surface has been thoroughly floated, it shall be brushed to leave markings of a uniform type, providing non-slip finish. No dusting or plastering will be allowed.

3.03 FINISHING

A. All joints and edges shall be finished with an edging tool. Dummy joints shall be formed about five (5) feet apart to form rectangular blocks. Expansion joints of 1/2 inch pre-molded expansion joint material shall be provided at the intersection of all vertical surfaces with the sidewalk's slabs and at approximately 20-feet intervals along the walks.

3.04 QUALITY CONTROL

A. The allowable variation shall be 1/8 inch to 10 feet transversely and longitudinally.

- END OF SECTION -

SECTION 323113

CHAIN LINK SECURITY FENCES AND GATES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and service required to furnish and install chain link fencing and gates according to the layout shown on the Contract Drawings. Height of the fencing fabric shall be seven (7) feet.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. SECTION 0##### - FINISH GRADING

B. SECTION 033000 – CAST-IN-PLACE CONCRETE

1.03 SUBMITTALS

A. Comply with provisions of Section 013323. At the time of submission, the Contractor shall in writing, call the Engineer's attention to any deviations that the submittals may have from the requirements of the Engineer's Contract Drawings and Specifications.

B. Shop Drawings:

Indicate details of fabrication and installation, including but not limited to fence height, post spacing, dimensions, unit weights and footing details.

C. Manufacturer's Literature:

1. Descriptive data of installation methods and procedures;

2. Standard drawings of fence and gate installation.

1.04 PRODUCT DELIVERY, HANDLING AND STORAGE

A. Deliver materials with manufacturer's tags and labels.

B. Handle and store material as to avoid damage.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Framework shall conform to one of the following:

1. Steel pipe with 1.8 ounces of zinc coating per square foot of surface area conforming to ASTM F1043 - Group IA; external coatings per F1043 paragraph 7.1.1 and internal coatings per F1043 paragraph 7.2.1.

2. High strength steel pipe triple coated per ASTM F1043 - Group IC; external coatings per F1043 paragraph 7.1.2, and internal coatings per F1043 paragraph 7.2.4.

All coatings to be applied after welding.

Pipe shall be straight, true to section and shall conform to the following weights:

Pipe Size Outside Diameter	Group 1A Weight (Lbs per Ft.)	Group 1C Weight (Lbs per Ft.)
1-5/8"	2.27	1.84
2"	2.72	2.28
2-1/2"	3.65	3.12
3"	5.79	4.64
3-1/2"	7.58	5.71
4"	9.11	6.56

B. Fabric: Fabric shall be aluminized fabric manufactured in accordance with ASTM A-491 and coated before weaving with a minimum of 0.4 ounces of aluminum per square foot of surface area. The steel wire and coating shall conform to ASTM A-817. Fabric shall be 9 gauge, woven in a 2" diamond mesh. Top selvage to be twisted and barbed. Bottom selvage to be knuckled.

The aluminum coated wire shall have a tensile strength of at least 80,000 pounds per square inch.

2.02 COMPONENTS

Components of the fencing system shall be in accordance with the following requirements:

A. Fence Posts:

	Group IA or Group IC	
Fabric Height	**Line Post O.D.**	**Terminal Post O.D.**
Under 6"	2"	2-1/2"
6' to 9'	2-1/2"	3"
9' to 12'	3"	4"

B. Gate Posts:

Single Gate Width	Double Gate Width	Group IA or Group IC Post O.D.
Up to 6'	Up to 12'	3"
7' to 12'	13' to 25'	4"

C. Rails and Braces: 1-5/8" O.D.

D. Fittings:

1. Post Caps: Pressed steel, cast iron or cast aluminum alloy designed to fit snugly over posts to exclude moisture. Supply cone type caps for terminal posts and loop type for line posts. All fittings to conform to ASTM F-626.

2. Rail and Brace Ends: Pressed steel, cast iron or cast aluminum alloy, cup-shaped to receive rail and brace ends.

3. Top Rail Sleeves: Tubular steel, 0.051 thickness x 7" long, expansion type.

4. Tension Bars: Steel strip, 5/8" wide x 3/16" thick.

5. Tension Bands: Pressed steel, 14-gauge thickness x 3/4" wide.

6. Brace Bands: Pressed steel, 12-gauge thickness x 3/4" wide.

7. Truss rods: Steel rod, 3/8" diameter merchant quality with turnbuckle.

8. Barbed Wire Arms: Pressed steel, cast iron or cast aluminum alloy fitted with clips or slots for attaching three strands of barbed wire. Arms shall be set outward on a 45-degree angle and be capable of supporting a 250-pound load at outer barbed wire connecting point without causing permanent deflection.

E. Tension Wire: Marcelled 7-gauge steel wire with minimum coating of 0.80 ounces of zinc or 0.40 ounces of aluminum per square foot of wire surface and conforming to ASTM A-824.

F. Tie Wires: Aluminum, 9-gauge, alloy 1100-H4 or equal.

G. Hog rings: Steel wire, 11 gauge, with a minimum zinc coating of 0.80 ounces per square foot of wire surface.

H. Barbed Wire: Commercial quality steel, 12-1/2-gauge, two strand twisted line wire with 4-point barbs at 5-inch spacing. Coating shall consist of a minimum of 0.80 ounces of zinc per square foot of wire surface conforming to ASTM A-121 or a minimum of 0.30 ounces of aluminum per square foot or wire surface conforming to ASTM A-585.

2.03 CONCRETE MIX

A. Concrete for footings shall be ASTM C-94 Portland Cement concrete with maximum 3/4" aggregate having a minimum compressive strength of 3,000 PSI at 28 days.

2.04 GATES

A. Gates shall be of the types and sizes shown on the Drawings. Gate filler fabric shall be of the same as that used in fence.

B. Frames:

Swing gate frames and cantilever slide gates shall be of 2" outside diameter galvanized Group IA or Group IC, having corners fitted with rigid watertight heavy malleable castings or electrically welded joints. Internal bracing shall be of 1-5/8" outside diameter galvanized steel pipe, Group IA or Group IC.

Cantilever slide gate widths shall be 1.5 times the opening and have external roller assemblies. The roller assemblies shall be on both the top and bottom of the gate frame.

Extend gateposts and frame end members above top of chain link fabric at both ends of gate frame, as required to attach barbwire.

C. Hinges:

Gate hinges shall be double clamping offset type allowing gates to swing back parallel with line of fence. They shall be malleable iron and forged steel heavily galvanized.

D. Latches and Keepers:

Gate latch shall be of eccentric double locking type which engage strike securely bolted to either gate frame or gate post at both top and bottom. Latches shall be readily locked with padlock.

Gatekeeper shall be furnished with each gate frame to automatically engage gate frame when swung to open position.

E. Gate manufacturer and supplier shall be responsible for all hardware associated with attaching gates and removable panels.

2.05 AUTOMATIC CANTILEVER SLIDE GATE OPERATOR

A. A pre-wired, self-contained, slide gate operator for horizontal sliding gates, including all selected attachments and accessory equipment, shall be provided for where shown on the drawings.

B. Operation shall be by means of a metal rail passing between a pair of hydraulically driven solid metal wheels with polyurethane treads. Operator motors shall be hydraulic, gear roller type, and system shall not include belts, gears, pulleys, roller chains or sprockets to transfer power from operator to gate panel. The operator shall generate a minimum horizontal pull of 300 pounds without the drive wheels slipping and without distortion of supporting arms. Operator shall be capable of handling gates weighing up to 1000 pounds. Gate panel velocity shall not be less than 1.0 feet per second and shall be stopped gradually to prevent shock loads to the gate and operator assembly.

C. Standard mechanical components shall include as a minimum:

1. Supporting arms: Cast aluminum channel. Arms shall incorporate a fully bushed, 1-1/2" bronze bearing surface, acting on arm pivot pins. (item 2 below)

2. Arm pivot pins: 3/4" diameter, stainless steel, with integral tabs for ease of removal.

3. Tension spring: 2-1/2" heavy duty, 800-pound capacity.

4. Tension adjustment: Finger tightened nut, not requiring the use of tools.

5. Drive release: Must instantly release tension on both drive wheels, and disengage them from contact with drive rail in a single motion, for manual operation.

6. Limit switches: Fully adjustable, toggle types, Nema 4.

7. Electrical enclosure: Oversized, metal, with hinged lid gasketed for protection from intrusion of foreign objects, and providing ample space for the addition of accessories.

8. Chassis: 1/4" steel base plate, and 10 Ga. sides and back welded and ground smooth.

9. Cover: 16GA. galvanized sheet metal with a powder paint finish. All joints welded, filled and ground smooth. Finished corners square and true with no visible joints.

10. Finish: Fully zinc plated then finish coat of high gloss powder paint withstanding 1000-hour salt spray test.

11. Drive wheels: 6" Dia. Metal hub with polyurethane tread.

12. Drive rail: Shall be extruded 6061 T6, not less than 1/8" thick. Drive rail shall incorporate alignment pins for ease of replacement or splicing. Pins shall enable a perfect butt splice.

13. Hydraulic hose: Shall be 1/4" synthetic, rated to 2750 psi.

14. Hydraulic valves: Shall be individually replaceable cartridge type, in an integrated hydraulic manifold.

15. Hose fittings: At manifold shall be quick-disconnect type, others shall be swivel type.

16. Hydraulic fluid: High performance type with a viscosity index greater than 375.

17. A zero to 2000-PSI pressure gauge, mounted on the manifold for diagnostics, shall be a standard component.

18. The hydraulic fluid reservoir shall be formed from a single piece of metal, non-welded, and shall be powder painted on the inside and the outside, to prevent fluid contamination.

19. A cabinet lock for the operator cover.

20. A lockable remote release device that allows the release of the grip of the slide gate rail without removing the operator cover.

D. Minimum standard electrical components:

1. Motor: Shall be a 1 HP, 56C, TEFC, continuous duty motor, with a service factor of 1.15, or greater, 480V, 3-phase.

2. All components shall have overload protection.

3. Transformer: 75 VA, non-jumpered taps, for all common voltages. Control circuit: 24VDC.

E. The gate operator shall come equipped with the following external sensors being capable of opening and/or reversing the gate in either direction upon sensing an obstruction.

1. The gate operator shall be capable of accepting a discrete input from the security access system to open the gate.

2. A “Torque Sensor” utilizing internal sensing devices to detect on object when encountered by the closing gate and reversing the gates direction.

3. An adjustable timer that signals the operator to close the gate after a prescribed set point.

F. The gate operator control board shall have a minimum of two ports for plug in loop detectors. Loop wiring shall be provided for inside and outside safety loops as well as an exit loop. The loop detectors shall plug into the ports on the control board. The loop detectors shall be installed “in-ground” and located per manufacturer’s recommendation. When the loop detector for the gate operator that operates on “exit” senses traffic, the slide gate shall open automatically. Safety loops shall allow the gate to stay open when vehicles are obstructing the path. The loop detectors shall be as manufactured by Door King Inc. model 9406-010 or equal.

G. Provide a five-year limited warranty against all defects in materials or workmanship. Defective materials shall be replaced with comparable materials furnished by the manufacturer, at no cost to the owner. Freight, labor and other incidental costs are not covered under the factory warranty, but may be covered by a separate service agreement between installing company and the owner.

H. Automatic Slide Gate Operators shall be as manufactured by Door King, Inc. model 9150 or equal and shall include all options necessary to meet all of the requirements noted for the swing gate operators in this specification section.

2.06 AUTOMATIC SWING GATE OPERATOR – NOT APPLICABLE

A. Swing Gate operators shall be microprocessor based vehicular swing gate operators. A swing gate operator shall be provided for each of the two leaves of the plant entrance gate, with a solid-state board on each operator to control all functions of the swing operator as described in this specification section. Provide all necessary boards, power supplies, special mounting hardware, connectors, cables, wiring and accessories for a complete operational system.

B. Each gate operator shall be capable of operating a 10-foot gate leaf. Each gate operator assembly shall include a 1 HP continuous duty motor rated for 480 V three-phase AC supply only.

C. The primary reduction and power transfer for each gate operator shall be provided by a single cog belt drive train and worm gear reduction. A harmonic linkage arm shall function from the bottom of the gate operator and shall start the gate slowly, accelerate through the cycle, then slow down prior to stopping to prevent the gate from bouncing.

D. The swing gate operator shall have an on-board microprocessor-based control board that will control all functions of operation. An adjustable timer shall be built into the control board to allow the gate leaf to automatically close. The swing gate operator shall be able to automatically set its own open and close limit settings. A dry set of relay contacts shall be available for external use, and have four programmable functions. As a minimum, the following status shall be available for external use: “gate open”, “gate closed”. The gate operator shall be capable of accepting a discrete input from the security access system to open the gate.

E. The gate operator control board shall have a minimum of two ports for plug in loop detectors. Loop wiring shall be provided for inside and outside safety loops as well as an exit loop. The loop detectors shall plug into the ports on the control board. The loop detectors shall be installed “in ground” and located per the manufacturer’s recommendation. When the loop detector for the gate operator that operates the outgoing gate leaf (gate operator for outgoing traffic) senses traffic, the outgoing gate leaf operator shall open that gate automatically.

Safety loops shall allow the gate to stay open when vehicles are obstructing the path. The loop detectors shall be as manufactured by Door King Inc. model 9406-010 or equal.

F. The gate operator shall have a “tamper detect” function that shall start the motor to re-close the gate if the gate is forced open without an authorized command. Functions shall be user-programmable by DIP-switches located on control board.

G. If an obstruction is met during the opening or closing cycles, the gate operator shall have the ability to automatically reverse the gate. This reverse system shall be an inherent function for the gate operator so that if the external reverse devices fail or become inoperative, the operator will still sense the obstruction and reverse the gate. The inherent reverse system shall consist of a primary system that reverses the gate if an obstruction is sensed. Should the primary system fail or become inoperative, a secondary inherent system shall sense the obstruction and reverse the gate. The primary system shall sense a clutch slippage and reverse the gate. Should the clutch fail to slip, the secondary system shall sense a stoppage and reverse the gate.

H. The gate operator shall have the capability to stop and activate the internal alarm upon sensing an entrapment (two sequential activations of the inherent sensing system) and shall require activation of the reset switch prior to returning to normal operation, as required by UL 325 safety standard. For enhanced safety, the operator shall upon sensing an entrapment, release pressure on the gate and assume a fail-safe condition to allow any entrapment the opportunity to free itself without the need for outside intervention.

I. The gate operator shall incorporate a “fail-safe” design that shall allow the manual operation of the gate from the inside without the need for any hand cranks, keys or mechanical devices. The manual release device shall be an integral (non-removable) part of the operator. The manual release or manual operation of the gate shall not result in a risk of injury to users if the operator is activated while the manual release is activated or being used.

J. The gate operator shall be in compliance with UL Standards for safety – Door, Drapery, Gate, Louver and Window Operators and systems; UL 325 (fourth edition); UL Standards for safety – Tests for Safety Related Controls Employing Solid State Devices, UL 991 (second edition).

K. Contractor’s submittals for the gate operator shall include an equipment list, data sheets, system description, block diagrams on equipment and electrical wiring diagrams for installation. The submittal shall include all data required to evaluate design, quality and configuration of the gate operator system.

L. Factory Warranty period for the gate operators shall be a minimum of two (2) years parts and workmanship.

M. The Swing gate operators shall be as manufactured by Door King Inc. model 6300 or equal, and shall include all options necessary to meet all the requirements noted for the swing gate operators in this specification section.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Installation to conform to ASTM F-567.

B. Post Spacing: Space line posts at intervals not exceeding ten feet.

C. Post Setting: Set terminal, gate and line posts plumb in concrete footings of the dimensions shown on the Details. Top of footing to be 2" above grade and sloped to direct water away from posts.

D. Bracing: Brace gate and terminal posts back to adjacent line posts with horizontal brace rails and diagonal truss rods.

E. Top Rail: Install through line post loop caps connecting sections with sleeves to form a continuous rail between terminal posts.

F. Top Tension Wire: If top rail is not required, stretch tension wire through loop caps and fasten to terminal posts.

G. Bottom Tension Wire: Stretch between terminal posts 6" above grade and fasten to outside of line posts with tie wires.

H. Fabric: Pull fabric taut with bottom selvage 2" above grade. Fasten to terminal posts with tension bars threaded through mesh and secured with tension bands at maximum 15" intervals. Tie to line posts and top rails with tie wires spaced at maximum 12" on posts and 24" on rails. Attach to bottom tension wire with top rings at maximum 24" intervals.

I. Barbed Wired: Anchor to terminal extension arms, pull taut and firmly install in slots of line post extension arms.

J. Gates: Install gates plumb, level and secure for full opening without interference. Anchor center stops and keepers in concrete.

K. Fasteners: Install nuts for fittings, bands, and hardware bolts on inside of fence.

3.02 COMPLETION

A. Adjust brace rails and tension rods for rigid installation.

B. Tighten hardware, fasteners, and accessories.

C. The area of installation shall be left free of debris caused by the installation of the fence.

- END OF SECTION -

SECTION 329200

TURF & GRASSES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Provide all labor, materials, equipment, and services required for seeding of all disturbed areas caused by construction activities and for installation of sod where indicated on the Contract Drawings or specified herein.

1.02 RELATED DOCUMENTS

A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to Work of this Section.

B. SECTION 312000 – EARTH MOVING

1.03 MAINTENANCE

A. Maintenance shall begin immediately following the last operation of installation for each portion of lawn.

B. Lawns shall be maintained by watering, mowing, and for re-sodding for a period of forty-five (45) days. At the end of this period an inspection will be made and any deficiencies, which may be attributable to the Contractor, will be noted in writing. At this time, the Owner will assume the maintenance. Another inspection will be made at the beginning of the next planting season, and any of the previously noted deficiencies still existing shall be repaired by the Contractor.

1.04 INSPECTION FOR ACCEPTANCE

A. The Inspection of the Work:

1. The inspection of the work of lawns to determine the completion of contract work exclusive of the possible replacement of plants, will be made by the Architect/Engineer upon written notice requesting such inspection submitted by the Contractor at least ten (10) days prior to the anticipated date.

B. Acceptance:

1. After inspection, the Contractor will be notified in writing by the Owner of acceptance of all work of this Section, exclusive of the possible replacement of plants subject to guaranty, or if there are any deficiencies of the requirements of completion of the Work.

PART 2 - PRODUCTS

2.01 WATER

A. Water used in this work shall be suitable for irrigation and free from ingredients harmful to plant life.

B. Hose and other watering equipment required for the Work shall be furnished by the Contractor.

2.02 TOPSOIL

A. The Contractor shall furnish and place sufficient topsoil for the seeding and installation of sod.

2.03 FERTILIZER

A. Commercial fertilizer for lawn areas shall be complete fertilizer, formula 10-10-10, for lawns and shall conform to the applicable state fertilizer laws. Fertilizer shall be uniform in composition, dry and free flowing and shall be delivered to the site in the original, unopened containers, each bearing the manufacturer's guarantee analysis. Any fertilizer which becomes caked or otherwise damaged making it unsuitable for use will not be accepted.

B. Fertilizer shall be applied at the rate of 25 pounds per 1,000 square feet.

2.04 GRASS SEED

A. The seed mixture to be sown shall be in the following proportions:

Common Name	Proportion by Weight	% of Purity	% of Germination
Fine Lawn Fescue	40	90	85
Chewings Fescue	25	90	85
Italian Rye Grass	20	90	85
Red Top	10	90	85
White Clover	5	95	90

B. All seed shall be fresh and clean and shall be delivered mixed, in unopened packages, bearing a guaranteed analysis of the seed mixture.

C. Germination must be certified to conform to the following minimums:

Purity	90%
Germination	85%

2.05 SOD

A. Sod shall be at least 70% Bluegrass, strongly rooted and free of pernicious weeds.

B. It shall be mowed to a height not to exceed 3" before lifting, and shall be of uniform thickness with not over 1-1/2" or less than 1" of soil.

2.06 MULCH

A. Mulch for seeded areas shall be Conwed Hydro Mulch, Silva-Fiber, or equal. It shall be suitable for use in a water slurry or for application with hydraulic equipment.

B. Clean straw is acceptable as mulch. It shall be spread at the rate of one (1) bale per 1,000 feet (approximately 2-inch loose depth).

C. Mulch on slopes greater than 1: 3 shall be held in place with erosion control netting.

D. Mulch on areas subject to surface water run-off or in drainage ditches shall be held in place with erosion control netting.

PART 3 - EXECUTION

3.01 TIME OF PLANTING

A. Planting operations shall be conducted under favorable weather conditions during seasons which are normal for such work as determined by accepted practice in the locality of the project. At the option and on full responsibility of the Contractor, planting operations may be conducted under unseasonable conditions without additional compensation.

3.02 LAWNS

A. Areas to be sodded are designated on the Drawings. All other lawn areas, including areas of cut and fill and where existing ground has been disturbed by construction operations shall be seeded.

B. Fertilizer:

1. Fertilizer shall be applied at the rate of 25 pounds per 1,000 square feet to the lawn area being prepared for planting and mixed lightly into the top few inches of topsoil. Fertilizer may be mixed with and distributed with grass seed.

C. Planting of Lawns:

1. Sowing of Seed:

a. Immediately before any seed is to be sown, the ground shall be scarified as necessary, and shall be raked until the surface is smooth, friable and of uniformly fine texture. Lawn areas shall be seeded evenly with a mechanical spreader at the rate of 4 pounds per 1,000 square feet of area, lightly raked, rolled with a 200-pound roller and watered with a fine spray. The method of seeding may be varied at the discretion of the Contractor on his own responsibility to establish a smooth, uniform turf composed of the grasses specified. The sowing of seed shall be done only within the season extending from March 1st to May 15th and from September 1st to October 15th, unless other seasons may be approved by the Owner.

2. Laying of Sod:

a. Before any sod is laid, all soft spots and inequalities in grade shall be corrected. Fertilizer spread shall be raked in. Sod shall be laid so that no voids occur, tamped or rolled and then thoroughly watered. The complete sodded surface shall be true to finished grade, even and firm at all points. Sodding shall be done only within the seasons extending from

March 1st to May 15th and from September 1st to October 15th, unless other seasons may be approved by the Owner.

3. Sod on Slopes:

   a. Sod on slopes 2 to 1 or steeper shall be held in place by wooden pins about 1-inch square and about 6 inches long driven through the sod into the soil until they are flush with the top of the sod, or by other approved methods for holding the sod in place.

4. Mulching:

   a. All seeded areas are to be mulched with Conwed Hydro Mulch, Silva-Fiber, or equal, or with clean straw as specified under PRODUCTS. Mulch shall be applied at the rate of 1,500 pounds per acre. It may be applied with hydraulic equipment or may be added to the water slurry in a hydraulic seeder and the seeding and mulching combined in one operation. Clean straw may be spread by hand to cover the seeded areas at a depth of two (2) inches. Erosion control netting shall be installed and anchored per manufacturer's instructions in areas of slopes, ditches, or surface water runoff.

3.03 CLEAN UP

A. All soil, peat or similar material which has been brought over paved areas by hauling operations or otherwise, shall be removed promptly, keeping these areas clean at all times. Upon completion of the planting all excess soil, stone and debris which have not previously been cleaned up shall be removed from the site or disposed of as directed by the Owner. All lawns shall be prepared for final inspection.

3.04 OTHER WORK

A. The Contractor also shall be responsible for the repair of any damage caused by his activities or those of his subcontractors, such as the storage of topsoil or other materials, operations or equipment, or other usages to all on-site areas outside the contract limits. Such repair operations shall include any regrading, seeding or other work necessary to restore such areas to an acceptable condition.

3.05 QUALITY CONTROL

A. Areas seeded shall be protected until a uniform stand develops, when it will be accepted and the Contractor relieved of further responsibility for maintenance. Displaced mulch shall be replaced or any damage to the seeded area shall be repaired promptly, both in a manner to cause minimum disturbance to the existing stand of grass. If necessary, to obtain a uniform stand, the Contractor shall re-fertilize, reseed and re-mulch as needed. Scattered bare spots up to one (1) square yard in size will be allowed up to a maximum of 10 percent of any area.

- END OF SECTION -

DIVISION 33

UTILITIES

SECTION 330507

BORING AND JACKING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Provide all labor, materials, equipment and services required to furnish and install all bored and jacked carrier pipes in encasement pipes under railroad and highway crossings as shown on the Drawings and/or specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. SECTION 312000 – EARTH MOVING

B. SECTION 312213 – ROUGH GRADING

C. SECTION 331413 – WATER DISTRIBUTION PIPING

1.03 SUBMITTALS

A. Descriptive literature, catalog cuts, and dimensional prints clearly indicating all dimensions and materials of construction, shall be submitted on all items specified herein to the Engineer for review before ordering.

B. At the time of submission, the Contractor shall, in writing, call the Engineer's attention to any deviations that the submittals may have from the requirements of the Contract Drawings and Specifications.

C. Comply with all requirements of DIVISION 01.

1.04 EXISTING CONDITIONS

A. The existing piping and other utilities shown on the Contract Drawings is based on the best available information. The Engineer makes no guarantee as to the accuracy of the locations or type of piping or utility depicted. All new piping which ties into existing lines must be made compatible with that piping.

B. So that piping conflicts may be avoided, Contractor shall locate the utility (vertically & horizontally) well ahead of the pipe laying operation to confirm exact locations of existing piping before installing any new piping.

C. Contractor shall provide all fittings and adapters necessary to complete all connections to existing piping.

PART 2 - PRODUCTS

2.01 CARRIER PIPE

A. Carrier pipe shall be as specified in the applicable Division 33 section unless otherwise noted. All carrier pipe installed in the casing pipe shall be restraint joint type for either DIP or PVC.

B. DIP Carrier Pipe – Restraint joints shall be made utilizing the FIELD LOK 350 Gasket as manufactured by U.S. Pipe; Fastite Joint with Fast-Grip Gasklet as manufactured by American Ductile Iron Pipe; or the Sure Stop 350 Gasket as manufactured by McWane Ductile; or Engineer approved equal.

C. PVC Carrier Pipe – Restraint joints shall be made utilizing a nylon spline and integral groove in the spigot end and pipe bell creating a bi-directional restraint. The restraint joint shall be the Certa-Lok restraint joint as manufactured by CertainTeed or Engineer approved equal.

2.02 CASING PIPE

A. Casing pipe shall be steel, plain end, have a minimum yield point strength of 35,000 psi and conform to ASTM A 252 Grade 2 or ASTM A 139 Grade B without hydrostatic tests. The steel pipe shall have welded joints and be in at least 18 foot lengths.

B. The diameter of the casing pipe shall be as follows:

Carrier Pipe Nominal Diameter (Inches)															
4	6	8	10	12	14	15	16	18	20	21	24	27	30	33	36
Casing Pipe Nominal Diameter (Inches)															
10	12	16	18	20	24	24	30	30	30	36	36	42	48	50	50

For carrier pipe sizes greater than 36-inches nominal diameter, the casing pipe diameter size shall be determined by the Engineer or as shown on the Contract Drawings.

C. The wall thickness of the casing pipe shall be as follows:

Casing Pipe Nominal Diameter (Inches)								
Under 20	20 & 22	24	30	36	38	42	48	50
Casing Pipe Nominal Thickness (Inches)								
.375”	.375”	.375”	.406”	.469”	.500”	.562”	.625”	.656”

However, should casing pipe thickness be specified or required on Highway or Railroad permit approval sheets, said permit thickness requirement shall govern. Permit approval sheets will be made available to the Contractor.

2.3 CASING SPACERS

A. Stainless Steel Casing Spacers: Stainless steel casing spacers shall be bolt-on style with a shell made in two (2) sections of heavy T-304 stainless steel. Connecting flanges shall be ribbed for extra strength. The shell shall be lined with a PVC liner .090" thick with 85-90 durometer. All nuts and bolts are to be 18-8 stainless steel. Runners shall be made of ultra high molecular weight polymer with inherent high abrasion resistance and a low coefficient of friction. Runners shall be supported by risers made of heavy T-304 stainless steel. The supports shall be mig welded to the shell and all welds shall be fully passivated. Stainless steel casing spacers shall be made by Cascade Waterworks Mfg. Co., or equal.

B. Solid Polyethylene Casing Spacers (to be used with PVC pipe only): Solid polyethylene casing spacers shall be bolt-on style with a shell made in two (2) sections. Carrier pipe shall be wrapped with rubber strap inside casing space to prevent slippage. All nuts and bolts are to be 18-8 stainless steel. Solid polyethylene casing spacers shall be made by Calpico Inc., Advance Products & Systems, Inc., or equal.

2.04 CASING END SEALS

A. Wrap-around end seals - Wrap-around end seals shall be made of a waterproof flexible coal tar membrane reinforced with fiberglass, or synthetic rubber. The two exposed edges of the wrap-around seal shall be adhesively bonded forming a watertight seal. The ends of the wrap shall be sealed on the casing and carrier pipe by stainless steel bands. Wrap-around end seals shall be made by Calpico Inc., Advance Products & Systems, Inc., or equal.

B. Upon approval the by Engineer, in lieu of wrap-around end seals, each end of the casing pipe and the carrier pipe shall be wrapped with two (2) layers of roofing felt.

PART 3 - EXECUTION

3.01 CROSSINGS - GENERAL

A. Where designated on the drawings, crossings beneath state maintained roads, not to be disturbed shall be accomplished by boring and jacking a casing pipe.

B. Steel casing pipe for crossings shall be bored and/or jacked (or open cut installed where indicated on the Drawings) into place to the elevations shown on the drawings. All joints between lengths shall be solidly butt-welded with a smooth non-obstructing joint inside. The casing pipe shall be installed without bends. The carrier pipe shall be installed after the casing pipe is in place, and shall extend a minimum of two (2) feet beyond each end of the casing to facilitate making joint connections. The carrier shall be braced and centered with casing spacers within the casing pipe to preclude possible flotation. Casing spacers shall be installed a maximum of eight (8) feet apart along the length of the carrier pipe within the casing pipe, within two (2) feet of each side of a pipe joint, and the rest evenly spaced. The height of the supports and runners combined shall be sufficient to keep the carrier pipe at least 0.75" from the casing pipe wall at all times. Manufacturer’s recommendations may govern these requirements.

C. At each end of the casing pipe, the carrier pipe shall be sealed with casing end seals. The end seals shall extend a minimum of 12 inches in each direction from the end of the casing pipe.

D. Wood skids are not an acceptable method of supporting the carrier pipe.

3.02 BORING AND JACKING

A. The Contractor shall excavate his own pits, as he may deem necessary, and will set his own line and grade stakes which shall be checked by the Engineer. Permits, as required, will be furnished or obtained by the Owner, but shall be in the Contractor’s hands before any excavating is commenced.

B. The boring method shall consist of pushing the pipe into the earth with a boring auger rotating within the pipe to remove the spoil.

1. The front of the pipe shall be provided with mechanical arrangements or devices that will positively prevent the auger from leading the pipe so that there will be no unsupported excavation ahead of the pipe.
2. The auger and cutting head arrangement shall be removable from within the pipe in the event an obstruction is encountered. If the obstruction cannot be removed without excavation in advance of the pipe, the pipe shall be abandoned in place and immediately filled with grout.
3. The over-cut by the cutting head shall not exceed the outside diameter of the pipe by more than 2 inch. If voids should develop or if the bored hole diameter is greater than the outside diameter of the pipe by more than approximately 1 inch, grouting or other approved methods must be used to fill such voids.
4. The face of the cutting head shall be arranged to provide a reasonable obstruction to the free flow of soft or poor material.
5. Any method which does not have this boring arrangement will not be permitted. Contractor's boring arrangement plans and methods must be submitted to, and approved by, the Engineer.

C. In the event an obstruction is encountered in boring which cannot be removed and it becomes necessary to withdraw the casing and commence elsewhere, the hole from which the casing is withdrawn shall be completely backfilled with coarse sand rammed in.

D. Insurance to be furnished by the Contractor to cover this type of work shall be adequate to meet the requirements of the Railroad and/or State or County Highway Departments. Insurance shall consist of comprehensive general liability and automobile liability insurance.

E. Before award of the contract, the Contractor shall furnish a statement of his experience of such work, or if inexperienced, shall advise the Owner as to whom he will sublet the work and give a statement of the experience of the subcontractor, which shall be satisfactory to the Owner.

3.03 CONTRACTOR’S RESPONSIBILITIES

A. Obtain a copy of the Highway Encroachment and/or Railroad Permit before beginning construction.

B. Attend a preconstruction meeting at the construction site with the City Inspector, Railroad Inspector, Highway Inspector Engineer, and Contractor being present.

- END OF SECTION -

SECTION 330561

CONCRETE MANHOLES

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall furnish all labor, material, and equipment necessary to construct manholes for sanitary storm sewers, including steps, frames, and covers, together with all appurtenances as shown and detailed on the Drawings and specified herein. Manhole materials shall be precast concrete.

1.02 DEFINITIONS

A. Standard Manhole: A standard manhole is defined as any manhole that is greater than 5 feet in depth, as measured from the invert of the manhole base at its center to the top (rim) of the manhole cover.

B. Shallow Manhole: A shallow manhole is defined as any manhole that is 5 feet or less in depth, as measured in the preceding sentence.

PART 2 - PRODUCTS

2.01 CONCRETE MANHOLES - GENERAL

A. Manholes shall conform in shape, size, dimensions, materials, and other respects as shown on the Drawings or specified herein.

B. All concrete manholes shall have precast reinforced concrete developed bases. No other type of base will be allowed. Invert channels shall be factory constructed when the base is made. Sloping invert channels shall be constructed whenever the difference between the inlet and outlet elevation is 2 feet or less.

C. The concrete manhole walls (barrels and cones) and base shall be precast concrete sections manufactured with **Xypex C-1000 RED cementitious crystalline admixture at dosage of 3.5% by weight of cement.** The top of the cone shall be built of reinforced concrete to allow adjustment rings to be added for adjustment of the frame to meet the finished surface. Minimum strength of the concrete for the precast sections shall be 4,000 psi at the time of shipment.

D. **Manholes that receive sewage from a force main discharge, and within 2,000 LF downstream or to the nearest manhole beyond the 2,000 LF, shall have concrete admixture ConShield, or approved equal.**

E. Manholes located in the 100-year floodplain shall have a concrete base that includes an anti-flotation collar. The collar shall have a radius 6-inches larger than the exterior wall of the base section.

F. For concrete manholes, the inverts of the developed bases shall conform accurately to the size of the adjoining pipes. Side inverts shall be curved and main inverts (where direction

changes) shall be laid out in smooth curves of the longest possible radius which is tangent, within the manhole, to the centerlines of adjoining pipelines.

G. Manholes shall be manufactured by Sherman Dixie, Oldcastle Precast or approved equal.

2.02 PRECAST CONCRETE SECTIONS

A. Precast concrete sections and appurtenances shall conform to the ASTM Standard Specifications for Precast Reinforced Concrete Manhole Sections, Designation C478, latest revision, with the following exceptions and additional requirements.

B. The base section shall be monolithic for 4-foot and 5-foot diameter manholes. Manholes with diameter of 6 feet or larger shall have a monolithic base or base slab.

C. The wall sections shall be not less than 5 inches thick.

D. Type II or type III cement shall be used except as otherwise permitted.

2.03 CONCRETE MANHOLE - FRAMES AND COVERS

A. The Contractor shall furnish all cast iron manhole frames and covers as shown in LFUCG Standard Drawings.

B. Castings shall be designed for H-20 traffic loading.

C. The castings shall be of good quality, strong, tough, even grained cast iron, smooth, free from scale, lumps, blisters, sand holes, and defects of every nature which would render them unfit for the service for which they are intended. Contact surfaces of covers and frame seats shall be machined to prevent rocking of covers.

D. Frames shall be set in mastic and bolted down in non-traffic areas with four ¾" SS Hilti anchor bolts and washers. Hilti anchor bolts shall be embedded a minimum of 4-inches into precast concrete cone section. In traffic areas, the frame shall be set in mastic and Class A concrete donut poured around frame to the top of concrete cone section. The concrete donut shall be 12-inches in width and in depth up to within 1 ½-inches of surface for bituminous asphalt pavement.

E. All casting shall be thoroughly cleaned and subject to a careful hammer inspection.

F. Castings shall be at least Class 25 conforming to the ASTM Standard Specifications for Gray Iron Casting, Designation A48, latest revision.

G. Unless otherwise specified, manhole covers shall be 22-3/4 inches in diameter, weighing not less than 305 pounds per frame and cover. Manhole covers shall set neatly in the rings, with contact edges machined for even bearings and tops flush with ring edge. They shall have sufficient corrugations to prevent slipperiness. The covers shall have two (2) pick holes about 1-1/4 inches wide and 1/2-inch deep with 3/8-inch undercut all around. Covers shall not be perforated. Frames and covers shall be J.R. Hoe and Sons Mc-350, or approved equal.

H. Watertight lids shall have neoprene T-gasket and concealed pick-hole.

2.04 MANHOLE STEPS (CONCRETE MANHOLES)

A. Manholes steps shall be the polypropylene plastic type reinforced with a 1/2-inch diameter deformed steel rod. The step shall be 10-3/4 inches wide and extend 5-3/4 inches from the

manhole wall. Steps shall line up over the downstream invert of the manhole. The steps shall be embedded into the manhole wall a minimum of 3-3/8 inches. Steps shall be uniformly spaced at 12-inch to 16-inch intervals.

2.05 PREMOLDED ELASTOMERIC-SEALED JOINTS

A. All holes for pipe connections in concrete barrels and bases shall have a factory-installed flexible rubber gasket to prevent infiltration. The manhole boots shall conform to the latest revision of ASTM-C923. The boots shall be Contour Seal or Kor-N-Seal manufactured by National Pollution Control Systems, Inc., Nashua, NH; A-Lok Manhole Pipe Seal manufactured by A-Lok Corporation, Trenton, NJ; or an approved equal.

2.06 MANHOLE DIAPHRAGM (FOR WATERTIGHT LID APPLICATIONS)

A. Diaphragm manhole inserts shall be manufactured from corrosion-proof material suitable for atmospheres containing hydrogen sulfide and diluted sulfuric acid. Diaphragm shall be installed in manholes susceptible to inflow as indicated on the Drawings.

B. The body of the manhole insert shall be made of high-density ethylene hexene-1 copolymer material meeting ASTM Specification D 1248, Class A, Category 5 (the insert shall have a minimum impact brittleness temperature of -180 degrees Fahrenheit). The thickness shall be uniform 1/8 inch or greater. The manhole insert shall be manufactured to dimensions as shown on the Drawings to allow easy installation within the manhole frame.

C. Gaskets shall be made of closed cell neoprene. The gasket shall have a pressure sensitive adhesive on one side and shall be placed under the weight bearing surface of the insert by the manufacturer. The adhesive shall be compatible with the manhole insert material so as to form a long-lasting bond in either wet or dry conditions.

D. Lift strap shall be attached to the rising edge of the bowl insert. The lift strap shall be made of 1-inch wide woven polypropylene web and shall be seared on all cut ends to prevent unraveling. The lift strap shall be attached to the manhole insert by means of a stainless-steel rivet. Location of the lift strap shall provide easy visual location.

E. Standard ventilation shall be by means of a valve or vent hole. Vent holes shall be on the side wall of the manhole insert approximately 3/4 inch below the lip. The valve or vent hole will allow a maximum release of 5 gallons per 24 hours when the insert is full.

F. The manhole insert shall be manufactured to fit the manhole frame rim upon which the manhole cover rests. The Contractor is responsible for obtaining specific measurements of each manhole cover to insure a proper fit. The manhole frame shall be cleaned of all dirt, scale and debris before placing the manhole insert on the rim.

G. Diaphragm shall be Rainstopper manufactured by Rainstopper, Inc. in color white, or approved equal.

2.07 DROP CONNECTIONS

A. Drop connections shall be installed on exterior of manhole as shown on the LFUCG Standard Drawings. The pipe material inside the drop manhole shall be of the same material as the sanitary sewer line.

PART 3 - EXECUTION

3.01 FABRICATION - PRECAST SECTIONS

A. Manhole sections shall contain manhole steps accurately positioned and embedded in the concrete when the section is cast.

B. All precast concrete manhole sections shall be cured in a manner to assure the highest quality:

1. Results of initial set tests (per ASTM C 403) shall be provided upon request. New test will be run in the event of change of cement supplier, mix design, or as otherwise necessary to maintain a quality product.
2. Forms on wet-cast concrete shall not be removed until the concrete attains compressive strength equal to 2500 psi based upon field-cured cylinders, cured under conditions which equal the most severe conditions to which the product is exposed.
3. Test cylinders for determining “shipping strength” shall be cured with similar methods as the product that they represent. In lieu of actual curing with the product, cylinders may be cured in curing chambers correlated in temperature and humidity with the product conditions.
4. Any precast concrete manhole section which freezes before attaining 500 psi compressive strength will be rejected.

C. No more than two (2) lifting hooks may be cast or drilled in each section.

D. Flat slab tops shall have a minimum thickness of 6 inches and reinforcement in accordance with ASTM C478.

E. The date of manufacture and the name or trademark of the manufacturer shall be clearly marked on the precast sections.

F. Acceptance of the sections will be on the basis of material tests and inspection of the completed product and test cylinders if requested by the Engineer.

G. Cones shall be precast sections of similar construction.

H. It shall be the responsibility of the precast manufacturer to handle all materials in such a manner as to avoid all damage to the product before and during delivery. This damage is defined as, but is not limited to, structural or spiderweb cracking, chips, spalls, pop-outs, or other damage.

I. All precast concrete manhole sections shall be stored in a manner that will maintain product quality, as well as provide damage protection from yard traffic. All concrete pipe greater than 36” in diameter shall be “stulled” with a minimum of two each, 4” x 4” wood posts providing vertical support during storage. This requirement shall apply both at the manufacturer’s storage yard and on the jobsite.

J. No precast concrete manhole sections shall be delivered to a jobsite or transported from the facility of origin until adequate quality and maturity has been attained, as described in these specifications.

1. All precast concrete manhole sections shall be a minimum age of 7 days.

2. All precast concrete manhole sections shall attain compressive strength equal to 4000 psi.

3.02 SETTING PRECAST MANHOLE SECTIONS

A. Precast-reinforced concrete manhole sections shall be set so as to be vertical and with sections and steps in true alignment.

B. Butyl mastic sealant shall be installed in all manhole joints in accordance with the manufacturer's recommendations. Butyl mastic sealant shall meet Federal Spec SS-S-210A, AASHTO M-19875l, and ASTM C990. Butyl mastic sealant shall be NPC Bidco C-56 as manufactured by Trelleborg Engineered Systems, or approved equal. Sealant shall be a minimum bead of 1 inch in rope configuration.

C. All holes in sections used for their handling shall be thoroughly plugged with rubber plugs made specifically for this purpose.

3.03 ADJUSTING MANHOLE FRAMES AND COVERS TO GRADE

A. Except where shown on the Drawings, the top of the precast concrete eccentric cone of a standard manhole or the top of the flat slab of a shallow manhole shall terminate 6 inches below existing grade in an unpaved non-traffic area except in a residential yard and 13 inches below existing grade in a paved or unpaved traffic area and in a residential yard. The remainder of the manhole shall be adjusted to the required grade.

B. When a manhole is located in an unpaved non-traffic area other than in a residential yard, the frame and cover shall be adjusted to an elevation 1 inch above the existing grade at the center of the cover. If field changes have resulted in the installed manhole invert elevation to be lower than the invert elevation shown on the Drawings, the adjustment to an elevation of 1 inch above existing grade shall be accomplished by the use of precast concrete or cast-iron adjusting rings. The area around the adjusted frame and cover shall be filled with the required material, sloping it away from the cover at a grade of 1 inch per foot.

C. When a manhole is located in a bituminous, concrete, or crushed stone traffic area, or in a residential yard, the frame and cover shall be adjusted to the grade of the surrounding area by the use of precast concrete or cast-iron adjusting rings. The adjusted cover shall conform to the elevation and slope of the surrounding area.

1. The Contractor shall coordinate elevations of manhole covers in paved streets with the local public works department. If resurfacing of the street in which sewers are laid is expected within twelve (12) months, covers shall be set 1-1/2 inches above the existing pavement surface in anticipation of the resurfacing operations.

3.04 ADJUSTING SECTIONS

A. Only clean adjusting sections shall be used. Each adjusting section shall be laid in a bead of butyl mastic sealant and shall be thoroughly bonded.

3.05 SETTING MANHOLE FRAMES AND COVERS

A. Manhole frames shall be set with the tops conforming to the required elevations set forth hereinbefore. Frames shall be set concentric with the top of the concrete and in a full bead (1”) of butyl mastic sealant so that the space between the top of the masonry and the bottom flange of the frame shall be completely watertight.

B. Manhole covers shall be left in place in the frames on completion of other work at the manholes.

3.06 VACUUM TESTING (ASTM C1244)

A. Scope

This test method covers procedures for testing precast concrete manhole sections when using the vacuum test method to demonstrate the integrity of the installed materials and the construction procedures. This test method is used for testing concrete manhole sections utilizing mortar, mastic, or gasketed joints.

B. References, ASTM Standards:

1. C 822 Terminology Relating to Concrete Pipe and Related Products.

2. C 924 Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.

3. C 969 Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.

C. Summary of Practice

All lift holes and any pipes entering the manhole are to be plugged. A vacuum will be drawn and the vacuum drop over a specified time period is used to determine the acceptability of the manhole.

D. Significance and Use

This is not a routine test. The values recorded are applicable only to the manhole being tested and at the time of testing.

E. Preparation of the Manhole

1. All lift holes shall be plugged.

2. All pipes entering the manhole shall be temporarily plugged, taking care to securely brace the pipes and plugs to prevent them from being drawn into the manhole.

F. Procedure

1. The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendations.

2. A vacuum of 10 inches of mercury 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.

3. The manhole shall pass if the **minimum time** for the vacuum reading to drop from 10 inches of mercury to 9 inches of mercury **exceeds 60 seconds (one minute)**.

4. If the manhole fails the initial test, necessary repairs shall be made by an approved method. The manhole shall then be retested until a satisfactory test is obtained.

5. Use or failure of this vacuum test shall not preclude acceptance by appropriate water infiltration or exfiltration testing, (see Practice C 969), or other means.

G. Precision and Bias

No justifiable statement can be made either on the precision or bias of this procedure, since the test result merely states whether there is conformance to the criteria for the success specified.

- END OF SECTION -

SECTION 331413

WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Provide all labor, materials, equipment and services required for furnishing and installing all piping and appurtenances specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. SECTION 331419 – VALVES & HYDRANTS

1.03 SUBMITTALS

A. A notarized certification shall be furnished for all pipe and fittings that verifies compliance with all applicable specifications.

B. The requirement for this certification does not eliminate the need for shop drawings submittals in compliance with DIVISION 01.

1.04 EXISTING CONDITIONS

A. The existing piping shown on the Contract Drawings is based on the best available information. The Engineer makes no guarantee as to the accuracy of the locations or type of piping depicted. All new piping which ties into existing lines must be made compatible with that piping.

B. So that piping conflicts may be avoided, Contractor shall open up his trench well ahead of the pipe laying operation to confirm exact locations of existing piping before installing any new piping.

C. Contractor shall provide all fittings and adapters necessary to complete all connections to existing piping.

1.05 UTILITY LINE ACTIVITIES COVERED UNDER NATIONWIDE PERMIT # 12

A. All activities involving utility line construction covered under the US Army Corps of Engineers NATIONWIDE PERMIT # 12 shall meet the following conditions:

1. Utility Line Activities. Activities required for the construction, maintenance, repair, and removal of utility lines and associated facilities in waters of the United States, provided the activity does not result in the loss of greater than 1⁄2-acre of waters of the United States for each single and complete project. Utility lines: This NWP authorizes the construction, maintenance, or repair of utility lines, including outfall and intake structures, and the associated excavation, backfill, or bedding for the utility lines, in all waters of the United States, provided there is no change in pre-construction contours. This NWP also authorizes temporary structures, fills, and work necessary to conduct the utility line activity.

2. Appropriate measures must be taken to maintain normal downstream flows and minimize flooding to the maximum extent practicable, when temporary structures,

work, and discharges, including cofferdams, are necessary for construction activities, access fills, or dewatering of construction sites. Temporary fills must consist of materials, and be placed in a manner, that will not be eroded by expected high flows. Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The areas affected by temporary fills must be revegetated, as appropriate.

3. Notification: The permittee must submit a pre-construction notification to the US Army Corps district engineer prior to commencing the activity if any of the following criteria are met: (1) The activity involves mechanized land clearing in a forested wetland for the utility line right-of-way; (2) a section 10 permit is required; (3) the utility line in waters of the United States, excluding overhead lines, exceeds 500 feet; (4) the utility line is placed within a jurisdictional area (i.e., water of the United States), and it runs parallel to or along a stream bed that is within that jurisdictional area; (5) discharges that result in the loss of greater than 1/10-acre of waters of the United States; (6) permanent access roads are constructed above grade in waters of the United States for a distance of more than 500 feet; or (7) permanent access roads are constructed in waters of the United States with impervious materials.

B. All activities involving utility line construction covered under KENTUCKY GENERAL CERTIFICATION of Nationwide Permit # 12 shall meet the following conditions:

The general Water Quality Certification applies to surface waters of the Commonwealth as defined in 401KAR10:001 Chapter 10, Section 1(80): Surface waters means those waters having well-defined banks and beds, either constantly or intermittently flowing, lakes and impounded waters; marshes and wetlands; and any subterranean waters flowing in well-defined channels and having a demonstrable hydrologic connection with the surface.

1. The activity will not occur within surface waters of the Commonwealth identified by the Kentucky Division of Water as Outstanding State or National Resource Water, Cold Water Aquatic Habitat, or Exceptional Waters.

2. The activity will not occur within surface waters of the Commonwealth identified as perpetually-protected (e.g. deed restriction, conservation easement) mitigation sites.

3. This general water quality certification does not authorize the installation of utility lines in a linear manner within the stream channel or below the top of the stream bank.

4 For a single crossing, impacts from the construction and maintenance corridor in surface waters shall not exceed 50 feet of bank disturbance.

5. This general certification shall not apply to nationwide permits issued for individual crossings which are part of a larger utility line project where the total cumulative impacts from a single and complete linear project exceed ½ acre of wetlands or 300 linear feet of surface waters. Cumulative impacts include utility line crossings, permanent or temporary access roads, headwalls, associated bank stabilization areas, substations, pole or tower foundations, maintenance corridor, and staging areas.

6. Stream impacts under Conditions 4 and 5 of this certification are defined as the length of bank disturbed. For the utility line crossing and roads, only one bank length is used in calculation of the totals.

7 Stream impacts covered under this General Water Quality Certification and undertaken by those persons defined as an agricultural operation under the Agricultural Water Quality Act must be completed in compliance with the Kentucky Agricultural Water Quality Plan (KWQP).

8. The Kentucky Division of Water may require submission of a formal application for an individual certification for any project if the project has been determined to likely have a significant adverse effect upon water quality or degrade the waters of the Commonwealth so that existing uses of the water body or downstream waters are precluded.

9. Activities that do not meet the conditions of this General Water Quality Certification require an Individual Section 401 Water Quality Certification.

10. Blasting of stream channels, even under dry conditions, is not allowed under this general water quality certification.

11. Utility lines placed parallel to the stream shall be located at least 50 feet from an intermittent or perennial stream, measured from the top of the stream bank. The cabinet may allow construction within the 50 foot buffer if avoidance and minimization efforts are shown and adequate methods are utilized to prevent soil from entering the stream.

12. Utility line stream crossings shall be constructed by methods that maintain flow and allow for a dry excavation. Water pumped from the excavation shall be contained and allowed to settle prior to re-entering the stream. Excavation equipment and vehicles shall operate outside of the flowing portion of the stream. Spoil material from the excavation shall not be allowed to enter the flowing portion of the stream.

13. The activities shall not result in any permanent changes in pre-construction elevation contours in surface waters or wetlands or stream dimension, pattern or profile.

14. Utility line activities which impact wetlands shall not result in conversion of the area to non-wetland status. Mechanized land clearing of forested wetlands for the installation or maintenance of utility lines is not authorized under this certification.

15. Activities qualifying for coverage under this General Water Quality Certification are subject to the following conditions:

    a. Erosion and sedimentation pollution control plans and Best Management Practices must be designed, installed, and maintained in effective operating condition at all times during construction activities so that violations of state water quality standards do not occur.
    b. Sediment and erosion control measures, such as check-dams constructed of any material, silt fencing, hay bales, etc., shall not be placed within surface waters of the Commonwealth, either temporarily or permanently, without prior approval by the Kentucky Division of Water's Water Quality Certification Section. If placement of sediment and erosion control measures in surface waters is unavoidable, design and placement of temporary erosion control measures shall not be conducted in such a manner that may result in instability of streams that are adjacent to, upstream, or downstream of the structures. All sediment and

erosion control devices shall be removed and the natural grade restored within the completion timeline of the activities.

c. Measures shall be taken to prevent or control spills of fuels, lubricants, or other toxic materials used in construction from entering the watercourse.

d. Removal of riparian vegetation shall be limited to that necessary for equipment access.

e. To the maximum extent practicable, all in-stream work under this certification shall be performed under low-flow conditions.

f. Heavy equipment, e.g. bulldozers, backhoes, draglines, etc., if required for this project, should not be used or operated within the stream channel. In those instances in which such in-stream work is unavoidable, then it shall be performed in such a manner and duration as to minimize turbidity and disturbance to substrates and bank or riparian vegetation.

g. Any fill shall be of such composition that it will not adversely affect the biological, chemical, or physical properties of the receiving waters and/or cause violations of water quality standards. If rip-rap is utilized, it should be of such weight and size that bank stress or slump conditions will not be created because of its placement.

h. If there are water supply intakes located downstream that may be affected by increased turbidity and suspended solids, the permittee shall notify the operator when such work will be done.

i. Should evidence of stream pollution or jurisdictional wetland impairment and/or violations of water quality standards occur as a result of this activity (either from a spill or other forms of water pollution), the Kentucky Division of Water shall be notified immediately by calling (800) 928-2380.

16. Non-compliance with the conditions of this general certification or violation of Kentucky state water quality standards may result in civil penalties.

1.06 CONSTRUCTION IN A FLOODPLAIN

A. No material shall be placed in the stream or in the flood plain to form construction pads, coffer dams, access roads, etc. unless prior approval has been obtained from the Environmental and Public Protection Cabinet.

B. The trench shall be backfilled as closely as possible to the original contour. All excess material from construction of the trench shall be disposed of outside the flood plain unless the applicant has received prior approval from the Cabinet to fill within the flood plain.

PART 2 - PRODUCTS

2.01 POLYVINYL CHLORIDE PLASTIC (PVC) PIPE

A. AWWA C-900

1. 4-inch through 12-inch - PVC plastic pipe shall conform to ANSI/AWWA C-900, DR 18 pressure class 235. PVC pipe shall have a maximum laying length of 20 feet, with bell end and elastomeric gasket, and with plain end for cast-iron or ductile-iron fittings. Elastomeric gasket shall conform with the requirements of ASTM F-477. The seal of the National Sanitation Foundation Testing Laboratory must appear on each pipe

B. CLASS 200 & 250

1. Polyvinyl chloride (PVC) pipe for water mains shall be Class 200 (SDR 21) or Class 250 (SDR 17) PVC pressure rated pipe as shown on the Drawings or indicated in the proposal form with either twin gasket joints or integral bell joints with rubber O-ring seals.

2. All PVC pipe shall conform to the latest revisions of ASTM D-1784 (PVC Compounds), ASTM D-2241 (PVC Plastic Pipe, SDR) and ASTM D-2672 (Bell-End PVC Pipe). Rubber gasketed joints shall conform to ASTM D-3139. The gaskets for the PVC pipe joint shall conform to ASTM F-477 and D-1869.

3. Couplings shall be furnished by the pipe manufacturer and shall accommodate the pipe for which they are used. Rubber gasket joints shall provide adequate expansion to allow for a 50 degree change in temperature on one length of pipe. Lubrication for rubber connected couplings shall be water soluble, non-toxic, be non-objectionable in taste and odor and have no deteriorating affect on the PVC or rubber gaskets and shall be as supplied by the pipe manufacturer. Couplings shall conform to ASTM D-3139; SDR-21, 200 psi.

4. All pipe and couplings shall bear identification markings that will remain legible during normal handling, storage and installation, which have been applied in a manner that will not reduce the strength of the pipe or coupling or otherwise damage them. Pipe and coupling markings shall include the normal size and OD base, material code designation, dimension ratio number, ASTM Pressure Class, ASTM designation number for this standard, manufacturer's name or trademark, seal (mark) of the testing agency that verified the suitability of the pipe material for potable-water service. Each marking shall be applied at intervals of not more than 5 feet for the pipe and shall be marked on each coupling.

C. Fittings shall be pressure class 350 ductile iron and have mechanical-joints or push-on joints in accordance with ANSI/AWWA C110/A21.10, latest revision, and shall conform to the details and dimensions shown therein. Fittings shall have interior cement-mortar lining as specified hereinbefore for the pipe. Compact ductile iron fittings meeting the requirements of ANSI/AWWA C153/A21.53, latest revision, will also be acceptable.

D. The basis of acceptance of PVC plastic water main pipe will be a written, notarized certification, accompanied by a copy of test results, that the pipe and pipe material has been sampled, tested and inspected in accordance with the designated standard specifications. These certifications shall be obtained from the manufacturer and delivered to the Engineer’s or Owner’s representative on the project site. A sufficient number of tests and certifications shall be made so as to be representative of the complete project. Copies of the test results shall be kept on file by the manufacturer and shall be available for review by the Engineer or Owner upon request.

E. Pipe shall be visually inspected on the project site for proper markings which shall include manufacturer’s name or trademark, nominal pipe size, pressure rating for water at 73.4 degrees F., plastic pipe material designation code (e.g. PVC 1120), dimension ratio, AWWA or ASTM designation and pressure class with which the pipe complies, and the National Sanitation Foundation NSF 14 Seal of Approval for drinking water.

2.02 DUCTILE IRON PIPE (D.I.P.)

A. AWWA C150/AWWA C151

1. Ductile iron pipe (D.I.P.) shall conform to ANSI/AWWA C150/A21.50, ANSI/AWWA C151/A21.51 Standard. The pipe shall conform to thickness class

350 unless noted otherwise. All pipe, fittings and joints should be capable of accommodating pressure up to 350 psi. Joint restraints required. *SEE SECTION 012500 PRODUCTS & SUBSITITUTIONS.*

2. All pipe shall be tar coated outside and shall receive a standard cement lining with bituminous seal coat on the inside in accordance with ASA Specification A21.40 (AWWA-C104).

3. Cement mortar lining and seal coating for pipe where applicable, shall be in accordance with ANSI/AWWA C104/A21.4. Bituminous outside coating shall be in accordance with ANSI/AWWA C151/A21.51 for pipe and ANSI/AWWA C110/A21.10 for fittings.

4. No separate pay item has been established for fittings and no determination of the number of fittings required on the job has been made. The Contractor, during the bidding phase, shall determine the number of fittings required on the job and include the cost of the fittings and installation in the unit price for pipe.

5. Push-on type joints shall be single rubber gasket, with cast gasket socket and recessed bell with a tapered annular opening and flared socket and shall conform to ANSI/AWWA C111/A21.11. Plain spigot ends shall be suitably beveled to permit easy entry into the bell, centering and compressing the gasket.

6. Ductile iron flanged joint pipe shall conform to ANSI/AWWA C115/A 21.15 Standard and have a Class of 350. The pipe shall have a rated working pressure of 350 psi with Class 125 flanges. Gaskets shall be ring gaskets with a thickness of 1/8-inch. Flange bolts shall conform to ANSI B16.1.

7. Flanged fittings shall meet all requirements of ANSI/AWWA C110/A21.10 and have Class 125 flanges. Fittings shall accommodate a working pressure up to 350 psi and be supplied with all accessories.

8. River crossing pipe shall be ductile iron with ball and socket type joint. The joint shall be boltless with restraint provided by a bayonet-type locking of the retainer over the bell. All pipe components shall be rugged, high strength ductile iron. The barrel is cast of 60-42-10 ductile iron in accordance with American National Standard A21.51. The bell, ball, and retainer are cast of 70-50-05 ductile iron in accordance with the applicable requirements of American National Standard A21.10. The gasket will be of high quality rubber and symmetrical in shape. The first and last section of river crossing pipe shall be furnished with mechanical joint ends suitable for connection to the remaining system piping.

9. Restraint glands or fittings shall be either "Meg-a-Lug" or "Series 100" or "Series 1200" as manufactured by EBBA Iron Sales, Inc., Eastland, Texas.

10. Restrained Joint Pipe:

    a. Restrained joints for 4" through 16" push-on joint pipe installation is required and indicated in the project plans or specifications, restrained push-on joint pipe and fittings utilizing ductile iron components shall be provided.

    b. Restrained joint pipe shall be ductile iron manufactured in accordance with the requirements of ANSI/AWWA C151/A21.51. Push-on joints for such pipe shall be in accordance with ANSI/AWWA C111/A21.11. Pipe

thickness shall be designed in accordance with ANSI/AWWA C150/A21.50, and shall be based on laying conditions and internal pressures as stated in the project plans and specifications. Pipe shall be U.S. Pipe TR FLEX pipe or equal.

c. Restrained joint fittings shall be ductile iron in accordance with applicable requirements of ANSI/AWWA C110/A21.10 with the exception of the manufacturer's proprietary design dimensions. Push-on joints for such fittings shall be in accordance with ANSI/AWWA C111/A21.11. Fittings shall be U.S. Pipe TR FLEX fittings or equal.

d. Cement mortar lining and seal coating for pipe and fittings, where applicable, shall be in accordance with ANSI/AWWA C104/A21.4. Bituminous outside coating shall be in accordance with ANSI/AWWA C151/A21.51 for pipe and ANSI/AWWA C110/A21.10 for fittings.

e. Restrained push-on joints for pipe and fittings shall be designed for a water working pressure of 350 psi in sizes 4" through 24" and 250 psi for sizes 30" through 54".

f. Restrained push-on joint pipe and fittings shall be capable of being deflected after assembly.

2.03 HIGH-DENSITY POLYETHYLENE AWWA C906

A. AWWA C906

1. General: This section is for High-density Polyethylene AWWA C906 and NSF 14 Approved Pipe for Potable Water Service in Sizes 4” to 24” DIPS (Ductile Iron Pipe Size) and defines the characteristics and properties of high-density polyethylene pipe. This specification governs the material, pipe, fittings, butt fusion, and general construction practice for HDPE piping systems.

a. Pipe shall have a hydrostatic design stress rating of 800 psi based on a material with a 1,600 psi at 23^{o} hydrostatic design basis as determined in accordance with ASTM D-2837.

b. Fittings shall be molded or fabricated from material meeting the same standards as the pipe.

c. Joints shall be made by the thermal butt fusion system. All joints shall be completely watertight, airtight and as strong as or stronger than the pipe wall, in strict accordance with the manufacturer's recommendations.

d. Sections of polyethylene pipe shall be joined into continuous lengths on the job site above ground. The joining method shall be the heat fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The heat fusion equipment used in the joining procedures shall be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400^{o}F, alignment, and 150 psi interfacial fusion pressure.

e. Heat fusion joining shall be 100% efficient offering a joint weld strength equal to or greater than the tensile strength of the pipe. Socket fusion shall not be used.

2. References: Where all or part of a Federal, ASTM, ANSI, AWWA, etc., standard specification is incorporated by reference in these Specifications, the reference standard shall be the latest edition and revision and considered a part of these specifications.

3. Material: Materials used for the manufacture of polyethylene pipe and fittings shall be extra high molecular weight, high density PE 3408 polyethylene resin. The material shall be listed by PPI (Plastics Pipe Institute, a division of the Society of the Plastics Industry) in PPI TR-4 with a 73°F hydrostatic design basis of 1,600 psi and a 140°F hydrostatic design basis of 800 psi. The PPI listing shall be in the name of the pipe manufacturer and shall be based on ASTM D 2837 testing.

4. Pipe and Fittings: Qualification of Manufacturers. The Manufacturer shall have manufacturing and quality assurance facilities capable of producing and assuring the quality of the pipe and fittings required by these Specifications. The Manufacturer's production facilities shall be open for inspection by the Owner or his Authorized Representative.

a. Pipe: Pipe supplied under this specification shall have a nominal DIPS (Ductile Iron Pipe Size) OD unless otherwise specified. The DR (Dimension Ratio) and the pressure rating of the pipe supplied shall be as shown on the drawings. The pipe shall be produced from approved HDPE pipe grade resin with the nominal physical properties as specified in the appropriate ASTM specifications for the sizes indicated. Pipe having a diameter 3” and larger will be made to the dimensions and tolerances specified in ASTM F 714.

The pipe shall contain no recycled compound except that generated in the manufacturer’s own plant. The pipe shall be homogeneous throughout and free of visible cracks, holes, voids, foreign inclusions, or other defects that may affect the wall integrity.

b. Pipe Performance: The pipe will be extruded from resin meeting the specifications of ASTM D 3350 with a minimum cell classification of 345464C.

c. Fittings: HDPE fittings shall be in accordance with ASTM D 3261 and shall be manufactured by injection molding, a combination of extrusion and machining, or fabrication from HDPE pipe conforming to this specification. The fittings shall be fully pressure rated and provide a working pressure equal to that of the pipe with an included 2:1 safety factor. The fittings shall be manufactured from the same base resin type and cell classification as the pipe itself. The fittings shall be homogeneous throughout and free from cracks, holes, foreign inclusions, voids, or other injurious defects.

d. Molded Fittings. Molded fittings shall be manufactured and tested in accordance with ASTM D 3261 and shall be so marked. Molded fittings shall be tested in accordance with AWWA C906.

e. X-Ray Inspection. The Manufacturer shall submit samples from each molded fittings production lot to x-ray inspection.

f. Fabricated Fittings. Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock or molded fittings. Fabricated fittings shall be rated for internal pressure service at least equal to the full service pressure rating of the mating pipe. Fabricated fittings shall be tested in accordance with AWWA C906.

g. Polyethylene Flange Adapters. Flange adapters shall be made with sufficient throughbore length to be clamped in a butt fusion-joining machine without the use of a stub-end holder. The sealing surface of the flange adapter shall be machined with a series of small v-shaped grooves (serrations) to promote gasketless sealing, or restrain the gasket against blowout.

5. Joining - Butt Fusion: Sections of polyethylene pipe shall be joined by the butt fusion process into continuous lengths at the job site. The joining method shall be the heat fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The heat fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer. Properly executed electrofusion fittings may be used. Extrusion welding or hot gas welding of HDPE shall not be used for pressure pipe applications or fabrications where shear or structural strength is important. Mechanical joint adapters, flanges, unions, grooved-couplers, transition fittings, and some mechanical couplings may be used to mechanically connect HDPE pipe. Refer to the manufacturer's recommendations.

6. Joining - Other Means: Polyethylene pipe and fittings may be joined together or to other materials by means of (a) flanged connections (flange adapters and back-up rings), (b) mechanical couplings designed for joining polyethylene pipe or for joining polyethylene pipe to another material, (c) MJ Adapters or (d) electrofusion. When joining by other means, the installation instructions of the joining device manufacturer shall be observed.

   a. ID Stiffener and Restraint. A stiffener shall be installed in the bore of the polyethylene pipe when an OD compression mechanical coupling is used and when connecting plain end PE pipe to a mechanical joint pipe, fitting or appurtenance. External clamp and tie rod restraint shall be installed where PE pipe is connected to the socket of a mechanical joint pipe, fitting or appurtenance except where an MJ Adapter is used.

7. Quality and Workmanship: The pipe and/or fitting manufacturer's production facilities shall be open for inspection by the owner or his designated agents with a reasonable advanced notice. During inspection, the manufacturer shall demonstrate that it has facilities capable of manufacturing and testing the pipe and/or fittings to standards required by this specification. Pipe which has been tested by the manufacturer and falls outside of the appropriate limits set forth in this specification will be cause for rejection.

8. QA Records: QA/QC records shall be maintained intact for a minimum of one year from the date of production.

9. Pipe Marking: During extrusion production, the HDPE pipe shall be continuously marked with durable printing including the following information:

Nominal Size
Dimension Ratio
Pressure Class, psi
Manufacturer's Name and Product Series
Cell Class
ASTM Basis
"NSF-PW"
Pipe Test Category
Plant Code & Extruder
Production Date
Operator Number (Shift Letter optional)
Resin Supplier Code

10. Pipe Packaging, Handling, & Storage: The manufacturer shall package the pipe in a manner designed to deliver the pipe to the project neatly, intact, and without physical damage. The transportation carrier shall use appropriate methods and intermittent checks to insure the pipe is properly supported, stacked, and restrained during transport such that the pipe is not nicked, gouged, or physically damaged. Pipe shall be stored on clean, level ground to prevent undue scratching or gouging. If the pipe must be stacked for storage, such stacking shall be done in accordance with the pipe manufacturer's recommendations. The pipe shall be handled in such a manner that it is not pulled over sharp objects or cut by chokers or lifting equipment. Sections of pipe having been discovered with cuts or gouges in excess of 10% of the pipe wall thickness shall be cut out and removed. The undamaged portions of the pipe shall be rejoined using the heat fusion joining method. Fused segments of pipe shall be handled so as to avoid damage to the pipe. Chains or cable type chokers must be avoided when lifting fused sections of pipe. Nylon slings are preferred. Spreader bars are recommended when lifting long fused sections.

11. Testing:

    a. Fusion Quality. The Contractor shall ensure the field set-up and operation of the fusion equipment, and the fusion procedure used by the Contractor's fusion operator while on site. Upon request by the Owner, the Contractor shall verify field fusion quality by making and testing a trial fusion. The trial fusion shall be allowed to cool completely; then test straps shall be cut out and bent strap tested in accordance with ASTM D 2657. If the bent strap test of the trial fusion fails at the joint, the field fusions represented by the trial fusion shall be rejected. The Contractor at his expense shall make all necessary corrections to equipment, set-up, operation and fusion procedure, and shall re-make the rejected fusions.

    b. Hydro-Test: Pipelines shall be tested to the requirements and specifications of the engineer of record. HDPE pressure pipe shall be tested in accordance with the specifications and requirements of the engineer of record and/or with the manufacturer's recommendations. The pressure rating of the pipe is a function of temperature at the time of hydro-test. Refer to the manufacturer's temperature related pressure ratings. At a minimum and if not specified elsewhere, hydro-test the piping system at 1.5 times the pressure rating of the pipe for 2 to 3 hours per Driscopipe Technical Note #35. If a system component such as a fabricated or mechanical fitting has a pressure rating less than that of the

pipe, the piping system should be pressure tested to manufacturer's guidelines on that component.

2.04 COUPLING AND ADAPTORS

A. Flexible couplings shall be of the sleeve type with a middle ring, two wedge shaped resilient gaskets at each end, two follower rings, and a set of steel track head bolts. The middle ring shall be flared at each end to receive the wedge portion of the gaskets. The follower rings shall confine the outer ends of the gaskets, and tightening of the bolts shall cause the follower rings to compress the gaskets against the pipe surface, forming a leak-proof seal. Flexible couplings shall be steel with minimum wall thickness of the middle ring or sleeve installed on pipe being 5/16-inch for pipe smaller than 10 inches, 3/8-inch for pipe 10 inches or larger. The minimum length of the middle ring shall be 5-inches for pipe sizes up to 10 inches and 7 inches for pipe 10 inches to 30 inches. The pipe stop shall be removed. Gaskets shall be suitable for 250 psi pressure rating or at rated working pressure of the connecting pipe. Couplings shall be harnessed and be designed for 250 psi.

B. Flanged adapters shall have one end suitable for bolting to a pipe flange and the other end of flexible coupling similar to that described hereinbefore. All pressure piping with couplings or adapters shall be harnessed with full threaded rods spanning across the couplings or adapters. The adapters shall be furnished with bolts of an approved corrosion resistant steel alloy, extending to the adjacent pipe flanges. Flanges on flanged adapter (unless otherwise indicated or required) shall be faced and drilled ANSI B16.1 Class 125.

C. Flexible couplings and flanged adapters shall be as manufactured by Dresser, Rockwell, or equal, per the following, unless otherwise specified and/or noted on the Drawings:

D. Steel couplings for joining same size, plain-end, steel, cast iron, and PVC plastic pipe.

Dresser	Rockwell
Style 138	4ll

E. Transition couplings for joining pipe of different outside diameters-

Dresser	Rockwell
Style 162 (4"-12")	413 steel (2"-24")
Style 62 (2"-24")	415 steel (6"-48")
	433 cast (2"-16")
	435 cast (2"-12")

F. Flanged adapters for joining plain-end pipe to flanged pipe, fittings, valves and equipment.

Dresser	Rockwell
Style 127 cast (3"-12")	912 cast (3"-12")
Style 128 steel (3"-48" C.I. Pipe)	913 steel (3" and larger)
Style 128 steel (2"-96" steel pipe)	

2.05 DETECTABLE UNDERGROUND UTILITY WARNING TAPES

A. Detectable underground utility warning tapes which can be located from the surface by a pipe detector shall be installed directly above nonmetallic (PVC, polyethylene, concrete) pipe.

B. The tape shall consist of a minimum thickness 0.35 mils solid aluminum foil encased in a protective inert plastic jacket that is impervious to all know alkalis, acids, chemical reagents and solvents found in the soil.

C. The minimum overall thickness of the tape shall be 5.5 mils and the width shall not be less than 2" with a minimum unit weight of 2-1/2 pounds/1" x 1,000'. The tape shall be color coded and imprinted with the legend as follows:

Type of Utility	Color Code	Legend
Water	Blue	Caution Buried Water Line Below

D. Detectable underground tape shall be “Detect Tape” as manufactured by Allen Systems, or equal.

E. Installation of detectable tapes shall be per manufacturer’s recommendations and shall be as close to the grade as is practical for optimum protection and detectability. Allow a minimum of 18" between the tape and the line.

F. Payment for detectable tapes shall be included in the linear foot price bid of the appropriate bid item(s) unless it is listed as a separate payment item in the bid schedule.

2.06 TRACER WIRE

A. Tracer wire shall be 12 gauge copper wire with 30-mil polyethylene jacket. Tracer wire shall be installed with all buried piping, “duct” taped to top of pipe.

B. Split Bolt connectors are required when connecting two (2) pieces of tracer wire. Wire and connector shall be wrapped with electrical tape.

C. Tracer wire shall be brought up into locator boxes with grounding devices. Locator boxes shall be valve boxes with a polystyrene donut that fits around the box to serve as a termination point for tracer wire. Locator boxes shall be installed at a maximum of 3000 linear feet apart, or where shown on the Drawings.

D. Payment for tracer wire and boxes shall be included in the linear foot price bid of the appropriate bid item(s) unless it is listed as a separate payment item in the bid schedule

2.07 CONCRETE PIPE ANCHORS, THRUST BLOCKS, CRADLE OR ENCASEMENT

A. Where indicated on the Drawings, required by the Specifications or as directed by the Engineer, concrete pipe anchors, thrust blocks, cradles or encasements shall be installed.

B. Concrete shall be 3,500 psi, and reinforcing bars shall be installed as indicated on the details.

2.08 CONNECTION OF NEW WATER MAINS TO EXISTING SYSTEM

A. The Contractor shall connect the new water main to existing water main where shown on the Drawings or directed by the Engineer, and shall furnish all necessary equipment and materials required to complete the connection.

2.09 POLYETHYLENE (PE) TUBING

A. Customer service tubing, sizes 3/4-inch and 1-inch, shall be Polyethylene (PE) DR-9 (200 psi) and conform to AWWA C901, ASTM F 741 with a pipe designation of PE 3408 defined per ASTM D 3035 for IPS sizes and ASTM D 2737 for CTS sizes.

2.10 CUSTOMER SERVICE RELOCATIONS AND RE-CONNECTIONS

Where water service lines are disturbed, the Contractor shall reconnect the existing service line to the new water main. The Contractor shall furnish and install the necessary piping, couplings, fittings, etc. necessary to complete the service line re-connection.

A. Service Lines Not Crossing a Road

1. Unless indicated otherwise on the plans, all service lines shall be of PE tubing.
2. Water service connections shall be made in accordance with the details shown on the Drawings and/or set forth herein. Locations of the various sizes shall be as directed by the Engineer and as shown on the Drawings.

B. Service Lines Crossing a County Road or City Streets

1. Same as subparagraph A, except that in general all pipe may be jacked beneath certain paved or blacktopped city streets or county roads, unless solid rock prevents using this method in which case, the open trench method will be used. Schedule 40 steel pipe shall be used as casing pipe unless otherwise indicated by the plans. The open trench method generally will be used on all unpaved city streets, county roads and private driveways. In general, blacktopped private driveways shall also be jacked under. In all cases where lines are under traffic, a minimum cover of thirty-six (36) inches shall be provided. All backfill shall be compacted by air tampers in layers no greater than 6-inch depth. Specific instructions as to the type of crossing to be installed will be shown on the plans.

C. Service Lines Crossing a State Highway

1. Services shall be jacked or pushed under paving. If solid rock is encountered, trench will be open-cut, pipe placed and backfilled all in accordance with current requirements of the State Highway Department or the crossing will be relocated to permit boring or jacking. Specific details will be shown on the plans. Where required on the plans or by the ENGINEER service pipe shall be encased under highways. Schedule 40 steel pipe shall be used as casing pipe unless otherwise indicated by the plans.

D. Existing Galvanized Iron Services

1. All galvanized services are to be replaced in their entirety, including service piping from the main to the meter, corporation stops, water meters, meter setters, meter boxes, and service piping five (5) feet past the meter. Service connections shall be made in accordance with the details shown on the Drawings and/or set forth herein.

2.11 CORPORATION STOPS AND FITTINGS FOR HOUSE SERVICE RECONNECTIONS

A. Corporation stops, of the size required, shall be tapped directly into the water main for Ductile Iron Pipe or by the use of a tapping saddle for PVC pipe.

B. Corporation stops shall have AWWA C800-66 C.S. threaded inlet. Outlets shall be suitable for the type of service piping furnished and laid, and the Contractor shall verify compatibility with "iron pipe size" or "copper tubing size" service piping as required before ordering stops.

C. Corporation stops shall match the listed manufacturer listed in SECTION 012500 – PRODUCTS & SUBSTITUTIONS or Owner and Engineer approved equal.

D. Fittings shall be brass.

PART 3 - EXECUTION

3.01 EXCAVATION FOR PIPELINE TRENCHES

A. Unless otherwise directed by the Engineer, trenches in which pipes are to be laid shall be excavated in open cut to the depths required by field conditions or as specified by the Engineer. In general this shall be interpreted to mean that machine excavation in earth shall not extend below an elevation permitting the pipe to be properly bedded. Installation shall be in accordance with ANSI/AWWA C600 for ductile iron and Cast Iron O.D. (AWWA) PVC pipe or ASTM F-645 for Iron Pipe O.D. (ASTM) PVC pipe except as modified herein.

B. If the foundation is good firm earth and the machine excavation has been accomplished as set out hereinbefore, the remainder of the material shall be excavated by hand, then the earth pared or molded to give full support to the lower quadrant of the barrel of each pipe. Where bell and spigot is involved, bell holes shall be excavated during this latter operation to prevent the bells from being supported on undisturbed earth. If for any reason the machine excavation in earth is carried below an excavation that will permit the type of bedding specified above, then a layer of granular material shall be placed so that the lower quadrant of the pipe will be securely bedded in compact granular fill.

C. Excavation may be undercut to a depth below the required invert elevation that will permit laying the pipe in a bed of granular material to provide continuous support for the bottom quadrant of the pipe. When this method is used, the bedding shall be as set out in Paragraph 3.02 hereinafter.

D. Trenches shall be of sufficient width to provide free working space on each side of the pipe and to permit proper backfilling around the pipe, but unless specifically authorized by the Engineer, trenches shall in no case be excavated or permitted to become wider then 2'-0" plus the nominal diameter of the pipe at the level of or below the top of the pipe. If the trench does become wider than 2'-0" at the level of or below the top of the pipe, special precaution may be necessary, such as providing compacted, granular fill up to top of the pipe or providing pipe with additional crushing strength as determined by the Engineer after taking into account the actual trench loads that may result and the strength of the pipe being used. The Contractor shall bear the cost of such special precautions as are necessary.

E. All excavated materials shall be placed a minimum of two feet (2') back from the edge of the trench.

F. Before laying the pipe, the trench shall be opened far enough ahead to reveal obstructions that may necessitate changing the line or grade of the pipeline.

G. The trench shall be straight and uniform so as to permit laying pipe to lines and grades given by the Engineer. It shall be kept free of water during the laying of the pipe and until the pipeline has been backfilled. Removal of trench water shall be at the Contractor's expense. Dry conditions shall be maintained in the excavations until the backfill has been placed. During the excavation, the grade shall be maintained so that it will freely drain and prevent surface water from entering the excavation at all times. When directed by Owner, temporary drainage ditches shall be installed to intercept or direct surface water which may affect work. All water shall be pumped or drained from the excavation and disposed of in a suitable manner without damage to adjacent property or to other work.

H. Minimum cover of 30" shall be provided for all pipelines, except those located in the State Highway Right of Way. Those shall have a minimum cover of 42”.

3.02 PIPE BEDDING

A. All pipe shall be supported on a bed of granular material, unless the trench has been prepared in accordance with Paragraph 3.1B. In no case shall pipe be supported directly on rock. Bedding shall not be a separate pay item unless otherwise set out in the Detailed Specifications. Bedding shall be provided in earth bottom trenches, as well as rock bottom trenches. Bedding material shall be free from large rock, foreign material, frozen earth, and shall be acceptable to the Engineer. Bedding shall be a minimum of 6" below pipe barrel.

B. In all cases the foundation for pipes shall be prepared so that the entire load of the backfill on top of the pipe will be carried on the barrel of the pipe so that none of the load will be carried on the bells.

C. Where flexible pipe is used, the bedding shall be placed up to at least the spring line (horizontal center line) of the pipe. The bedding material and procedures shall conform to ASTM D 2321 and any Technical Specifications set out hereinafter. If conditions warrant, the Engineer may require the bedding to be placed above the spring-line of the pipe. Granular bedding shall be Size #9-m or ASTM C 33, Size #7 crushed stone, fine gravel, or sand, and is not a separate pay item.

D. Where undercutting and granular bedding is involved it shall be of such depth that the bottom of the bells of the pipe will be at least three inches above the bottom of the trench as excavated. Undercutting is not a separate pay item.

E. In wet, yielding mucky locations where pipe is in danger of sinking below grade or floating out of line or grade, or where backfill materials are of such a fluid nature that such movements of the pipe might take place during the placing of the backfill, the pipe must be weighted or secured permanently in place by such means as will prove effective. When ordered by the Engineer, yielding and mucky materials in subgrades shall be removed below ordinary trench depth in order to prepare a proper bed for the pipe. Crushed stone or other such granular material, if necessary, as determined by the Engineer to replace poor subgrade material, shall be a separate pay item and classified as "Special Granular Fill". Removal of poor material is not a separate pay item.

F. Installation shall be in accordance with ASTM D 2321 except as modified hereinafter.

3.03 SPECIAL GRANULAR FILL

A. As noted in Paragraph 3.2E, granular material for "Special Granular Fill" when directed by the Engineer shall be Department of Transportation crushed limestone, Size #57. Payment for "Special Granular Fill" must have approval from the Engineer prior to installation.

3.04 LAYING PIPE

A. The laying of pipe in finished trenches shall be commenced at the lowest point so the spigot ends point in the direction of flow.

B. All pipes shall be laid with ends abutting and true to line and grade as given by the Engineer. Supporting of pipes shall be as set out hereinbefore under "Pipe Bedding" and in no case shall the supporting of pipes on blocks be permitted.

C. Before each piece of pipe is lowered into the trench, it shall be thoroughly inspected to insure that it is clean. Each piece of pipe shall be lowered separately unless special permission is given otherwise by the Engineer. No piece of pipe or fitting which is known to be defective shall be laid or placed in the lines. If any defective pipe or fitting shall be discovered after the pipe is laid, it shall be removed and replaced with a satisfactory pipe or fitting without additional charge. In case a length of pipe is cut to fit in a line it shall be so cut as to leave a smooth end at right angles to the longitudinal axis of the pipe.

D. Pipe shall not be laid on solid rock. A pad of granular material as specified in Paragraph 3.02 "Pipe Bedding", shall be used as a pipe bedding. Pipe bedding is not a separate pay item. Irregularities in subgrade in an earth trench shall be corrected by use of granular material.

E. When ordered by the Engineer, unsuitable materials in subgrades shall be removed below ordinary trench depth in order to prepare a proper bed for the pipe.

F. When laying of pipe is stopped for any reason, the exposed end of such pipe shall be closed with a plywood or fabricated plug fitted into the pipe bell, so as to exclude earth or other material, and precautions taken to prevent flotation of pipe by runoff into trench.

G. No backfilling (except for securing pipe in place) over pipe will be allowed until the Engineer has had an opportunity to make an inspection of the joints, alignment and grade, in the section laid.

3.05 BACKFILLING PIPELINE TRENCHES

A. Backfilling of pipeline trenches shall be accomplished as shown on the Drawings and with details set forth hereinafter. Before final acceptance, the Contractor will be required to level off all trenches or to bring the trench up to grade. The Contractor shall also remove from roadways, rights-of-way and/or private property all excess earth or other materials resulting from construction. In the event that pavement is not placed immediately following trench backfilling in paved areas, the Contractor shall be responsible for maintaining the trench surface in a level condition at proper pavement grade at all times. Under pavement, all trench backfill shall be in accordance with Method C as shown on the Detail Drawings. All other trench backfill shall be in accordance with Method A or B.

B. Method "A" - Backfilling in Open Terrain:

Backfilling of pipeline trenches in open terrain shall be accomplished in the following manner:

1. The lower portion of the trench, from the pipe bedding to a point 12" above the top of the pipe, shall be backfilled with material free from rock and/or material acceptable to the Engineer. This material shall be placed in a manner approved by the Engineer, and shall be carefully compacted to avoid displacement of the pipe. Compaction shall be accomplished by hand-tamping or by approved mechanical methods.
2. The upper portion of the trench above the compacted portion shall be backfilled with material which is free from large rock. Incorporation of rock having a volume exceeding one-half cubic foot is prohibited. Backfilling this portion of the trench may be accomplished by any means approved by the Engineer. The trench backfill shall be heaped over or leveled as directed by the Engineer.

C. Method "B" - Backfilling Under Sidewalks & Unpaved Driveways:

Backfilling of pipeline trenches under sidewalks and unpaved driveways shall be accomplished in the following manner.

1. The lower portion of the trench, from the pipe bedding to a point 12 inches above the top of the pipe, shall be backfilled with material free from rock and/or material acceptable to the Engineer. This material shall be placed in a manner to avoid displacement of the pipe. Compaction shall be accomplished by hand-tapping or by approved mechanical methods.
2. The middle portion of the trench, from a point 12" above the top of the pipe to a point 6" below the grade line, shall be backfilled with material free from rock and/or acceptable to the Engineer. This material shall be placed and compacted in layers of approximately 6 inches. Water (puddling) may be used as required to obtain maximum compaction.

    a. Upon approval of the Engineer, the Contractor may backfill the middle portion of the trench with crushed stone, fine gravel, or sand in lieu of materials which require compaction.

3. The upper portion of the trench shall be temporarily backfilled and maintained with crushed stone or gravel until such time as the sidewalk is constructed or the driveway surface is restored.

D. Method "C" - Backfilling Under Streets, Roads, and Paved Driveways:

Backfilling of pipeline trenches under streets, roads and paved driveways shall be accomplished in the following manner:

1. The lower portion of the trench from the pipe bedding to a point 6" below the bottom of the pavement or concrete sub-slab, shall be backfilled with # 9 crushed stone.
2. The upper portion of the trench, from a point 6" below the bottom of the pavement or concrete sub-slab to grade, shall be backfilled with a base course of dense graded aggregate. At such time that pavement replacement is accomplished, the excess base course shall be removed as required.

E. Trenches outside existing sidewalks, driveways, streets, and highways shall be backfilled in accordance with Method "A". Trenches within the limits of sidewalk and unpaved driveways shall be backfilled in accordance with Method "B". Trenches within the paving limits of existing streets, highways and driveways shall be backfilled in accordance with Method "C". All methods are shown on the Detail Drawings. When directed by the Engineer, the Contractor shall wet backfill material to assure maximum compaction.

1. Before final acceptance, the Contractor will be required to level off all trenches or to bring the trench up to grade. The Contractor shall also remove from roadways, rights-of-ways and/or private property all excess earth or other materials resulting from construction.
2. In the event that pavement is not placed immediately following trench backfilling in streets and highways, the Contractor shall be responsible for maintaining the trench surface in a level condition at proper pavement grade at all times.

3.06 SETTLEMENT OF TRENCHES

A. Whenever lines are in, or cross, driveways and streets, the Contractor shall be responsible for any trench settlement which occurs within these rights-of-way within one (1) year from the time of final acceptance of the work. If paving shall require replacement because of trench settlement within this time, it shall be replaced by the Contractor at no extra cost to the Owner. Repair of settlement damage shall meet the approval of the Owner.

3.07 CONCRETE THRUST BLOCKS, CRADLE, ANCHORS OR ENCASEMENT

A. Concrete thrust blocks, cradle, anchors or encasement shall be placed where shown on the Drawings, required by the Specifications, or as directed by the Engineer.

B. For cradle and encasement, concrete shall be 3000 psi and shall be mixed sufficiently wet to permit it to flow under the pipe to form a continuous bed.

C. For thrust blocks and anchors, concrete shall be 3000 psi, and shall be formed or be sufficiently stiff to maintain the forms indicated on the Details.

D. In tamping concrete, care shall be taken not to disturb the grade or line of the pipe or injure the joints. Concrete placed outside the specified limits or without authorization from the Engineer will not be subject to payment.

E. Water mains shall have concrete thrust or “kicker” blocks at all pipe intersections and changes of direction to resist forces acting on the pipeline. All reducers (increasers) shall be anchored.

3.08 BITUMINOUS CONCRETE HIGHWAY, STREET AND DRIVEWAY REPLACEMENT

A. The Contractor shall replace those sections of existing roads, streets and driveways required to be removed to install the pipe lines under this contract. He shall construct same to the original lines and grades and in such manner as to leave all such surfaces in fully as good or better condition than that which existed prior to the operations.

B. Prior to trenching, the pavement shall be scored or cut to straight edges at least twelve (12) inches outside each edge of the proposed trench to avoid unnecessary damage to the remainder of the paving. Edges of the existing pavement shall be re-cut and trimmed to square, straight edges after the pipeline has been installed and prior to placing the new base and pavement.

C. Backfilling of the trench shall be in accordance with Method "C" as described hereinbefore. Base course for the paving shall be dense graded crushed limestone furnished and placed in accordance with the current requirements of the Standard Specifications for Road and Bridge Construction of the Department of Transportation, to a depth of six (6) inches in roads and streets and four (4) inches in driveways.

D. A sub-slab of reinforced concrete shall be placed for state-maintained highways as indicated on the Drawings. The sub-slab shall have a minimum thickness of 6 inches. Concrete for the sub-slab shall be 3000 psi, in accordance with the Details shown on the Drawings.

3.09 UNPAVED DRIVEWAY (CRUSHED STONE) SURFACE REPLACEMENT

A. The Contractor shall replace those sections of existing driveways and parking areas required to be removed to install the pipe lines under this contract. He shall construct same to the original lines and grades and in such manner as to leave all such surfaces in fully as good or better condition than that which existed prior to the operations.

B. Material for backfilling of the pipeline trench shall be dense-graded aggregate in accordance with Method “B” as described hereinbefore.

3.10 REMOVING AND REPLACING CONCRETE CURB AND GUTTER OR SIDEWALK

A. The Contractor shall remove the curb and gutter or sidewalk when encountered when required for laying the pipe. Only that portion of the curb and gutter or sidewalk needed to lay the pipe shall be removed.

B. Where concrete curb and gutter or sidewalk is removed or disturbed during the construction work, it shall be replaced, using 3000 psi concrete, in fully as good or better condition than that which existed prior to the Contractor's operation.

3.11 REPLACEMENT OF EXISTING MAIL BOXES, CULVERTS, CLOTHES LINE POSTS, FENCES AND OTHER SUCH FACILITIES

A. Existing mail boxes, drainage culverts, clothes line posts, fences and the like shall not be damaged or disturbed unless necessary, in which case, they shall be replaced in as good condition as found as quickly as possible. Existing materials shall be reused in replacing such facilities when materials have not been damaged by the Contractor's operations. Existing facilities damaged by Contractor's operation shall be replaced with new materials of the same type at the Contractor's expense. Work in this category is not a pay item.

B. Replacement of paved drainage ditches within highway right-of-way shall be accomplished in accordance with Department of Transportation specifications.

3.12 PORTLAND CEMENT CONCRETE DRIVEWAY REPLACEMENT

A. Wherever Portland cement concrete driveways are removed, they shall be reconstructed to the original lines and grades and in such manner as to leave all such surfaces in fully as good or better condition than existed prior to the operation.

B. The existing concrete paving shall be sawed or cut to straight edges 12-inches outside the edges of the trench or broken out to an existing joint, as directed by the Engineer. The concrete pavement shall be equal to the existing pavement thickness but not less than 6-inches in thickness for driveways.

C. Pavement shall be reinforced with 6 x 6 #10-10 wire mesh and shall be constructed with 3000 psi concrete.

3.13 RIP-RAP STREAM BANK SLOPE PROTECTION

A. The Contractor shall install rip-rap stream bank slope protection at locations directed by the Engineer. Rip-rap slope protection shall be 12-inches thick and shall meet State D.O.T. Standard Specifications.

3.14 TESTING

A. All pressure piping (lines not laid to grade) shall be given a hydrostatic test of at least 1.5 times the normal operating pressure of the pipe (at its lowest elevation), but not to exceed the rated working pressure of the pipe or valves. Note: Engineer shall verify test pressure. Loss of pressure during the test shall not exceed 0 psi in a 4 hour period and 5 psi in a 24 hour period. Any test results that do not meet either of these requirements shall constitute a failure of the pressure test.

B. Leakage in pipelines, when tested under the hydrostatic test described above, shall not exceed 10 gallons per 24 hours per inch of diameter per mile of pipe.

C. Contractor shall furnish a recording gauge and water meter for measuring water used during leakage test and recording pressure charts during duration of test. Recording pressure charts shall be turned over to the Engineer at conclusion of tests. The pressure recording device shall be suitable for outside service, with a range from 0-200 psig, 24-hour spring wound clock, designed for 9-inch charts, and shall be approved by the Engineer.

D. Pipelines shall be tested before backfilling at joints except where otherwise required by necessity or convenience.

E. Duration of test shall be not less than four (4) hours where joints are exposed and not less than 24 hours where joints are covered.

F. Where leaks are visible at exposed joints, evident on the surface where joints are covered, and/or identified by isolating a section of pipe, the joints shall be repaired and leakage must be minimized, regardless of total leakage as shown by test.

G. All pipe, fittings, valves, and other materials found to be defective under test shall be removed and replaced at no additional expense to the Owner.

H. Lines which fail to meet tests shall be repaired and retested as necessary until test requirements are complied with.

I. Where nonmetallic joint compounds are used, pipelines should be held under normal operating pressure for at least three days before testing.

J. The Owner will provide initial water for testing the pressure piping. Should the first test fail to pass, all additional water required for subsequent tests shall be furnished at the Contractor's expense.

K. The cost of testing of pressure piping is incidental and is to be included in the Contractor’s unit Contract Price.

3.15 CLEAN UP

A. Upon completion of installation of the piping and appurtenances, the Contractor shall remove all debris and surplus construction materials resulting from the Work. The

Contractor shall grade the ground along each side of pipe trenches in a uniform and neat manner leaving the construction area in a shape as near as possible to the original ground line.

3.16 DISINFECTION OF POTABLE WATER LINES

A. The new potable waterlines shall not be placed in service--either temporarily or permanently--until they have been thoroughly disinfected in accordance with AWWA Standard C651-05, 2005 and to the satisfaction of the Engineer.

B. After testing, a solution of hypochlorite using HTH or equal shall be introduced into the section of the line being disinfected sufficient to insure a chlorine dosage of at least 50 ppm in the main. While the solution is being applied, the water should be allowed to escape at the ends of the line until tests indicate that a dosage of at least 50 ppm has been obtained throughout the pipe. Open and close all valves and cocks while chlorinating agent is in the piping system. The chlorinated water shall be allowed to remain in the pipe for 24 hours, after which a residual of at least 25 ppm shall be obtained. The disinfection shall be repeated until 25 ppm is obtained after which time the main shall be thoroughly flushed until the residual chlorine content is not greater than 1.0 ppm, and then may be connected to the system. Also, no additional payment will be allowed for providing taps for chlorine injection and/or flushing, if necessary. The Contractor is responsible for the disposal of highly chlorinated water flushed from the main.

C. The new water line shall not be put into service until bacteriological samples taken at the points specified herein are examined and shown to be negative after disinfection, following the requirements of “Standard Methods for Examination of Water and Wastewater”. Two consecutive sets of acceptable samples, taken at least 24 hours apart shall be collected from the new line. Samples are to be taken and tested at every 1200 feet of new water line, at each branch and at each dead end.

D. If trench water has entered the pipe, or excessive quantities of dirt or debris have entered the pipe, samples shall be taken at intervals of approximately 200 feet and the locations identified. Samples shall be taken of water that has stood in the new line for at least 16 hours after flushing is completed.

E. If the initial disinfection does not produce satisfactory bacteriological results, the new line shall be re-flushed and resampled. If samples fail, the line shall be rechlorinated by the continuous-feed or slug method until satisfactory results are obtained.

F. All testing documentation shall be submitted to the Owner.

- END OF SECTION -

SECTION 331419

VALVES & HYDRANTS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Provide all labor, materials, equipment and services required for furnishing and installing all hydrants and appurtenances specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. SECTION 016100 – OWNER PRODUCT REQUIREMENTS

B. SECTION 312200 – GRADING

C. SECTION 331413 – WATER DISTRIBUTION PIPING

1.03 SUBMITTALS

A. Submit shop drawings and product data in accordance with DIVISION 01 of this specification.

B. Descriptive literature, catalog cuts, and dimensional prints clearly indicating all dimensions and materials of construction, shall be submitted on all items specified herein to the Engineer for review before ordering.

C. At the time of submission, the Contractor shall, in writing, call Engineer's attention to any deviations that the submittals may have from the requirements of the Engineer's Contract Drawings & Specifications.

PART 2 - PRODUCTS

2.01 FLUSHING HYDRANTS

A. The Contractor shall furnish and install fire hydrants and auxiliary gate valves where shown on the Drawings or directed by the Engineer. Hydrants shall conform in all respects to the most recent requirements of AWWA C502. Hydrant barrel shall have safety breakage feature above the ground line. All flushing hydrant, type 1 shall have 6-inch mechanical joint shoe connection, two (2) 2-1/2-inch discharge nozzles, and one (1) 4 1/2-inch pumper nozzle with rubber gasketed caps fitted with cap chains. All Flushing Hydrant, Type 2 shall have a 6-inch mechanical joint shoe connection and two (2) 2-1/2-inch discharge nozzles with rubber gasketed caps fitted cap chains. Cap nuts are to be five (5) sided. Connection threads shall be National Standard Thread. Main valve shall have 5-1/4-inch full opening and be of the compression type opening against water pressure so that valve remains closed should barrel be broken off.

B. Hydrants shall be fully bronze mounted. Main valve shall have a threaded bronze seat ring assembly of such design that it is easily removable by unscrewing from a threaded bronze drain ring. Bronze drain ring shall have multiple ports providing positive automatic

drainage as the main valve is opened or closed. Drainage waterways shall be completely bronze to prevent rust and corrosion.

C. The operating nut shall be five (5) sided bronze or bronze with a five (5) sided ductile iron cap, and mounted so that a counter clockwise motion will open the valve. There must be cast on top an arrow and the word “Open” indicating the direction of turn to open the hydrant.

D. Operating stem shall be equipped with anti-friction thrust bearing to reduce operating torque and assure easy opening. Stop shall be provided to limit stem travel. Stem threads shall be enclosed in a permanently sealed lubricant reservoir protected from weather and the waterway with O-ring seals.

E. Hydrants shall be shop tested to 300 psi pressure with main valve both opened and closed. Under test the valve shall not leak, the automatic drain shall function and there shall be no leakage into the bonnet.

F. Type of shoe connection shall be mechanical joint and size shall be six inches (6").

G. Hydrants shall be given two (2) coats of enamel high visibility paint to be selected by the Owner.

H. Hydrants shall be provided as described in DIVISION 01.

2.02 GATE VALVES

A. Gate valves shall conform with AWWA C-509 standard, and shall be of the resilient seat type, iron body, fully bronze mounted, non-rising stem and have a design working pressure of 250 psi. All assembly bolts shall be stainless steel. Valves shall be of standard manufacturer and of the highest quality both as to materials and workmanship.

B. All gate valves shall be furnished with mechanical joint connections, unless otherwise shown on the Drawings or specified hereinafter.

C. An epoxy coating conforming to AWWA C-550 shall be applied to the interior and exterior ferrous surfaces of the valve except for finished or seating surfaces.

D. All gate valves shall have the name or monogram of the manufacturer, the year the valve casting was made, the size of the valve, and the working water pressure cast on the body of the valve.

E. Gate valves 12” and smaller shall be installed in a vertical position. Gate valves greater than 12” shall have the bonnet mounted in the horizontal position and have a bevel gear actuator. Gate valves shall be provided with a 2-inch square operating nut and shall be opened by turning to the left (counter-clockwise). All valve operating nuts shall be set within a cast iron valve box. There shall be a maximum 48" depth of valve operating nut. Contractor must use extension stems, if necessary, to raise operator nut within 48" of final grade.

2.02 GATE VALVES - BURIED

A. Gate valves shall conform to the Specifications of Section 331219, Paragraph 2.2, except be designed for buried service, have mechanical joint ends, have all exterior surfaces shop painted with two coats of Fed. Spec. TT-V-51F Asphalt Varnish, with 2-inch square nut operator in a vertical position for use in a valve box.

2.03 VALVE BOXES - BURIED VALVES

A. Valve boxes shall be of 5-1/4-inch standard cast iron, two-piece, screw type valve box with drop cover marked "WATER", "SEWER", "DRAIN", as applicable. Valve boxes for gate valves larger than 8 inches shall be three-piece. Valve boxes shall be accurately centered over valve operating nut, and backfill thoroughly tamped about them. Valve boxes shall not rest on the valves but shall be supported on crushed stone fill. They shall be set vertically and properly cut and/or adjusted so that the tops of boxes will be at grade in any paving, walk or road surface, and in grass plots, fields, woods or other open terrain. Valve boxes and covers shall be as manufactured by Tyler Corporation, Opelika Foundry, Bingham & Taylor, or equal.

B. Wherever valve boxes fall outside of the pavement, the top of the box shall be set in a cast-in-place concrete slab 24” x 24” x 6” thick with the top of the slab and box flush with the top of the ground. This provision shall apply to all new and all existing valve boxes which fall within the limits of the contract, unless otherwise stated on the plans or ordered by the Engineer.

2.04 TAPPING SLEEVES AND VALVES

A. DI tapping sleeves for use in connections to existing water lines, where indicated on the drawings or as directed by the Engineer, shall be constructed of ductile iron conforming to the requirements of ASTM A-536, and have the body of the tapping sleeve seal around the carrier pipe by use of mechanical joints on each end. Tapping outlet connections shall be flanged with drillings in accordance with ANSI class 125#/150#. Tapping sleeves shall be suitable for working pressures of 250 psi and shall be Mueller No. H-615, American Valve and Hydrant No. 2800-C, or approved equal.

B. SST tapping sleeves for use in connections to existing water lines, where indicated on the drawings or as directed by the Engineer, shall have the body and neck constructed of ASTM A-240 type 304 stainless steel and shall be compressed to the carrier pipe by use of heavy gauge triangular sidebars running the length of the body. Bolts, nuts and washers shall be constructed of type 304 stainless steel. The gasket between the tapping sleeve and carrier pipe shall be constructed of Buna N rubber and be NSF 61 approved. The gasket shall have a grid pattern to help secure it in place and have seal around the full circumference of the pipe. Tapping outlet connections shall be constructed of ductile iron conforming to ASTM A-536 and have either a mechanical joint connection conforming to AWWA C-111, or a flanged connection with drillings in accordance with ANSI class 125#/150#. Tapping Sleeves shall be suitable for the following working pressures: 4”-12” 250 psi, 14”-24” 200 psi and shall be Mueller No. H-304, Romac Industries SST III, or approved equal.

C. Tapping valves shall meet the requirements of paragraph 2.1 hereinbefore and shall be coordinated to connect to the tapping sleeve with either a flanged end or a mechanical joint end.

D. All existing water mains to be tapped under this contract shall be exposed in order to verify line sizes prior to ordering tapping sleeves and valves.

PART 3 - EXECUTION

3.01 SETTING OF FIRE HYDRANTS

A. Location:

1. Hydrants shall be located as shown or as directed so as to provide complete accessibility and minimize the possibility of damage from vehicles or injury to pedestrians.
2. When placed behind the curb, the hydrant barrel shall be set so that the pumper or hose nozzle cap will be a minimum of five feet (5') from the back of curb.
3. When set in the lawn space between the curb and the sidewalk or between the sidewalk and the property line, no portion of the hydrant or nozzle cap shall be within six inches (6") of the sidewalk.

B. Position:

1. All hydrants shall be set plumb with not less than two (2) cubic feet of crushed stone and shall have their nozzles parallel with the roadway, with the pumper nozzle facing toward the roadway. Hydrants shall be set to the established grade, with nozzles at least eighteen inches (18") above the ground, as shown or as directed by the Engineer.

C. Connection to Main:

1. Each hydrant shall be connected to the main with a six-inch (6") restrained joint ductile iron branch controlled by an independent six -inch (6") gate valve, unless otherwise specified.

D. Hydrant Drainage in Pervious Soil:

1. Whenever a hydrant is set in soil that is pervious, drainage shall be provided at the base of the hydrant by placing uncrushed course aggregate (AAHSTO M-43) No. 57 from the bottom of the trench to at least six inches (6") above the drain opening in the hydrant and to a distance of one foot (1') around the elbow. No drainage system shall be connected to a sewer.

E. Hydrant Drainage in Impervious Soil:

1. Whenever a hydrant is set in clay or impervious soil, a drainage pit two feet (2') in diameter and three feet (3') deep shall be excavated below each hydrant and filled compactly with uncrushed course aggregate (AASHTO M-43) No. 57 under and around the elbow of the hydrant and to a level of six inches (6") above the drain opening. No drainage pit shall be connected to a sewer (see Standard Details).

3.02 ANCHORAGE

A. The bowl of each hydrant shall be tied to the pipe with suitable anchor couplings, as shown on the Standard Details in the Drawings or as directed by the Owner or Engineer.

3.03 FIRE HYDRANT WRENCHES

A. One (1) hydrant wrench shall be furnished for each ten (10) hydrants or less. When the number of hydrants furnished and installed exceeds twenty-five (25), one (1) hydrant repair kit shall be supplied at no additional cost to the Owner.

3.04 INSTALLATION OF VALVES

A. All valves shall be installed in accordance with details on the Contract Drawings and with the manufacturer's recommendations.

B. All valves shall be anchored in accordance with the details on the Contract Drawings.

- END OF SECTION -

SECTION 331900

METERING EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes service pipelines constructed of CTS polyethylene tubing as shown on the Contract Drawings, complete with fittings and accessories.

B. Certain features of the CTS tubing shall be as scheduled.

C. The Contractor shall furnish all labor, tools, equipment, and materials necessary to complete the meter service connections as shown on the Contract Drawings and herein specified.

1.02 REFERENCES

A. Materials and installation shall be in accordance with the latest revisions of the following codes, standards and specifications, except where more stringent requirements have been specified herein:

1. American Society for Testing and Materials (ASTM)
2. American Water Works Association (AWWA)

1.03 SUBMITTALS

A. In addition to those submittals identified in the General Provisions, the following items shall be submitted:

1. Manufacturer’s certification that all materials furnished are in compliance with the applicable requirements of the referenced standards and this specification.

2. Layout drawings showing the location of copper tube including details of the support system, sleeves, unions and appurtenances.

PART 2 PRODUCTS

2.01 SERVICE CLAMPS

All service connections of all sizes shall be made through the use of service clamps or saddles. Service saddles shall have ductile iron body, double strapped with O-ring resilient gasket, suitable for use on ductile iron pipe or PVC pipe, and tapped with same threads as the corporation stops. Saddles for all mains shall be double strap type saddles and have a maximum working pressure of 350 psi.

2.02 CORPORATION STOPS

Corporation stops for use in service clamps shall be equal for 3/4", 1" and 2" service tubing and have a maximum working pressure of 350 psi. Corporation stops shall have iron pipe threads with compression coupling connection for copper tubing outlets. A rigid stainless-steel insert

stiffener shall be used inside the PE tubing, when encountered. *SEE SECTION 01600 MATERIAL AND EQUIPMENT* for APPROVED MANUFACTURE.

2.03 SERVICE TUBING 3/4", 1" AND 2" POLYETHYLENE TUBING (CTS SERVICE TUBING)

A. Pipe shall be made from virgin, ultra-high molecular weight polyethylene resin meeting the requirements of Type III, Class C, Category P34 polyethylene as defined by ASTM D-1248, latest revision, "Polyethylene Plastics Molding and Extrusion Materials".

B. Dimensions and tolerances shall meet the values as listed in AWWA C-901, latest revision, "Polyethylene (PE) Pressure Pipe Tubing and Fittings". Standard dimension ratio shall be DR-7.3 (OD base), Pressure Class 200 psi.

C. Pipe shall be rated for use with water at 73.4 degrees F. at a hydrostatic design stress of 630 psi and a maximum working pressure of 200 psi. The pipe shall sustain a water pressure as defined in ASTM D 1598 for 1000 hours with water at 73.4 degrees F.

D. Surface shall be homogeneous inside and out and completely free of irregularity. Random testing shall be performed at intervals during all production runs to assure uniformity in all respects. The tubing shall carry the National Sanitation Foundation seal of approval for drinking water.

E. Pipe shall be marked in lettering at intervals of not more than five (5) feet and such marking shall include nominal size; manufacturer's name or trademark; pressure rating for water at 73.4 degrees F., 200 psi; applicable ASTM specification,; ASTM material specification, PE 3406; standard dimension ratio, DR-7.3; the National Sanitation Foundation Seal of Approval (NSF mark) and production code.

F. Pipe shall be guaranteed in writing against rot, corrosion and defects for 50 years from date of installation, with pipe replacement and labor cost warranted in writing for 25 years from date of installation.

2.04 RESERVED

2.05 METER SETTING EQUIPMENT

A. Meters shall be placed inside meter boxes using copper setters with 3/4" or 1" saddle nut connection for the meter. All copper setters shall have a ball angle meter valve (lockable) stop at the meter inlet and dual check valve on the outlet. Copper setters shall be 12 inches in height with connections for the appropriate service tubing and have a maximum working pressure of 300 psi**.**

B. For larger meters (1-1/2" and 2") the meters shall be installed with ball meter valves on inlet side and the meter outlet side. Meters shall be placed on concrete block or equivalent support inside the meter box.

C. For individual meter with pressure reducing valves or more than one meter the copper setters shall be the Tandem type copper setters as manufactured by Ford, Mueller or Engineer approved equal and 12 inches in height and placed in meter boxes with 18" I.D.

D. A rigid stainless-steel insert stiffener shall be used inside the PE tubing at all connections to the copper setters.

2.06 SERVICE METERS

The service meter main body shall be of high-grade bronze, with hinges, single lid cover and raised characters cast on the body indicating the direction of flow. Meter shall have a working pressure rating of 150 psi. The register shall be straight reading gallon type. The register unit shall be hermetically sealed, and driven by permanent magnets. The register shall have a center sweep hand and a test circle shall be divided into 100 equal parts and include a flow finder. The register shall carry a minimum 10-year warranty.

The meters shall be manufactured by **BADGER**. The entire unit is to be pre-assembled in a workmanlike manner with all components fitted snugly into the box and fastened to prevent movement. All joints shall be sealed with Teflon tape. The inlet and outlet are to be equipped with compression couplings.

2.08 METER BOXES

Meter boxes shall be precast concrete with dimension as shown on the Drawings. The meter box where installation is to be roadways or sidewalks shall be of concrete construction for vehicular traffic. The meter box, cover and meter setting shall be constructed as shown on the drawings or as directed by the Owner or Engineer.

2.08 ACCESSORIES

A. Fittings and Couplings

1. Fittings for copper tube shall be wrought copper or cast bronze for soldered joints and brass for flared joints.

2. Flexible couplings as shown or required for copper tube shall be flexible metal hose couplings.

B. Joints

1. Joints for seamless copper water tube to be installed in concrete and underground shall be flared type and shall have threads in accordance with AWWA C 800.

2. Joints for seamless copper water tube and copper drainage tube installed exposed and inside structures shall be soldered.

   a. Solder and flux used in joints of water lines, shall contain no more than 0.2% lead.

   b. Solder shall be Tin-Silver or approved equal.

   c. Solder flux shall be as recommended by the solder manufacturer.

3. Joints for bright annealed seamless copper tube used in liquid fuel lines shall have flared joints, approved by Underwriter's Laboratories.

4. Joints for small tubing (3/8 inch and smaller) shall be of the locking type compression fittings or soldered as shown in the piping schedule and as directed.

PART 3 - EXECUTION

3.01 INSTALLATION OF METER SERVICES

All customer meter services shall be reconnected at the closest distance from the existing service line. All locations of the meters shown on the plans are approximate locations. The Owner reserves the right to change the location of the connections from the existing line to the new main.

3.02 INSTALLATION OF SERVICE TUBING

A. All service tubing installed beneath bituminous or concrete roads shall be jacked under the roads. When State maintained roads are being jacked and rock is encountered, permission to open cut the road shall be obtained by the Contractor from the Department of Transportation's District Permit Engineer. If permission is refused, the Contractor shall attempt to jack at another location and shall continue to do so until a successful crossing is obtained.

B. Minimum cover for all service lines shall be 36 inches (at all locations) when within the proposed and existing highway right-of-way and construction easements. Additional cover may be required at proposed drainage ditch, storm sewer, or other noted locations.

3.03 BACKFILLING SERVICE TUBING

When service tubing is laid in an open cut across a road of any type surface (crushed stone, bituminous or concrete), the backfill shall consist of Class II granular material (dense graded aggregate) and shall be placed full depth. Payment for Class II material used will not be paid as a separate pay item, but will be included in the price for installing the service tubing.

3.04 INSTALLATION OF COPPER TUBING (not in contract)

3.05 FIELD TESTING AND CHLORINATION

A. Perform hydrostatic and leakage tests in accordance with the applicable provisions of the Section entitled "Leakage Tests", at the test pressure specified or scheduled.

B. Disinfect piping and appurtenances in accordance with the Section entitled "Chlorination", where specified or scheduled.

-END OF SECTION-

SECTION 333111

SEWER GRAVITY PIPING

PART 1 - GENERAL

1.01 WORK INCLUDED

The Contractor shall furnish all labor, material, and equipment necessary to install gravity and pressure sewer piping together with all appurtenances as shown and detailed on the Drawings and specified herein. THE CONTRACTOR WILL BE PERMITTED TO LAY PIPE, AND MAKE SERVICE CONNECTIONS ONLY WHEN THE ENGINEER OR HIS REPRESENTATIVE IS PRESENT.

1.02 RELATED WORK

A. Section 02222 - Excavation.

B. Section 02226 – Trench, Backfilling and Compacting.

C. Section 02330 - Manholes, Frames and Covers.

D. Section 02340 - Encasement Pipe.

1.03 REFERENCES

A. AWWA C104.

B. AWWA C111.

C. AWWA C151.

D. ASTM C443.

E. ASTM C478.

F. ASTM D1785 and D1784.

G. ASTM D2467

H. ASTM D2564.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

A. Ductile Iron (DI) Pipe Gravity Sewers:

1. Ductile iron pipe shall conform to ANSI A21.50 (AWWA C150) and ANSI A21.51 (AWWA C151). The pipe shall be designed for an internal working pressure of 150 psi and external loading based on flat bottom trenches without blocks and un-tamped backfill laying conditions. The pipe shall conform to the minimum pressure class: of 150 psi.

2. Ductile iron fittings shall have a rating of 250 psi in accordance with ANSI A 21.10 (AWWA C 110).

3. Joints shall be push-on type, or mechanical joint type conforming to ANSI A21.11 (AWWA C 111) or type. Unless specifically required at designated locations by the Drawings, the type of joint used is optional.

   a. Push-on joints shall have an annular recess in the pipe socket to accommodate a single rubber gasket. Plain ends shall be suitably beveled to permit easy entry into the bell. The gasket and annular recess of the socket shall be so designed and shaped that the gasket is located in place against displacement as the joint is assembled.

   b. Mechanical joints shall be bolted and of the stuffing box type and shall consist of a bell with exterior flange and interior recess for the sealing gasket, a pipe or fitting plain end, a sealing gasket, a follower gland, tee-head bolts and hexagon nuts.

4. All ductile iron pipe and fittings shall have the manufacturer's outside coal tar or asphaltic base coating and a polyethylene lining complying with ANSI/ASTM D1248 on the inside.

5. The inside lining material for pipe and fittings shall be virgin polyethylene complying with ANSI/ASTM D1248, compounded with an inert filler and with sufficient carbon black to resist ultra-violet rays during aboveground storage of the pipe and fittings. The polyethylene shall be bonded to the interior of the pipe of fitting by heat.

   All surface areas to be lined shall be blast cleaned comparable to the requirements of SSPC-SP6 or NACE #3.

   Polyethylene linings shall cover the inner surface of pipe and fittings as shown and described below. In pipe utilizing push-on gaskets, the lining shall extend from the spigot end through the socket to the edge of the gasket sealing area. In mechanical joint pipe the lining shall extend from the spigot end through the socket to the edge of the gauging ring. The lining in fittings shall cover the interior surfaces including the socket areas as defined above.

   Lining in piping and in the fittings shall be 40 mils nominal thickness. Minimum lining thickness shall be 30 mils.

6. Pipe shall be furnished in lengths of 16, 16.5, 18, and 20 feet nominal laying lengths. The weight of any single pipe shall not be less than the tabulated weight by more than 5 percent for pipe 12 inches or smaller in diameter, not by more than 4 percent for pipe larger than 12 inches in diameter.

7. The net weight, class or nominal thickness and sampling period shall be marked on each pipe. The pipe shall also be marked to show that it is ductile iron.

B. Polyvinyl Chloride (PVC) Gravity Sewer:

1. Polyvinyl chloride (PVC) pipe and fittings, 4 to 15 inch in diameter, for gravity sewers shall conform to the requirements of ASTM specification D-3034 (SDR 35), current approval, "Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings." Minimum pipe stiffness shall be 26.

2. Polyvinyl chloride (PVC) pipe and fittings, 18 inches to 27 inches in diameter shall conform to the requirements of ASTM specification F679, current approval.

3. Joints for PVC pipe shall be of the elastomeric gasket type and installed per the manufacturer's recommendations. Pipe that has been field cut must be beveled for insertion into gasketed joints. Bevel can be made with hand or power tool. In either case, the finished bevel should be the same as the factory bevel. All pipe shall be provided with home marks to insure proper gasket seating. Gasket material shall comply with the physical requirements specified in ASTM D-1869, C-361, C-433, current approval.

4. Fittings for service connections shall be of the factory-made inline type conforming with the requirements of ASTM specification D-3034, current approval. Saddle type fittings shall not be used.

5. PVC sewer pipe shall be supplied in standard lengths of at least 12'6". Longer lengths are permitted.

6. PVC sewer pipe shall be marked with the manufacturer's name, production lot number, ASTM designation, PVC, and the nominal diameter.

7. All underground piping shall have a metallic tape laid 2 foot above the pipe. The tape shall have the word "Caution" printed on it and shall identify the pipe use. Product shall be Seton Name Plate Corp., New Haven, CT, No. 210, or equal.

8. Five copies of directions for handling and installation of pipe per the manufacturer's directions shall be furnished the Contractor at the first delivery of the pipe to the job.

2.02 HIGH-DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS (GRAVITY SEWER)

A. HDPE pipe used in this project shall meet the following specifications.

1. ASTM D1248: Type III, Class B, Grade P34, Category 5.
2. PPI rating of PE 3408 when compounded.
3. ASTM D1693: melt flow, condition E, 5 g/10 min.
4. ASTM D2837-69: 1600 psi material, design basis.
   800 psi hydrostatic design stress.
5. ASTM D3350: minimum cell classification 34543D or E. For forcemains, 345434C.

B. The inner walls of the pipe shall be light in color so that television recording quality is fully enhanced.

C. HDPE fittings shall be molded or fabricated from a material meeting the same specifications as the pipe. Fittings shall be SDR 7 or as approved by the Engineer. Saddle-type fittings are not permitted.

D. HDPE fittings shall be of the compression type. The service connection shall be specifically designed for connection to the sewer main being installed and shall be Inserta Tee as manufactured by Inserta Fittings Co., or approved equal. Install using procedures and equipment as referenced in manufacturer's written installation instructions. All stainless steel shall be corrosion and rust proof. Parts shall meet the specifications listed below:

Types	Gasketed Bell SDR 35
PVC Hub	ASTM D3034 SDR 35

Gasket	ASTM F477
Band	301 SS
Screw	305 SS
Housing	301 SS
Rubber Sleeve	ASTM C443

E. HDPE pipe shall be supplied in standard lengths of at least 12 ft.-6 inches. Longer lengths are permitted.

F. HDPE pipe shall be marked with the manufacturer's name, production lot number, ASTM designation, and nominal diameter.

G. The minimum wall thickness of HDPE pipe shall meet the following requirements.

Depth	Minimum SDR
0 to 16.0 ft	17
16.1 ft or deeper	13.5

2.03 PIPE JOINTING FOR HDPE PIPE

A. Jointing of HDPE pipe and fittings shall be by the butt thermal-fusion method and shall be performed in strict conformance with the pipe manufacturer's recommendations using approved equipment.

B. Joining of HDPE pipe to ductile iron pipe with mechanical joints shall be made with a flanged fitting. Special flanged fittings shall be manufactured to connect to the end flange on the HDPE pipe, so connection can then be made to the ductile iron pipe mechanical joints.

C. All joints shall be completely watertight, airtight and as strong as or stronger than the pipe wall, in strict accordance with the manufacturer's recommendations.

D. Where HDPE pipe is to be used in roadway crossing casings, the Contractor shall take precautions to ensure no damage to the pipe when placing it into the casing.

2.04 PIPE JOINTING FOR DUCTILE IRON PIPE

Mechanical Joint:

A. Mechanical joints are to be furnished according to AWWA Specifications C111. All pipe joints must be furnished complete with all accessories. Mechanical joint bolts and nuts shall be of alloy cast iron (such as Acipcoloy) or alloy steel (Corten type such as US alloy) or approved equal. Rubber gaskets shall be made of plain first grade rubber, free of imperfections and porosity. Hardness shall be 70 to 75 durometers.

B. Mechanical joints shall be used where specifically called for on the Drawings.

C. Push-in socket joints shall be equal to manufacturer's specifications for "Tyton," "Bell-Tite," or "Fastite." The joints shall consist of a rubber ring gasket compressed in groove in bell of pipe with beveled spigot end of pipe for initial centering into rubber gasket in bell.

PART 3 - EXECUTION

3.01 SHORING, SHEETING, AND BRACING OF EXCAVATION

A. Where unstable material is encountered or where the depth of excavation in earth exceeds five (5) feet, the sides of the trench or excavation shall be supported by substantial sheeting, bracing, and shoring, or the sides sloped to the angle of repose. Sloping the sides of the ditch to the angle will not be permitted in streets, roads, narrow rights-of-way or other constricted areas unless otherwise specified. The design and installation of all sheeting, sheet piling, bracing and shoring shall be based on computations of pressure exerted by the materials to be retained under obtaining conditions. Adequate and proper shoring of all excavations shall be the entire responsibility of the Contractor; however, the Engineer may require the submission of shoring plans (accompanied by supporting computations) for approval prior to the Contractor undertaking any portion of the work. The standards of the Federal Occupational Safety and Health Act and the Kentucky Labor Cabinet shall be followed.

B. Foundations, adjacent to where the excavation is to be made below the depth of the existing foundation, shall be supported by shoring, bracing or underpinning as long as the excavation shall remain open, or thereafter if required to insure the stability of the structure supported by the foundation, and the Contractor shall be held strictly responsible for any damage to said foundations.

C. Solid sheeting will be required for wet or unstable material. It shall consist of continuous vertical sheet piling of timber or steel with suitable wales and braces.

D. Care shall be taken to avoid excessive backfill loads on the completed pipelines and the trench width requirements at the level of the crown of the pipe and at the level of a road or street be strictly observed.

E. Trench sheeting shall not be removed until sufficient backfill has been placed to protect the pipe.

F. All sheeting, planking, timbering, bracing and bridging shall be placed, renewed and maintained as long as is necessary.

3.02 PIPE BEDDING - GRAVITY SEWERS

A. All gravity sewer pipe shall be laid on a bed of granular material except when a concrete encasement situation occurs. All pipe bedding material shall be No. 9 crushed stone aggregate and shall be placed to a depth of 4" in an earth trench and 6" in a rock trench. The Contractor will not be permitted to use dense graded aggregate material for pipe bedding.

B. Pipe bedding shall be graded to provide for a uniform and continuous support beneath the pipe at all points.

C. After each pipe has been brought to grade, aligned, and placed in final position No. 9 crushed stone aggregate material shall be deposited and densified to a minimum density of 90% Standard Proctor per AASHTO T-99 under the pipe haunches and on each side of the pipe to the trench wall up to the spring line of the pipe to prevent lateral displacement and hold the pipe in proper position during subsequent pipe jointing, bedding, and backfilling operations.

D. In wet, yielding and mucky locations where pipe is in danger of sinking below grade or floating out of grade or line, or where backfill materials are of such a fluid nature that such movements of pipe might take place during the placing of the backfill, the pipe must be weighted or secured permanently in place by such means as will prove effective.

E. Where an unstable (i.e., water, mud, etc.) trench bottom is encountered, stabilization of the trench bottom is required. This is to be accomplished by undercutting the trench depth and replacing to grade with a foundation of crushed stone aggregate. The depth of the foundation is dependent upon the severity of the trench bottom. The size of stone aggregate used in the foundation will be determined by the condition of the unstable material. Once the trench bottom has been stabilized, the required No. 9 crushed stone aggregate bedding material can be placed. No compensation for Crushed Stone for Pipe Foundation will be made.

F. It should be noted that no pipe shall be laid on solid or blasted rock.

3.03 PIPE LAYING

A. The pipe shall be protected during handling against impact shocks and free fall. Care shall be taken to avoid dragging the spigot ring on the ground or allowing it to be damaged by contact with gravel, crushed stone, or other hard objects.

B. After being delivered alongside the trench, the pipe shall be carefully examined for soundness or damage. No piece of pipe or fitting which is known to be defective shall be laid or placed in the lines. If any defective pipe or fitting shall be discovered after the pipe is laid, it shall be removed and replaced with a satisfactory pipe or fitting without additional charge. Before each piece of pipe is lowered into the trench, it shall be thoroughly cleaned out. Each piece of pipe shall be lowered separately unless special permission is given otherwise by the Engineer. In case a length of pipe is cut to fit in a line, it shall be so cut as to leave a smooth end at right angles to the longitudinal axis of the pipe.

C. The bell and spigot of the joint shall be cleaned of dirt and foreign matter immediately prior to jointing. The contact surfaces shall be coated with the lubricant, primer or adhesive recommended by the pipe pushed together until the joint snaps distinctly in place. The pushing together of the pipe may be done by hand or by the use of a bar.

D. All pipe shall be laid straight between changes in alignment and at uniform grade between changes in grade. When jointed in the trench the pipe shall form a true and smooth line.

E. Trenches shall be kept dry during pipe laying. Before pipe laying is started, all water that may have collected in the trench shall be removed.

F. All pipe shall be laid starting at the lowest point and installed so that the spigot ends point in the direction of the flow.

3.04 PIPE BACKFILLING

A. Backfilling is defined as that material which is placed over the gravity sewer from the spring line to a predetermined point above the top of the pipe according to various backfilling situation as defined in Section C, this article. The material shall be No. 9 crushed stone aggregate and may be machine placed without compaction. Uneven places in the backfill shall be leveled by hand.

B. Final Backfill: There are four cases where the method of final backfilling varies. The various cases and trench situations are as follows:

1. Case I: Areas not subject to vehicular traffic.

2. Case II: Gravel areas subject to light vehicular traffic such as residential driveways; church and commercial parking lots and entrances; and farm drives.

3. Case III: City and County gravel roads; gravel and bituminous road shoulders; all bituminous surface areas such as City and County streets, residential driveways,

church and commercial parking lots, and entrances; City and County road shoulders.

4. Case IV: State maintained streets and road; road shoulders for State roads and streets.

C. In all cases, walking or working on the completed pipeline, except as may be necessary in backfilling, will not be permitted until the trench has been backfield to a point 12 inches above the top of the pipe. The method of final backfilling for each of the above cases is as follows:

1. Case I - The trench shall be backfilled from a point 6"(12" for a rock trench) above the top of the pipe to a point 8" below the surface of the ground with earth material free from large rock over 0.3 cubic feet, acceptable to the Engineer. The remainder of the trench to existing grade shall be backfilled with earth material reasonably free of any rocks.

   Earth backfill used in this Case is not a separate pay item and is considered incidental to the work for the pay item "Sewer Main."

2. Case II - The trench shall be backfilled from a point 6" (12" for a rock trench) above the top of the pipe to a point 12" below the surface of the ground with Class I (No. 9 crushed stone aggregate) material. The trench shall be tamped to assure maximum possible compaction (approximately 80 to 85 percent of Standard Proctor density). Extreme care shall be exercised to prevent damage to the pipe during tamping operation. The remainder of the trench to existing grade shall be backfilled with Class II (dense graded aggregate) material with the material being mounded over the trench. The trench shall be tamped again to assure additional compaction. The trench may be left with a slight mound if permitted by the Engineer.

   Class I material used and method of backfilling used in this case is not a separate pay item and is considered incidental to the work for the item ”Sewer Main."

   Class II material used in this method of backfill is not a separate pay item and is considered incidental to the work for the item "Sewer Main."

   Sufficient stockpiles of Class II material shall be placed throughout the project area to insure immediate replacement by the Contractor of any settled areas. The Contractor shall maintain the trench and replace or fill any settled areas until the section of main is accepted by the Owner. No extra payment will be made for the filling in of settled areas by the Contractor. Earth material shall not be used in this Case for backfill material.

3. Case III - The trench shall be backfilled from a point 6" (12" for a rock trench) above the top of pipe to the height indicated in the "City and County Maintained Streets, Roads and Driveway Pavement Replacement" detail with Class I (No. 9 crushed stone aggregate) material. Said material shall be tamped as described for Case II. A 12-inch layer of Class II (dense graded aggregate) material shall be placed over the compacted backfill before bituminous or concrete surface is placed as shown in the previously mentioned details. The 12-inch layer of Class II material is NOT a separate pay item but such expense will be borne by the Contractor and is considered incidental to the bid items "Bituminous or Concrete Surface Replacement". Also considered incidental is all temporary stone required for a temporary surface between backfilling and pavement replacement.

Sufficient stockpiles of Class II material shall be placed throughout the project area to insure immediate replacement by the Contractor of any settled areas. The Contractor shall maintain the trench and replace or fill any settled areas with crushed stone until the section of main is accepted by the Owner or until the final bituminous or concrete surface is placed over the trench. No extra payment will be made for the filling in of settled areas by the Contractor. Class II material used in this method of backfill is considered incidental and as a support item under the item "Bituminous Surface Replacement" or "Concrete Surface Replacement" at its unit price.

Class I material used for backfilling is not a separate pay item and is considered incidental to the bid item "Sewer Main"

4. Class IV- The trench shall be backfilled from the spring line to a point 1 foot above the top of the pipe with earth material free from rock and acceptable to the Engineer, it shall be carefully and solidly tamped by approved mechanical methods. The remainder of the trench shall be backfilled to the height indicated in the "State Maintained Streets and Roads Pavement Replacement Detail" in the Contract Drawings, with material free from rock and acceptable to the Engineer; said material shall be mechanically tamped in approximately 6-inch layers to obtain the maximum possible compaction. The backfilling method is NOT a separate pay item. A 12-inch layer of dense graded aggregate shall be placed over the compacted earth backfill when a bituminous or concrete surface street or road has been trenched. The 12-inch layer of stone is not a separate pay item but such expense will be borne by the Contractor.

D. Excavated materials from trenches and tunnels, in excess of quantity required for trench backfill, shall be disposed of by the Contractor. The Contractor may contact the Owner regarding the location of a suitable disposal site; however, if the Owner cannot recommend a site, it shall be the responsibility of the Contractor to obtain locations or permits for the disposal of the waste material. Unit prices for the various pipe sizes shall include the cost of disposing of excess excavated materials, as set forth herein, no additional compensation being allowed for hauling or overhaul.

3.05 CONNECTION TO EXISTING MANHOLES

A. The Contractor shall connect all proposed piping to existing PVC stubs or manhole walls. Connection to existing stubs must conform to the lines and grades as shown on the Plans. Connection to each existing manhole will be made with a waterproof elastomeric seal cast in the manhole wall as specified in Section 02330, Part 2.07.

B. All materials, accessories, and construction methods used in making the joints shall be supplied or approved by the manufacturer of the pre-molded elastomeric-sealed joint.

C. The Contractor shall furnish to the Engineer the manufacturer's written instructions for installation and certification that the product will perform satisfactorily under the conditions of the intended application prior to such installation.

D. Contractor shall construct a concrete cradle under each manhole connection as shown on the Drawings for a standard manhole.

3.06 SERVICE LATERALS

A. Low pressure air testing, deflection testing, bedding, and backfill, including compaction of materials shall be completed by the contractor and approved by the engineer or his representative, prior to connection of the service laterals to the main.

B. The contractor shall be responsible for providing temporary wastewater collection and disposal service as required. Discharges of sewage of any nature will not be permitted. Interruption of sanitary sewer service will not be permitted. The contractor will be permitted to dispose of collected sanitary sewage at the owner's wastewater treatment plant. The costs of providing temporary wastewater collection and disposal service including all labor, materials, and equipment, shall be included in the contract unit price for pipe.

C. The Contractor shall provide a new service wye, piping, fittings, and adapters necessary to construct a new service connection both horizontally and vertically as measured a minimum of 15 feet from the center line of the new main to the existing service lateral. The service wye, piping and fittings from the main to the point of service connection shall be low pressure air tested as defined in 3.06A above. All fittings, cleanouts, watertight plugs and accessories shall be as manufactured and furnished by the pipe supplier and have bell and spigot configurations compatible with that of the pipe. Connections to the existing service lateral shall be watertight, and are subject to testing requirements for pipe as specified hereinbefore if deemed necessary by the Engineer or his representative.

3.07 UTILITY CROSSING CONCRETE ENCASEMENT

A. At locations shown on the Contract Drawings, required by the Specifications, or as directed by the Engineer, concrete encasement shall be used when the clearance between the proposed sanitary sewer pipe or force main and any existing utility pipe is eighteen (18) inches or less. Utility pipe includes underground water, gas, telephone and electrical conduit, storm sewers, and any other pipe as determined by the Engineer.

B. There are two cases of utility crossing encasement. Case I is applicable when the proposed sanitary sewer line is <u>below</u> the existing utility line. Case II is applicable when the proposed sanitary sewer line is laid <u>above</u> the utility line. In either case, the concrete shall extend to at least the spring line of each pipe involved.

C. Concrete shall be Class B (3000 psi) and shall be mixed sufficiently wet to permit it to flow between the pipes to form a continuous bridge. In tamping the concrete, care shall be taken not to disturb the grade or line of either pipe or damage the joints.

D. Concrete is not a separate pay item and will be considered incidental to gravity sewer installation.

3.08 BITUMINOUS PAVEMENT REPLACEMENT

A. Sections of pavement shall be replaced as required to install the pipelines under the work of this Section. Disturbed pavement shall be reconstructed to original lines and grades with bituminous binder as detailed on the Drawings and in such manner as to leave all such surfaces in fully as good or better condition than that which existed prior to these operations.

B. Prior to trenching, the pavement shall be scored or cut to straight edges along each side of the proposed trench to avoid unnecessary damage to the remainder of the paving. Edges of the existing pavement shall be recut and trimmed as necessary to square, straight edges after the pipe has been installed and prior to placement of the binder course.

C. Backfilling of trenches shall be in accordance with the applicable portions of Section 02230.

D. Bituminous concrete binder shall be one course construction in accordance with applicable provisions of the Kentucky Department of Highways Standard Specifications, Section 402. Placement and compaction of binder course shall he in accordance with Section 402 of the

Kentucky Department of Highways Standard Specifications. Minimum thickness after compaction shall be as shown on the Drawings.

3.09 CRUSHED STONE BACKFILL

A. The Class I granular material used in Case II and Case III backfill situations shall be No. 9 Crushed Stone aggregate (No. 9 Stone). Granular material will be paid for as a separate bid item.

B. The twelve inches (12") of crushed stone backfill that is required in "City and County Maintained Streets, Roads and Driveway Pavement Replacement" or "State Maintained Streets and Roads Pavement Replacement" will not be paid for under the provisions of this article.

3.10 CRUSHED STONE SURFACE REPLACEMENT

The Class II granular material used in Case II backfill situations shall be dense graded aggregate (D.G.A.). Granular material will be paid for at the unit price per linear foot under the pay item "Crushed Stone Surface Replacement".

3.11 TESTING OF GRAVITY SEWER LINES

A. After the gravity piping system has been brought to completion, and prior to final inspection, the contractor shall rod out the entire system by pushing through each individual line in the system, from manhole to manhole appropriate tools for the removal from the lines of any and all dirt, debris, and trash. If necessary, during the process of rodding the system, water shall be turned into the system in such quantities to carry off the dirt, debris and trash.

B. During the final inspection, the Engineer will inspect each individual line, from manhole to manhole, either by use of lights, television or other means at his disposal to determine whether the completed lines are true to line and grade as laid out or as shown on the Drawings.

1. Deflection Test

a. The Engineer may require deflection tests be performed on all flexible pipe. The test shall be conducted after the final backfill has been in place at least 30 days to permit stabilization of the soil-pipe system.

b. No pipe shall exceed a deflection of 5 percent. If deflection exceeds 5 percent, replacement or correction shall be accomplished at the Contractor's expense.

c. 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 of the pipe. The pipe shall be measured in compliance with ASTM D 2122 Standard Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings. The test shall be performed without mechanical pulling devices. The Contractor shall thoroughly clean the line prior to the deflection test.

2. The test shall be conducted as construction of the main progresses from manhole to manhole in accordance with Section 02310, Paragraph 3.06

3. All lines or sections of lines that are found to be laid improperly with respect to line or grade, that are found to contain broken or leaking sections of pipe, or are

obstructed in such a manner that they cannot be satisfactorily corrected otherwise, shall be removed and replaced at the Contractor's expense.

C. The pipe line shall be made as nearly watertight as practicable, and leakage tests and measurements shall be made if required by the Engineer. The Contractor shall be responsible for providing temporary wastewater collection and disposal until a satisfactory leakage test is obtained. All apparatus and equipment required for testing shall be furnished by the Contractor and the cost shall be included in the unit price bid for pipe.

1. The Engineer may require the Contractor to smoke test the first section (manhole to manhole) of each size of pipe and type of joint prior to backfilling, to establish and check laying and jointing procedures. The test shall consist of smoke blown into closed-off sections of sewer under pressure and observing any smoke coming from the pipe line indicating the presence of leaks. Other supplementary smoke tests prior to backfilling may be performed by the Contractor at his option; however, any such tests shall not supplant the final tests of the completed work unless such final tests are waived by the Engineer.

2. Where the groundwater level is more than 1 foot above the top of the pipe at its upper end, the Contractor shall conduct either infiltration tests or low-pressure air test on the completed pipeline.

3. Where the groundwater level is less than 1 foot above the top of the pipe at its upper end, the Contractor shall conduct either exfiltration tests or low-pressure air tests on the completed pipeline.

D. Low pressure air tests shall be made using equipment specifically designed and manufactured for the purpose of testing sewer lines using low pressure air. The equipment shall be provided with an air regulator valve or air safety valve so set that the internal pressure in the pipeline cannot exceed 8 psig. The contractor will be required to conduct a low-pressure air test on the completed main and service connections before making the service connections and placing the line in service. Continuous sanitary sewer service shall be provided by the contractor.

1. The test shall be made on each manhole-to-manhole section of pipeline after placement of the backfill. The Engineer or his designated representative must be present to witness each satisfactory air test before it will be accepted as fulfilling the requirements of these specifications.

2. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.

3. Low pressure air passing through a single control panel, shall be introduced into the sealed line until the internal air pressure reaches 4 psig greater than the maximum pressure exerted by groundwater that may be above the invert of the pipe at the time of test. However, the internal air pressure in the sealed line shall not be allowed to exceed 8 psig. When the maximum pressure exerted by the groundwater is greater than 4 psig, the Contractor shall conduct only an infiltration test.

4. At least two minutes shall be allowed for the air pressure to stabilize in the section under test. After the stabilization period the low-pressure air supply hose shall be quickly disconnected from the control panel. The time required in minutes for the pressure in the section under test to decrease from 3.5 to 2.5 psig (greater than the maximum pressure exerted by groundwater that may be above the invert of the pipe) shall not be less than that shown in the following table:

Pipe in Diameter in Inches	Minutes
4	2.5
6	4.0
8	5.0
10	6.5
12	7.5
15	9.5

5. When the sewer section to be tested contains more than one size of pipe, the minimum allowable time shall be based on the largest diameter pipe in the section, and shall be the time shown in the table reduced by 0.5 minutes.

E. Infiltration tests shall be made after underdrains, if present, have been plugged and other groundwater drainage has been stopped such that the groundwater is permitted to return to its normal level insofar as practicable.

1. Upon completion of a section of the pipeline, the line shall be dewatered and a satisfactory test conducted to measure infiltration for at least 24 hours. The amount of infiltration, including pipe, manholes, tees and connections, shall not exceed 50 gallons per nominal inch diameter per mile of sewer per 24 hours.

2. The rate of leakage from the sewers shall be determined by measuring the amount of water required to maintain the level 2 feet above the top of the pipe.

F. Exfiltration tests which subject the pipeline to an internal pressure, shall be made by plugging the pipe at the lower end and then filling the line and manholes with clean water to a height of 2 feet above the top of the sewer at its upper end. Where conditions between manholes may result in test pressures which would cause leakage at the plugs or stoppers in branches, provisions shall be made by suitable ties, braces and wedges to secure the plugs against leakage resulting from the test pressure.

1. The rate of leakage from the sewers shall be determined by measuring the amount of water required to maintain the level 2 feet above the top of the pipe.

2. Leakage from the sewers under test shall not exceed the requirements for leakage into sewers as hereinbefore specified.

G. The Contractor shall furnish suitable test plugs, water pumps, and appurtenances, and all labor required to properly conduct the tests. Suitable bulkheads shall be installed, as required, to permit the test of the sewer. The Contractor shall construct weirs or other means of measurements as may be necessary.

H. Should the sections under test fail to meet the requirements, the Contractor shall do all work of locating and repairing the leaks and retesting as the Engineer may require without additional compensation.

I. If in the judgement of the Engineer, it is impracticable to follow the foregoing procedures for any reason, modifications in the procedures shall be made as required and as acceptable to the Engineer, but in any event, the Contractor shall be responsible for the ultimate tightness of the line within the above test requirements.

3.12 PLACEMENT OF IDENTIFICATION TAPE

A. The placement of detectable underground marking tape shall be installed over all utility lines. Care shall be taken to ensure that the buried marking tape is not broken when installed and shall be Lineguard brand encased aluminum foil, Type III. The identification tape is manufactured by Lineguard, Inc., P. O. Box 426, Wheaton, IL 60l87.

B. The identification tape shall bear the printed identification of the utility line below it, such as "CAUTION - BURIED SEWER LINE BELOW". Tape shall be reverse printed. Surface printing will not be acceptable. The tape shall be visible in all types and colors of soil and provide maximum color contrast to the soil. The tape shall meet the APWA color code, and shall be two (2) inches in width. Colors are: yellow - gas, green - sewer, red - electric, blue - water, orange - telephone, brown - force main.

C. The tape shall be the last equipment installed in the ditch so as to be first out. The tape shall be buried 4 - 6 inches below top of grade. After trench backfilling, the tape shall be placed in the backfill and allowed to settle into place with the backfill. The tape may be plowed in after final settlement, installed with a tool during the trench backfilling process, unrolled before final restoration or installed in any other way acceptable to the Owner or his agent or Engineer.

- END OF SECTION -

SECTION 333123

FORCE MAIN PIPING

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Provide all labor, materials, equipment and services required for furnishing and installing all piping and appurtenances specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. DIVISION 31 – EARTHWORK

B. DIVISION 33 – UTILITIES

1.03 SUBMITTALS

A. A notarized certification shall be furnished for all pipe and fittings that verifies compliance with all applicable specifications.

B. The requirement for this certification does not eliminate the need for shop drawings submittals in compliance with Section 01340.

1.04 UTILITY LINE ACTIVITIES COVERED UNDER NATIONWIDE PERMIT # 12

All activities involving utility line construction covered under NATIONWIDE PERMIT # 12 shall meet the following conditions:

A. The general Water Quality Certification is limited to the crossing of intermittent and perennial streams by utility lines.

B. The construction of permanent or temporary access roads will impact less than 300 linear feet of intermittent and perennial streams and less than one acre of jurisdictional wetlands.

C. Utility lines shall be located at least 50 feet away from a stream which appears as a blue line on a USGA 7 ½ minute topographic map except where the utility line alignment crosses the stream. Utility lines that cross streams shall be constructed by methods that maintain normal stream flow and allow for a dry excavation. Water pumped from the excavation shall be contained and allowed to settle prior to re-entering the stream. Excavation equipment and vehicles shall operate outside of the flowing portion of the stream. Spoil material from the utility line excavation shall not be allowed to enter the flowing portion of the stream.

D. The activities shall not result in any permanent changes in preconstruction elevation contours in waters or wetlands or stream dimension, pattern or profile.

E. Utility line construction projects through jurisdictional wetlands shall not result in conversion of the area to non-wetland status.

F. Measures shall be taken to prevent or control spills of fuels, lubricants, or other toxic materials used in construction form entering the watercourse.

G. Removal of riparian vegetation in the utility line right-of-way shall be limited to that necessary for equipment access. Effective erosion and sedimentation control measures must be employed at all times during the project to prevent degradation of waters of the Commonwealth. Site regarding and reseeding will be accomplished with 14 days after disturbance.

H. To the maximum extent practicable, all in stream work under this certification shall be performed during low flow.

I. Heavy equipment, e.g. bulldozers, backhoes, draglines, etc., if required for this project, should not be used or operated within the stream channel. In those instances where such in stream work is unavoidable, then it shall be performed in such a manner and duration as to minimize turbidity and disturbance to substrates and bank or riparian vegetation.

J. Any fill shall be of such composition that it will not adversely affect the biological, chemical, or physical properties of the receiving waters and/or cause violations of water quality standards. If riprap is utilized, it is to be of such weight and size that bank stress or slump conditions will not be created because of its placement.

K. Removal of existing riparian vegetation should be restricted to the minimum necessary for project construction.

L. Should evidence of stream pollution or jurisdictional wetland impairment and/or violations of water quality standards occur as a result of this activity (either from a spill or other forms of water pollution), the Kentucky Division of Water shall be notified immediately by calling 800/928-2380.

1.05 CONSTRUCTION IN A FLOODPLAIN

A. No material shall be placed in the stream or in the flood plain to form construction pads, coffer dams, access roads, etc. unless prior approval has been obtained from the Environmental and Public Protection Cabinet.

B. The trench shall be backfilled as closely as possible to the original contour. All excess material from construction of the trench shall be disposed of outside the flood plain unless the applicant has received prior approval from the Cabinet to fill within the flood plain.

PART 2 - PRODUCTS

2.01 DUCTILE IRON PIPE AND FITTINGS

A. Ductile iron pipe shall conform to the current requirements of AWWA C151, Pressure Class 350, with push-on joints unless otherwise noted on drawings.

B. The interior of the pipe shall be cement-mortar lined with bituminous seal coat in accordance with the current requirements of AWWA C104 and have a Protecto 401 ceramic epoxy coating per manufacturers requirements. Thickness of the lining shall be

set forth in Section 4.10.1 of the aforementioned specification unless otherwise directed by the Engineer. The exterior of all pipe, unless otherwise specified, shall receive either coal tar or asphalt base coating a minimum of 1 mil thick.

C. Each piece of pipe shall bear the manufacturer's name or trademark, the year in which it was produced and the letters "DI" or the word "DUCTILE". Pipe manufacturer shall furnish notarized certificate of compliance to the above AWWA or ANSI specifications. Fittings shall be ductile iron and rated for a minimum of 350 psi in accordance with the current requirements of AWWA C110 (ANSI A21.10) shown therein. Fittings shall have mechanical joints meeting the current requirements of AWWA C111 (ANSI A21.11). Fittings shall have interior cement-mortar lining as specified for the pipe. Compact ductile iron fittings meeting the current requirements of AWWA C153 will also be acceptable. Provide notarized certificate of compliance to the AWWA specifications.

D. Provide AWWA C110 mechanical joint plugs and locked or restrained pipe joints where indicated on Drawings. Fittings under structures shall be mechanical joint with retainer glands. Retainer glands shall be of the “wedge action” design, where tightening the screws causes the wedge to lock onto the pipe. Retainer glands shall be Uni-Flange Series 1400 or equal.

E. The cleaning and assembly of pipe and fitting joints shall be in accordance with the manufacturer's recommendations.

2.02 POLYVINYL CHLORIDE PLASTIC (PVC) PIPE

A. AWWA C-900

1. 4-inch through 12-inch - PVC plastic pipe shall conform to ANSI/AWWA C-900, DR 18 pressure class 235. PVC pipe shall have a maximum laying length of 20 feet, with bell end and elastomeric gasket, and with plain end for cast-iron or ductile-iron fittings. Elastomeric gasket shall conform with the requirements of ASTM F-477. The seal of the National Sanitation Foundation Testing Laboratory must appear on each pipe. ALL PIPE SHALL BE GREEN IN COLOR.

B. CLASS 200 & 250

1. Polyvinyl chloride (PVC) pipe for force mains shall be Class 200 (SDR 21) or Class 250 (SDR 17) PVC pressure rated pipe as shown on the Drawings or indicated in the proposal form with either twin gasket joints or integral bell joints with rubber O-ring seals. ALL PIPE SHALL BE GREEN IN COLOR.

2. All PVC pipe shall conform to the latest revisions of ASTM D-1784 (PVC Compounds), ASTM D-2241 (PVC Plastic Pipe, SDR) and ASTM D-2672 (Bell-End PVC Pipe). Rubber gasketed joints shall conform to ASTM D-3139. The gaskets for the PVC pipe joint shall conform to ASTM F-477 and D-1869.

3. Couplings shall be furnished by the pipe manufacturer and shall accommodate the pipe for which they are used. Rubber gasket joints shall provide adequate expansion to allow for a 50 degree change in temperature on one length of pipe. Lubrication for rubber connected couplings shall be water soluble, non-toxic, be non-objectionable in taste and odor and have no deteriorating affect on the PVC or rubber gaskets and shall be as supplied by the pipe manufacturer. Couplings shall conform to ASTM D-3139; SDR-21, 200 psi.

4. All pipe and couplings shall bear identification markings that will remain legible during normal handling, storage and installation, which have been applied in a manner that will not reduce the strength of the pipe or coupling or otherwise damage them. Pipe and coupling markings shall include the normal size and OD base, material code designation, dimension ratio number, ASTM Pressure Class, ASTM designation number for this standard, manufacturer's name or trademark, seal (mark) of the testing agency that verified the suitability of the pipe material for potable-water service. Each marking shall be applied at intervals of not more than 5 feet for the pipe and shall be marked on each coupling.

C. Fittings shall be pressure class 350 ductile iron and have mechanical-joints or push-on joints in accordance with ANSI/AWWA C110/A21.10, latest revision, and shall conform to the details and dimensions shown therein. Fittings shall have interior cement-mortar lining as specified hereinbefore for the pipe. Compact ductile iron fittings meeting the requirements of ANSI/AWWA C153/A21.53, latest revision, will also be acceptable.

D. The basis of acceptance of PVC plastic force main pipe will be a written, notarized certification, accompanied by a copy of test results, that the pipe and pipe material has been sampled, tested and inspected in accordance with the designated standard specifications. These certifications shall be obtained from the manufacturer and delivered to the Engineer’s or Owner’s representative on the project site. A sufficient number of tests and certifications shall be made so as to be representative of the complete project. Copies of the test results shall be kept on file by the manufacturer and shall be available for review by the Engineer or Owner upon request.

E. Pipe shall be visually inspected on the project site for proper markings which shall include manufacturer’s name or trademark, nominal pipe size, pressure rating for water at 73.4 degrees F., plastic pipe material designation code (e.g. PVC 1120), dimension ratio, AWWA or ASTM designation and pressure class with which the pipe complies, and the National Sanitation Foundation NSF 14 Seal of Approval for drinking water.

2.03 HIGH-DENSITY POLYETHYLENE AWWA C906

A. AWWA C906

1. General: This section is for High-density Polyethylene AWWA C906 and NSF 14 Approved Pipe for Potable Water Service in Sizes 4” to 24” DIPS (Ductile Iron Pipe Size) and defines the characteristics and properties of high-density polyethylene pipe. This specification governs the material, pipe, fittings, butt fusion, and general construction practice for HDPE piping systems.

   a. Pipe shall have a hydrostatic design stress rating of 800 psi based on a material with a 1,600 psi at 23^{o} hydrostatic design basis as determined in accordance with ASTM D-2837.

   b. Fittings shall be molded or fabricated from material meeting the same standards as the pipe.

   c. Joints shall be made by the thermal butt fusion system. All joints shall be completely watertight, airtight and as strong as or stronger than the pipe wall, in strict accordance with the manufacturer's recommendations.

   d. Sections of polyethylene pipe shall be joined into continuous lengths on the job site above ground. The joining method shall be the heat fusion method and shall be performed in strict accordance with the pipe

manufacturer's recommendations. The heat fusion equipment used in the joining procedures shall be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400°F, alignment, and 150 psi interfacial fusion pressure.

e. Heat fusion joining shall be 100% efficient offering a joint weld strength equal to or greater than the tensile strength of the pipe. Socket fusion shall not be used.

2. References: Where all or part of a Federal, ASTM, ANSI, AWWA, etc., standard specification is incorporated by reference in these Specifications, the reference standard shall be the latest edition and revision and considered a part of these specifications.

3. Material: Materials used for the manufacture of polyethylene pipe and fittings shall be extra high molecular weight, high density PE 3408 polyethylene resin. The material shall be listed by PPI (Plastics Pipe Institute, a division of the Society of the Plastics Industry) in PPI TR-4 with a 73°F hydrostatic design basis of 1,600 psi and a 140°F hydrostatic design basis of 800 psi. The PPI listing shall be in the name of the pipe manufacturer and shall be based on ASTM D 2837 testing.

4. Pipe and Fittings: Qualification of Manufacturers. The Manufacturer shall have manufacturing and quality assurance facilities capable of producing and assuring the quality of the pipe and fittings required by these Specifications. The Manufacturer's production facilities shall be open for inspection by the Owner or his Authorized Representative.

a. Pipe: Pipe supplied under this specification shall have a nominal DIPS (Ductile Iron Pipe Size) OD unless otherwise specified. The DR (Dimension Ratio) and the pressure rating of the pipe supplied shall be as shown on the drawings. The pipe shall be produced from approved HDPE pipe grade resin with the nominal physical properties as specified in the appropriate ASTM specifications for the sizes indicated. Pipe having a diameter 3” and larger will be made to the dimensions and tolerances specified in ASTM F 714.

The pipe shall contain no recycled compound except that generated in the manufacturer’s own plant. The pipe shall be homogeneous throughout and free of visible cracks, holes, voids, foreign inclusions, or other defects that may affect the wall integrity.

b. Pipe Performance: The pipe will be extruded from resin meeting the specifications of ASTM D 3350 with a minimum cell classification of 345464C.

c. Fittings: HDPE fittings shall be in accordance with ASTM D 3261 and shall be manufactured by injection molding, a combination of extrusion and machining, or fabrication from HDPE pipe conforming to this specification. The fittings shall be fully pressure rated and provide a working pressure equal to that of the pipe with an included 2:1 safety factor. The fittings shall be manufactured from the same base resin type and cell classification as the pipe itself. The fittings shall be homogeneous throughout and free from cracks, holes, foreign inclusions, voids, or other injurious defects.

d. Molded Fittings. Molded fittings shall be manufactured and tested in accordance with ASTM D 3261 and shall be so marked. Molded fittings shall be tested in accordance with AWWA C906.

e. X-Ray Inspection. The Manufacturer shall submit samples from each molded fitting production lot to x-ray inspection.

f. Fabricated Fittings. Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock or molded fittings. Fabricated fittings shall be rated for internal pressure service at least equal to the full-service pressure rating of the mating pipe. Fabricated fittings shall be tested in accordance with AWWA C906.

g. Polyethylene Flange Adapters. Flange adapters shall be made with sufficient through bore length to be clamped in a butt fusion-joining machine without the use of a stub-end holder. The sealing surface of the flange adapter shall be machined with a series of small v-shaped grooves (serrations) to promote gasketless sealing, or restrain the gasket against blowout.

5. Joining - Butt Fusion: Sections of polyethylene pipe shall be joined by the butt fusion process into continuous lengths at the job site. The joining method shall be the heat fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The heat fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer. Properly executed electrofusion fittings may be used. Extrusion welding or hot gas welding of HDPE shall not be used for pressure pipe applications or fabrications where shear or structural strength is important. Mechanical joint adapters, flanges, unions, grooved-couplers, transition fittings, and some mechanical couplings may be used to mechanically connect HDPE pipe. Refer to the manufacturer's recommendations.

6. Joining - Other Means: Polyethylene pipe and fittings may be joined together or to other materials by means of (a) flanged connections (flange adapters and back-up rings), (b) mechanical couplings designed for joining polyethylene pipe or for joining polyethylene pipe to another material, (c) MJ Adapters or (d) electrofusion. When joining by other means, the installation instructions of the joining device manufacturer shall be observed.

   a. ID Stiffener and Restraint. A stiffener shall be installed in the bore of the polyethylene pipe when an OD compression mechanical coupling is used and when connecting plain end PE pipe to a mechanical joint pipe, fitting or appurtenance. External clamp and tie rod restraint shall be installed where PE pipe is connected to the socket of a mechanical joint pipe, fitting or appurtenance except where an MJ Adapter is used.

7. Quality and Workmanship: The pipe and/or fitting manufacturer's production facilities shall be open for inspection by the owner or his designated agents with a reasonable advanced notice. During inspection, the manufacturer shall demonstrate that it has facilities capable of manufacturing and testing the pipe and/or fittings to standards required by this specification. Pipe which has been tested by the manufacturer and falls outside of the appropriate limits set forth in this specification will be cause for rejection.

8. QA Records: QA/QC records shall be maintained intact for a minimum of one year from the date of production.

9. Pipe Marking: During extrusion production, the HDPE pipe shall be continuously marked with durable printing including the following information:

    Nominal Size
    Dimension Ratio
    Pressure Class, psi
    Manufacturer's Name and Product Series
    Cell Class
    ASTM Basis
    "NSF-PW"
    Pipe Test Category
    Plant Code & Extruder
    Production Date
    Operator Number (Shift Letter optional)
    Resin Supplier Code

10. Pipe Packaging, Handling, & Storage: The manufacturer shall package the pipe in a manner designed to deliver the pipe to the project neatly, intact, and without physical damage. The transportation carrier shall use appropriate methods and intermittent checks to insure the pipe is properly supported, stacked, and restrained during transport such that the pipe is not nicked, gouged, or physically damaged. Pipe shall be stored on clean, level ground to prevent undue scratching or gouging. If the pipe must be stacked for storage, such stacking shall be done in accordance with the pipe manufacturer's recommendations. The pipe shall be handled in such a manner that it is not pulled over sharp objects or cut by chokers or lifting equipment. Sections of pipe having been discovered with cuts or gouges in excess of 10% of the pipe wall thickness shall be cut out and removed. The undamaged portions of the pipe shall be rejoined using the heat fusion joining method. Fused segments of pipe shall be handled so as to avoid damage to the pipe. Chains or cable type chokers must be avoided when lifting fused sections of pipe. Nylon slings are preferred. Spreader bars are recommended when lifting long fused sections.

11. Testing:

    a. Fusion Quality. The Contractor shall ensure the field set-up and operation of the fusion equipment, and the fusion procedure used by the Contractor's fusion operator while on site. Upon request by the Owner, the Contractor shall verify field fusion quality by making and testing a trial fusion. The trial fusion shall be allowed to cool completely; then test straps shall be cut out and bent strap tested in accordance with ASTM D 2657. If the bent strap test of the trial fusion fails at the joint, the field fusions represented by the trial fusion shall be rejected. The Contractor at his expense shall make all necessary corrections to equipment, set-up, operation and fusion procedure, and shall re-make the rejected fusions.

    b. Hydro-Test: Pipelines shall be tested to the requirements and specifications of the engineer of record. HDPE pressure pipe shall be tested in accordance with the specifications and requirements of the engineer of record and/or with the manufacturer's recommendations. The pressure rating of the pipe is a function of temperature at the time of hydro-test. Refer to the manufacturer's temperature related pressure

ratings. At a minimum and if not specified elsewhere, hydro-test the piping system at 1.5 times the pressure rating of the pipe for 2 to 3 hours per Driscopipe Technical Note #35. If a system component such as a fabricated or mechanical fitting has a pressure rating less than that of the pipe, the piping system should be pressure tested to manufacturer's guidelines on that component.

2.04 COUPLING AND ADAPTORS

A. Flexible couplings shall be of the sleeve type with a middle ring, two wedge shaped resilient gaskets at each end, two follower rings, and a set of steel trackhead bolts. The middle ring shall be flared at each end to receive the wedge portion of the gaskets. The follower rings shall confine the outer ends of the gaskets, and tightening of the bolts shall cause the follower rings to compress the gaskets against the pipe surface, forming a leak-proof seal. Flexible couplings shall be steel with minimum wall thickness of the middle ring or sleeve installed on pipe being 5/16-inch for pipe smaller than 10 inches, 3/8-inch for pipe 10 inches or larger. The minimum length of the middle ring shall be 5-inches for pipe sizes up to 10 inches and 7 inches for pipe 10 inches to 30 inches. The pipe stop shall be removed. Gaskets shall be suitable for 250 psi pressure rating or at rated working pressure of the connecting pipe. Couplings shall be harnessed and be designed for 250 psi.

B. Flanged adapters shall have one end suitable for bolting to a pipe flange and the other end of flexible coupling similar to that described hereinbefore. All pressure piping with couplings or adapters shall be harnessed with full threaded rods spanning across the couplings or adapters. The adapters shall be furnished with bolts of an approved corrosion resistant steel alloy, extending to the adjacent pipe flanges. Flange's on flanged adapter (unless otherwise indicated or required) shall be faced and drilled ANSI B16.1 Class 125.

C. Flexible couplings and flanged adapters shall be as manufactured by Dresser, Rockwell, or equal, per the following, unless otherwise specified and/or noted on the Drawings:

D. Steel couplings for joining same size, plain-end, steel, cast iron, and PVC plastic pipe –

Dresser	Rockwell
Style 138	4ll

E. Transition couplings for joining pipe of different outside diameters-

Dresser	Rockwell
Style 162 (4"-12")	413 steel (2"-24")
Style 62 (2"-24")	415 steel (6"-48")
	433 cast (2"-16")
	435 cast (2"-12")

F. Flanged adapters for joining plain-end pipe to flanged pipe, fittings, valves and equipment.

Dresser	Rockwell
Style 127 cast (3"-12")	912 cast (3"-12")
Style 128 steel (3"-48" C.I. Pipe)	913 steel (3" and larger)
Style 128 steel (2"-96" steel pipe)	

2.05 DETECTABLE UNDERGROUND UTILITY WARNING TAPES

A. Detectable underground utility warning tapes which can be located from the surface by a pipe detector shall be installed directly above nonmetallic (PVC, polyethylene, concrete) pipe.

B. The tape shall consist of a minimum thickness 0.35 mils solid aluminum foil encased in a protective inert plastic jacket that is impervious to all know alkalis, acids, chemical reagents and solvents found in the soil.

C. The minimum overall thickness of the tape shall be 5.5 mils and the width shall not be less than 2" with a minimum unit weight of 2-1/2 pounds/1" x 1,000'. The tape shall be color coded and imprinted with the message as follows:

Type of Utility	Color Code	Legends
Sewer	Safety Green	Caution Buried Sewer Line Below

D. Detectable underground tape shall be ”Detect Tape” as manufactured by Allen Systems, or equal.

E. Installation of detectable tapes shall be per manufacturer’s recommendations and shall be as close to the grade as is practical for optimum protection and detectability. Allow a minimum of 18" between the tape and the line.

F. Payment for detectable tapes shall be included in the linear foot price bid of the appropriate bid item(s) unless it is listed as a separate payment item in the bid schedule.

2.06 TRACER WIRE

A. Tracer wire shall be 12-gauge steel clad copper wire with 30-mil polyethylene jacket. Tracer wire shall be installed with all buried piping, “duct” taped to top of pipe.

B. Splicing connectors shall meet or exceed UL 486D, UL Standard for Safety Sealed Wire Connectors and shall be compatible with tracer wire.

C. Tracer wire shall be brought up into locator boxes with grounding devices. Locator boxes shall be either TriView Test Station or HideOut by Rhino Markers or Engineer Approved Other. Locator boxes shall be installed at a maximum of 1,000 linear feet apart, or where shown on the Drawings.

D. Payment for tracer wire and boxes shall be included in the linear foot price bid of the appropriate bid item(s) unless it is listed as a separate payment item in the bid schedule.

2.07 CONCRETE PIPE ANCHORS, THRUST BLOCKS, CRADLE OR ENCASEMENT

A. Where indicated on the Drawings, required by the specifications or as directed by the Engineer, concrete pipe anchors, thrust blocks, cradles or encasements shall be installed. Concrete shall be 2000 psi, and reinforcing bars shall be as installed as indicated on the details.

PART 3 – EXECUTION

3.01 EXCAVATION FOR PIPELINE TRENCHES

A. Unless otherwise directed by the Engineer, trenches in which pipes are to be laid shall be excavated in open cut to the depths required by field conditions or as specified by the Engineer. In general, this shall be interpreted to mean that machine excavation in earth shall not extend below an elevation permitting the pipe to be properly bedded. Installation shall be in accordance with ASTM-D-2321 except as modified herein.

B. If the foundation is good firm earth and the machine excavation has been accomplished as set out hereinbefore, the remainder of the material shall be excavated by hand, then the earth pared or molded to give full support to the lower quadrant of the barrel of each pipe. Where bell and spigot are involved, bell holes shall be excavated during this latter operation to prevent the bells from being supported on undisturbed earth. If for any reason the machine excavation in earth is carried below an excavation that will permit the type of bedding specified above, then a layer of granular material shall be placed so that the lower quadrant of the pipe will be securely bedded in compact granular fill.

C. Excavation may be undercut to a depth below the required invert elevation that will permit laying the pipe in a bed of granular material to provide continuous support for the bottom quadrant of the pipe. When this method is used, the bedding shall be as set out in Paragraph 3.02 hereinafter.

D. Trenches shall be of sufficient width to provide free working space on each side of the pipe and to permit proper backfilling around the pipe, but unless specifically authorized by the Engineer, trenches shall in no case be excavated or permitted to become wider then 2'-0" plus the nominal diameter of the pipe at the level of or below the top of the pipe. If the trench does become wider than 2'-0" at the level of or below the top of the pipe, special precaution may be necessary, such as providing compacted, granular fill up to top of the pipe or providing pipe with additional crushing strength as determined by the Engineer after taking into account the actual trench loads that may result and the strength of the pipe being used. The Contractor shall bear the cost of such special precautions as are necessary.

E. All excavated materials shall be placed a minimum of two feet (2') back from the edge of the trench.

F. Before laying the pipe, the trench shall be opened far enough ahead to reveal obstructions that may necessitate changing the line or grade of the pipeline.

G. The trench shall be straight and uniform so as to permit laying pipe to lines and grades given by the Engineer. It shall be kept free of water during the laying of the pipe and until the pipeline has been backfilled. Removal of trench water shall be at the Contractor's expense. Dry conditions shall be maintained in the excavations until the backfill has been placed. During the excavation, the grade shall be maintained so that it will freely drain and prevent surface water from entering the excavation at all times. When directed by Owner, temporary drainage ditches shall be installed to intercept or direct surface water which may affect work. All water shall be pumped or drained from the excavation and disposed of in a suitable manner without damage to adjacent property or to other work.

H. Minimum cover of 30" shall be provided for all pipelines, except those located in the State Highway Right of Way. Those shall have a minimum cover of 42”.

3.02 PIPE BEDDING

A. All sewer pipe shall be supported on a bed of granular material unless the trench has been prepared in accordance with Paragraph 3.01B. In no case shall pipe be supported directly on rock. Bedding shall not be a separate pay item unless otherwise set out in the Detailed Specifications. Bedding shall be provided in earth bottom trenches, as well as rock bottom trenches. Bedding material shall be free from large rock, foreign material, frozen earth, and shall be acceptable to the Engineer. Bedding shall be a minimum of 6" below pipe barrel.

B. In all cases the foundation for pipes shall be prepared so that the entire load of the backfill on top of the pipe will be carried on the barrel of the pipe so that none of the load will be carried on the bells.

C. Where flexible pipe is used, the bedding shall be placed up to at least the spring line (horizontal center line) of the pipe. The bedding material and procedures shall conform to ASTM D 2321 and any Technical Specifications set out hereinafter. If conditions warrant, the Engineer may require the bedding to be placed above the springline of the pipe. Granular bedding shall be Size #9-m or ASTM C 33, Size #7 crushed stone, fine gravel, or sand, and is not a separate pay item.

D. Where undercutting and granular bedding is involved it shall be of such depth that the bottom of the bells of the pipe will be at least three inches above the bottom of the trench as excavated. Undercutting is not a separate pay item.

E. In wet, yielding mucky locations where pipe is in danger of sinking below grade or floating out of line or grade, or where backfill materials are of such a fluid nature that such movements of the pipe might take place during the placing of the backfill, the pipe must be weighted or secured permanently in place by such means as will prove effective. When ordered by the Engineer, yielding and mucky materials in subgrades shall be removed below ordinary trench depth in order to prepare a proper bed for the pipe. Crushed stone or other such granular material, if necessary, as determined by the Engineer to replace poor subgrade material, shall be classified as "Fill" (No separate pay item). Removal of poor material is not a separate pay item.

F. Installation shall be in accordance with ASTM D 2321 except as modified hereinafter.

3.03 SPECIAL GRANULAR FILL

A. As noted in Paragraph 3.02E, granular material for "Special Granular Fill " when directed by the Engineer shall be Department of Transportation crushed limestone, Size #57. Payment for "Special Granular Fill" must have approval from the Engineer prior to installation.

3.04 LAYING PIPE

A. The laying of pipe in finished trenches shall be commenced at the lowest point so the spigot ends point in the direction of flow.

B. All pipes shall be laid with ends abutting and true to line and grade as given by the Engineer. Supporting of pipes shall be as set out hereinbefore under "Pipe Bedding" and in no case shall the supporting of pipes on blocks be permitted.

C. Before each piece of pipe is lowered into the trench, it shall be thoroughly inspected to insure it's being cleaned. Each piece of pipe shall be lowered separately unless special permission is given otherwise by the Engineer. No piece of pipe or fitting which is known to be defective shall be laid or placed in the lines. If any defective pipe or fitting shall be discovered after the pipe is laid, they shall be removed and replaced with a satisfactory pipe or fitting without additional charge. In case a length of pipe is cut to fit in a line it shall be so cut as to leave a smooth end at right angles to the longitudinal axis of the pipe.

D. Pipe shall not be laid on solid rock. A pad of granular material as specified in Paragraph 3.02 "Pipe Bedding", shall be used as a pipe bedding. Pipe bedding is not a separate pay item. Irregularities in subgrade in an earth trench shall be corrected by use of granular material.

E. When ordered by the Engineer, unsuitable materials in subgrades shall be removed below ordinary trench depth in order to prepare a proper bed for the pipe.

F. When laying of pipe is stopped for any reason, the exposed end of such pipe shall be closed with a plywood or fabricated plug fitted into the pipe bell, so as to exclude earth or other material, and precautions taken to prevent flotation of pipe by runoff into trench.

G. No backfilling (except for securing pipe in place) over pipe will be allowed until the Engineer has had an opportunity to make an inspection of the joints, alignment and grade, in the section laid.

3.05 BACKFILLING PIPELINE TRENCHES

A. Backfilling of pipeline trenches shall be accomplished with the requirements set forth in DIVISION 31 – EARTHWORK as shown on the Drawings and with details set forth hereinafter.

B. Method "A" - Backfilling in Open Terrain:

Backfilling of pipeline trenches in open terrain shall be accomplished in the following manner:

1. The lower portion of the trench, from the pipe bedding to a point 12" above the top of the pipe, shall be backfilled with material free from rock and/or material acceptable to the Engineer. This material shall be placed in a manner approved by the Engineer, and shall be carefully compacted to avoid displacement of the pipe.

   Compaction shall be accomplished by hand-tamping or by approved mechanical methods.

2. The upper portion of the trench above the compacted portion shall be backfilled with material which is free from large rock. Incorporation of rock having a volume exceeding one-half cubic foot is prohibited. Backfilling this portion of the trench may be accomplished by any means approved by the Engineer. The trench backfill shall be heaped over or leveled as directed by the Engineer.

C. Method "B" - Backfilling Under Sidewalks & Unpaved Driveways:

Backfilling of pipeline trenches under sidewalks and unpaved driveways shall be accomplished in the following manner.

1. The lower portion of the trench, from the pipe bedding to a point 12 inches above the top of the pipe, shall be backfilled with material free from rock, and acceptable to the Engineer or with crushed stone as specified in ”Pipe Bedding”. This material shall be placed in a manner to avoid displacement of the pipe. Compaction shall be accomplished by hand-tapping or by approved mechanical methods.

2. The middle portion of the trench, from a point 12" above the top of the pipe to a point 6" below the grade line, shall be backfilled with material free from large rock and acceptable to the Engineer. This material shall be placed and compacted in layers of approximately 6 inches. Water (puddling) may be used as required to obtain maximum compaction.

   Upon approval of the Engineer, the Contractor may backfill the middle portion of the trench with crushed stone, fine gravel, or sand in lieu of materials which require compaction.

3. The upper portion of the trench shall be temporarily backfilled and maintained with crushed stone or gravel until such time as the sidewalk is constructed or the driveway surface is restored.

D. Method "C" - Backfilling Under Streets, Roads, and Paved Driveways:

Backfilling of pipeline trenches under streets, roads and paved driveways shall be accomplished in the following manner:

1. The lower portion of the trench from the pipe bedding to a point 6" below the bottom of the pavement or concrete sub-slab, shall be backfilled with # 9 crushed stone.

2. The upper portion of the trench, from a point 6" below the bottom of the pavement or concrete sub-slab to grade, shall be backfilled with a base course of dense graded aggregate. At such time that pavement replacement is accomplished, the excess base course shall be removed as required.

E. Trenches outside existing sidewalks, driveways, streets, and highways shall be backfilled in accordance with Method "A". Trenches within the limits of sidewalk and unpaved driveways shall be backfilled in accordance with Method "B". Trenches within the paving limits of existing streets, highways and driveways shall be backfilled in accordance with Method "C". All methods are shown on Sheet SD-2 of the Drawings. When directed by the Engineer, the Contractor shall wet backfill material to assure maximum compaction.

F. Before final acceptance, the Contractor will be required to level off all trenches or to bring the trench up to grade. The Contractor shall also remove from roadways, rights-of-ways and/or private property all excess earth or other materials resulting from construction.

G. In the event that pavement is not placed immediately following trench backfilling in streets and highways, the Contractor shall be responsible for maintaining the trench surface in a level condition at proper pavement grade at all times.

3.06 SETTLEMENT OF TRENCHES

A. Whenever lines are in, or cross, driveways and streets, the Contractor shall be responsible for any trench settlement which occurs within these rights-of-way within one year from the time of final acceptance of the work. If paving shall require replacement because of trench settlement within this time, it shall be replaced by the Contractor at no extra cost to the Owner. Repair of settlement damage shall meet the approval of the Owner and/or the State Department of Transportation.

3.07 CONCRETE THRUST BLOCKS, CRADLE, ANCHORS OR ENCASEMENT

A. Concrete thrust blocks, cradle, anchors or encasement shall be placed where shown on the Drawings, required by the specifications, or as directed by the Engineer.

B. For cradle and encasement, concrete shall be 2000 psi and shall be mixed sufficiently wet to permit it to flow under the pipe to form a continuous bed.

C. For thrust blocks and anchors, concrete shall be 2000 psi, and shall be formed or be sufficiently stiff to maintain the forms indicated on the Details.

D. When tamping concrete, care shall be taken not to disturb the grade or line of the pipe or injure the joints. Concrete placed outside the specified limits or without authorization from the Engineer will not be subject to payment.

3.08 BITUMINOUS CONCRETE HIGHWAY, STREET AND DRIVEWAY REPLACEMENT

A. The Contractor shall replace those sections of existing roads, streets and driveways required to be removed to install the pipe lines under this contract. He shall construct same to the original lines and grades and in such manner as to leave all such surfaces in fully as good or better condition than that which existed prior to the operations.

B. Prior to trenching, the pavement shall be scored or cut to straight edges at least twelve (12) inches outside each edge of the proposed trench to avoid unnecessary damage to the remainder of the paving. Edges of the existing pavement shall be re-cut and trimmed to square, straight edges after the pipeline has been installed and prior to placing the new base and pavement.

C. Backfilling of the trench shall be in accordance with Method "C" as described hereinbefore. Base course for the paving shall be dense graded crushed limestone furnished and placed in accordance with the current requirements of the Standard Specifications for Road and Bridge Construction of the Department of Transportation, to a depth of six (6) inches in roads and streets and four (4) inches in driveways.

D. A subslab of reinforced concrete shall be placed for state-maintained highways as indicated on the Drawings. The subslab shall have a minimum thickness of 6 inches. Concrete for the subslab shall be 2500 psi, in accordance with the Details shown on the Drawings.

3.09 REMOVING AND REPLACING CONCRETE CURB AND GUTTER

A. The Contractor shall remove the curb and gutter when encountered when required for laying the sewer. Only that portion of the curb and gutter needed to lay the sewer line shall be removed. Where concrete curb and gutter removed or disturbed during the

construction work, it shall be replaced, using 3000 psi concrete, in fully as good or better condition than which existed prior to the Contractor's operation.

3.10 REPLACEMENT OF EXISTING MAIL BOXES, CULVERTS, CLOTHES LINE POSTS, FENCES AND OTHER SUCH FACILITIES

A. Existing mail boxes, drainage culverts, clothes line posts, fences and the like shall not be damaged or disturbed unless necessary, in which case, they shall be replaced in as good condition as found as quickly as possible. Existing materials shall be reused in replacing such facilities when materials have not been damaged by the Contractor's operations. Existing facilities damaged by Contractor's operation shall be replaced with new materials of the same type at the Contractor's expense. Work in this category is not a pay item.

B. Replacement of paved drainage ditches within highway right-of-way shall be accomplished in accordance with Department of Transportation specifications.

3.11 TESTING

A. All pressure piping (lines not laid to grade) shall be given a hydrostatic test of at least 1.5 times the normal operating pressure of the pipe (at its lowest elevation), but not to exceed the rated working pressure of the pipe or valves. Note: Engineer shall verify test pressure. Loss of pressure during the test shall not exceed 0 psi in a 4-hour period and 5 psi in a 24-hour period. Any test results that do not meet either of these requirements shall constitute a failure of the pressure test.

B. Leakage in pipelines, when tested under the hydrostatic test described above, shall not exceed 10 gallons per 24 hours per inch of diameter per mile of pipe.

C. Contractor shall furnish a recording gauge and water meter for measuring water used during leakage test and recording pressure charts during duration of test. Recording pressure charts shall be turned over to the Engineer at conclusion of tests. The pressure recording device shall be suitable for outside service, with a range from 0-200 psig, 24-hour spring wound clock, designed for 9-inch charts, and shall be approved by the Engineer.

D. Pipelines shall be tested before backfilling at joints except where otherwise required by necessity or convenience.

E. Duration of test shall be not less than four (4) hours where joints are exposed and not less than 24 hours where joints are covered.

F. Where leaks are visible at exposed joints, evident on the surface where joints are covered, and/or identified by isolating a section of pipe, the joints shall be repaired and leakage must be minimized, regardless of total leakage as shown by test.

G. All pipe, fittings, valves, and other materials found to be defective under test shall be removed and replaced at no additional expense to the Owner.

H. Lines which fail to meet tests shall be repaired and retested as necessary until test requirements are complied with.

I. Where nonmetallic joint compounds are used, pipelines should be held under normal operating pressure for at least three days before testing.

J. The Owner will provide initial water for testing the pressure piping. Should the first test fail to pass, all additional water required for subsequent tests shall be furnished at the Contractor's expense.

K. The cost of testing of pressure piping is incidental and is to be included in the Contractor's unit Contract Price.

3.12 CLEAN UP

A. Upon completion of installation of the piping and appurtenances, the Contractor shall remove all debris and surplus construction materials resulting from the Work. The Contractor shall grade the ground along each side of pipe trenches in a uniform and neat manner leaving the construction area in a shape as near as possible to the original ground line.

END OF SECTION

SECTION 333216

RESIDENTIAL WASTEWATER PUMPING STATIONS

PART 1 GENERAL

1.01 Provide all labor, materials, and equipment necessary for furnishing and installing underground residential simplex submersible sewage grinding pump station(s) complete and in proper operating condition. The work includes all work shown or implied on the Drawings. The work includes (but is not limited to):

1. Coordination of final station location and controls location with resident and OWNER.

2. Furnishing, installation and start-up of factory built simplex submersible grinder pump station complete with enclosure, plumping and controls.

3. All related electrical work required to place the pumping unit in service including connection of the station's power supply to the resident's meter base or home electrical panel.

4. Connection of the resident's sewer lateral to the completed pump station.

5. Furnishing and installation of the 1-1/4" service main isolation valve and check valve in a standard meter vault at the point of connection of the service main with the main force main.

6. All related site work including clearing, grading, trenching, backfilling, surface restoration, clean-up, etc.

PLEASE NOTE – Installation of the Pumping Station 1-1/4" service main between the pump station and the main force main is covered under a separate specification and is not a part of this specification.

1.02 QUALITY CONTROL

A. Base Bidding: These specifications and the Drawings are based on the provision of a generic pumping unit. To simplify repairs and inventory of spare parts, the OWNER has mandated that the SUCCESSFUL BIDDING (CONTRACTOR) provide a single pump unit for use throughout the system.

B. Warranty: The manufacturer of the submersible pumping station shall guarantee all equipment supplied against defects in workmanship and material for a **period of sixty (60) months after notice of OWNER's acceptance, but not greater than sixty-five (65) months after receipt of shipment.** The OWNER will report any defects found during the warranty period to the MANUFACTURER.

Warranty Performance Certification: As a bid certification requirement, each bidder shall provide with their bid schedule a Warranty Performance Certification statement executed by the most senior executive officer of the grinder pump **MANUFACTURER**, which certifies a minimum of a 60-month warranty. They must further detail any exclusions from the warranty or additional cost items required to maintain the equipment in warrantable condition, including all

associated labor and shipping fees, and certify that the **MANUFACTURER** will bear **all** costs to correct any original equipment deficiency for the effective period of the warranty. All preventive maintenance type requirements shall be included in this form as exclusions. These requirements include, but are not limited to, unjamming of grinder mechanism, periodic motor maintenance, and periodic cleaning of liquid level controls. Should the **CONTRACTOR** (supplier) elect to submit a performance bond in lieu of the experience clause outlined above, this Warranty Performance Certification shall also be used as a criterion to evaluate the **CONTRACTOR'S** (supplier's) performance over the warranty period. A Warranty Performance Certification form is included in the specifications and must be completed and submitted as part of the bid package. Bids with incomplete forms or missing forms will be considered nonresponsive.

C. In the event a component fails to perform as specified or is proven defective in service during the warranty period, the Manufacturer shall repair or replace, at his discretion, such defective part without cost to the OWNER. He shall further provide, without cost, such labor as may be required to replace, repair, or modify major equipment components.

D. Start-Up: The manufacturer shall provide the services of a factory-trained representative for a maximum period two site visits/eight working days on-site to perform initial start-up of the pumping units and to instruct the OWNER'S operating personnel in the operation and maintenance of the equipment. Additional information in Section 4.01 Start-Up and Field Testing.

1.03 SUBMITTALS

A. Each pump manufacturer that is not the basis of design must provide to the ENGINEER the information listed below 10 calendar days prior to bid. Approved manufacturers will be notified through addendum. This submittal does not relive the apparent successful bidder from full submittal responsibilities after award to the bid. Submit five (5) bound copies of the following:

1. Manufacturer's warranty/guarantee and warranty certification form bound in these specifications.

2. Pump station Shop Drawings complete with station drawing, electrical schematics, and accessory components.

3. Pump station O & M Manuals. Manuals are to provide basic instructions for preventative and cyclic maintenance, sources of spare parts, etc.

4. A list of 5 operating systems, with contact names and phone numbers, operating a low-pressure system with a least 400 of the like type manufacturer's pump stations installed.

5. A detailed hydraulic analysis of the low pressure sewer system that includes total dynamic head for each zone, accumulated total dynamic head, total pumps in each zone, capacity of each zone, retention time of each zone, accumulated retention time, total quantity of each size of pipe.

1.04 MANUFACTURER

Grinder pump stations, complete with all appurtenances, form an integral system, and as such, shall be supplied by one grinder pump station manufacturer. The **CONTRACTOR** shall be

responsible for the satisfactory operation of the entire system. The equipment specified shall be a product of a company experienced in the design and manufacture of grinder pumps for specific use in low pressure sewage systems. The company shall submit detailed installation and user instructions for its product, submit evidence of an established service program including complete parts and service manuals, and be responsible for maintaining a continuing inventory of grinder pump replacement parts. The **MANUFACTURER** shall provide, upon request, a reference and contact list from ten of its largest contiguous grinder pump installations of the type of grinder pumps described within this specification.

The **MANUFACTURER** of the grinder pump station shall be Liberty or ENGINEER Approved Equal.

Attention is directed to the fact that the drawings and overall system design are based on a particular piece of equipment from a particular manufacturer. These specifications are intended to provide guidelines for standard equipment of a recognized manufacturer who already meets all the requirements of this specification.

1.05 ALTERNATE EQUIPMENT

See SECTION 012500 – PRODUCTS & SUBSTITUTIONS.

1.06 EXPERIENCE CLAUSE

The equipment furnished hereunder shall be the product of a company experienced in the design and manufacture of grinder pumps specifically designed for use in low pressure systems. All manufacturers proposing equipment for this project shall demonstrate experience in the design and manufacture of units of identical size(s) and performance to the specified units. All manufacturers proposing equipment for this project must have successful installations of low-pressure sewer systems utilizing grinder pumps of like type to the grinder pumps specified herein. An installation is defined as a minimum of 25 pumps discharging into a common force main which forms a low pressure sewer system. The **CONTRACTOR** (supplier) proposing alternate equipment shall also submit, as part of the bid schedule, an installation list with contact person(s), phone number(s) and date(s) of at least 10 installations of the type of pump specified herein that have been in operation for at least 10 years.

In lieu of this experience clause, the **CONTRACTOR** (supplier) of alternate equipment will be required to submit a 5-year performance bond for 100 percent of the stipulated cost of all the equipment as bid and as shown in the Bid Schedule. This performance bond will be used to guarantee the replacement of the equipment in the event that it fails within the bond period.

PART 2 - PRODUCTS

2.01 WET WELL BASIN

A. BASIN

The tank shall be 24” in diameter x 60” in height and consist of a single wall, laminated fiberglass construction. The resin used shall be of a commercial grade suitable for the environment. The reinforcing material shall be a commercial grade of glass fiber capable of bonding with the selected resin. The inner surface shall have a smooth finish and be free of cracks and crazing. The exterior tank surface shall be relatively smooth with no exposed fiber or sharp projections present. The basin shall have a minimum wall thickness of ¼-inch. A steel anti-flotation plate shall be molded into the bottom of the basin.

B. The basin shall include a fiberglass non-skid cover. The cover shall be bolted to the basin with stainless steel cap screws. Cadmium plated nuts for the screws shall be embedded in the fiberglass to prevent turning and for corrosion resistance. A 2" green mushroom vent with galvanized nipple shall be installed in each cover.

2.02 DISCHARGE PIPING

A. Discharge piping shall consist of components/fittings with a high-pressure hose discharge, as detailed below and shown on the drawings. The basin discharge (exit from the station) shall be a 2" threaded flange of thermoplastic construction. The horizontal discharge piping shall include one (1) 1-1/4" stainless still nipple, one (1) brass NPT gate valve with stainless steel extension handle, one (1) 1-1/4" slip fit disconnect, one (1) cast iron ball check valve and one (1) 1-1/4" stainless steel street elbow for connecting the discharge hose. The removable discharge components shall include a stainless-steel pull rod to assist in pump removal.

B. The discharge hose assembly shall connect the pump discharge to the horizontal discharge line. This hose assembly shall include: 24.5" of 1-1/4" flexible hose rated for the maximum pump pressure; one (1) D125P poly female coupling; one (1) A125P insert and one (1) poly nipple barb banjo fitting.

2.03 PUMPS

A. The BASIS OF DESIGN submersible grinder pump shall be a Liberty model LSGX-200, driven by a 2 HP, 230 volt, 1-phase submersible motor. The pump shall be capable of performing over a range of 2 GPM @ 180' TDH through 38 GPM @ 10' TDH. The submersible grinder pump shall be capable of handling residential sewage and grinding it to a fine slurry, enabling it to be pumped over long distances in pipelines as small as 1.25" in diameter.

B. Each centrifugal grinder pump shall be equal to the Liberty LSGX series as manufactured by Liberty Pumps, Bergen, NY or ENGINEER approved equal.

C. The castings shall be constructed of class 25 cast iron. The motor housing shall be oil filled to dissipate heat. Air filled motors shall not be considered equal since they do not properly dissipate heat form the motor.

D. All mating parts shall be machined and sealed with a Buna-N O-ring. All fasteners exposed to the liquid shall be stainless steel. The motor shall be protected on the top side with a seal cord entry plate with molded pins to conduct electricity eliminating the ability of water to enter internally through the cord. The motor shall be protected on the lower side with a dual seal arrangement. The first seal is a double lip seal molded in FKM fluoroelastomer of Buna-N. The second / main seal shall be a unitized hard face silicon carbide seal with stainless steel housings and spring.

E. The upper and lower bearing shall be capable of handling all radial thrust loads. The lower bearing shall have the additional ability to handle the downward axial thrust produced by the impeller and cutters by design of angular contact roller races. The pump housing shall be of the concentric design thereby equalizing the pressure forces inside the housing which will extend the service life of the seals and bearings. Additionally, there shall be no cutwater in the housing volute in order to discourage the entrapment of flowing debris. The pump shall be furnished with stainless steel handle having a nitrile grip.

F. The submersible pump shall be supplied with 25 feet of multiconductor power cord. It shall be cord type SJOOW (1-phase) or SEOOW (3-phase), capable of continued exposure to the pumped liquid. The power cord shall be sized for the rated full load amps of the pump in accordance with the National Electric Code. The power cable shall not enter the motor housing directly but will conduct electricity to the motor by means of a water tight compression fitting cord plate assembly, with molded pins to conduct electricity. This will eliminate the ability of water to enter internally through the cord, by means of a damaged or wicking cord.

G. Single phase motors shall be oil filled, capacitor start / capacitor run, class B insulated NEMA B design, rated for continuous duty. Three phase motors shall be polyphase. At maximum load the winding temperature shall not exceed 135 degrees C unsubmerged. Since air filled motors are not capable of dissipating heat, they shall not be considered equal. Single phase pump motors shall have an integral thermal overload switch in the windings for protecting the motor. Three phase motors shall be used with an appropriate controller with integral overload protection. The capacitor circuit shall be mounted internally on single phase pumps. Single phase motors shall have an integral solid-state starting circuit switch for switching the start winding off.

H. An upper radial and lower thrust bearing shall be required. The upper bearing shall be a single ball / race type bearing. The lower bearing shall be an angular contact heavy duty ball / race type bearing, designed to handle axial grinder pump thrust loads. Both bearings shall be permanently lubricated by the oil, which fills the motor housing. The bearing system shall be designed to enable proper cutter alignment from shut off head to maximum load at 10 ' of TDH. The motor shaft shall be made of 300 or 400 series stainless steel and have a minimum diameter of .670".

I. The pump shall have a dual seal arrangement consisting of a lower and upper seal to protect the motor from the pumping liquid. The lower seal shall be an FKM molded double lip seal, designed to exclude foreign material away from the main upper seal. The upper seal shall be a unitized silicon carbide hard face seal with stainless steel housings and spring equal to Crane Type T-6a. The motor plate / housing interface shall be sealed with a Buna-N O-ring. fluoroelastomer OR Buna N.

J. The impeller shall be an investment cast stainless steel impeller, with pump out vanes on the back shroud to keep debris away from the seal area. It shall be keyed and bolted to the motor shaft.

K. The cutter and plate shall consist of 440 stainless steel with a Rockwell C hardness of 55-60. The stationary cutter plate shall have specially designed orifices through it, which enable the slurry to flow through the pump housing at an equalized pressure and velocity. The stationary cutter shall consist of V shapes to maximize cutting action and arc shape exclusion slots to outwardly eject debris from under the rotary cutter. The rotary cutter shall have (4) blades and be designed with a recessed area behind the cutting edge to prevent the accumulation and binding of any material between rotary cutter and the stationary cutter. The cutting system must incorporate close tolerances for optimum performance. Ring or radial cutters, or those that grind on the outside circumference of shall not be considered equal.

L. The exterior of the casting shall be protected with Powder Coat paint. The pump shall have cast iron support legs, enabling it to be a free-standing unit. The legs will be high enough to allow solids and long stringy debris to enter the cutter assembly.

M. The pump shall have a ground continuity check and the motor chamber shall be Hi-potted to test for electrical integrity, moisture content and insulation defects. The motor and volute housing shall be pressurized, and an air leak decay test is performed to ensure

integrity of the motor housing. The pump shall be run, voltage current monitored, and the tester checks for noise or other malfunction.

N. The pump shall be manufactured in an ISO 9001 certified Facility and shall include a standard manufacture three-year warranty.

2.04 CONTROL PANEL

A. A pump control panel shall be furnished with each pumping unit to be installed as shown on the plans. The control panel shall be housed in a fully gasketed NEMA 4X fiberglass enclosure with a hinged door. Each enclosure shall have a quick-release lockable latch.

B. The panel shall be sized for 230 volt, 1-phase incoming power and shall be sized to handle the pump motor requirements. Each panel shall include a 30-amp circuit breaker for the pump and a 15-amp breaker for the control circuitry. All circuit breakers shall be Square D model QOU230.

C. The control panel should include an adequately sized Square D LC1D18G7 motor starter. Starting/stopping/alarm of the pump shall be accomplished via two float switches within the pump station. The lower float switch shall start/stop the pump based on the level in the wet well. While the high-level float should energize the alarm light if the water level reaches a preset level.

D. The control panel should include a system interface area consisting of the pump Hand-Off-Auto switch, a pump running pilot light and an alarm test toggle switch. Each panel shall include a large terminal strip area for landing of all system control wires.

E. The control enclosure shall be fitted with a red lexan (polycarbonate) alarm light. The light shall be approximately 2″ high by 1-1/2″ in diameter. The globe shall be mounted on top of the enclosure with a neoprene gasket. The lens cannot be removed from the exterior of the enclosure. The lens may be removed by entering the interior of the enclosure and removing four (4) #8 screws. The bulbs shall be easily replaced by removing a thumb screw from the support bracket on the interior of the panel.

F. A schematic diagram (showing wire numbering) shall be permanently fastened to the inside of the enclosure

2.05 CHECK VALVE

The pump discharge shall be equipped with a factory installed, gravity operated, flapper-type integral check valve built into the discharge piping. The check valve will provide a full-ported passageway when open, and shall introduce a friction loss of less than 6 inches of water at maximum rated flow. Moving parts will be made of a 300 Series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A nonmetallic hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating even at a very low back-pressure. The valve body shall be an injection molded part made of an engineered thermoplastic resin. The working pressure of the valve shall be at least 235 psi. Ball-type check valves are unacceptable due to their limited sealing capacity in slurry applications.

2.06 LATERAL ASSEMBLY

A pump isolation valve and check valve shall also be provided in a standard meter box enclosure at the point of connection of the service main to the main pressure sewer header.

PART 3 - EXECUTION

A. Electrical: All electrical work shall be inspected and approved by an electrical inspector. Two copies of the Certificate of Approval shall be provided to the ENGINEER before final acceptance.

B. Pump Test: The completed installation shall be given a running test of all equipment. While the pump(s) is/are running, all piping and seals shall be checked to insure that no leaks occur. All controls and warning indicators shall be checked for proper operation.

C. Smoke Test: The CONTRACTOR shall smoke test the resident's incoming sewer system (in the presence of the ENGINEER) to verify that roof leaders are not connected to the grinder system. A written report of all smoke testing, with emphasis on non-complying homeowners, shall be furnished to the ENGINEER at the completion of the project.

D. Repair: Any defects or failure to meet the requirements of these specifications shall be promptly corrected by the CONTRACTOR by replacement. The decision of the OWNER as to whether or not the CONTRACTOR has fulfilled his obligation shall be final and binding on all parties.

3.01 SERVICEABILITY

The grinder pump core, including level sensor assembly, shall have two lifting hooks complete with lift-out harness connected to its top housing to facilitate easy core removal when necessary. The level sensor assembly must be easily removed from the pump assembly for service or replacement. All mechanical and electrical connections must provide easy disconnect capability for core unit removal and installation. Each EQD half must include a water-tight cover to protect the internal electrical pins while the EQD is unplugged. A pump push-to-run feature will be provided for field trouble shooting. The push-to-run feature must operate the pump even if the level sensor assembly has been removed from the pump assembly. All motor control components shall be mounted on a readily replaceable bracket for ease of field service.

3.02 OSHA CONFINED SPACE

All maintenance tasks for the grinder pump station must be possible without entry into the grinder pump station (as per OSHA 1910.146 Permit-required confined spaces). *"Entry means the action by which a person passes through an opening into a permit-required confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space."*

3.03 SAFETY

The grinder pump shall be free from electrical and fire hazards as required in a residential environment. As evidence of compliance with this requirement, the completely assembled and wired grinder pump station shall be listed by Underwriters Laboratories, Inc., to be safe and appropriate for the intended use. UL listing of components of the station, or third-party testing to UL standard are not acceptable.

The grinder pump shall meet accepted standards for plumbing equipment for use in or near residences, shall be free from noise, odor, or health hazards, and shall have been tested by an independent laboratory to certify its capability to perform as specified in either individual or low-pressure sewer system applications. As evidence of compliance with this requirement, the grinder pump shall bear the seal of NSF International. Third-party testing to NSF standard is not acceptable.

3.04 START-UP AND FIELD TESTING

The **MANUFACTURER** shall provide the services of qualified factory trained technician(s) who shall inspect the placement and wiring of each station, perform field tests as specified herein, and instruct the **OWNER'S** personnel in the operation and maintenance of the equipment before the stations are accepted by the **OWNER**.

All equipment and materials necessary to perform testing shall be the responsibility of the **INSTALLING CONTRACTOR.** This includes, as a minimum, a portable generator and power cable (if temporary power is required), water in each basin (filled to a depth sufficient to verify the high level alarm is operating), and opening of all valves in the system. These steps shall be completed prior to the qualified factory trained technician(s) arrival on site.

The services of a trained, factory-authorized technician shall be provided at a rate of 40 hours for every 100 grinder pump stations supplied. A maximum of two trips of service technician time will be included in pump station pricing to complete start-up. Any additional cost associated with additional trips will be the responsibility of the contractor.

Upon completion of the installation, the authorized factory technician(s) will perform the following test on each station:

1. Make certain the discharge shut-off valve in the station is fully open.

2. Turn ON the alarm power circuit and verify the alarm is functioning properly.

3. Turn ON the pump power circuit. Initiate the pump operation to verify automatic "on/off" controls are operative. The pump should immediately turn ON.

4. Consult the Manufacturer's Service Manual for detailed start-up procedures.

Upon completion of the start-up and testing, the **MANUFACTURER** shall submit to the **ENGINEER** the start-up authorization form describing the results of the tests performed for each grinder pump station. Final acceptance of the system will not occur until authorization forms have been received for each pump station installed and any installation deficiencies corrected.

3.05 ACCESSORIES

A. All materials exposed to wastewater shall have inherent corrosion protection. Acceptable corrosion protection includes fully epoxy-coated cast iron to 8-10 mil Nominal dry thickness, wet applied, fiberglass, stainless steel, polyethylene, nylon, and PVC.

B. **Power and Control Cable – The Contractor shall provide extra power and control cables in the length of (1) 50ft, (1) 75ft and (1) 100 ft in length. The cost of the spare cables shall be incidental to the Contract and there shall be no separate payment made therefore.**

C. Electrical Systems & Components – All electrical systems and components shall be in full accordance with the current edition of the National Electrical Code. All power supply lines and control lines to the pump station shall be fully encased in rigid conduit meeting NEC requirements. All electrical systems and components in wet wells and enclosed spaces shall comply with National Electrical Code requirements. All conduits extending from the wet well to the control panel shall be sealed at the entrance to the control panel to prevent the intrusion of corrosive gases! The control circuitry shall be provided with "Ground Fault" interruption protection, which will de-energize the circuit in the event of any failure in the electrical integrity of the pump power cable.

3.06 INSTALLATION

A. Maintenance of Service: Wastewater service shall be maintained throughout the construction activity. No discharge to surface waters shall be allowed.

B. Installation shall be in accordance with the Manufacturer's requirements and the referenced codes and specifications.

C. Excavation: CONTRACTOR shall select means, methods, sequences and techniques of construction to both protect adjacent properties and to provide a stable, safe working environment. Decision as to whether to use sheet piles with wales and struts, manhole trench box, piles and lagging, or other methods of excavation support shall be the CONTRACTOR'S.

D. Backfilling: Before backfilling is started, the excavated pit shall be cleared of all rubbish and debris and shall be de-watered. The backfill materials shall be free of frozen lumps, vegetation and debris. Backfill material shall be placed in uniform horizontal layers not exceeding 6 inches in thickness (loose measure). As a precaution against the development of unbalanced stresses, the backfill shall be placed and compacted symmetrically about the excavation to 95% of Standard Proctor Density.

E. Factory Testing: Each grinder pump shall be submerged and operated for a minimum of 5 minutes. Included in this procedure will be the testing of all ancillary components such as, the anti-siphon valve, check valve, discharge line, level sensors and each unit's dedicated controls. All factory tests shall incorporate each of the above listed items. Actual appurtenances and controls, which will be installed in the field, shall be particular to the tested pump only. A common set of appurtenances and controls for all pumps will not be acceptable. Certified test results shall be available upon request showing the operation of each grinder pump at two (2) different points on its curve, with the maximum pressure no less than 60 psi. The ENGINEER reserves the right to inspect such testing procedures with representatives of the OWNER, at the grinder pump manufacturer's facility.

WARRANTY PERFORMANCE CERTIFICATION

As a pre-bid certification requirement, each bidder shall provide a Warranty Performance Certification executed by the most senior executive officer, which certifies a minimum of a five (5) year warranty. They must further detail any exclusions from the warranty or additional cost items required to maintain the equipment in warrantable condition, including all associated labor and shipping fees, and certify that the manufacturer will bear **all** costs to correct original equipment deficiency for the effective period of the warranty.

I,_____, by and through my duly authorized signature below as its most senior operating executive, certify that _____ _____ will provide a five (5) year warranty on grinder pump equipment manufactured and supplied by _____ _____ for the _____ _____ project. I further certify that, other than failure to install equipment in accordance with manufacturer's instructions, no exclusions and/or cost items to maintain said equipment in warrantable condition, including labor, travel and shipping fees, exist except as detailed immediately below:

EXCLUSIONS: 1. _____
2. _____
3. _____

COST ITEMS TO MAINTAIN EQUIPMENT IN WARRANTABLE CONDITION:	Required Frequency (mos)	Avg. monthly cost ($) times warranty period
1. _____	_____	$ _____
2. _____	_____	$ _____
3. _____	_____	$ _____
4. _____	_____	$ _____
5. _____	_____	$ _____

Total labor/material cost to maintain equipment in warrantable condition for warranty period ($):

For any items not identified as exclusions or additional cost items above, OR for additional labor & material costs required to maintain equipment in warrantable condition that exceed the Avg. monthly cost ($) detailed above, _____ will bear all costs to correct such original equipment deficiency for the effective period of the warranty including all applicable labor, travel and shipping fees.

_____ _____
Signature Date

_____
Title

-END OF SECTION-

SECTION 335216

MEDIUM DENSITY POLYETHYLENE PIPING FOR NATURAL GAS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Provide all labor, materials, equipment and services required for furnishing and installing all piping and appurtenances specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. DIVISION 31 – EARTHWORK

B. DIVISION 33 – UTILITIES

1.03 SUBMITTALS

A. A notarized certification shall be furnished for all pipe and fittings that verifies compliance with all applicable specifications.

B. The requirement for this certification does not eliminate the need for shop drawings submittals in compliance with Section 013323.

1.04 UTILITY LINE ACTIVITIES COVERED UNDER NATIONWIDE PERMIT # 12

All activities involving utility line construction covered under NATIONWIDE PERMIT # 12 shall meet the following conditions:

A. The general Water Quality Certification is limited to the crossing of intermittent and perennial streams by utility lines.

B. The construction of permanent or temporary access roads will impact less than 300 linear feet of intermittent and perennial streams and less than one acre of jurisdictional wetlands.

C. Utility lines shall be located at least 50 feet away from a stream which appears as a blue line on a USGA 7 ½ minute topographic map except where the utility line alignment crosses the stream. Utility lines that cross streams shall be constructed by methods that maintain normal stream flow and allow for a dry excavation. Water pumped from the excavation shall be contained and allowed to settle prior to re-entering the stream. Excavation equipment and vehicles shall operate outside of the flowing portion of the stream. Spoil material from the utility line excavation shall not be allowed to enter the flowing portion of the stream.

D. The activities shall not result in any permanent changes in preconstruction elevation contours in waters or wetlands or stream dimension, pattern or profile.

E. Utility line construction projects through jurisdictional wetlands shall not result in conversion of the area to non-wetland status.

F. Measures shall be taken to prevent or control spills of fuels, lubricants, or other toxic materials used in construction form entering the watercourse.

G. Removal of riparian vegetation in the utility line right-of-way shall be limited to that necessary for equipment access. Effective erosion and sedimentation control measures must be employed at all times during the project to prevent degradation of waters of the Commonwealth. Site regarding and reseeding will be accomplished with 14 days after disturbance.

H. To the maximum extent practicable, all in stream work under this certification shall be performed during low flow.

I. Heavy equipment, e.g. bulldozers, backhoes, draglines, etc., if required for this project, should not be used or operated within the stream channel. In those instances where such in stream work is unavoidable, then it shall be performed in such a manner and duration as to minimize turbidity and disturbance to substrates and bank or riparian vegetation.

J. Any fill shall be of such composition that it will not adversely affect the biological, chemical, or physical properties of the receiving waters and/or cause violations of water quality standards. If riprap is utilized, it is to be of such weight and size that bank stress or slump conditions will not be created because of its placement.

K. Removal of existing riparian vegetation should be restricted to the minimum necessary for project construction.

L. Should evidence of stream pollution or jurisdictional wetland impairment and/or violations of water quality standards occur as a result of this activity (either from a spill or other forms of water pollution), the Kentucky Division of Water shall be notified immediately by calling 800/928-2380.

1.05 CONSTRUCTION IN A FLOODPLAIN

A. No material shall be placed in the stream or in the flood plain to form construction pads, coffer dams, access roads, etc. unless prior approval has been obtained from the Environmental and Public Protection Cabinet.

B. The trench shall be backfilled as closely as possible to the original contour. All excess material from construction of the trench shall be disposed of outside the flood plain unless the applicant has received prior approval from the Cabinet to fill within the flood plain.

PART 2 - PRODUCTS

2.01 MEDIUM-DENSITY POLYETHYLENE UAC 2000

A. UAC 2000

1. General: This section is for Medium-density Polyethylene (MDPE) UAC 2000 approved Pipe for natural gas conveyance of natural gas in Sizes ½” to 12” and defines the characteristics and properties of medium-density polyethylene pipe.

This specification governs the material, pipe, fittings, butt fusion, and general construction practice for MDPE piping systems.

a. All materials provide physical and mechanical properties as classified in accordance to ASTM D3350 and have a cell classification of 234373E. These materials are listed with Plastics Pipe Institute (PPI) as PE 2406/2708 medium-density polyethylene.

b. UAC 2000 polyethylene gas pipes are manufactured in accordance with all applicable specifications including ASTM D2513, the standard specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings, and by reference meet the Department of Transportation Title 49, Part 192 “Transportation of Natural and Other Gas by Pipe Line Minimum Safety Standards”.

c. Fittings shall be molded or fabricated from material meeting the same standards as the pipe.

d. Joints shall be made by the thermal butt fusion or electrofusion system. All joints shall be completely watertight, airtight and as strong as or stronger than the pipe wall, in strict accordance with the manufacturer's recommendations.

e. Sections of polyethylene pipe shall be joined into continuous lengths on the job site above ground. The joining method shall be the heat fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The heat fusion equipment used in the joining procedures shall be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400^{o}F, alignment, and 150 psi interfacial fusion pressure.

f. Heat fusion joining shall be 100% efficient offering a joint weld strength equal to or greater than the tensile strength of the pipe. Socket fusion shall not be used.

2. References: Where all or part of a Federal, ASTM, ANSI, AWWA, etc., standard specification is incorporated by reference in these Specifications, the reference standard shall be the latest edition and revision and considered a part of these specifications.

3. Material: Materials used for the manufacture of polyethylene pipe and fittings shall be extra high molecular weight, medium density PE 2708 polyethylene resin. The material shall be listed by PPI (Plastics Pipe Institute, a division of the Society of the Plastics Industry) in PPI TR-4 with a 73°F hydrostatic design basis of 1,250 psi. The PPI listing shall be in the name of the pipe manufacturer and shall be based on ASTM D 2837 testing.

4. Pipe and Fittings: Qualification of Manufacturers. The Manufacturer shall have manufacturing and quality assurance facilities capable of producing and assuring the quality of the pipe and fittings required by these Specifications. The Manufacturer's production facilities shall be open for inspection by the Owner or his Authorized Representative.

a. Pipe: Pipe supplied under this specification shall have a nominal DIPS (Ductile Iron Pipe Size) OD unless otherwise specified. The DR

(Dimension Ratio) and the pressure rating of the pipe supplied shall be as shown on the drawings. The pipe shall be produced from approved MDPE pipe grade resin with the nominal physical properties as specified in the appropriate ASTM specifications for the sizes indicated. Pipe having a diameter 3" and larger will be made to the dimensions and tolerances specified in ASTM F 714.

The pipe shall contain no recycled compound except that generated in the manufacturer's own plant. The pipe shall be homogeneous throughout and free of visible cracks, holes, voids, foreign inclusions, or other defects that may affect the wall integrity.

b. Pipe Performance: The pipe will be extruded from resin meeting the specifications of ASTM D 3350 with a minimum cell classification of 345464C.

c. Fittings: MDPE fittings shall be in accordance with ASTM D 3261 and shall be manufactured by injection molding, a combination of extrusion and machining, or fabrication from MDPE pipe conforming to this specification. The fittings shall be fully pressure rated and provide a working pressure equal to that of the pipe with an included 2:1 safety factor. The fittings shall be manufactured from the same base resin type and cell classification as the pipe itself. The fittings shall be homogeneous throughout and free from cracks, holes, foreign inclusions, voids, or other injurious defects.

d. Molded Fittings. Molded fittings shall be manufactured and tested in accordance with ASTM D 3261 and shall be so marked. Molded fittings shall be tested in accordance with AWWA C906.

e. X-Ray Inspection. The Manufacturer shall submit samples from each molded fitting production lot to x-ray inspection.

f. Fabricated Fittings. Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock or molded fittings. Fabricated fittings shall be rated for internal pressure service at least equal to the full-service pressure rating of the mating pipe. Fabricated fittings shall be tested in accordance with AWWA C906.

g. Polyethylene Flange Adapters. Flange adapters shall be made with sufficient through bore length to be clamped in a butt fusion-joining machine without the use of a stub-end holder. The sealing surface of the flange adapter shall be machined with a series of small v-shaped grooves (serrations) to promote gasketless sealing, or restrain the gasket against blowout.

5. Joining - Butt Fusion: Sections of polyethylene pipe shall be joined by the butt fusion process into continuous lengths at the job site. The joining method shall be the heat fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The heat fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer. Properly executed electrofusion fittings may be used. Extrusion welding or hot gas welding of MDPE shall not be used for pressure pipe applications or fabrications where shear or structural strength is important. Mechanical joint adapters, flanges, unions, grooved-couplers, transition fittings,

and some mechanical couplings may be used to mechanically connect MDPE pipe. Refer to the manufacturer's recommendations.

6. Joining - Other Means: Polyethylene pipe and fittings may be joined together or to other materials by means of (a) flanged connections (flange adapters and back-up rings), (b) mechanical couplings designed for joining polyethylene pipe or for joining polyethylene pipe to another material, (c) MJ Adapters or (d) electrofusion. When joining by other means, the installation instructions of the joining device manufacturer shall be observed.

   a. ID Stiffener and Restraint. A stiffener shall be installed in the bore of the polyethylene pipe when an OD compression mechanical coupling is used and when connecting plain end PE pipe to a mechanical joint pipe, fitting or appurtenance. External clamp and tie rod restraint shall be installed where PE pipe is connected to the socket of a mechanical joint pipe, fitting or appurtenance except where an MJ Adapter is used.

7. Quality and Workmanship: The pipe and/or fitting manufacturer's production facilities shall be open for inspection by the owner or his designated agents with a reasonable advanced notice. During inspection, the manufacturer shall demonstrate that it has facilities capable of manufacturing and testing the pipe and/or fittings to standards required by this specification. Pipe which has been tested by the manufacturer and falls outside of the appropriate limits set forth in this specification will be cause for rejection.

8. QA Records: QA/QC records shall be maintained intact for a minimum of one year from the date of production.

9. Pipe Marking: During extrusion production, the HDPE pipe shall be continuously marked with durable printing including the following information:

   Nominal Size
   Dimension Ratio
   Pressure Class, psi
   Manufacturer's Name and Product Series
   Cell Class
   ASTM Basis
   Pipe Test Category
   Plant Code & Extruder
   Production Date
   Operator Number (Shift Letter optional)
   Resin Supplier Code

10. Pipe Packaging, Handling, & Storage: The manufacturer shall package the pipe in a manner designed to deliver the pipe to the project neatly, intact, and without physical damage. The transportation carrier shall use appropriate methods and intermittent checks to insure the pipe is properly supported, stacked, and restrained during transport such that the pipe is not nicked, gouged, or physically damaged. Pipe shall be stored on clean, level ground to prevent undue scratching or gouging. If the pipe must be stacked for storage, such stacking shall be done in accordance with the pipe manufacturer's recommendations. The pipe shall be handled in such a manner that it is not pulled over sharp objects or cut by chokers or lifting equipment. Sections of pipe having been discovered with cuts or gouges in excess of 10% of the pipe wall thickness shall be cut out and removed. The undamaged portions of the pipe shall be rejoined using the heat fusion joining method. Fused segments of pipe

shall be handled so as to avoid damage to the pipe. Chains or cable type chokers must be avoided when lifting fused sections of pipe. Nylon slings are preferred. Spreader bars are recommended when lifting long fused sections.

11. Testing:

a. Fusion Quality. The Contractor shall ensure the field set-up and operation of the fusion equipment, and the fusion procedure used by the Contractor's fusion operator while on site. Upon request by the Owner, the Contractor shall verify field fusion quality by making and testing a trial fusion. The trial fusion shall be allowed to cool completely; then test straps shall be cut out and bent strap tested in accordance with ASTM D 2657. If the bent strap test of the trial fusion fails at the joint, the field fusions represented by the trial fusion shall be rejected. The Contractor at his expense shall make all necessary corrections to equipment, set-up, operation and fusion procedure, and shall re-make the rejected fusions.

b. Hydro-Test: Pipelines shall be tested to the requirements and specifications of the engineer of record. HDPE pressure pipe shall be tested in accordance with the specifications and requirements of the engineer of record and/or with the manufacturer's recommendations. The pressure rating of the pipe is a function of temperature at the time of hydro-test. Refer to the manufacturer's temperature related pressure ratings. At a minimum and if not specified elsewhere, hydro-test the piping system at 1.5 times the pressure rating of the pipe for 2 to 3 hours per Driscopipe Technical Note #35. If a system component such as a fabricated or mechanical fitting has a pressure rating less than that of the pipe, the piping system should be pressure tested to manufacturer's guidelines on that component.

2.04 COUPLING AND ADAPTORS

A. Flexible couplings shall be of the sleeve type with a middle ring, two wedge shaped resilient gaskets at each end, two follower rings, and a set of steel trackhead bolts. The middle ring shall be flared at each end to receive the wedge portion of the gaskets. The follower rings shall confine the outer ends of the gaskets, and tightening of the bolts shall cause the follower rings to compress the gaskets against the pipe surface, forming a leak-proof seal. Flexible couplings shall be steel with minimum wall thickness of the middle ring or sleeve installed on pipe being 5/16-inch for pipe smaller than 10 inches, 3/8-inch for pipe 10 inches or larger. The minimum length of the middle ring shall be 5-inches for pipe sizes up to 10 inches and 7 inches for pipe 10 inches to 30 inches. The pipe stop shall be removed. Gaskets shall be suitable for 250 psi pressure rating or at rated working pressure of the connecting pipe. Couplings shall be harnessed and be designed for 250 psi.

2.05 FULL PORT PE VALVES

A. All valves being installed for the natural gas piping system shall be full port polyethylene valves meeting the pipe rating per specification.

2.06 EXCESSIVE FLOW VALVES

A. All service line installations shall have excess flow valves. For service line reinstatement, it is the responisibility of CONTRACTOR to field verify and/or review with OWNER if an EFV exists.

B. All EFV shall be made of virigin material, no rework shall be accepted.

C. All material that is made of PE will be of pipe extruded from HP516 resin (PE 8100 and PE 8300) and come from virgin material, no rework material will be accepted.

D. All materials used must be compatible with the components found in natural gas.

E. All polyethylene pipe extensions (pups) must have the pipe manufactured date visibly indicated on the pipe by print line, label or another acceptable method that is clearly and completely readable.

F. The fittings will be designed for use in gas distribution systems in all class locations, at pressures up to 100 psig, and at temperatures up to 140° F (60° C) simultaneously. All product features must be acceptable to OWNER.

G. The EFV will be designed so that no harmful or hazardous substances will be released from the EFV into the gas and/or ground.

H. In accordance with ASTM F-1802, the fittings will be designed so that oils and other agents and debris commonly found in natural gas pipelines will not adversely affect the product serviceability.

I. Manufacturer specifications must be provided for each size EFV in the following categories:

- Maximum bleed-by flow rates.
- Bleed-by reset rate.
- Average pressure drop at flow rate prior to shutoff.
- Maximum recommended length of service lines based upon inlet pressures.
- Minimum trip flow rates with respect to inlet pressure.
- A graph indicating minimum flow rates relative to inlet pressure.

J. The EFV will be mono-directional and will be of the bleed-by reset type.

2.05 DETECTABLE UNDERGROUND UTILITY WARNING TAPES

A. Detectable underground utility warning tapes which can be located from the surface by a pipe detector shall be installed directly above nonmetallic (PVC, polyethylene, concrete) pipe.

B. The tape shall consist of a minimum thickness 0.35 mils solid aluminum foil encased in a protective inert plastic jacket that is impervious to all know alkalis, acids, chemical reagents and solvents found in the soil.

C. The minimum overall thickness of the tape shall be 5.5 mils and the width shall not be less than 2" with a minimum unit weight of 2-1/2 pounds/1" x 1,000'. The tape shall be color coded and imprinted with the message as follows:

Type of Utility	Color Code	Legends
Natural Gas	Safety Yellow	Caution Buried Sewer Line Below

D. Detectable underground tape shall be ”Detect Tape” as manufactured by Allen Systems, or equal.

E. Installation of detectable tapes shall be per manufacturer’s recommendations and shall be as close to the grade as is practical for optimum protection and detectability. Allow a minimum of 18" between the tape and the line.

F. Payment for detectable tapes shall be included in the linear foot price bid of the appropriate bid item(s) unless it is listed as a separate payment item in the bid schedule.

2.06 TRACER WIRE

A. Tracer wire shall be 12-gauge steel clad copper wire with 30-mil polyethylene jacket. Tracer wire shall be installed with all buried piping, “duct” taped to top of pipe.

B. Splicing connectors shall meet or exceed UL 486D, UL Standard for Safety Sealed Wire Connectors and shall be compatible with tracer wire.

C. Tracer wire shall be brought up into locator boxes with grounding devices. Locator boxes shall be either TriView Test Station or HideOut by Rhino Markers or Engineer Approved Other. Locator boxes shall be installed at a maximum of 1,000 linear feet apart, or where shown on the Drawings.

D. Payment for tracer wire and boxes shall be included in the linear foot price bid of the appropriate bid item(s) unless it is listed as a separate payment item in the bid schedule.

2.07 CONCRETE PIPE ANCHORS, THRUST BLOCKS, CRADLE OR ENCASEMENT

A. Where indicated on the Drawings, required by the specifications or as directed by the Engineer, concrete pipe anchors, thrust blocks, cradles or encasements shall be installed. Concrete shall be 2000 psi, and reinforcing bars shall be as installed as indicated on the details.

PART 3 – EXECUTION

3.01 EXCAVATION FOR PIPELINE TRENCHES

A. Unless otherwise directed by the Engineer, trenches in which pipes are to be laid shall be excavated in open cut to the depths required by field conditions or as specified by the Engineer. In general, this shall be interpreted to mean that machine excavation in earth shall not extend below an elevation permitting the pipe to be properly bedded. Installation shall be in accordance with ASTM-D-2321 except as modified herein.

B. If the foundation is good firm earth and the machine excavation has been accomplished as set out hereinbefore, the remainder of the material shall be excavated by hand, then the earth pared or molded to give full support to the lower quadrant of the barrel of each pipe. Where bell and spigot are involved, bell holes shall be excavated during this latter operation to prevent the bells from being supported on undisturbed earth. If for any reason the machine excavation in earth is carried below an excavation that will permit the type of bedding specified above, then a layer of granular material shall be placed so that the lower quadrant of the pipe will be securely bedded in compact granular fill.

C. Excavation may be undercut to a depth below the required invert elevation that will permit laying the pipe in a bed of granular material to provide continuous support for the bottom

quadrant of the pipe. When this method is used, the bedding shall be as set out in Paragraph 3.02 hereinafter.

D. Trenches shall be of sufficient width to provide free working space on each side of the pipe and to permit proper backfilling around the pipe, but unless specifically authorized by the Engineer, trenches shall in no case be excavated or permitted to become wider then 2'-0" plus the nominal diameter of the pipe at the level of or below the top of the pipe. If the trench does become wider than 2'-0" at the level of or below the top of the pipe, special precaution may be necessary, such as providing compacted, granular fill up to top of the pipe or providing pipe with additional crushing strength as determined by the Engineer after taking into account the actual trench loads that may result and the strength of the pipe being used. The Contractor shall bear the cost of such special precautions as are necessary.

E. All excavated materials shall be placed a minimum of two feet (2') back from the edge of the trench.

F. Before laying the pipe, the trench shall be opened far enough ahead to reveal obstructions that may necessitate changing the line or grade of the pipeline.

G. The trench shall be straight and uniform so as to permit laying pipe to lines and grades given by the Engineer. It shall be kept free of water during the laying of the pipe and until the pipeline has been backfilled. Removal of trench water shall be at the Contractor's expense. Dry conditions shall be maintained in the excavations until the backfill has been placed. During the excavation, the grade shall be maintained so that it will freely drain and prevent surface water from entering the excavation at all times. When directed by Owner, temporary drainage ditches shall be installed to intercept or direct surface water which may affect work. All water shall be pumped or drained from the excavation and disposed of in a suitable manner without damage to adjacent property or to other work.

H. Minimum cover of 30" shall be provided for all pipelines, except those located in the State Highway Right of Way. Those shall have a minimum cover of 42”.

3.02 PIPE BEDDING

A. All pipe shall be supported on a bed of granular material unless the trench has been prepared in accordance with Paragraph 3.01B. In no case shall pipe be supported directly on rock. Bedding shall not be a separate pay item unless otherwise set out in the Detailed Specifications. Bedding shall be provided in earth bottom trenches, as well as rock bottom trenches. Bedding material shall be free from large rock, foreign material, frozen earth, and shall be acceptable to the Engineer. Bedding shall be a minimum of 6" below pipe barrel.

B. In all cases the foundation for pipes shall be prepared so that the entire load of the backfill on top of the pipe will be carried on the barrel of the pipe so that none of the load will be carried on the bells.

C. Where flexible pipe is used, the bedding shall be placed up to at least the spring line (horizontal center line) of the pipe. The bedding material and procedures shall conform to ASTM D 2321 and any Technical Specifications set out hereinafter. If conditions warrant, the Engineer may require the bedding to be placed above the springline of the pipe. Granular bedding shall be Size #9-m or ASTM C 33, Size #7 crushed stone, fine gravel, or sand, and is not a separate pay item.

D. Where undercutting and granular bedding is involved it shall be of such depth that the bottom of the bells of the pipe will be at least three inches above the bottom of the trench as excavated. Undercutting is not a separate pay item.

E. In wet, yielding mucky locations where pipe is in danger of sinking below grade or floating out of line or grade, or where backfill materials are of such a fluid nature that such movements of the pipe might take place during the placing of the backfill, the pipe must be weighted or secured permanently in place by such means as will prove effective. When ordered by the Engineer, yielding and mucky materials in subgrades shall be removed below ordinary trench depth in order to prepare a proper bed for the pipe. Crushed stone or other such granular material, if necessary, as determined by the Engineer to replace poor subgrade material, shall be classified as "Fill" (No separate pay item). Removal of poor material is not a separate pay item.

F. Installation shall be in accordance with ASTM D 2321 except as modified hereinafter.

3.03 SPECIAL GRANULAR FILL

A. As noted in Paragraph 3.02E, granular material for "Special Granular Fill " when directed by the Engineer shall be Department of Transportation crushed limestone, Size #57. Payment for "Special Granular Fill" must have approval from the Engineer prior to installation.

3.04 LAYING PIPE

A. The laying of pipe in finished trenches shall be commenced at the lowest point so the spigot ends point in the direction of flow.

B. All pipes shall be laid with ends abutting and true to line and grade as given by the Engineer. Supporting of pipes shall be as set out hereinbefore under "Pipe Bedding" and in no case shall the supporting of pipes on blocks be permitted.

C. Before each piece of pipe is lowered into the trench, it shall be thoroughly inspected to insure it’s being cleaned. Each piece of pipe shall be lowered separately unless special permission is given otherwise by the Engineer. No piece of pipe or fitting which is known to be defective shall be laid or placed in the lines. If any defective pipe or fitting shall be discovered after the pipe is laid, they shall be removed and replaced with a satisfactory pipe or fitting without additional charge. In case a length of pipe is cut to fit in a line it shall be so cut as to leave a smooth end at right angles to the longitudinal axis of the pipe.

D. Pipe shall not be laid on solid rock. A pad of granular material as specified in Paragraph 3.02 "Pipe Bedding", shall be used as a pipe bedding. Pipe bedding is not a separate pay item. Irregularities in subgrade in an earth trench shall be corrected by use of granular material.

E. When ordered by the Engineer, unsuitable materials in subgrades shall be removed below ordinary trench depth in order to prepare a proper bed for the pipe.

F. When laying of pipe is stopped for any reason, the exposed end of such pipe shall be closed with a plywood or fabricated plug fitted into the pipe bell, so as to exclude earth or other material, and precautions taken to prevent flotation of pipe by runoff into trench.

G. No backfilling (except for securing pipe in place) over pipe will be allowed until the Engineer has had an opportunity to make an inspection of the joints, alignment and grade, in the section laid.

3.05 BACKFILLING PIPELINE TRENCHES

A. Backfilling of pipeline trenches shall be accomplished with the requirements set forth in DIVISION 31 – EARTHWORK as shown on the Drawings and with details set forth hereinafter.

B. Method "A" - Backfilling in Open Terrain:

Backfilling of pipeline trenches in open terrain shall be accomplished in the following manner:

1. The lower portion of the trench, from the pipe bedding to a point 12" above the top of the pipe, shall be backfilled with material free from rock and/or material acceptable to the Engineer. This material shall be placed in a manner approved by the Engineer, and shall be carefully compacted to avoid displacement of the pipe.

   Compaction shall be accomplished by hand-tamping or by approved mechanical methods.

2. The upper portion of the trench above the compacted portion shall be backfilled with material which is free from large rock. Incorporation of rock having a volume exceeding one-half cubic foot is prohibited. Backfilling this portion of the trench may be accomplished by any means approved by the Engineer. The trench backfill shall be heaped over or leveled as directed by the Engineer.

C. Method "B" - Backfilling Under Sidewalks & Unpaved Driveways:

Backfilling of pipeline trenches under sidewalks and unpaved driveways shall be accomplished in the following manner.

1. The lower portion of the trench, from the pipe bedding to a point 12 inches above the top of the pipe, shall be backfilled with material free from rock, and acceptable to the Engineer or with crushed stone as specified in ”Pipe Bedding”. This material shall be placed in a manner to avoid displacement of the pipe. Compaction shall be accomplished by hand-tapping or by approved mechanical methods.

2. The middle portion of the trench, from a point 12" above the top of the pipe to a point 6" below the grade line, shall be backfilled with material free from large rock and acceptable to the Engineer. This material shall be placed and compacted in layers of approximately 6 inches. Water (puddling) may be used as required to obtain maximum compaction.

   Upon approval of the Engineer, the Contractor may backfill the middle portion of the trench with crushed stone, fine gravel, or sand in lieu of materials which require compaction.

3. The upper portion of the trench shall be temporarily backfilled and maintained with crushed stone or gravel until such time as the sidewalk is constructed or the driveway surface is restored.

D. Method "C" - Backfilling Under Streets, Roads, and Paved Driveways:

Backfilling of pipeline trenches under streets, roads and paved driveways shall be accomplished in the following manner:

1. The lower portion of the trench from the pipe bedding to a point 6" below the bottom of the pavement or concrete sub-slab, shall be backfilled with # 9 crushed stone.

2. The upper portion of the trench, from a point 6" below the bottom of the pavement or concrete sub-slab to grade, shall be backfilled with a base course of dense graded aggregate. At such time that pavement replacement is accomplished, the excess base course shall be removed as required.

E. Trenches outside existing sidewalks, driveways, streets, and highways shall be backfilled in accordance with Method "A". Trenches within the limits of sidewalk and unpaved driveways shall be backfilled in accordance with Method "B". Trenches within the paving limits of existing streets, highways and driveways shall be backfilled in accordance with Method "C". All methods are shown on Sheet SD-2 of the Drawings. When directed by the Engineer, the Contractor shall wet backfill material to assure maximum compaction.

F. Before final acceptance, the Contractor will be required to level off all trenches or to bring the trench up to grade. The Contractor shall also remove from roadways, rights-of-ways and/or private property all excess earth or other materials resulting from construction.

G. In the event that pavement is not placed immediately following trench backfilling in streets and highways, the Contractor shall be responsible for maintaining the trench surface in a level condition at proper pavement grade at all times.

3.06 SETTLEMENT OF TRENCHES

A. Whenever lines are in, or cross, driveways and streets, the Contractor shall be responsible for any trench settlement which occurs within these rights-of-way within one year from the time of final acceptance of the work. If paving shall require replacement because of trench settlement within this time, it shall be replaced by the Contractor at no extra cost to the Owner. Repair of settlement damage shall meet the approval of the Owner and/or the State Department of Transportation.

3.07 CONCRETE THRUST BLOCKS, CRADLE, ANCHORS OR ENCASEMENT

A. Concrete thrust blocks, cradle, anchors or encasement shall be placed where shown on the Drawings, required by the specifications, or as directed by the Engineer.

B. For cradle and encasement, concrete shall be 2000 psi and shall be mixed sufficiently wet to permit it to flow under the pipe to form a continuous bed.

C. For thrust blocks and anchors, concrete shall be 2000 psi, and shall be formed or be sufficiently stiff to maintain the forms indicated on the Details.

D. When tamping concrete, care shall be taken not to disturb the grade or line of the pipe or injure the joints. Concrete placed outside the specified limits or without authorization from the Engineer will not be subject to payment.

3.08 BITUMINOUS CONCRETE HIGHWAY, STREET AND DRIVEWAY REPLACEMENT

A. The Contractor shall replace those sections of existing roads, streets and driveways required to be removed to install the pipe lines under this contract. He shall construct

same to the original lines and grades and in such manner as to leave all such surfaces in fully as good or better condition than that which existed prior to the operations.

B. Prior to trenching, the pavement shall be scored or cut to straight edges at least twelve (12) inches outside each edge of the proposed trench to avoid unnecessary damage to the remainder of the paving. Edges of the existing pavement shall be re-cut and trimmed to square, straight edges after the pipeline has been installed and prior to placing the new base and pavement.

C. Backfilling of the trench shall be in accordance with Method "C" as described hereinbefore. Base course for the paving shall be dense graded crushed limestone furnished and placed in accordance with the current requirements of the Standard Specifications for Road and Bridge Construction of the Department of Transportation, to a depth of six (6) inches in roads and streets and four (4) inches in driveways.

D. A subslab of reinforced concrete shall be placed for state-maintained highways as indicated on the Drawings. The subslab shall have a minimum thickness of 6 inches. Concrete for the subslab shall be 2500 psi, in accordance with the Details shown on the Drawings.

3.09 REMOVING AND REPLACING CONCRETE CURB AND GUTTER

A. The Contractor shall remove the curb and gutter when encountered when required for laying the sewer. Only that portion of the curb and gutter needed to lay the sewer line shall be removed. Where concrete curb and gutter removed or disturbed during the construction work, it shall be replaced, using 3000 psi concrete, in fully as good or better condition than which existed prior to the Contractor's operation.

3.10 REPLACEMENT OF EXISTING MAIL BOXES, CULVERTS, CLOTHES LINE POSTS, FENCES AND OTHER SUCH FACILITIES

A. Existing mail boxes, drainage culverts, clothes line posts, fences and the like shall not be damaged or disturbed unless necessary, in which case, they shall be replaced in as good condition as found as quickly as possible. Existing materials shall be reused in replacing such facilities when materials have not been damaged by the Contractor's operations. Existing facilities damaged by Contractor's operation shall be replaced with new materials of the same type at the Contractor's expense. Work in this category is not a pay item.

B. Replacement of paved drainage ditches within highway right-of-way shall be accomplished in accordance with Department of Transportation specifications.

3.11 TESTING

A. All pressure piping (lines not laid to grade) shall be given a hydrostatic test of at least 1.5 times the normal operating pressure of the pipe (at its lowest elevation), but not to exceed the rated working pressure of the pipe or valves. Note: Engineer shall verify test pressure. Loss of pressure during the test shall not exceed 0 psi in a 4-hour period and 5 psi in a 24-hour period. Any test results that do not meet either of these requirements shall constitute a failure of the pressure test.

B. Leakage in pipelines, when tested under the hydrostatic test described above, shall not exceed 10 gallons per 24 hours per inch of diameter per mile of pipe.

C. Contractor shall furnish a recording gauge and water meter for measuring water used during leakage test and recording pressure charts during duration of test. Recording pressure charts shall be turned over to the Engineer at conclusion of tests. The pressure

recording device shall be suitable for outside service, with a range from 0-200 psig, 24-hour spring wound clock, designed for 9-inch charts, and shall be approved by the Engineer.

D. Pipelines shall be tested before backfilling at joints except where otherwise required by necessity or convenience.

E. Duration of test shall be not less than four (4) hours where joints are exposed and not less than 24 hours where joints are covered.

F. Where leaks are visible at exposed joints, evident on the surface where joints are covered, and/or identified by isolating a section of pipe, the joints shall be repaired and leakage must be minimized, regardless of total leakage as shown by test.

G. All pipe, fittings, valves, and other materials found to be defective under test shall be removed and replaced at no additional expense to the Owner.

H. Lines which fail to meet tests shall be repaired and retested as necessary until test requirements are complied with.

I. Where nonmetallic joint compounds are used, pipelines should be held under normal operating pressure for at least three days before testing.

J. The Owner will provide initial water for testing the pressure piping. Should the first test fail to pass, all additional water required for subsequent tests shall be furnished at the Contractor's expense.

K. The cost of testing of pressure piping is incidental and is to be included in the Contractor’s unit Contract Price.

3.12 CLEAN UP

A. Upon completion of installation of the piping and appurtenances, the Contractor shall remove all debris and surplus construction materials resulting from the Work. The Contractor shall grade the ground along each side of pipe trenches in a uniform and neat manner leaving the construction area in a shape as near as possible to the original ground line.

END OF SECTION