

SECTION 3 – CONSTRUCTION

1. GENERAL

The streets, roads, and easements in which lines shall be placed have been indicated on the Plans. Any change from locations approved by the Engineering Department shall be approved by the Engineering Department before construction.

Where the excavation exceeds the required depth, the Contractor shall bring the excavation to proper grade through the use of an approved incompressible backfill material (generally crushed stone or fill concrete, depending upon the nature of the facility to be placed thereon). In the event unstable soil conditions are encountered at the bottom of the excavation, the Engineer will direct the Contractor to continue the excavation to firm soil or to provide pilings or other suitable special foundations, with such action subject to approval by the Engineering Department.

The Contractor shall take such precautions as may be necessary to avoid endangering personnel, pavement, adjacent utilities or structures through cave-ins, slides, settlement or other soil disturbance resulting from his operations.

Backfilling shall be carried out as expeditiously as possible, but shall not be undertaken until the Engineer has been given the opportunity to inspect the work. The Contractor must carry out all backfilling operations with due regard for: the protection of pipes, structures and appurtenances; the use of prescribed backfill materials; and procedures to obtain the desired degree of compaction.

All shade trees, telephone poles, power poles, etc., along the line of work shall be protected, and sufficient barricades, lanterns, etc., shall be provided for the protection of the public.

2. TRENCH EXCAVATION

2.1 General

Trenching must be done in a neat and workmanlike manner maintaining proper vertical and horizontal alignment. Alignment shall be maintained by the use of offset hubs and batter boards at maximum 50 foot intervals or with a laser device or with other methods approved by the Engineering Department. The Engineer shall check all cut sheets before construction begins.

Trenches shall be neatly excavated to the alignment and depth required for the proper installation of pipe, bedding material and appurtenances. Trenches shall be opened up far enough ahead of pipe laying to reveal obstructions, but in general shall not include more than 300 feet of continuous open trench at any time.

The Contractor will be required to follow up trenching operations promptly with pipe laying, backfill and clean-up, and in event of failure to do so, may be prohibited from opening additional trench until such work is completed. This requirement is particularly applicable to work being done in developed areas.

The Contractor shall plan his operations so as to cause a minimum of inconvenience to property owners and to traffic. No road, street or alley may be closed unless absolutely necessary, and then only if the following conditions are met:

1. Permit is secured from appropriate State, County or Municipal authorities having jurisdiction.
2. The following offices must be contacted prior to the cutting or closing of any City Street:
 - A. LEBANON SPECIAL SCHOOL DISTRICT 453-8522
 - B. WILSON COUNTY SCHOOLS 444-3282
 - C. WILSON COUNTY SHERIFF'S OFFICE 444-1412
 - D. WEMA 444-8777
 - E. LEBANON POLICE DEPARTMENT 444-2323
 - F. FIRE DEPARTMENT 443-2827
 - G. PUBLIC SERVICES 444-0825
 - H. CITY OF LEBANON STREE DEPARTMENT 444-0825
 - I. TDOT 443-2755
 - J. LEBANON DEMOCRAT 444-3952 ext 13.
3. Suitable detours are provided and are clearly marked.

No driveways shall be cut or blocked without first notifying the occupant of the property. Every effort shall be made to schedule the blocking of drives to suit the occupants convenience, and except in case of an emergency, drives shall not be blocked for a period of more than 8 hours. The Contractor shall furnish and maintain barricades, signs, flashing lights, and other warning devices as necessary for the protection of public safety. Flagmen shall be provided as required on heavily traveled streets to avoid traffic jams or accidents.

Trench width shall be held to a minimum consistent with proper working space for assembly of pipe. Maximum trench width up to point one foot above top of pipe shall be limited to the outside pipe diameter plus 16 inches. Boulders, large stone, shale and rock shall be removed to provide clearance of 6" below and on each side of the pipe. Trench walls shall be in accordance with OSHA Regulations for depth and type of soil. Where unstable soil conditions are encountered at the trench bottom, the Contractor shall remove such additional material as may be directed by the Engineer and replace the excavated material with approved backfill, or otherwise provide stable bedding for pipe as directed by the Engineer and approved by the Engineering Department.

The Contractor shall excavate by hand wherever necessary to protect existing structures or utilities from damage or to prevent over depth excavation in the trench subgrade.

Excavated material shall be stored safely away from the edge of trench and in such a way as to avoid encroachment on private property.

2.2 Rock Excavation

Where rock is encountered, the excavation shall be carried to a depth of 6" below the barrel of the pipe, or the bottom of the structure. The excess excavation shall be backfilled with crushed stone, sand or other approved bedding material firmly compacted. Boulders and large stones, rock or shale shall be removed to provide a clearance of at least 6" below all parts of the pipe or fittings and to clear width of at least 6" on each side of all pipe and appurtenances.

Where rock is encountered, the Contractor shall "mattress" the trench during blasting operations and shall use all precautions necessary to protect adjacent property against damage resulting from his operations. Rock excavation in proximity to other pipes or structures shall be conducted with the utmost care to prevent damage to the existing structures and any such damage caused shall be promptly repaired at the Contractor's expense. Blasting operations shall not be conducted within 25' of finished sewer or water pipe and rock excavation shall be completed at least 25' ahead of pipe laying.

Extreme care shall be exercised in blasting with signals of danger given and displayed before the firing of any charge. The Contractor shall, in all his acts, conform to and obey all rules and regulations for the protection of life and property that may be imposed by any public authorities or that may be made from time to time by the Engineer relative to the storing and handling of explosives and the blasting operations. No blasting shall be done at any time except by persons experienced in this line of work.

Where rock is encountered in the immediate vicinity of gas mains, telephone cables, building footings, gasoline tanks, or other hazardous areas, the Contractor shall remove the rock by means other than blasting. Care shall be taken in blasting operations to see that pipe or other structures previously installed are not damaged by blasting.

2.3 Sheeting and Shoring

The Contractor shall provide such bracing, sheeting or shoring as may be necessary for the protection of life and property, or where such protection is specifically required by the Engineer because of potential danger to life, property or the completed structure. Sheeting will be required where necessary to restrict the trench width to acceptable limits above the top of pipe.

Sheeting, shoring or bracing shall conform to applicable safety codes and shall be left in place until the pipe is laid, checked, and backfilled to a safe level at or above top of pipe. The bracing or sheeting may then be removed in an approved manner unless the Engineer specifically directs that the sheeting be left in place. Where the sheeting is left in place either at the direction of the Engineer or option of the Contractor, the sheeting shall be cut off at least 18" below the finished ground level.

Care shall be taken in removing sheeting to avoid weakening the trench, increasing the backfill load, or endangering adjacent property. Voids left by the removal of sheeting shall be filled in and compacted with suitable material using tamps intended for this purpose.

2.4 Surface Obstructions

All buildings, walls, fences, poles, bridges, railroads, trees, and other property or improvements encountered shall be carefully protected from all injury, and in the event that any of the foregoing are damaged or removed during the process of the work, they shall be repaired or replaced in a satisfactory manner. Special care must be exercised in trenching under or near railroads in order to avoid or minimize delays or injuries resulting therefrom. Where it is necessary to cross beneath railroad tracks, the Contractor shall make such installations in a casing of large diameter as approved by the Railroad Company and the Engineering Department.

2.5 Subsurface Obstructions

In excavating, backfilling, and laying pipe, care must be taken not to remove, disturb, or injure other pipes, conduits, or structures, without the approval of the Engineering Department. If necessary, the Contractor, at his own expense, shall sling, shore up and maintain such structures in operation, and within reasonable time shall repair any damage done thereto. Repairs to these facilities shall be made to the satisfaction of the Engineering Department.

The Contractor shall give sufficient notice to the interested utility of his intention to remove or disturb any other pipe, conduit, etc., and shall abide by their regulations governing such work. In the event subsurface structures are broken or damaged in the prosecution of the work, the Contractor shall immediately notify the proper authorities and shall be reasonable for any damage to persons or property caused by such breaks.

When pipes or conduits providing service to adjoining buildings are broken during the progress of the work, the Contractor shall have them repaired at once. Delays, such as would result in buildings being without service overnight or for needlessly long periods during the day will not be tolerated, and the Department of Public Services reserves the right to make repairs at the Contractor's expense without prior notification. Should it become necessary to move the position of a pipe, conduit, or structure, it shall be done by the Contractor in strict accordance with instruction given by the Engineer or the utility involved.

3. INSTALLATION OF SEWER PIPE AND ACCESSORIES

3.1 General

The Contractor shall use only experienced men in the final assembly of pipe in the trench, and all pipe shall be laid in accordance with these Specifications and the recommended practice of the pipe manufacturer. Trench bottoms shall be carefully prepared, shall be free of water and bedding as specified shall be in place.

Care shall be exercised to insure that pipe of the proper strength or classification meeting the specifications in every respect is provided at the site of pipe laying operations. Recommended tools, equipment, lubricant and other accessories needed for proper assembly or installation of the pipe shall be provided at the site of the work. Any damaged or defective pipe discovered during the pipe laying operations shall be discarded and removed from the site of the pipe laying operations.

Alignment and grade shall be carefully maintained during the laying operations. The method used for maintaining grade and alignment must be acceptable to the Engineer and the Engineering Department and must produce the desired results. The top of the bedding material must be brought to the exact grade and must be shaped so as to provide effective support for the bottom quadrant of the pipe except at the bells.

The Contractor shall exercise care in the storage and handling of pipe, both on the storage yard and at the site of laying operations. Suitable clamps, slings, or other lifting devices shall be provided for handling pipe and fittings. Pipe and fittings shall be inspected for defects and for dirt or other foreign material immediately before placing them in the trench. Suitable swabs shall be available at the site of laying operations, and any dirt or foreign material shall be removed from the pipe before it is lowered into the trench.

3.2 Bedding

It is desired that trench widths from a point 1 foot above the top of the pipe down to the bottom of the trench be held to a minimum consistent with the provisions of necessary space for proper assembly of the pipe. In general, the trench width shall not exceed the nominal pipe diameter plus 16 inches.

A minimum of 6" of crushed stone bedding shall be placed in the bottom of the trench to provide continuous support of the bottom quadrant of the pipe. The Contractor shall bring the crushed stone bedding up to the required level to provide support to the bottom quadrant and shall then shape the bedding to receive the pipe. Bell holes shall be dug so that the bottom of the bells will not support the pipe.

After the bedding has been shaped and the pipe has been installed, crushed stone backfill shall be carefully placed by hand and compacted on both sides of the pipe and up to level 12" above the top of the pipe.

In addition to maximum trench width, the selection of pipe has been based on the use of 6" of crushed stone bedding to provide continuous support of the bottom quadrant of the pipe plus crushed stone backfill carefully placed and compacted on both sides of the pipe and up to a level 12" above the top of the pipe. It is therefore essential that these conditions be observed in the installation of the pipe.

3.3 Pipe Laying

After the pipe has been cleaned and inspected for defects and lowered into the trench, the mating surfaces of the compression joint shall be wiped clean and coated with lubricant of a type supplied by the pipe manufacturer. The pipe shall then be assembled with due care

being taken to insure that the spigot end of the pipe is shoved home and that the pipe is left in proper grade and alignment.

Whenever pipe laying operations are to be discontinued for a period of time exceeding 2 hours, the end of the pipe shall be carefully secured to avoid displacement or misalignment and a tight fitting plug or stopper shall be placed in the line. Upon resumption of laying operations, the plug or stopper shall not be removed from the line until any water, mud or other debris has been removed to avoid entry into the completed section of the sewer.

Installation of sewer pipe including force mains shall conform to provisions of these Specifications and recommendations of the pipe manufacturer. Installation instructions provided by the pipe manufacturer shall be available at all times at the location of the work.

The proper gaskets and lubricants shall be furnished by the pipe manufacturer and lubricants shall be delivered to the job site in properly labeled, unopened containers.

Wye branches or tees and other fittings shall be placed in the sewer line as shown on the Drawings or as directed by the Engineer as pipe laying progresses. The Contractor shall keep accurate records of their location.

ALL gravity piping shall have tracer wire and detection tape.

a. Laying Polyvinyl Chloride Pipe (PVC)

Installation of polyvinyl chloride pipe shall conform to ASTM 2321, latest revision. PVC pipe shall be laid on crushed stone bedding and shall be backfilled with compacted crushed stone around and above the pipe as outlined in Paragraph 3.03.2 and 3.06.1. The bedding material shall be shaped to provide continuous support for the PVC pipe throughout its length except at bells. Blocking shall not be used to bring the pipe to grade.

Whenever it is necessary to cut a joint of pipe in order to fit the trench conditions, the cutting may be made with either hand or mechanical saws or plastic pipe cutters. The cut shall be square and perpendicular to the pipe axis. The cut end shall be beveled to as closely resemble the factory bevels as possible.

Assemble all joints in accordance with recommendations of the manufacturer.

b. Laying Ductile Iron Pipe

Where ductile iron pipe is shown, specified or directed by the Engineer the pipe shall be of the type and class as indicated. Ductile iron pipe to be installed in trenches shall be laid on crushed stone bedding and shall be backfilled with compacted crushed stone around and above the pipe as specified for other pipe materials. The bedding material shall be shaped to provide continuous support for the ductile iron pipe throughout its length except at bells.

Whenever it is necessary to cut a joint in order to fit the trench conditions, the cutting shall be done using the equipment as recommended by the manufacturer for the specific type of pipe involved. The cut shall be made so as to leave a smooth end at right angles to the axis of the bore and the end shall be beveled or finished as required to make the joint without risk of damage to the gasket.

In stream crossings, ravines, shallow cuts and other locations where the pipe will not be laid on bedding placed on original subgrade the pipe shall be supported on concrete piers as detailed on the Drawings or as directed by the Engineer.

Piers shall be of Class A concrete with reinforcing as shown. The tops of piers shall be carefully set at the exact elevation and shall be shaped so as to provide support for the bottom half of the pipe with allowance being made for the outside diameter of the pipe plus the thickness of a layer of tarred felt around the outside of the pipe. After the concrete has obtained satisfactory strength the ductile iron pipe may be installed across the piers using one or more layers of tarred felt between the surface of the concrete and the outside diameter of the pipe. The Contractor may, at his option, install the pipe to exact grade and alignment using temporary supports and then construct the permanent piers for the pipe, provided suitable precautions are taken to avoid any misalignment during the construction of the piers.

c. Installation of Pressure Sewer

Lay the pressure sewer to and keep it at the lines and grades required by the Drawings. All fittings shall be at the required locations and spigots well centered in the bells.

Unless otherwise indicated by the Drawings, all pressure sewers shall have at least 30 inches of cover. No departure from this policy shall be made except at the order of the Sewer Department.

Provide and use tools and facilities that are satisfactory to the Sewer Department and that will allow the work to be done in a safe and convenient manner. Use a derrick, ropes, or other suitable equipment to lower all pipe fittings into the trench one piece at a time. Carefully lower each piece so that neither it nor any protective coating or lining it may have will be damaged. Under no circumstances, drop or dump pressure sewer materials into the trench.

Lower no pipes and fittings into the trench until they have been swabbed to remove any mud, debris, etc. that may have accumulated within them. After the pipe has been lowered, remove all unnecessary materials from it. Before any pipe is laid, brush and wipe clean the outside of its spigot end and the inside of its bell and ensure that the pipe is dry and oil-free.

Take every precaution to keep foreign material from getting into the pipe while it is being placed in the line. If the crew laying the pipe cannot put it into the trench and in place without allowing earth to get inside it, then place a heavy, tightly woven canvas bag of suitable size over each end of the pipe and leave it there until it is time to connect that pipe to the one adjacent to it.

Place no debris, tools, clothing, or other materials in the pipe during laying operations. After a length of pipe has been placed in the trench, center the spigot end in the bell of the adjacent pipe and then insert to the depth specified by the manufacturer and bring to the correct line and grade. Secure the pipe in place by tamping an approved backfill material around it.

Bell holes shall be big enough so that there is ample room for the pipe joints to be properly made. Between bell holes, carefully grade the bottom of the trench so that each pipe barrel will rest on a solid foundation for its entire length.

Whenever pipe laying is not in progress, the pipe shall be carefully secured to avoid displacement or misalignment and a tight fitting plug or stopper shall be placed in the line. This shall be done not only at the end of each working day but also before work is stopped for lunch periods, bad weather, or any other reason. If there is water in a trench, this seal shall remain in place until the trench has been pumped completely dry.

The cutting of pipe so that fittings or closure pieces can be inserted shall be done in a neat and workmanlike manner and without any damage to the pipe. Follow the manufacturer's recommendations concerning how to cut and machine the ends of the pipe in order to leave a smooth end at right angles to the pipe's axis.

The flame cutting of pipe by means of an oxyacetylene torch will not be allowed.

Unless otherwise directed by the Engineer, lay pipe with the bell ends facing in the direction of laying.

Wherever pipe must be deflected from a straight line (in either the vertical or horizontal plane) in order to avoid obstructions of plumb stems or wherever long radius curves are permitted, the amount of deflection shall not exceed that necessary for the joint to be satisfactorily made, nor that recommended by the pipe manufacturer, and shall be approved by the Engineer.

Lay no pipe in water or when it is the Engineer's opinion that trench conditions are unsuitable. If crushed stone is used to improve trench conditions or as backfill for bedding the pipe, this shall be considered incidental to the project.

Install thrust blocks wherever the force main changes direction (e.g., at tees and bends), at dead ends, or at any other point where the manufacturer recommends and/or the Engineer indicates that they are to be used.

Make all joints, whether standard mechanical or push-on joints, in conformance with the recommendations of the joint manufacturer as approved by the Engineer.

The detectable tape and 14-gauge insulated copper tracer wire shall be buried in the utility line trench directly above the installation to be identified. The tracer wire shall be placed directly on top of the pressure sewer and the marking tape shall be placed 15-inches from finish grade of the trench. The tape shall be placed in the trench with the

printed side up and be essentially parallel to the finished surface. The Contractor will take necessary precautions to ensure that the tape and tracer wire are not pulled, distorted, or otherwise misplaced in completing the trench backfill. Tape and wire shall be placed in all trenches.

Pressure Sewer Service Assemblies

Materials

Ball Valve: The valve on the service line at the connection to the main shall be a PVC ball valve of true union design with permanently lubricated Teflon seats and elastomer "O"-ring seals. The valves are to open and close with a quarter turn.

Working pressure at 70 degrees F shall be 150 pounds per square inch.

Redundant Check Valve (E-1 Glass Line): Each service line shall include a check valve for installation in the discharge line between the grinder pump and the pressure sewer to ensure maximum protection against backflow in the event of sewer service line break.

Installation

The service line shall have a minimum of 24 inches of cover.

The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the wrench nut of the valve, with the box cover flush with the surface of the finish pavement or centered over the valve and cleanout or approximately 1/2-inch above the ground surface or such other level as may be directed.

Pressure Sewer Valves

Air Release Valves: At the locations shown on the Contract Drawings and in accordance with these Specifications, install an air release valve. The valve shall have a body of cast iron construction, a stainless steel float and a Buna-N seat. The valve shall have a 2-inch inlet.

Fittings: Fittings shall be of the solvent welded type for use in conjunction with valves. Fittings shall be fabricated by the manufacturer of the pipe used.

Valve Boxes Shall be as indicated on the Contract Drawings: Unless otherwise shown, valve boxes shall be a standard plastic meter box with a nominal size of 16" x 10-3/4" x 12" and a 6" extension. The meter box shall be injection molded meeting ASTM D-2853-70, Class 1212. It shall be a rigid combination of polyolefin with inorganic component reinforcing and UV stabilizer additive to assure resistance to material degradation for ultraviolet light.

The cover shall be molded of the same material and designed with no molded protrusions for latching. A 2-1/2-inch diameter 16-gauge steel reflector with

dichromate coating shall be applied to the underside of the plastic cover for electronic detection. The cover shall be green with the words "CONTROL VALVE" imprinted on the top.

d. Connections to Structures

Connections of pipes to manholes or other large structures shall be made using short lengths of pipe to avoid stressing the pipe at the point where it is placed in the wall of the structure. Pipes entering or leaving masonry or concrete walls shall have one flexible joint located not more than 6" outside the structure wall followed by a length of pipe not more than 2' in length with another flexible joint at the end of the 2' pipe length in such a way as to provide for limited lateral or vertical movement of the pipe line as well as limited deflection. Ordinary compression type joints of the types specified for gravity sewers shall be considered as having sufficient flexibility for this purpose. The supplier of the pipe for the sewer lines shall furnish with the pipe order the required number of specials and short lengths of pipe for the Contractor to install the required flexible connections without improvising.

For all situations where connections are made to existing manholes, the connections shall be accomplished by resilient connectors and shall be Kor-N-Seal, or approved equal. Contractors are required to vacuum test existing manholes prior to making any new connection. Any deficiencies found in the existing manhole must be addressed prior to making the connection.

e. Connecting to Existing System

No pipe shall be connected to the existing sewage system until all new upstream construction has been completed, tested, and is free of foreign materials and obvious defects have been corrected. In addition, approval must be given by the Engineering Department for connection. New lines, then, must remain disconnected from the existing system by actual physical separation, by plugs of a type approved by the Engineering Department, or by other means approved by the Engineering Department. A note on the construction plans stating this requirement shall be required for the approval of the plans.

For all situations where main to be tapped has been lined with Cured In Place Pipe (CIPP), saddle must be epoxied in place.

3.4 Concrete and/or earthen Trench Dam

Where shown on the Drawings or as directed by the Engineer, the Contractor shall install concrete and/or earthen trench dams to prohibit the flow of water along the sewer trench. Concrete and/or earthen trench dams shall be installed in accordance with the Standard Detail Drawing.

3.5 Pipe Sewers in Tunnel and/or Bore

All work performed beneath existing structures, across railroad right-of-ways, and under pavements shall be performed in accordance with the requirements of the parties or agencies having jurisdiction over these locations. The Contractor shall contact the parties or agencies prior to starting work and shall meet all requirements of the parties or agencies in regard to methods of construction and the parties or agencies in regard to methods of construction and the safety precautions to be taken in performing the tunnel work. All costs involved in meeting these requirements shall be paid for by the Contractor and no additional compensation will be allowed.

A. Bore Method

At the Contractor's option and with consent of the parties or agencies having jurisdiction, steel pipe or other acceptable material may be jacked or bored into place in lieu of a liner plate tunnel provided the Contractor be responsible for all approvals from the parties and/or agencies having jurisdiction including, but not limited to, furnishing complete details of the methods to be employed for approval.

Refer to casing pipe specifications in Material Section for Bores.

The carrier pipe shall be secured inside the steel casing pipe with casing chocks (minimum three per joint) as manufactured by Powerseal Pipeline Products Corporation of Wichita Falls, Texas, or Engineer approved equal. Additionally, the end of the steel casing pipe shall be sealed with casing pipe "End Seals", "Link-seal" or Engineer approved equal." Excavation shall be unclassified and no distinction made between rock and other materials excavated, with the cost of excavation merged in the unit price per foot of pipe sewer in tunnel/bore.

B. Tunneling Method

Construction of the culvert shall be carried on in such a manner that settlement of the ground surface above the culvert shall be held to an absolute minimum. Where ground conditions are unstable, poling plates or poling boards shall be used to prevent caving of material above the tunnel before the liner plates can be installed.

Steel liner plates shall be installed as soon after the excavation is removed as possible and excavation shall not be removed more than 24 inches ahead of the installed liner plates. Excavation shall be carried on in such a manner that voids behind the liner plates will be held to a minimum. However, should any boulders larger than 1 foot in diameter be encountered, they shall be removed so that none are closer than 6 inches to the outer face of the liner. Where boulders or piling are excavated, the holes shall be backfilled by tamped material.

The steel lining shall consist of plates not to exceed 18 inches wide. Each circumferential ring shall be composed of the number and length of plates to complete the required diameter. The Contractor shall submit details of the lining for approval.

The strength of the casing or tunnel lining will be determined by its section modulus. Thickness of the metal for these steel plates shall not be less than 8 gauge allowing for standard mill tolerance.

All plates shall be punched for bolting on both longitudinal and circumferential seams and shall be so fabricated as to permit complete erection for the inside of the tunnel. The longitudinal seam shall be of the lap type with offset equal to gauge of metal for full width of plates including flanges and shall have staggered bolt construction so fabricated as to allow the cross-section of the plate to be continuous through the seam. All plates shall be of uniform fabrication and those intended for one size tunnel shall be interchangeable.

The material used for the construction of these plates shall be new and unused and suitable for the purpose intended. Workmanship shall be first-class in every respect.

After the plates are formed to shape and after all holes are punched, the plates shall be galvanized on all surfaces by the hot-dip process. A coating of prime western spelter, or equal, shall be applied at the rate of not less than 3 ounces per foot of double-exposed surface. If the average spelter coating as determined from the required samples is less than the amount specified above, or if any one specimen shows a deficiency of 0.2 ounce, the lot shall be rejected. Spelter coating shall be of first-class commercial quality free from injurious defects such as blisters, flux and uncoated spots.

All nuts and bolts shall be galvanized.

Plates shall be fabricated with grout holes to facilitate grouting above and around the tunnel liner. These grout openings shall be 2-inch I.P.T. half couplings welded into a hole in the center corrugation of a plate and a galvanized C.I. plug shall be provided for each opening to permit tight closure after grout is pumped. All rings are to be provided with grout holes so that the spacing of holes will be on a maximum spacing of 18-inch centers at the top of the tunnel and at the top quarter points, staggered with the holes at the top.

Field coating material shall be asphaltic mastic, Trumball 5X, or approved equal, and shall be applied with hydraulic spray equipment using a minimum of 2,400 pounds pressure at the nozzle tip.

The material shall be supplied at spraying consistency and shall be applied both to the outside and inside of the liner plates. Plates may be hot-dipped to produce a similar coating.

When installing a liner plate by the tunneling method, the excavation shall be performed in such a manner that voids between the undisturbed earth and the liner plate shall be maintained at a minimum. Any void occurring shall be filled with a Portland cement and sand grout pumped under pressure through grouting openings in the liner plate.

Pumping of grout shall be done (1) at the completion of the installation of approximately each 9 feet of liner plate, (2) at more frequent intervals than 9 feet if conditions indicate the necessity, and (3) at the end of a work shift or for stopping of work for any reason.

Measurement for payment shall be for the linear feet of tunnel measured from the face of tunnel to the face of tunnel.

4. MANHOLES

- A. The Contractor shall submit details of the proposed manholes together with the name of the supplier to the Owner or his authorized representative for approval before any of the precast manholes are shipped to the job site. Precast manholes shall be used consisting of precast monolithic bases with resilient connectors for all pipes entering or leaving the manhole. Precast risers shall be furnished with resilient connector openings for pipes entering and leaving the manhole. Individual riser sections shall be furnished for the exact conditions to be encountered in the field and shall be constructed so as to suit field conditions and to line up properly with the pipes and manhole steps in other riser sections. Misalignment of steps or improperly located holes for incoming pipes shall be cause for rejection of the manhole sections. Precast manhole sections shall be joined together in such a way as to present a smooth uniform joint, which shall be structurally sound and watertight.

All connections of pipes to manhole sidewalls shall be made with resilient connectors. Openings in the manhole sidewall shall be so constructed as to include the resilient connector such that it is an integral part of the sidewall and to provide for the manhole. The sidewall opening shall be manufactured to allow for lateral and vertical movement, as well as angular adjustments through 20°. The resilient connector shall be the Kor-N-Seal as manufactured by NPC, Inc. or approved equal. The resilient connector shall meet all physical and performance requirements as set forth by ASTM C-923.

See materials section regarding the requirement for XYPEX® C-1000 concrete admix for water proofing and corrosive protection for all manholes.

Flow channels shall consist of smooth uniform cross sections conforming to the cross section of the pipe so as to provide a minimum of turbulence and avoid deposition of solids.

Flow channels shall have a depth at least equal to ½ the pipe diameter. The finished flow of the manhole shall have a slope of approximately ½" from wall to channel to provide for proper drainage, but at the same time offer a safe footing for workmen.

Brick or pieces of brick may be used for filler material in forming the flow channel and finished floor in the manholes provided that no brick shall be left within 1" of the finished surface. A minimum fall of 0.1' shall be maintained across the manhole.

Temporary covers, preferably a cone and casting, must be placed on manholes that have been installed in the undeveloped areas that are not to final grade. Care shall be taken not to let water stormwater or foreign material enter the sewer system.

B. Manhole Sealing and Protective Coating

Manhole sidewall, invert, and bench sealing and rehabilitation shall be performed on existing manholes indicated or as directed by the Engineer. The sealing of sidewalls and inverts in the manhole shall conform to the following specifications and Section 2 - Materials.

The manhole coating and sealing materials as allowed in Section 2 - Materials shall be applied in strict accordance with manufacturer's recommendations and as approved by the Engineer.

Safety regulations and precautions set out by the manufacturer and OSHA shall be strictly observed.

Manholes to be waterproofed and sealed must first be cleaned by high-velocity cleaning equipment to remove all foreign matter from the walls and base. This cleaning shall remove oil, grease, loose mortar, paints, protective coatings, efflorescence, laitance and curing compounds.

The Contractor shall use a spray from above of a 10 percent solution of muriatic acid. The Contractor shall wash this material off and the manhole allowed to dry.

The manhole and invert shall then be gone over by patching with a quick setting Portland Cement based hydraulic cement to seal all cracks, etc.

This work shall be done in complete accordance with the manufacturer's recommendations. For material requirements see Section 2 - Materials.

The manhole is now ready for the sealing application process. Mixing shall be as per the manufacturer's recommendations. The first coat shall be applied by vertical brush strokes so that all brick joints in the direction receive an adequate coating of material. The first coat will be white in color to ease inspection and make the second coat visually simple to apply. After the first coat has cured, the surface is ready for the second coat. This second coat will be gray in color and should be applied with horizontal brush strokes to insure complete coverage of joints.

The sealant coatings shall be applied and be capable of withstanding a hydrostatic pressure of 7 psi (16 feet of water).

This sealing and waterproofing procedure shall be applied to the sidewalls, base, invert, and benches. As necessary to accomplish this work, the Contractor shall control the sewage flow through the manhole.

After all sealing, the Engineer and Contractor shall inspect the sealed manholes after rainfall events have sufficiently raised the ground water table. See Section 4 - Testing and Acceptance for other requirements including vacuum testing.

This inspection shall be scheduled at a time to be determined by the Engineer.

See Supplementary Condition to Contract for requirements of the Contractor to provide pre-construction and post-construction photographs for all manholes rehabilitated on this Project.

Manholes which do not pass this inspection / testing shall be resealed at no additional costs to the Owner.

The Contractor's attention is directed to the fact that some or all of the existing manholes may not contain steps installed in the sidewall. This may require the Contractor to perform some work by the use of short portable ladders or other equipment.

5. SERVICE CONNECTIONS

PVC Services shall be SDR-26. Sewer service lines shall be provided as shown on the plans or as directed by the Engineer. Service connections shall consist of a tee or wye with 6" branch connection, 6" bends, and piping as required to complete the sewer service connection. Pipe and fitting joints shall be compression type as used on the main sewer. Service pipe and fittings shall be of the same material as used for the main sewer. Service pipe shall be laid on a slope of 1/4" per foot, where this grade is not available and the Engineering Department specifically approves, 1/8" per foot may be used. Sewer service lines shall conform to details as shown on the Standard Detail Drawings and shall terminate at the property line with a tight compression plug braced to withstand pressure of air pressure test.

In the event that it should be necessary to install a service connection where a tee has not been provided, saddles must be used and shall be attached to the main sewer by epoxy in such a way as to effect a permanent water tight joint.

Excavation, laying and backfilling for service lines shall conform to the applicable specifications.

"As-Built" drawings submitted to the Engineering Department shall indicate the service line locations in such a manner that they can be accurately located in the field using information shown on the drawings.

Service lines shall be located approximately 20' from downstream property corner, adjacent to the sewer main, unless otherwise approved by the City Engineer.

- a) A 3/8" to 1/2" steel rod shall be driven at the end of each stubout. The rod shall be 24" long and be covered/backfilled 4" to 6".
- b) All service taps shall have a tracer wire attached to the pipe the same as gravity line, one foot of bedding and then location tape installed above pipe.

6. BACKFILL

Above the pipe zone as defined below may be suitable excavated material or, where called for on approved construction drawings, crushed stone, placed in layers generally not exceeding 12" and vibrated in place.

Bedding backfill shall be crushed stone for PVC pipes and DIP pipes.

Where crushed stone backfill is required the crushed stone shall be No. 57 size as designated by Tennessee Department of Transportation (TDOT) Standards and shall meet all requirements of the TDOT Standards for crushed stone used in road surfacing.

Where crushed stone is not required but the excavated material is unsuitable for use in the backfill, the Contractor may use fine dry selected earth or clay as backfill material. Material containing excessive organic matter, stumps, roots, refuse or foreign matter or hard clay lumps that cannot readily be compacted will not be acceptable for use as backfill.

6.1 Backfill for Trenches

Backfill up to the spring line of the pipe shall be placed as pipe laying progresses in order to maintain proper grade and alignment. Additional backfill shall not be placed until after the pipe has been inspected by the Engineer and approved for backfill.

Backfill to a depth of 12" above the top of pipe (pipe zone) shall be crushed stone, placed by hand to avoid damage or misalignment of the pipe. Additional backfill may be placed by means of front-end loaders, bulldozers or other suitable mechanical equipment subject to a 9" limitation of maximum thickness of layers placed before compaction.

In highways, streets, drives or other paved or traveled areas, backfill above pipe zone as described above shall be entirely No. 57 size crushed stone to within one (1) foot of subgrade. The remaining one (1) foot shall be backfilled with compacted mineral aggregate Class "A" Grading "D" as designated by Tennessee Department of Transportation (TDOT) Standards.

Where trench is located in open country or on public right-of-way outside the ditch lines where not subject to traffic, the backfill up to a point 12" above the top of the pipe shall be placed as specified in the preceding paragraphs. Above this point the backfill may consist of excavated material placed so as to avoid excessive settlement of the trench provided such material is selected to exclude rocks larger than 12" in any dimension. No rocks larger than 1 1/2" may be used in the top 6" of backfill material.

In wide deep trenches the Engineer may, at his discretion, permit the use of rock larger than 12" in the backfill, provided such rock is carefully placed in such a manner that the final position of the rock will not be within the vertical prism lying directly over the pipe or within 9" on either side of the pipe.

In all instances, sufficient care must be exercised to avoid leaving any holes or voids over, around or under stones, boulders, or other backfill material which may later be filled by leaching or settlement of surrounding material thereby causing future trench settlement. Where the Contractor desires to use excavated rock for backfill material and such rock meets the dimensional requirements as specified herein, the Contractor shall provide additional backfill material of a suitable nature to fill the voids as required.

In locations not subject to traffic where excavated material is permitted in the backfill such material shall be brought up to the original ground level and shall then be mounded over to provide for additional settlements. Compaction of this backfill material will not be required, however, if the Contractor shall exercise care to confine the mound to the area immediately over the trench and shall be responsible for bringing in such additional fill material as may be required from time to time during the one year warranty period to fill in areas where excessive settlement has occurred.

The Contractor shall be responsible for and shall protect all sewers, storm sewers and electric, telephone, water or other pipes or conduits against danger or damage while the trenches are being backfilled and from future settlement of the backfill. Where such damage should occur as a result of the Contractor's operations, he shall repair such damage promptly.

The Contractor's attention is called to the fact that he will be held completely responsible for any damage to pavement, sidewalks, curbs, gutters, meter or valve boxes, street inlets, or other structure or appurtenances as a result of the Contractor's operations. It should be specifically noted that the Contractor shall be responsible for damage even though the character or nature of the original pavement or structure was such that it was not capable of carrying the load of the construction equipment regardless of the construction methods used.

6.2 Backfill at Manholes and Other Structures

Backfill around manholes located in highways, streets, or other traveled areas shall consist of carefully placed granular material as specified under "Backfill for Trenches". Backfill around manholes, piers or other structures in locations not subject to traffic may consist of excavated material subject to the following restrictions.

- 1) No rock larger than 12" in any dimension shall be placed within 12" of the manhole walls, or pipes entering or leaving the manhole.
- 2) No rock larger than 12" in any dimension shall be placed in the vertical prism above and extending 9" outside of the pipe lines.
- 3) Crushed stone shall be a minimum of 6" deep under and 12" thick around the manhole encasing the barrel sections in $\frac{3}{4}$ " stone. To a point 12" below finish grade in unpaved areas.
- 4) Excavated material used for backfill outside of the required stone envelope shall be carefully placed in layers and compacted in such manner as to fill voids and prevent excessive settlement.

6.3 Backfill for Force Mains

Backfill around sewage force mains of ductile iron or PVC areas shall consist of ¾" crushed stone placed by hand around both sides of the pipe and tamped to eliminate voids and provide firm support for the pipe. The backfill shall be compacted in 4" layers and shall be continued in this manner until the backfill has been placed to a finished depth of 12" over the top of the pipe.

After the backfill has been placed and compacted in layers to a depth of 12" above the top of the pipe the remainder of the backfill may be placed by machine and compacted by running suitable wheel type construction equipment along the ditch provided, however, that no rock larger than 6" in any dimension is included within the backfill and no rock larger than 1 ½" is included in the top 6". Should the Contractor fail, refuse, or neglect to systematically exclude or remove oversize rock from the backfill material, he may be required to place and compact the backfill by other suitable methods, which will permit the rocks to be detected and removed.

Under highways, roadways, streets or parking areas having permanent type pavement or heavy traffic, when indicated on approved construction drawings, the backfill shall consist of crushed stone placed in 4" to 6" layers and thoroughly compacted up to the top of the trench.

7. PAVEMENT REMOVAL

Where existing paved streets, roads, parking lots, drives or sidewalks must be disturbed during construction of the project the Contractor shall take the necessary steps to minimize damage. Permanent type pavement shall be saw cut in a straight line before removal and care shall be taken during excavation to avoid damage to adjacent pavement. Where trucks or other heavy equipment must cross curbs or sidewalks, such areas shall be suitably protected.

A ROAD EXCAVATION PERMIT must be obtained before excavating in any city Street.

8. PAVEMENT REPLACEMENT

In paved or improved roads, or where sidewalks, curbs, gutters or driveways have been damaged by Contractor, and where replacement of surfaces or damaged items is required, items shall be repaired or replaced without any needless delay in the best workmanlike manner with same kind of materials as were removed or damaged in the construction operation. Underlying foundation courses of roads, etc., finished surface, etc., shall conform to undisturbed portions of damaged items and shall in every respect be equal to quality, materials and workmanship in original, undisturbed item. Decision of Engineer shall be final as to classification of any form of pavement or surfacing not specified on project plans or of any forms of pavement or surfacing where classification is at all doubtful. Should Contractor fail or refuse to repair any damage after receiving directions of the Engineer, the Department of Public Services may, after 24 hours written notice, employ such force and furnish such materials as may be necessary to do the work with cost to be billed to the Contractor.

9. CLEAN-UP PROCEDURES AND REQUIREMENTS

The Contractor shall not, without the permission of the Engineer, remove from the line of work any earth excavated until the excavation has been refilled and surfaced.

As soon as the backfilling of any excavation is completed and when in areas of existing development, the Contractor must at once begin the removal of all surplus dirt except that actually necessary to provide for the settlement of the filling unless otherwise provided in the special specifications. He shall also remove all the pipe and other material placed or left on the street by him except material needed for the replacement of paving, and the street shall be opened up and made passable for traffic. Following the above work, the repairing and complete restoration of the street surfaces, bridges, crossings and all places affected by the work shall be done as promptly as possible.

All excavated material shall be cleared from adjacent street surfaces, gutters, sidewalks, parkways, railroads, grass plots, yards, etc., and the whole work shall be left in tidy and acceptable conditions. Contractor will be required to regrass lawns or neutral grounds where trenches are excavated in these locations or where Contractor has damaged lawns or neutral ground by his operations.

The Engineer shall be sole authority in determining time in which rough and final clean up shall be prosecuted. Rough clean-up shall consist of removal of rocks larger than 1 foot in any dimension, grading of excess backfill material over pipeline or removal of said material, opening of any drainage device, restoration of any street or roadway to condition so that traffic may safely and conveniently use street or roadway, restoration of pedestrian ways to condition where pedestrians may safely and conveniently use same.

Rough clean up shall, in general, be prosecuted no later than 1 day after pipe laying and backfilling or no farther behind pipe laying operations than 1000 feet, whichever time limit is shortest shall govern. Final clean up consisting of pavement replacement, sidewalk replacement, removal of rocks, hand raking with seeding, strawing, etc., of lawns and neutral grounds, adjusting grade of ground over pipeline, property repairs, and other items shall, in general, be prosecuted no later than 2 weeks after pipe has been laid and backfilled.

10. SLOPE PROTECTION AND EROSION CONTROL

This section shall consist of temporary control measures as shown in the Drawings or directed by the Engineer or as required by the State of Tennessee – Water Pollution Control Division during the life of the Contract to control erosion and water pollution through the use of hay bales and other control devices.

Note: The Developer/Contractor's attention is directed to the fact that a permit from the Division of Water Pollution Control might be required for aquatic resource alteration for work in and/or around streams.

The temporary pollution control provisions contained herein shall be coordinated with the permanent erosion control features, to assure economical, effective, and continuous erosion control throughout the construction and post-construction period.

- a) Rock check dams are temporary measures to control erosion and prevent siltation. Rock check dams shall be used where the existing ground slopes in ditches or other areas where siltation erosion or water run-off is a problem.
- b) Temporary Silt Fences – Silt fences utilizing posts, filter cloth (burlap or plastic filter fabric, etc.) or other approved materials are temporary measures for erosion control. These fences shall be installed to retain suspended silt particles in the run-off water.
- c) The temporary erosion control features installed by the Contractor shall be acceptably maintained by the Contractor until no longer needed or permanent erosion control methods are installed. Any materials removed shall become the property of the Contractor.

In the event that temporary erosion control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as part of work as scheduled and are ordered by the Engineer, such work shall be performed by the Contractor at his own expense.

Where the work to be performed is not attributed to the Contractor's negligence, carelessness, or failure to install permanent controls and falls within the specifications for a work item that has a contract price, the units of work shall be paid for at the proper contract price.

- d) Erosion Control Outside Project Area – Temporary pollution control shall include construction work outside the project area where such work is necessary as a result of construction such as borrow pit operations, haul roads, and equipment storage sites. Bid price in such cases shall include all necessary clearing and grubbing, construction restoration when no longer needed.
- e) No separate measurement and payment will be made for this work. It will be considered a subsidiary obligation of the Contractor under other bid items to which it reflects.

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