



Standard Specifications and Details

Water Main and Sanitary Sewer Projects

Tittabawassee Township

Saginaw County, Michigan

Sections Included:

*02660-Water Distribution

*02732-Sanitary Sewer

*02225-Trenching

*02223-Backfilling

*02722-Rear Lot Drainage

*Water Main and Sanitary Sewer Details

Revision Date: March 2014
December 2017

1. PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe and Pipe Fittings.
- B. Valves.
- C. Hydrants.
- D. Water Main Installation.
- E. Water Services.

1.2 RELATED SECTIONS

- A. Section 02211 - Rough Grading: Top soil removal.
- B. Section 02223 - Backfilling: Fill material.
- C. Section 02225 - Trenching: Excavation and backfilling.

1.3 UNIT PRICE-BASIS OF MEASUREMENT

- A. Pipe and Fittings:
 - 1. Basis of Measurement: By the linear foot of water main installed.
 - 2. Basis of Payment: Includes hand trimming, excavating, bedding, backfilling, pipe and fittings, testing and complete installation as stated in the specifications and indicated on the drawings.
 - 3. Fittings added or deleted from the Contract will be paid or deducted from the Contract at the negotiated price at the time of revision.
- B. Gate Valves and Boxes, Hydrants:
 - 1. Basis of Measurement: Per each installed.
 - 2. Basis of Payment: Includes hand trimming, excavating, bedding, backfilling and complete installation as stated in the specifications and indicated on the drawings.
- C. Water Services:
 - 1. Basis of Measurement: Per each service installed.
 - 2. Basis of Payment: Includes hand trimming, excavating, bedding, backfilling, tapping and complete installation as stated in the specifications and indicated on the drawings.
- D. Tapping Sleeves, Gate Valves and Boxes:
 - 1. Basis of Measurement: Per each tapping sleeve, gate valve and box installed.
 - 2. Basis of Payment: Includes hand trimming, excavating, bedding, backfilling and tapping for a complete installation as stated in the proposal.

- E. Hydrant Extensions and Valve Box Extensions, Relocated Hydrant, Removed Hydrant:
 - 1. Basis of Measurement: Each extension installed, or Hydrant relocated or removed.
 - 2. Basis of Payment: Installation complete as stated in the specifications and indicated on the drawings. The Owner reserves the right increase or decrease the number of extensions without any consideration for adjustment to the bid price. Extensions will not be paid for if the hydrant on the plan shows a depth greater than 6'-0".

- F. Testing Water Main:
 - 1. Basis of Measurement: Included in the unit price bid per linear foot of water main installation.
 - 2. Basis of Payment: Includes all associated labor, material and equipment for testing water main required for this project for a complete installation.

- G. Cleaning and Disinfecting Water Main:
 - 1. Basis of Measurement: Included in the unit price bid per linear foot of water main installation.
 - 2. Basis of Payment: Includes all associated labor, material and equipment for cleaning and disinfecting water main required for the project for a complete installation.

- H. Joints Restraint, Polyethylene Encasement and Corrosion Protection. Plug or Seal Ex. Water Main, Hydrant Lead:
 - 1. Basis of Measurement: Included in unit price bid per linear foot of water main installation.
 - 2. Basis of Payment: Includes all associated labor, material and equipment for joint restraint required for this project for a complete installation.

- I. Blow-offs:
 - 1. Basis of Measurement: Each blow off installed.
 - 2. Basis of Payment: Includes all associated labor, material and equipment required for blow off installation (tapped, plug, curb stop and box, copper pipe, and fittings).

- J. CMP with Flared End Sections:
 - 1. Basis of Measurement: By the lineal foot of the size culvert installed as shown on the Proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment, bedding, backfilling, trimming, flared end sections, and bonding for culverts required for this project for a complete installation.

- K. Reconnecting Tiles, Sump Lead, and Service Leads:
 - 1. Basis of Measurement: Included in the other pay items for the project.
 - 2. Basis of Payment: Includes all associated labor, material, and equipment to replace, reconnect or investigate all tiles, sump leads, storm sewer leads, sanitary sewer leads, service leads etc., for the project whether shown on the plans or located in the field for a complete installation for the project.

- L. Connect to Existing Water Main:
 - 1. Basis of Measurement: Included in the lump sum price bid as stated in the proposal.
 - 2. Basis of Payment: Includes all associated labor, material, equipment, bedding, excavation, fittings, adaptors, backfill and compaction required for a complete installation.

1.4 GENERAL

- A. The work to be done under this Contract consists of the construction of water main with appurtenances.
- B. The Contractor shall furnish all labor, tools, equipment and materials, except as noted herein, required for the construction as shown on the plans or called for in the specifications.
- C. The Owner will not furnish miscellaneous materials such as sand, concrete or similar items required for water main construction.
- D. Any Contractor not completing the project by the completion date shall preclude himself from bidding any other projects with the Owner.
- E. Working hours for the purpose of pipe installation and any excavation work shall be from 7:00 a.m. until 6:00 p.m., Monday through Friday. Cleanup will be allowed outside of these hours.
- F. All inspection on this project will be performed by the Township Engineer or Engineering firm approved by the Township.
- G. Final restoration and cleanup for this project shall meet the approval of the Road Commission and the owner. The Owner shall get final acceptance of the restoration and cleanup in writing from the County Road Commission.

1.5 REFERENCES

- A. ASME B16.1-Cast Iron Pipe Flanges and Flanged Fittings Class 25,125, 250 and 800.
- B. ASME B16.26-Cast Bronze Fittings for Flared Copper Tubes.
- C. ASTM B88-Seamless Copper Water Tube.
- D. ASTM F477-Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- E. AWWA C500-Gate Valves for Water and Sewerage Systems.
- F. AWWA C502-Dry-Barrel Fire Hydrants.
- G. AWWA C509-Resilient Seated Gate Valves for Water and Sewerage Systems.
- H. AWWA C651-Disinfecting Water Mains.
- I. AWWA C900-Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12inch for Water Distribution.
- J. NSF14-Plastic Piping System Components and Related Materials.
- K. NSF61-Drinking Water System Components.
- L. ASTM D3139-Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- M. ASTM A126-Gray Iron Casting for Valves, Flange and Pipe Fittings.
- N. AWWA C105-Polyethylene Easement for Ductile Iron Pipe Systems.

- O. AWWA C111-Rubber Gasket Joints for Ductile Iron Pressure Fittings.
- P. AWWA C151-Ductile Iron Pipe, Centrifugally Cast for Water.
- Q. AWWA C153-Ductile Iron Compact fittings, 3 inch through 24 inch and 54 inch through 64 inch for water service.
- R. AWWA C104-Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
- S. AWWA C909-Molecularly Oriented Polyvinyl Chloride (PVCO) pressure pipe, 4 inch through 24 inch (100mm through 600mm), for water distribution.

1.6 SUBMITTALS

- A. Submit under provisions of Section 01300-Submittals.
- B. Product Data: Provide data on pipe materials, pipe fittings, and accessories not furnished by the Township. Provide manufacturers catalog information.

1.7 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01700 -Contract Closeout.
- B. Record actual locations of valves.

1.8 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01700–Contract Closeout.
- B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.9 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Pipe: Marked according to AWWA and NSF/ANSI 14 and 61 Standards, "NSF-pw".

1.10 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- B. Installer: Company specializing in performing the work of this section with a minimum five years experience.

1.11 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with Municipality standards.

1.12 CONTROL OF VALVES AND HYDRANTS

- A. Possess in tool inventory, the proper valve and hydrant wrenches.
- B. Use of pipe wrench, monkey wrench, or open-end type wrench is prohibited on valves and hydrants.
- C. Shut off and turn on hydrants and valves in accordance with the following regulations and instructions.
 - 1. Only Owner shall turn valves on existing water.
 - 2. If turning a valve on or off will affect service to private property, notice shall be given to those affected before the shut off.
 - 3. Procedure for notifying property owners will be as directed by the Owner
 - 4. Date, time, and duration will be written on the notice.
 - 5. Repair or replace valves and hydrants damaged during Contractor usage.

2. PART 2 PRODUCTS

2.1 WATER MAIN MATERIAL

- A. PVC Pipe: AWWA C900 or C909 SDR 18, NSF-pw approved markings, MDEQ approved.
 - 1. Fittings: Gray or Ductile Iron; AWWA C153 and C104.
 - 2. Joints for Fittings: Mechanical or Push-on with rubber gasket; AWWA C111.
 - 3. Joints for Pipe: Push-on with elastomeric gasket; ASTM D3139 and ASTM F477.
 - 4. Standard Pipe Lengths: 20 feet with a maximum of 15 percent random lengths not less than 10 feet.
- B. Ductile Iron Pipe: Class 52, AWWA 151.
 - 1. Fittings: Gray or Ductile Iron, AWWA C153 and C104.
 - 2. Joint for Pipe; Push-on Mechanical Joint with a compressed nitrile gasket as the seal such as Bell-Tite, Tylon.
 - 3. Joints for Fittings: Push-on type or Mechanical Joint with nitrile gasket; ASTM D-3139 and ASTM F-477.
 - 4. Standard Pipe Lengths: 20 feet with a maximum of 15 percent random lengths not less than 10 feet.

2.2 WATER SERVICE PIPING AND APPURTENANCES

- A. Copper Tubing: ASTM B88, Type K, annealed. Minimum $\frac{3}{4}$ inch diameter.
 - 1. Fittings: ASME B16.26, cast bronze.
 - 2. Joints Flared.
- B. Saddles, couplings, adapters, corporations, etc. shall be Mueller Co.

2.3 GATE VALVES

- A. Manufacturers
 - 1. Mueller
 - 2. EJIW
- B. Up to and including 12inch: AWWA C509, iron body, bronze trim, non-rising stem, single wedge, stainless steel body bolts, resilient seat, mechanical joints.
- C. Two inch operating nut for key operation, painted red to show right hand open.
- D. Direction for opening shall be counter clockwise ("Left hand open") and indicated by an arrow cast on the operating nut skirt.

2.4 HYDRANTS

- A. Manufacturers
 - 1. EJIW 5BR Breakaway.
- B. AWWA C502, for 150 pound working pressure, compression-type, opening with the line pressure, mechanical joints.
- C. Bronze mounted throughout with no iron to iron or steel contacts or threads.
- D. Operating stem in base and valve seat shall be bronze.
- E. Iron parts of high strength grey iron conforming ASTM Designation A-126 Class B.
- F. 5 1/4 inch valve opening for hydrants with a 6 inch mechanical joint inlet.
- G. Minimum inside barrel dimension of 8 inches.
- H. Completely assembled at factory with drain opening sealed with threaded plug.
- I. Two fire hose connections and one pumper connection.
- J. Hydrant shall open " Left" (Counter Clockwise) and shall be plainly marked with an arrow near the operating nut showing the opening direction. 3/4" square operating nut.
- K. Provide proper length for installation in a trench depth of 6-0" or as indicated on the drawings. Install hydrant to grade according to "bury line" marked on the hydrant assembly. Adjust hydrant to proper grade as necessary.
- L. Tested to 300 pounds hydrostatic pressure from inlet side with valve in both open and closed position.
- M. Painted above the grade line a color in conformance with the municipal standards and black below.
- N. Designed so one man can easily remove or replace the working parts without removing the main valve seat.
- O. Hydrant culverts shall be installed as called for on the plans, as part of Hydrant complete installation, in accordance with S.C.R.C. specifications and others provided.

2.5 TAPPING SLEEVES AND VALVES

- A. Manufacturers
 - 1. Mueller
- B. Tapping valve shall be as specified in paragraph 2.3 Gate Valves.

2.6 VALVE BOXES

- A. Manufacturers
 - 1. Mueller
 - 2. EJIW
 - 3. Or equal
- B. Cast Iron 5 1/2 inch diameter, three piece adjustable screw type, for installation of a 6 foot trench.
- C. Valve box extensions for trench depths greater than 6'-6".
- D. No. 6 round base for gate valves up to 8".
- E. No.160 oval base for valves 10" and greater.
- F. Drop covers marked "water".

2.7 CORPORATION STOPS AND SADDLES

- A. Manufacturers
 - 1. Mueller
- B. Single strap saddles for 3/4 inch and 1 inch and double strap saddles for 1 1/2 inch and 2 inch services.
- C. Threads compatible with Municipal standards.
- D. Corporations stops shall be flared type.

2.8 CURB STOP BOX

- A. Mueller
- B. Cast Iron body, 2" I.D. of upper section, one piece lid.
- C. Extension type with Arch pattern base.
- D. Foot piece required for 1 1/2 or larger curb stop.
- E. Mueller H10314 5'6" depth bury 48" stainless steel rod with pin.

2.9 CORROSION PROTECTIVE MATERIAL

- A. Coatings: To be applied to buried nuts, bolts (Core Blue or Stainless Steel), threaded rod and flanges, including those used for flanged, mechanical and restrained joints.
 - 1. Manufacturers:
 - a. San Chem Inc., 1600 South Canal Street, Chicago, Illinois 60616.
Product: NO-OXG-GG-2
 - b. Coronado Paint Product: Coal Tar Epoxy, 10 mil (DMT)
 - c. Or equal.

- B. Polyethylene Encasement: ANSI/AWWA C105/A21.5, 8 mil linear low-density polyethylene film or 4 mil high-density, cross-laminated polyethylene film. Encasement to be wrapped around all ductile iron pipe, fittings, valves, and hydrants to within a foot of finish grade. Secure wrap in place according to manufactures instructions.

2.10 BLOWOFF

- A. The Contractor shall furnish and install a blow off on the end of the water main as shown on the plan or as directed by the Engineer.
- B. The blow off shall include furnishing and installing the tapped plug, curb stop and box, copper pipe of sufficient length to extend to the existing ground elevation and any necessary adaptor fittings required.

2.11 JOINT RESTRAINT

- A. Manufacturer: MEGALUG by EBBA Iron.
 - 1. Series 1100 for mechanical joints restraints on ductile iron pipe.
 - 2. Series 1700 for push joint/bell restraints on ductile iron pipe.
 - 3. Series 2000 PV for mechanical joint restraints on PVC pipe.
 - 4. Series 1600 for push joint/bell restraints on PVC pipe.
- B. Restrain all mechanical joints with retainer glands. Restrain all joints within length (s) according to restraint schedule.
- C. Restrain hydrants, tees, valves etc. according to manufacturer's requirements for application soil type, trench detail, test pressure of 150 psi, safety factor of 2 and depth of bury.
- D. Mechanical joint restraint shall be incorporated into the design of the follower gland. The restraint mechanism shall consist of plurality of individually actuated gripping surfaces to maximize restraint capability. Glands shall be manufactured of ductile iron conforming to ASTM A536-80.

The gland shall be such that it can replace the standardized mechanical joint gland and can be used with the standardized mechanical joint bell conforming to ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53 of latest version. Twist off nuts, sized same as tee-head bolts, shall be used to insure proper actuating of restraining devices.

The restraining glands shall have a pressure rating equal to that of the pipe on which it is used. The restraining glands shall have been tested to ASTM F1674-96, be listed by Underwriters Laboratories, and be approved by Factory Mutual. The restraint shall be MegaLug as manufactured by EBBA iron or approved equal.

- E. Ductile iron pipe restraint shall consist of a wedge action restraint ring on the spigot joined to a ductile iron follower gland behind that bell. The restraint ring shall have individually actuated wedges that increase their resistance to pullout as pressure or external forces increase. The restraint ring and its wedging components shall be made of a minimum grade of 60-42-10 ductile iron conforming to ASTM A536. The wedges shall be heat-treated to a minimum hardness of 370 BHN. Torque limiting twist off nuts shall be used to insure proper actuation of the restraining wedges. The follower gland shall be made of a minimum grade of 60-42-10 ductile iron conforming to ASTM A536. The connecting tie rods that join the two rings shall be made of low alloy steel that conforms to ANSI/AWWA C111/A21.11. The assembly shall have a rated pressure, with a minimum two to one safety factor of 350 psi in sizes sixteen inch and below and 250 psi in the sized eighteen inch through thirty-six inch. The product shall be the Series 1700 MegaLug restraint harness manufactured by EBBA Iron or approved equal.

- F. Restraint for PVC pipe bell (AWWA C900) shall consist of the following. The restraint shall be manufactured of ductile iron conforming to ASTM A536. A split ring shall be utilized behind the pipe bell. A serrated ring shall be used to grip the pipe and a sufficient number of bolts shall be used to connect the bell ring and the gripping ring. The combination shall have a minimum working pressure rating of 150 psi. The restraint shall be approved by Factory Mutual. The restraint shall be the Series 1600 as manufactured by EBBA Iron, Inc. or approved equal.
- G. Submit to Engineer in accordance with Section 1300-Submittals, product information and restraint schedule showing locations of use.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that excavations are to required grade, dry and not over-excavated.

3.2 PREPARATION

- A. Hand trim trench excavation to required elevations. Correct over excavation with compacted MDOT 6A crushed limestone at no additional cost.
- B. Remove large stones or other hard matter which could damage pipe.

3.3 WATER MAIN CROSSING WATERCOURSES

- A. Water mains crossing County drains shall be made in dry trench conditions and shall conform to the requirements of the Public Works Commissioner.

3.4 CONNECTION TO EXISTING WATER MAIN

- A. The Contractor shall connect the proposed water main to the existing water main as shown on the plans or as directed by the Engineer.
- B. The Contractor shall locate the existing water main prior to construction of the proposed water main and shall furnish and install the necessary fittings, including tees, bends, crosses, cutting-in-sleeves, pipe and/or adaptors as necessary to complete the connection.
- C. The Contractor shall be paid for the linear feet of water main installed at his bid price necessary to accomplish the connection.

3.5 CROSSING EXISTING UTILITIES

- A. Where gas mains and services, water mains and services, sewers or any underground utilities cross the trench in open cut, compacted sand backfill shall be required to bed the crossing line.
- B. The sand backfill shall extend to 4 inches above the top of the pipe or conduit which is being supported.
- C. In addition to the sand backfill it may be necessary to support the pipe crossing the trench with a 6"x6" timber with ends supported on solid earth at both sides of the trench.
- D. When supporting pipes with collars or bell joints, the timber shall be placed 3" below such collars or bells and the barrel of the pipe supported with hardwood blocking at 3 foot centers.

- E. The cost of sand backfill used for supporting cross trench piping and the timber supports shall be considered incidental to the project.

3.6 BACKFILLING TRENCH NOT REQUIRING COMPLETE SAND BACKFILL

- A. As soon as the backfill has been brought to the original surface, the material in the trench shall be saturated with water by the method known as spiking, whereby water is forced into the backfill material through a 1" or larger nozzle-type pipe pushed into the backfill $\frac{3}{4}$ of the distance from the surface of the ground to the top of the pipe and allowing water to run until it appears at the surface, other than around the nozzle.
- B. This should be repeated at 6'-to-10' intervals along the trench, depending upon the character of the soil.
- C. After saturation, the fill should be allowed to dry out before the backfilling is completed.
- D. Should a deficiency in the backfilling occur, in either quantity or quality of excavated materials taken from the trench, the Contractor shall supply the deficiency without extra charge to the Owner.
- E. No foreign nor perishable material shall be used in the backfilling.

3.7 DISPOSAL OF FLUSHING WATER

- A. The Contractor shall provide outlets to existing drainage for flushing purposes.

3.8 WATER COST

- A. The Contractor shall pay for all water used during construction, including water main breaks and water necessary for testing, cleaning, and chlorinating water mains.
- B. The actual volume of water used shall be determined by the Engineer.
- C. The rate of pay for all water used shall be at the current rate per 1,000 gallons.
- D. The water necessary to fill the volume of the water main at the completion of the project shall be paid by the Owner.

3.9 MAINTAINING WATER SERVICE

- A. The Contractor shall coordinate any proposed interruptions in the existing water system with both the Owner and Engineer.
- B. If any portions of the existing water mains cannot remain in service due to construction of the proposed water mains, the Contractor shall extend a temporary 1-1/4" polyethylene service to each customer affected by the outage.
- C. The cost of these temporary connections, if required, shall be included in all other items of the Contract.
- D. Services shall be reconnected to the existing water main.

3.10 JOINTING

- A. Mechanical Joints:
 - 1. Make joints in accordance with manufacturer's instructions.
- B. Push-on Joints:
 - 1. Make joints in accordance with manufacturer's instructions.
- C. Flanged Joints:
 - 1. Make joints in accordance with manufacturer's instructions.

3.11 INSTALLATION-PIPE, FITTINGS AND ACCESSORIES

- A. Install pipe, fittings and accessories in accordance with manufacturer's instructions.
- B. Install to the line and elevations shown on the drawings.
- C. Water Main shall have a minimum cover of 5'-6" from proposed finish grade. Unless shown otherwise on the drawings or directed by the Engineer.
- D. After the trench or tunnel has been graded, place a minimum 4 inches of compacted Type B, material, as specified in Section 02223-Backfilling in the trench as a bed for the pipe.
- E. Hand trim for bell and spigot pipe joints.
- F. Carefully lay the pipe on the bedding to insure positive bearing along the full length of the pipe.
- G. Place 4 inches tamped Type B fill along the side of the pipe, filling any void space under the pipe. Execute tamping with a T bar or other tamping device approved by the Engineer.
- H. Place additional tamped Type B fill alongside the pipe to a height equal to the top of the pipe.
- I. Place and compact Type B fill material to 12 inches above the top of the pipe.
- J. Restrain pipe and fittings as detailed on the drawings, or as described in the specifications.

3.12 POLYETHYLENE ENCASEMENT

- A. Install in accordance with manufacturer's instructions and AWWA C105.
- B. Install to prevent contact between ductile iron pipe, fittings, valves and hydrants and the surrounding backfill and bedding material.
- C. Encasement is not intended to be a completely air tight nor water tight enclosure.
- D. Overlap joints a minimum of 24 inches and secure with adhesive tape for the purpose of holding polyethylene in place until backfilling operations are complete.
- E. Encase valves up to the operating nut without interfering with valve operation.
- F. Encase hydrants to the grade line.
- G. Repair rips, punctures and other damage with adhesive tape or with a piece of polyethylene secured in place.

3.13 INSTALLATION-HYDRANTS

- A. Install in accordance with manufacturer's instructions.
- B. Set at plan location and grade as directed by the Engineer.
- C. Set on concrete block with minimum dimensions of 4 inches by 8 inches by 16 inches.
- D. Restrain as detailed on the plans.
- E. Set plumb.
- F. Rotate up to 180 degrees to face the direction shown on the plans.
- G. Set only when the Engineer is present.
- H. Obtain approval of the Engineer prior to backfilling.
- I. Backfill according to Section 02225 –Trenching: Backfilling.

3.14 INSTALLATION-VALVES

- A. Install in accordance with manufacturer's instructions.
- B. Tighten nuts on valve body (stainless hardware only).
- C. Set plumb on a 4"x 8"x16" concrete block. Use larger blocks for larger valves.
- D. Backfill with Type A material to a minimum of 2 inches above the flange of the valve dome.
- E. Leave valves in the open position except for the valves that connect to the existing water main.

3.15 INSTALLATION-VALVE BOXES

- A. Set base on Type A material a minimum of 2 inches above the flange on the valve dome and centered over the operating nut. Backfill to finish subgrade according to Section 02225-Trenching: Backfilling.
- B. Set box plumb and centered over the valve operating nut.
- C. Adjust the top of the valve box to match proposed finish grade.
- D. Install extensions for trench depth greater than 6'-10".

3.16 INSTALLATION-TAPPING SLEEVES AND VALVES

- A. Install in accordance with manufacturer's instructions.
- B. Install valve in accordance with provisions of paragraph 3.14, INSTALLATION-VALVES.

3.17 REMOVING / RELOCATING EXISTING HYDRANTS

- A. Relocate existing hydrants as noted on the plans.
- B. Remove hydrant, horizontal pipe lead and hydrant valve and box. Plug and block existing water main at hydrant tee.
- C. Reinstall according to previous paragraphs.

3.18 WATER SERVICE CONNECTIONS

- A. Work shall include all material for complete operation.
- B. This work shall not begin until the proposed main has been tested, disinfected, accepted by the Engineer and is in operation.
- C. Services shall pass visual inspection by the Engineer, under system pressure prior to backfilling.
- D. Backfill according to Section 02225 –Trenching: Backfilling.

3.19 FIELD QUALITY CONTROL

- A. Field inspection will be performed under provisions of Section 01400-Quality Control.

3.20 TESTING

- A. Pressure Leakage Test.
 - 1. Perform after entire water main or a section between two valves has been installed and has passed the visual leakage test.
 - 2. Each section of pipe between two valves shall be pressure tested (maximum distance is 5280 LF). If the Contractor elects to test a longer distance of pipe, the shortest length between two valves shall be used for allowable leakage calculation. Contractor must then verify all gate valves are working properly.
 - 3. Fill pipe slowly, expelling all air.
 - 4. Pressurize pipe to 150 psi and maintain for one half hour.
 - 5. Reduce pressure to 100 psi and re-pressurize pipe to 150 psi and maintain for two hours.
 - 6. The amount of water added to maintain test pressure shall be defined as the leakage.
 - 7. Leakage shall not exceed 0.14 gallons per hour per inch of pipe diameter per 100 joints.
 - 8. Read line pressure on a 4 inch diameter gauge with snubber and a range of 0 to 200 psi in 2 psi increments as manufactured by Wika Instrument Corporation, or equal.
 - 9. Measure water added to the pipe with a tested water meter connected to the water supply line.
 - 10. For short sections of pipe, water may be added through a sterilized container and the amount calculated by direct measurement.
 - 11. Find and repair leaks.
 - 12. Flush pipe with potable water.

B. Visual Leakage Test

1. When directed by the Engineer, a visual leakage test may be performed in lieu of a pressure leakage test.
2. Place sufficient backfill to prevent pipe from buckling or shifting.
3. Joints remain exposed.
4. Restraints are installed.
5. Place and block test plug at the end of the pipe.
6. Fill pipe slowly with water expelling all air.
7. Increase water pressure to equal pressure from existing supply water main.
8. Visually inspect joints for leakage.
9. Repair leaks and repeat test.
10. Backfill after successful completion of test.

3.21 DISINFECTION OF NEW WATER MAINS

- A. Disinfection of water mains must conform to AWAA C651, latest revision.
- B. Verify that water main is complete, flushed and clean.
- C. Minimum flushing velocity for cleaning debris from the water main prior to final disinfection is 3.0 ft. /sec.
- D. For the tablet method of disinfection, the chlorine residual after 24 hours must be at least 0.20 mg/l.
- E. After disinfection and final flushing, collect 2 samples 16 hours apart, or wait 16 hours and then collect two samples 15 minutes apart.
- F. With prior approval of both the Tittabawassee Township Department of Public Works and the Michigan Department of Environmental Quality the spray disinfection method may be used.

**PIPE RESTRAINT SCHEDULE FOR
GROUND BURIED PRESSURE PIPES ^{1 2}**

LENGTH OF RESTRAINT REQUIRED ³

Deflection Angle	22 ½	33 ¾	45	56 ¼	67 ½	78 ¾	90 Tee or Dead End
Pipe							
6"	8	12	16	20	25	31	59
8"	10	15	20	26	33	40	77
10"	12	18	25	32	40	49	93
12"	14	21	29	37	47	57	109
14"	16	24	33	41	54	66	125
16"	18	27	37	47	60	74	141
18"	20	30	41	53	67	82	157
20"	22	33	45	58	73	90	172
24"	25	39	53	68	85	105	202
30"	30	46	63	82	102	126	244
36"	35	54	74	95	119	146	283
42"	40	61	83	107	133	164	320
48"	44	67	92	118	148	181	356

END OF SECTION

¹ This table is based on a test pressure of 150 PSI (operating pressure + water hammer). For other test pressures, all values shall be increased or decreased proportionally.

² Table is valid for depths of bury 5 feet or greater. For depths of bury less than 5 feet, consult D.I.P.R.A. guidelines.

³ In each direction from point of deflection or termination, except for tee at which only the branch in the direction of the tee stem.

1. PART 1 GENERAL**1.1 SECTION INCLUDES**

- A. Extension of municipal sanitary sewerage drainage piping, fittings, accessories and bedding.
- B. Manholes.

1.2 RELATED SECTIONS

- A. Section 01500-Construction Facilities and Temporary Controls: Dewatering.
- B. Section 02223-Backfilling: Backfill Material
- C. Section 02225-Trenching: Excavating subsoil for sewer system piping.
- D. Section 02225-Trenching: Backfilling over pipe bedding up to subgrade elevation.
- E. Section 02279-Filter Fabric: Bedding and backfill separator.

1.3 UNIT PRICE • BASIS OF MEASUREMENT

- A. Pipe and Fittings:
 - 1. Basis of Measurement: By the linear foot.
 - 2. Basis of Payment: Includes hand trimming, excavating, bedding, backfilling, pipe and fittings, testing and complete installation as stated in the specifications and indicated on the drawings.
 - 3. Fittings added or deleted from the Contract will be paid or deducted from the Contract at the supplier's cost at the time of the revision.
- B. 4' Diameter Manhole:
 - 1. Basis of Measurement: Per each installed.
 - 2. Basis of Payment; Includes all associated labor, material and equipment required for a completed installation.
- C. Testing Sanitary Sewer:
 - 1. Basis of Measurement: Included in the unit price bid per linear foot of sanitary sewer.
 - 2. Basis of Payment: Includes all associated labor, material and equipment required for a completed installation.
- D. Reconnecting Tiles, Sump Leads, and Service Leads:
 - 1. Basis of Measurement: Included in the other pay items for the project.
 - 2. Basis of Payment: Includes all associated labor, material, and equipment to replace, reconnect, or investigate all tiles, sump leads, storm sewer leads, sanitary sewer leads, service leads, etc., for the project whether shown on the plans or located in the field for a complete installation for the project.

1.4 REFERENCES

- A. ANSI/ASTM C478 -Precast Reinforced Concrete Manhole Sections.
- B. ANSI/ASTM D2321-Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
- C. ANSI/ASTM D3034-Type PSM (Poly Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- D. ANSI/ASTM F1417-Plastic Pipe Air Testing.
- E. ANSI/ASTM C828-Vitrified Clay Pipe Air Testing.

1.5 DEFINITIONS

- A. Bedding: Fill placed under, beside and 12" directly over pipe, prior to subsequent backfill operations.

1.6 SUBMITTALS

- A. Submit under provisions of Section 01300-Submittals.
- B. Product Data: Provide data indicating pipe, pipe accessories, and manholes frames & covers.
- C. Manufacturer's Installation Instructions: Indicate special procedures required to install products specified.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.7 PROJECT RECORD DOCUMENTS

- A. Submit documents under provisions of Section 01700–Project Closeout.
- B. Accurately record location of pipe runs, connections, cleanouts, and invert elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.8 REGULATORY REQUIREMENTS

- A. Conform to applicable code for materials and installation of the work of this section.

1.9 COORDINATION

- A. Coordinate work under provisions of Section 01039-Coordination and Meetings.
- B. Coordinate the Work with termination of sanitary sewer connection at the property line.

2. PART 2 PRODUCTS

2.1 SEWER PIPE MATERIALS

- A. Plastic Pipe: ANSI/ASTM D3034, SDR 35, Type PSM, (PolyVinyl Chloride) (PVC) material; inside nominal diameter of 6, 8, 10 and 12 inches, rubber gasket joints. (sewers 19' deep or less). Joints shall meet ASTM D3212.
- B. Plastic Pipe: ANSI/ASTM D2241, SDR 26 Type PSM (Poly Vinyl Chloride) (PVC) material; inside nominal diameter of 6, 8, 10, 12 and 15 inches, rubber gasket joints. (Sewers deeper than 19'). Joints shall meet ASTM D3139.
- C. Ductile Iron Pipe: AWWA C150 and C151, Class 52, cement lined. Joints shall be gasketed push on or compression fitting suitable for D.I. Pipe and for gravity sewer application.

2.2 PIPE ACCESSORIES

- A. Fittings and Branch Connections: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, wyes, cleanouts, reducers, traps and other configurations required.

2.3 MANHOLES AND ACCESSORIES

- A. All manholes shall have wye directional changes inside the structure. No "T"s will be allowed.
- B. All manhole flow channels shall utilize the sanitary sewer thru the structure as shown on the Township standard detail sheet.
- C. Barrel and conical top section.
 - 1. Reinforced, precast concrete pipe section conforming to ASTM C478.
 - 2. Nominal diameter of 48 inches or as indicated on the drawings.
 - 3. Pre-cast reinforced concrete base.
 - 4. Plastic coated steel steps at 15 inches on center.
 - 5. O-ring rubber gasket premium type joints.
 - 6. 1/2 inch diameter galvanized pipe nipple with cap through the manhole wall at an elevation equal to the top of the pipe. Nipple shall extend 3 inches into the manhole.
 - 7. Connect main line to manholes utilizing a flexible neoprene gasket with stainless steel band.
 - a. Kor-N-Seal, by National Pollution Control Systems, Inc.
 - b. Model Psl0, by Press Seal Gasket Corp.
 - c. A-Lok, by A-Lok Products, Inc.
 - d. Concrete manhole adaptors are NOT allowed, unless approved by the Township Engineer.

2.4 MANHOLE COVERS AND FRAMES

- A. As indicated on the plans.
- B. Manhole frame shall have 4 holes in the base flange for bolting to cone section.
- C. Furnish 4 inch by 5/8 inch cadmium coated threaded studs with nuts and washers for bolting frame to cone section.
- D. Manholes shall be adjusted to grade using grade rings (maximum of 2) with 3/4" butyl rope. Brick and mortar is NOT allowed for manhole adjustment to grade.

2.5 BEDDING MATERIALS

- A. PVC Pipe: Type A fill to top of pipe and Type B fill to 12 inches above top of pipe.
- B. D.I. Pipe: Type B to 12 inches above top of pipe.
- C. Filter Fabric: Place filter fabric as specified in Section 02279-Filter Fabric over Type A fill for the complete width of the trench.

2.6 MORTAR FOR MANHOLES

- A. Mix mortar per ASTM C270, utilizing the Proportion Method to achieve 2,500 psi 28 day strength.
- B. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C270.
- C. Add admixtures in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.
- D. Do not use anti-freeze compounds to lower the freezing point of mortar.
- E. If water is lost by evaporation, retemper only within two hours of mixing.
- F. Use mortar within two hours after mixing at temperatures of 80 degrees F, or two-and-one-half hours at temperatures under 50 degrees F.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on drawings.

3.2 PREPARATION

- A. Hand trim excavations to required elevations. Correct over excavation with Type A fill.
- B. Remove large stones or other hard matter which could damage pipe or impede consistent backfilling or compaction.

3.3 BEDDING

- A. Excavate pipe trench in accordance with Section 02225–Trenching for work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated.
- B. Dig out for pipe bells.
- C. Place bedding material at trench bottom, level materials in continuous layer not exceeding 6 inches compacted depth, compact to 95 percent.
- D. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION-PIPE

- A. Install pipe, fittings, and accessories in accordance with ASTM C12 for rigid pipe and ASTM D2321 for flexible pipe and manufacturer's instructions. Seal joints water tight.
- B. Lay pipe to the line and grade indicated on the drawings by the use of a laser beam alignment method proven reliable and operated by competent experienced personnel.
- C. PVC Pipe Bedding.
 - 1. Install bedding material MDOT 6A compacted crushed limestone to a depth of $\frac{1}{4}$ of the outside pipe diameter, but not less than 4" under the pipe barrel.
 - 2. Bring first lift of MDOT 6A compacted crushed limestone half way up the side of the pipe and compact with mechanical tamping tools.
 - 3. Bring next lift of MDOT 6A compacted crushed limestone to the top of the pipe and compact.
 - 4. Place filter fabric over second lift of bedding material through the roadways or areas receiving complete sand backfill
 - 5. Third lift of compacted granular material (sand) shall extend 12" above the top of the pipe.
- D. D.I. Pipe Bedding
 - 1. Install bedding material granular material to a depth of $\frac{1}{4}$ of the outside pipe diameter, but not less than 4" under the pipe barrel.
 - 2. Bring first lift half way up the side of the side of the pipe and compact with mechanical tamping tools.
 - 3. Bring next lift to the top of the pipe and compact.
 - 4. Third lift of compacted granular material (sand) shall extend 12" above the top of the pipe.
- E. Refer to Section 02225-Trenching for backfilling requirements. Do not displace or damage pipe when compacting.
- F. Connect to municipal sewer system.

3.5 INSTALLATION-BRANCH CONNECTIONS OR SERVICES

- A. Install according to manufacturer's instructions.
- B. Install the size indicated on the drawings.
- C. Install at locations indicated on the drawings or as directed by the Engineer.
- D. Install according to the details on the drawings.
- E. Place plugs in connections which will not have pipe connected to them immediately. Plugs shall withstand the pressures of air testing.
- F. Lay branch connections and services lying within the trench on 1300 psi concrete from the bottom of the trench to the springline of the pipe with a thickness equal to 6" greater than the diameter of the pipe.
- G. Verify inverts of proposed services.

3.6 INSTALLATION-MANHOLES

- A. Install according to manufacturer's instructions.
- B. Trim bottom of excavation clean and smooth to connect elevation.
- C. Install precast bases on 6 inches of Type A fill.
- D. Form and place reinforced concrete base to correct elevation.
- E. Install stubs connections as Indicated. Service leads are not allowed in manholes.
- F. Bed stubs and branch connections with Type A fill.
- G. Install barrel sections, cone section, and frame and cover to required finish landscape grade.
- H. Maximum height from top of cone to bottom of frame shall be 18 Inches.
- I. Bolt frames to cones.
- J. Cover frame with mortar from cone to within 1 ½ inches of top of frame.
- K. Adjusting rings will be limited to no more than two on any individual manhole.

3.7 INFILTRATION TESTING

- A. All sewers and manholes shall be subject to an infiltration test.
- B. Maximum Infiltration for P.V.C. and D. I. pipe shall be 50 gallons per inch of pipe diameter per mile of pipe per day.
- C. Length of sewer to be tested at one time shall not exceed 1500 feet.
- D. Ground water level at the time of the test shall be a minimum 2 feet above the top of the pipe or Contractor shall saturate trench.
- E. Repair sections of sewer that exceed the infiltration limit.

3.8 AIR TESTING

- A. Test sewers 24 inches in diameter and smaller in accordance with ASTM F1417 for PVC pipe and ASTM C828 for vitrified clay pipe.
- B. Furnish Owner with acceptable air test results for each 1000 feet segment prior to further testing.
- C. Test in increments between manholes.
- D. Clean and plug pipe at each manhole.
- E. Plugs shall be designed to hold against the test pressure and provide an air tight seal.

- F. One plug shall have an orifice through which air can be pumped in to the sewer.
- G. An air supply line fitted with control valves and a pressure gauge to measure the air pressure in the pipe shall be connected to the orifice.
- H. The air pressure gauge shall have a minimum diameter of 3 ½ inches, arrange of 0-10 psig, increments of 0.10 psig and accuracy of ± 0.04 psig.
- I. Check water level over pipe by connecting a clear plastic tube to the 1/2 inch pipe nipple in each manhole.
- J. Increase test pressure by 0.433 psig for each foot of ground water above the top of the pipe.
- K. Pressurize the sewer pipe to 4 psig greater than the greatest back pressure caused by ground water over top of the sewer pipe.
- L. Allow two minutes for air pressure to stabilize between 3.5 and 4.0 psig.
- M. Add air to the pipe to begin the test at a pressure between 3.5 and 4.0 psig.
- N. Close valve at the end of the stabilization period so that no more air enters the pipe.
- O. Record the gauge pressure and begin timing for the test.
- P. Test will not begin if pressure is less than 3.5 psig or greater if required to compensate for ground water pressure.
- Q. The time required for the air pressure to decrease 0.5 psig for PVC pipe during the test shall not be less than the time shown in the following table.
- R. Repair and retest failed sections.
- S. Follow safety procedures.
 - 1. Block plugs securely.
 - 2. Relieve air pressure completely before removing plugs.
 - 3. A 15" plug with 4.5 psig applied exerts almost 800 pounds of force.

PVC PIPE

SPECIFICATION TIME REQUIRED FOR A 0.5 PSIG PRESSURE DROP

FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q=0.0015

1 Pipe Diameter (in.)	2 Minimum Time (min.:sec.)	3 Length for Min. Time (ft.)	4 Time for Longer Length (sec.)	SPECIFICATION TIME FOR LENGTH (L) SHOWN (MIN:SEC)								
				100 ft.	150 ft.	200 ft.	250 ft.	300 ft.	350 ft.	400 ft.	450 ft.	
4	1:53	597	.190 L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	.427 L	2:50	2:50	2:50	2:50	2:50	2:50	2:50	2:50	2:50
8	3:47	298	.760 L	3:47	3:47	3:47	3:48	4:26	5:04	5:04	5:04	5:42
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57	5:56	6:55	6:55	7:54	8:54
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	9:58	11:24	12:50
15	7:05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	15:35	17:48	20:02
18	8:30	133	3.846 L	8:30	9:37	12:49	16:01	19:14	22:26	22:26	25:38	28:51
21	9:55	114	5.235 L	9:55	13:05	17:27	21:49	26:11	30:32	30:32	34:54	39:16
24	11:20	99	6.837 L	11:24	17:57	22:48	28:30	34:11	39:53	39:53	45:35	51:17
27	12:45	88	8.653 L	14:25	21:38	28:51	36:04	43:16	50:30	50:30	57:42	46:54
30	14:10	80	10.683 L	17:48	26:43	35:37	44:31	53:25	62:19	62:19	71:13	80:07
33	15:35	72	12.926 L	21:33	32:19	43:56	53:52	64:38	75:24	75:24	86:10	96:57
36	17:00	66	15.384 L	25:39	38:28	51:17	64:06	76:55	89:44	89:44	102:34	115:23

3.9 DEFLECTION TEST

- A. Test PVC sewer for deflection by a deflectometer or the "Go-No-Go" nine point mandrel method.
- B. Perform deflection test no sooner than 30 days after completion of backfilling.
- C. Re-excavate trench in areas where deflection exceeds 5%.
 - 1. Remove and replace pipe and bedding where pipe is damaged.
 - 2. Remove and replace bedding where pipe is not damaged.
- D. Retest pipe for deflection no sooner than 30 days after replacement of backfill.
- E. Refer to page 279 of the "Handbook of the PVC Pipe, Design and Construction" ,published by the Uni-Bell Plastic Pipe Association for determination of the base inside pipe diameters for deflection testing.
- F. Refer to the following chart for base inside diameters for the classes of pipe specified.

SIZE	DR35	DR26	SERIES 46
8"	7.76	7.79	00.00
10"	9.71	9.71	00.00
12"	11.56	11.52	00.00
18"	00.00	16.61	17.65
24"	00.00	22.15	23.65

- G. Provide testing equipment.

3.10 CLEANING

- A. Clean and flush the sewer when installation and testing is complete.

3.11 INTERNAL TELEVISION INSPECTION

- A. The Contractor will employ the services of a company specializing in the videotaping services to provide an internal television inspection of the sewers installed under this contract. The Sub contractor TV service shall provide a report and CD of the video work performed within 48 hour of the work performed or it will be required to be redone and witnessed.
- B. Contractor shall clean the sewers and manholes prior to internal Inspection.
- C. Provide access to the sewers for the internal inspection.
- D. Correct deficiencies made apparent by the internal Inspection prior to final acceptance of the project.

3.12 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01400-Quality Control.
- B. Request inspection prior to and immediately after placing bedding.
- C. If tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to Owner.
- D. Frequency of Tests: As directed by the Engineer.
- E. Pressure Test: Test in accordance with Paragraph 3.8.
- F. Infiltration Test: Test in accordance with Paragraph 3.7.
- G. Deflection Test: Test in accordance with Paragraph 3.9.
- H. Internal Television Test in accordance with Paragraph 3.11.

3.13 PROTECTION

- A. Protect finished installation under provisions of Section 01500-Construction Facilities and Temporary Controls.
- B. Protect pipe and bedding from damage or displacement until backfilling operation is in progress.

END OF SECTION

1. PART1 GENERAL**1.1 SECTION INCLUDES**

- A. Excavate trenches for water main, sanitary sewer, force main and their services to the line and grade shown on the drawings.
- B. Trench backfilling and compaction.

1.2 RELATED SECTIONS

- A. Section 01400-Quality Control: Testing fill compaction.
- B. Section 01500-Construction Facilities and Temporary Controls: Water control in excavations.
- C. Section 02160-Excavation Support Systems: Temporary Sheeting.
- D. Section 02211-Rough Grading: Topsoil and subsoil removal from site surface.
- E. Section 02223-Backfilling: General backfilling.
- F. Section 02660-Water Distribution: Pipe bedding materials.

1.3 UNIT PRICE-BASIS OF MEASUREMENT

- A. Trenching:
 - 1. Basis of Measurement: included in the unit price bid for utility installation.
 - 2. Basis of Payment: Includes all trenching, fill, labor, material and equipment required for trenching on this project.

1.4 REFERENCES

- A. ANSI/ASTM C136-Method for Sieve Analysis of Fine and Coarse Aggregates.
- B. ASTM D2992-Test Methods of Density of Soil and Soil-Aggregate in place by the clear Methods (Shallow Depth).
- C. ASTM C 12-Standard Practice for Installing Vitrified Clay Pipe Lines.
- D. ASTM D2321-Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity-Flow Applications.

1.5 FIELD MEASUREMENTS

- A. Verify that survey benchmark and intended elevations for the work are as shown on drawings.

2. PART 2 PRODUCTS

2.1 BED MATERIALS

- A. See individual utility specification section for bedding material and placement.

2.2 FILL MATERIALS

- A. Type A-Course Stone Fill: MDOT 6A compacted crushed limestone-for wet excavation, pipe bedding, refill for poor soil or over excavation in pipe trench, compacted to 95 percent of maximum density. A ballast type crushed limestone free of shale, clay, friable material, sand debris graded in accordance with ANSI/ASTM C136.
- B. Type B-Engineered Fill: MDOT Class II-for dry excavation, compacted to 95 percent of maximum density or MDOT Class III A-for PVC sanitary sewer pipe.
- C. Type C-Acceptable Native Subsoil: Reused, free of gravel larger than 3 inch size and debris, compacted to 95 percent of maximum density.
- D. Type D-Dense Aggregate: MDOT 22A compacted crushed limestone-for access roads temporary patches on traveled surfaces and aggregate base course of asphalt pavement compacted to 95 percent of maximum density.

3. PART 3 EXECUTION

3.1 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Maintain and protect existing utilities remaining, which pass through work area.
- C. Protect bench marks, grade and slope stakes.

3.2 EXCAVATION

- A. Excavate subsoil required for utility piping and accessories as indicated on the drawings.
- B. Excavate on the required line to the depth required below the pipe grade for bedding thickness required.
- C. Trenches for pipe shall be excavated to the following minimum of and maximum widths measured at the top of the pipe:

Pipe Size	Trench Width	
	Minimum	Maximum
6" and smaller	18"	24"
8" & 10"	24"	30"
12" & 15"	30"	36"
18"	34"	40"
21"	38"	42"
24"	42"	46"
27"	45"	49"
30"	49"	53"
36"	56"	60"
Larger than 36"	I.D. + 20"	I.D. + 24"

- D. Where trench widths exceed the maximum specified above, the Owner's representative may require special bedding or the use of extra strength pipe at the Contractor's expense.
- E. Minimum trench width is 18 inches.
- F. Excavation shall not interfere with normal 45 degree bearing splay of foundations.
- G. Hand trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
- H. Remove lumped subsoil, boulders, and rock 6 inches below bottom of pipe.
- I. Where soil in the bottom of the trench is unstable, excavate below the trench bottom and place Type A fill.
- J. Correct unauthorized excavation at no cost to Owner.
- K. Correct areas over-excavated by error with Type A fill, in accordance with Section 02223.
- L. Stockpile excavated material in area designated on site and remove excess material not being reused from site.
- M. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- N. Notify Owner's representative of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.
- O. Protect excavation by methods required to prevent cave-in or loose soil from falling into excavation.
- P. Provide, operate and maintain pumping equipment to keep trench dry.
- Q. Use trench boxes or other form of temporary protection when required by OSHA Standards or when protection of existing utilities is necessary.

3.3 BEDDING

- A. Support pipe and conduit during placement and compaction of bedding fill.
- B. See individual utility specification sections for bedding material and placement.

3.4 BACKFILLING

- A. Backfill storm sewer trenches under paved areas with Type B fill.
- B. Backfill water pipe and sanitary sewer trenches with Type C fill.
- C. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- D. Place geotextile fabric over Type A fill bedding prior to placing last lift of bedding.

- E. Type B fill: Place and compact materials in continuous layers not exceeding 9 inches to 95 percent of maximum dry density as determined by MDOT Standard Requirements. Fill to finish subgrade elevation.
- F. Employ a placement method that does not disturb or damage installed utility and existing utilities in trench.
- G. Employ a compaction method for trench backfill that does not disturb or damage installed utilities and existing utilities in the trench. Compact backfill to specified density. If required compaction is not achieved and verified using mechanical methods, settling or spiking the trench with water may be used as a compaction method in conformance with ASTM C12 and D2321, as approved by the Engineer.
- H. Maintain optimum moisture content of backfill materials to attain required compaction density.
- I. Leave fill material stockpile areas completely free of excess fill materials.
- J. Backfill simultaneously around all sides of structures, manholes and catch basins.

3.5 TOLERANCES

- A. Top Surface of Backfilling: Under Paved Areas: Plus or minus 1/2 inch from required elevations.

3.6 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01400-Quality Control.
- B. Tests and analysis of fill material will be performed in accordance with MDOT Standard Requirements and with Section 01400-Quality Control.
- C. Compaction testing will be performed in accordance with MDOT Standard Requirements and with Section 01400-Quality Control.
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to Owner.
- E. Frequency of Tests: As directed by the Soils Engineer.
- F. Proof roll compacted fill surfaces under paving.

3.7 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 01500-Temporary Controls.
- B. Recompact fills subjected to vehicular traffic prior to placing wearing surface.

END OF SECTION

1. PART1 GENERAL

1.1 SECTION INCLUDES

- A. Building pads filling to subgrade elevations.
- B. Site berming.
- C. Fill under slabs-on-grade pads.
- D. Fill under roadways, driveways, sidewalks, parking lots and other traveled surfaces.
- E. Fill for over-excavation.
- F. Fill for subgrade undercutting.
- G. Consolidation and compaction.

1.2 RELATED SECTIONS

- A. Section 01400-Quality Control: Testing fill compaction.
- B. Section 02222-Excavation.
- C. Section 02225-Trenching: Backfilling of utility trenches.
- D. Section 02660-Water Distribution: Pipe bedding.
- E. Section 02732-Sanitary Sewerage System: Pipe bedding.

1.3 UNIT PRICE-BASIS OF MEASUREMENT

- A. Backfilling:
 - 1. Basis of Measurement: Included in the unit price bid for utility installation.
 - 2. Basis of Payment: Includes all excavation, fill, labor, material, and equipment required for backfill on this project.

1.4 REFERENCES

- A. ANSI/ASTM C117-Test Method for Materials Finer than 75mm (No.200) Sieve in Mineral Aggregates by Washing.
- B. ANSI/ASTM C136-Method for Sieve Analysis of Fine and Coarse Aggregates.
- C. Current MDOT Standard Specifications for Construction.
- D. ASTM D2992 -Test Methods of Density of Soil and Soil-Aggregate in Place by the Nuclear Method (Shallow Depth).

1.5 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Samples: Submit 10 lb. sample of each type of fill to Soils Engineer, in air-tight containers.

2. PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Type A-Coarse Stone Fill: MDOT 6A compacted crushed limestone-for wet excavation, pipe bedding, refill for poor soil or over excavation in pipe trench, compacted to 95 percent of maximum density. A ballast type crushed limestone free of shale, clay, friable material, sand debris graded in accordance with ANSI/ASTM C136.
- B. Type B-Engineered Fill: MDOT Class II-for dry excavation, compacted to 95 percent of maximum density.
- C. Type C-Acceptable Native Subsoil: Reused, free of gravel larger than 3 inch size, and debris, compacted to 95 percent of maximum density.
- D. Type D-Dense Aggregate: MDOT 22A compacted crushed limestone-for access roads temporary patches on traveled surfaces and aggregate base course of asphalt pavement compacted to 95 percent of maximum density.

3. PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify fill materials to be reused are acceptable.

3.2 PREPARATION

- A. Thoroughly proof-roll all areas of building pads, slabs-on-grade, bituminous pavement, concrete curb and gutter and sidewalks with a fully loaded tandem-axle truck, or its equivalent
- B. Loose or soft areas revealed during the proof-rolling operations are to be compacted or removed and replace with compacted Type B or C fill.
- C. Install geotextile fabric between subgrade and aggregate in parking and drive areas as specified by the Soils Engineer.
- D. Prior to placement of fill material in building and paved areas, compact upper 12 inches of the subgrade to 95 percent of its maximum dry density as determined by MDOT Standard Requirements.

3.3 BACKFILLING

- A. Backfill areas to proposed subgrade with unfrozen materials.
- B. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- C. Engineered Type B fill: Place and compact materials in continuous layers not exceeding 9 inches compacted depth.
- D. Acceptable Native Subsoil Type C fill: Place and compact material in continuous layers not exceeding 9 inches compacted depth.
- E. Employ a placement method that does not disturb or damage utilities in trenches.
- F. Maintain optimum moisture content of backfill materials to attain required compaction density.
- G. Backfill against supported foundation walls.
- H. Make grade changes gradual. Blend slope into level areas.
- I. Slope fill away from structures a minimum 2 inches in 10 feet.
- J. Leave fill material stockpile areas completely free of excess fill materials.

3.4 TOLERANCES

- A. Top surface of fill for building pads plus or minus ¼ inch from required elevation.
- B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1/2 inch from required elevations.

3.5 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01400-Quality Control.
- B. Tests and analysis of fill material will be performed in accordance with current MDOT Standard Specifications for Construction and with Section 01400.
- C. Compaction testing will be performed in accordance with current MDOT Standard Specifications for Construction and with Section 01400.
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to Owner.
- E. Frequency of Tests: As directed by the Soils Engineer.

3.6 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 01500.
- B. Recompect fills subjected to vehicular traffic.

3.7 SCHEDULE

- A. Fill Under Grass Areas:
 - 1. Subsoil Type C fill, to 6 inches below finish grade, compacted to 95 percent maximum dry density as determined by MDOT Standard Requirements.

- B. Fill Under Landscaped Curb Island Areas:
 - 1. Type C fill, to 12 inches below finish grade, compacted to 95 percent maximum dry density as determined by MOOT Standard Requirements.

- C. Fill Under Asphalt Paving:
 - 1. Type B or C fill, to underside of aggregate base course elevation, compacted to 95 percent maximum dry density as determined by MOOT Standard Requirements.

- D. Fill Under Concrete Building Pads, Concrete Pads, Concrete Curb and Gutter and Sidewalks:
 - 1. Type B or C fill, to within 4" of underside of concrete slab. All fill to be compacted to 95 percent maximum dry density as determined by MDOT Standard Requirements.

- E. Backfill for Utility Trenches:
 - 1. Bedding as specified in individual utility specification section.
 - 2. Backfill material as specified in Section 02225-Trenching and as defined herein for typed fill.

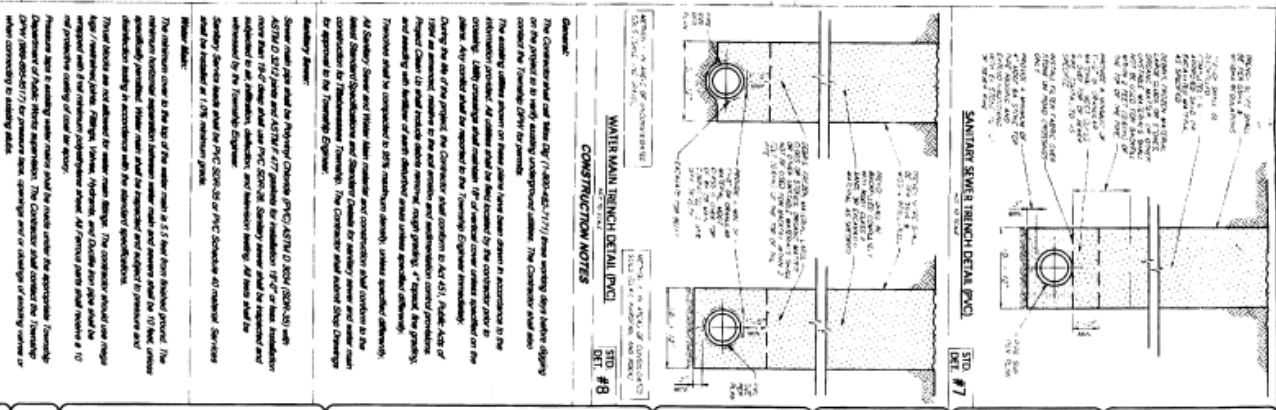
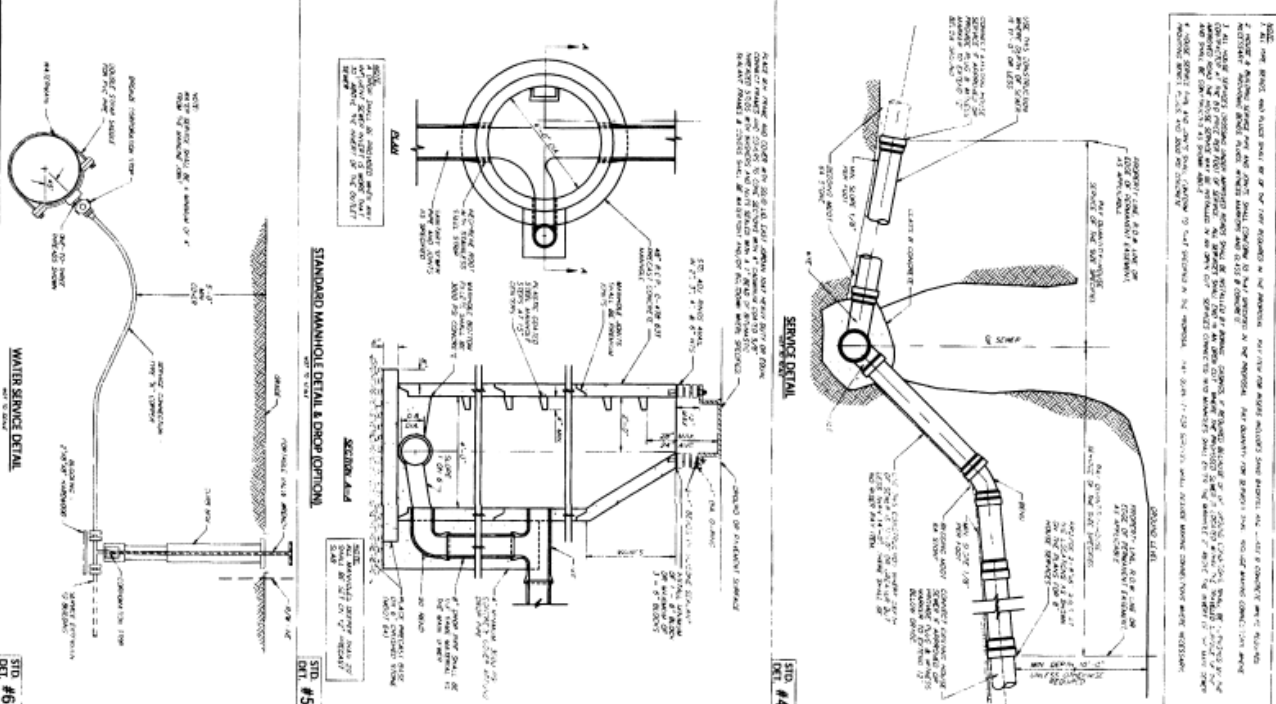
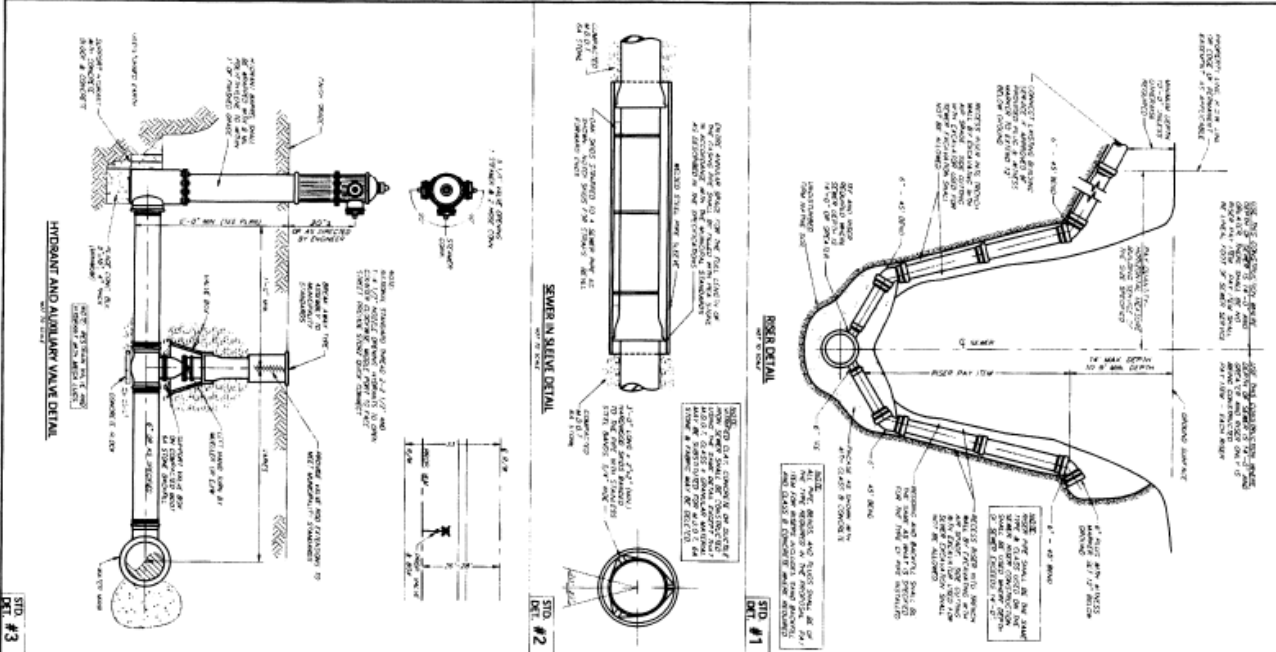
- F. Fill for Subgrade and Undercutting:
 - 1. Type B fill to proposed subgrade elevation, compacted to 95 percent maximum dry density as determined by MDOT Standard Requirements.

END OF SECTION

1. PART1 GENERAL

- 1.1** Rear lot drainage shall consist of a minimum of four-inch SDR 35 plastic tile installed, with a minimum of four inches of 2NS sand under the pipe and backfilled with a cover of six inches of 2NS sand. A minimum of six inches of topsoil shall be placed over the backfill mixture. Pipe shall have a minimum cover of two feet. A four-inch drain line shall not serve any more than one gross acre of land.
- 1.2** Two-foot diameter or larger precast concrete catch basins shall be installed at all natural depressions; however, they shall not be spaced more than 300 feet apart, unless a better alternative can be made effective and is approved by the township planning commission. Any bends, 90-degree turns, or dead ends shall include a two-foot diameter catch basin.
- 1.3** Where a proposed subdivision/condominium abuts the rear of an existing subdivision/condominium with rear lot drainage, the proposed development will be required to install its own lot drainage system, or the developer may obtain a written agreement with the existing subdivision/condominium owners to use the existing rear lot drainage if it is approved by the planning commission and the township engineer. Such agreement shall be recorded with the county register of deeds.
- 1.4** All drains must connect to an approved storm water drainage system.
- 1.5** Where a proposed subdivision/condominium abuts the rear of an existing subdivision/condominium with inadequate rear lot drainage, the proposed subdivision must install rear lot drainage.
- 1.6** Rear lot drainage systems shall be owned and maintained by the subdivision/condominium. Public utility maintenance easements ten feet wide shall be provided for the rear lot drainage system in all cases, even when rear lot drainage may not be required, as stated under subsection (3) of this section. Such easements shall be written so as to permit neighboring property or condominium owners with a specific interest in the rear lot drainage to maintain such drainage as it may affect their property. For example, a lot owner in a subdivision may repair a drain tile which extends through his neighbor's lot in order to maintain his drainage, provided the neighbor's lot is restored to its original condition.
- 1.7** It shall be the responsibility of the developer to construct the rear lot drainage system at 100 percent his cost prior to final plat or site plan approval. The proprietor and engineer of the plat or condominium shall certify that the rear lot drainage system has been installed in accordance with the proposed plan and specifications prior to final plat approval.

END OF SECTION



WATER MAIN AND SANITARY SEWER STANDARD DETAILS

TITTABAWASSEE TOWNSHIP
 SAGINAW COUNTY, MICHIGAN

STANDARD DETAILS

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