

**The Charter Township of Union
Use of Approval and Design Requirements
And Standard Specifications
For Construction of
Sanitary Sewer and Water System**

All connections, additions, extension or relocation to the Charter Township of Union's public sanitary sewer or water systems shall first be approved by the Union Township Public Works Department. Inquiries to the Township should be made during the preliminary planning stages of a project.

Any sanitary sewer or water facilities which services two or more separate buildings or dwellings shall be deemed public unless the buildings are part of a singly-owned industrial or commercial complex or a public complex where future divisions of ownership is not anticipated, and the extension of the system will not be required by the Township.

Approval and Design requirements shall be followed and used by property owners, developers, and design engineers in connection with the design and construction of public and private sanitary sewage and/or water system improvements in the Charter Township of Union, Isabella County.

The Standard Technical Specifications and Construction Details shall be used by property owners, developers and design engineers in connection with the construction of public and private sanitary sewage system and/or water system improvements in the Charter Township of Union, Isabella County. These Standard Technical Specifications, details and forms shall be used without change.

Projects must be submitted for review and approval to the Charter Township of Union. Projects must use the latest Ten State Standard Technical Specifications and Details, without change, in order to obtain approval.

These Approval and Design requirements, and Standard Technical Specifications have been published to facilitate construction, administration, operation, and maintenance of these respective sewer or water systems, or both. The Charter Township of Union does not assume any liability to owners, engineers, or other person for any responsibility undertaken by the Townships or agency pursuant to the document. The operation of the sewer and water systems in question is a governmental function and the Township reserves the right to assert the defense of governmental immunity in all cases to which it applies.

Copies of a handbook that include approval and design requirements for sanitary sewer and water systems, and Standard Technical Specification are available on our website at www.uniontownshipmi.com.

**Approval and Design Requirements for
Construction of
Water Supply and Distribution Systems
In the Charter Township of Union
Isabella County**

SECTION 1 – GENERAL

- A. All plans, regardless of the quantity being installed, for additions to or the extension or relocation of the Township public water system require a permit for construction from the Michigan Department of Environmental Quality. These shall first be approved by the Township and then submitted to the Michigan Department of Environmental Quality by the developer. A copy of the State approved permit must be provided to Union Township before any construction may commence.
- B. No additions to or extensions of the Township public water system shall be placed in service until satisfactory test results, permanent easements, bonds, guarantees and payment of any fees have been received by the Township and the guarantees and payment of any fees have been received by the Township and the addition, extension, or modification has been approved by the Township and the Township has accepted operational control and such approval and acceptance shall be conditioned on the submission of record drawing and operation and maintenance materials being submitted to the Township upon acceptance. If all required materials are not received by the Township within 60 days acceptance will be withdrawn. No permits will be issued for this project or acceptance of system by Township will commence until all materials have been received.
- C. Any water main meeting requirements applicable to public water mains which services two or more separate buildings or dwellings shall be deemed public water main unless the buildings are part of a singly-owned industrial or commercial complex or a public complex where further division of ownership is not anticipated, and the extension of the system will not be required by the Township.
- D. Water supply and distribution systems shall be designed to take into consideration future service areas.
- E. Water main shall be extended to the boundary line of all subdivisions and/or across all lots of property being served. In accordance with Ten State Standards dead ends shall be minimized by making appropriate tie-ins

whenever practical, in order to provide increased reliability of service and reduce head loss.

- F. The Township requires that an escrow fund be established with funds to provide for plan review, permit application, construction observation, and project close out. When applicable, the Township shall require establishment of a separate escrow account for installation of telemetry equipment.

SECTION 2 – GENERAL DESIGN REQUIREMENTS

- A. Water main shall be a minimum of 8” in diameter.
- B. Water supply and distribution systems shall be designed in accordance with these Approval and Design Requirements, Township Ordinance the Standard Technical Specifications and details, the current Standards of the Michigan Department of Environmental Quality, the “Ten States Standards for Water Works” and good engineering practice for this region.
- C. Normal working pressures in the water distribution system shall be an average of 60 psi and not less than 35 psi.
- D. Fire hydrant spacing shall be at or near road intersections and at no greater than 400-foot intervals. Additional hydrants and hydrant locations in housing, commercial, or industrial developments may be required upon review and recommendation of the local fire department.
- E. Valve locations

Three (3) valves shall be located at every tee intersection and four (4) valves at every cross intersection of the water main.
- F. All water leads shall be installed at the time of construction in accordance with Township Specifications. All lead locations and intended uses of the leads are to be approved by the Township prior to installation.
- G. Metering in large multi unit housing facilities shall be done with a master meter of appropriate size.
- H. Systems shall be installed in accordance with the approved plans. Any changes must be reviewed and approved by the Township and the Michigan Department of Environmental Quality prior to installation.

SECTION 3 – PLANS

- A. Seven (7) sets of plans, standard details (24”x36”), and technical specifications shall be submitted to the Township for all proposed public

water supply and distribution systems, additions thereto the public water system, private system connections, and modifications or relocations thereof. Plans that are complete, sealed by an engineer, and approved by the Township shall be transmitted by the developer to the appropriate state agency for issuance of a construction permit. A copy of the approved construction permit must be provided to Union Township before any construction may commence. Upon completion of the project a digital file of all plans must be submitted to Union Township. Digital files must be submitted in DWG or DXF format.

- B. The following data shall be incorporated in the plans:
1. Drawings submitted for approval shall consist of plan and profile views showing existing and proposed terrain elevation.
 2. A location map indicating the $\frac{1}{4}$ section in which the project is located. Plans shall be drawn to a scale no greater than 1"=50'.
 3. When more than one sheet is required for the plans, a small scale overall plan shall be shown.
 4. Each set of plans and specifications shall bear the embossed seal of an engineer licensed in the State of Michigan who is responsible for the plans.
 5. Two benchmarks shall be shown on each plan sheet.
 6. Existing utilities and proposed utilities shall be shown on plans and profiles.
 7. Existing hydrants and valves shall be numbered on plans and profile according to Township systems.
 8. An easement shall be designated on the plans for each run of public water main not in a public right-of-way. The minimum easement shall be twenty (20) feet wide or as required by the Township. Copies of any required easements for private water leads/mains must be provided to Union Township prior to construction.
 9. The following notes shall appear on the plans:
 - a.) All construction and materials shall conform to the Township's current standards, specifications, and details.
 - b.) All elevations shall be based on USGS or NGVD Datum.
 10. Details of pipe bedding, thrust blocks, hydrant valves, valve manholes, and all appurtenances shall be in accordance with the Standard Specification details.
 11. Details of cross connection devices shall be in accordance with the Michigan Water Supply Cross Connection Rules Manual. State of Michigan Plumbing Code and the Charter Township Cross Connection Control Program.

**APPROVAL AND DESIGN REQUIREMENTS FOR
CONSTRUCTION OF
SEWAGE COLLECTION SYSTEMS
IN THE CHARTER TOWNSHIP OF UNION
ISABELLA COUNTY**

SECTION 1. – GENERAL

- A. All plans for additions to or the extension or relocation of the Township sanitary sewer system that require a permit for construction from the Michigan Department of Environmental Quality shall first be approved by the Township and then submitted to the Michigan Department of Environmental Quality by the developer. A copy of the approved permit must be provided to Union Township before any construction may commence. Any privately owned sanitary sewer systems must be reviewed and approved by the Charter Township of Union prior to the installation of any sanitary sewer lines.
- B. No additions to or extensions or relocating of the Township sanitary sewer system shall be placed in service and no building drain connections shall be made thereto until satisfactory test results, permanent easements, bonds, guarantees, and payment of any fees have been received by the Township and the addition, extension or modification has been approved by the Township and The Township has accepted operational control. Such approval and acceptance shall be conditioned on record drawings and operation and maintenance material being submitted to the Township within 90 days after the date of acceptance.
- C. Any sanitary sewer which services two or more separate buildings or dwellings shall be deemed a public sewer unless the buildings are part of a singly-owned industrial or commercial complex or a public complex where further division or ownership is not anticipated and the extension of the system will not be required by the Township.
- D. Sanitary sewers shall be designed to take into consideration future service areas.
- E. Sanitary sewer lines shall be extended to the boundary lines of all subdivisions and or across all lots on property being served as approved by the Township.
- F. Combined sewer systems shall not be permitted.
- G. All sanitary sewer shall be designed in accordance with current Township and Standard Technical Specification, Michigan Department of Environmental Quality requirements, Ten State Standards, and good engineering practice for this region.

- H. The Township requires that an escrow fund be established with funds to provide For plan review, permit application, construction observation, witness of acceptance testing, and project close out. When applicable, the Township shall require establishment of a separate escrow account for installation of telemetry equipment.

SECTION 3 – PUBLIC SANITARY SEWERS

- A. Material used in the construction of sanitary sewers shall be as specified in the Standard Technical Specifications.
- B. Sewers and force mains lying within 75 feet of a private water well, or within 200 feet of municipal water well shall be constructed of special materials as specified by the Michigan Department of Environmental Quality.
- C. Sewer joints and materials shall be as in the Standard Technical Specifications.
- D. A bulkhead or plug shall be installed at each outlet to an existing system and shall not be removed until the new sewer system has been accepted by the Township.
- E. General Design:
1. Sanitary sewers shall be a minimum of 8” in diameter.
 2. Sanitary sewers shall be designed for mean velocities, when flowing full of not less than 2.0 feet per second based on Mannings formula using an “n” value of 0.013. Use of other “n” values may be permitted by the Township, if deemed justifiable, on the basis of research of field data presented. The following are the recommended minimum slopes which should be provided for sewers 42inches or less: however, slopes greater than these are desirable for construction, to control sewer gases or to maintain self-cleaning velocities at all rates of flow within the design limits.
 3. Sanitary sewers shall be designed with a uniform slope and direction between manholes.
 4. When a smaller sewer joins a larger one, the invert of the larger sewer shall be lowered at least enough to maintain the .8 depth point of both sewers at the same elevation.
 5. Where velocities greater than 12 feet per second are anticipated, special provisions may be required to protect against scouring and thrust displacement.

6. All sanitary sewer systems shall be designed so as to limit infiltration to less than 100 gallons per inch of pipe diameter per mile per day or as determined by the Township.
7. Sanitary sewers shall be sufficiently deep so as to prevent freezing. The minimum depth of cover shall be 5 feet without insulation.
8. All sanitary sewer leads shall be installed at the time of construction in accordance with Township specifications.

SECTION 4 – MANHOLES

- A. Manholes shall be installed at the end of each line, at all changers in grade, type of pipe, size, alignment, at all intersections, and at distances not greater than 400 feet. On the ends of our lines of which will be extended, and if this includes lateral, a cleanout as provided for the Charter Township of Union Standard Specifications in lieu of a manhole may be provided with the approval of the Township Engineers. If this line has no initial use no clean-out will be required.
- B. A standard drop connection shall be provided for a sewer whose invert is at an Elevation of 24 inches or more above the manhole invert. Drops of less than 24 inches shall have a partial channel and paved slope of not greater than 70 percent.
- C. The minimum inside diameter of manholes shall be 48 inches. A minimum access diameter of 24 inches shall be provided.
- D. Only solid watertight manhole covers are to be used. Where venting is required, vent pipes shall be installed. In areas of intermittent surface water (ditches, low lands, shorelines, etc.), bolted covers shall be required.
- E. The flow channel through manholes shall be full depth and made to conform in shape and slope to the inside of the sewers, as detailed in the Standard Specifications.
- F. Three-inch manhole adjustment rings shall be installed on all manholes within paved areas. See Standard Specifications.
- G. Where corrosive conditions due to septicity or other causes are anticipated, corrosion protection on the interior of the manholes shall be provided.

SECTION 5 – PUMPING SYSTEM

- A. All pump stations and lift stations shall conform to the Standard Specifications and details require that certain types of equipment or materials be utilized to provide for system uniformity.

B. All pumping systems shall be equipped with an approved ultrasonic level measuring device. In addition, pump stations shall be equipped with appropriate dry contacts for installation of telemetry system by the Township. The following dry contacts shall be provided.

1. High Water Level Alarm
2. Low Water Level Alarm
3. Water in the Dry Well
4. Power Failure
5. Seal Fail
6. Sewage Pump On
7. Sewage Pump off
8. AMPS
9. Pump Hours
10. Volts
11. Power Factor
12. Flow Meter
13. Pump Speed
14. Floats/Level Sensors
15. Surge Protection
16. Motor Overload

C. An emergency power supply connection receptacle for pumping stations shall be required. Emergency power supply may be required by connection of the station to at least two (2) independent public utility sources or by provision of in-place internal combustion engine equipment which will generate electrical or mechanical energy, or by the provision of a connection receptacle for portable generating equipment which meets current requirements.

D. Spare Parts:

1. Submersible pump stations shall include an extra pump
2. Dry well stations shall include a set if impellers

E. Operation and Maintenance Manuals

Four (4) operation and maintenance manuals shall be provided to the Township for all pumping stations.

SECTION 6 – FORCE MAINS

A. At design minimum flow, a cleansing velocity of at least two (2) feet per second shall be maintained.

B. An automatic air relief valve shall be placed at high points in the force main to prevent air locking.

- C. Force main cleanouts shall be provided at intervals of approximately 1,000 feet.
- D. A velocity reducing device may be required at the juncture of the force main with the gravity sewer.
- E. All 90 degree bends shall be long radius elbows 2-45 degree bends.

SECTION 7 – TESTING

A. Sanitary Sewer Systems:

1. Leakage tests shall be as specified in the Charter Township of Union Standard Specifications. This may include appropriate water or low pressure air testing.
2. All sewer lines shall be televised when completed. Videotape in DVD format of the sewer line shall be submitted to the Township. Tests and/or television inspection shall be witnessed by the Township personnel. Satisfactory results shall be obtained prior to permitting any building sewer connections.

B. Pumping Stations:

1. Tests shall be conducted to verify performance curves of each pumping device installed in the system and telemetering.

SECTION 8 – PLANS

A. Seven (7) sets of plans (24" x 36"), standard details, specifications and basic design shall be submitted to the Township for all proposed public sanitary sewage collection systems, additions thereto, and modifications or relocation thereof. Plans that are complete, sealed by and Engineer, and approved by the Township shall be transmitted by the developer to the appropriated state agency for issuance of a construction permit. Upon completion of the project a digital file must be submitted to Union Township. The digital file needs to be submitted in DWG or DXF format.

B. The following data shall be incorporated in the plans:

1. Drawings submitted for approval shall consist of plan and profile views showing existing and proposed terrain.
2. A location map indicating the ¼ section in which the project is located
3. Plans shall be drawn to a scale no greater than 1" = 50'.

4. When more than one sheet is required for the plans, a small scale overall plan shall be shown.
5. Each set of plans and specifications shall bear the seal of an engineer licensed in the State of Michigan who is responsible for the plans.
6. Two benchmarks shall be shown on each plan sheet.
7. Existing utilities and all proposed utilities shall be shown on plans and profile.
8. All existing sewer inverts must be field measured and shall be so designated on the plans.
9. A profile including inverts, top of casting grades, gradient, length and drop connection (if applicable) shall be shown for each run of sewer or force main.
10. Proposed and existing elevation of curb or road, or ground above the sewer shall be shown on the profile. Where the difference in elevation between the road grade and sewer invert is less than 7.0 feet basement elevations should be indicated on the plans.
11. The locations of stoppers and bulkheads shall be indicated on the plans.
12. Manholes shall be numbered on plans and profile according to Township system.
13. An allowable type of pipe, joint and stoppers for public and building sewers shall be indicated on the plans and in the specifications.
14. An easement shall be designated on the plans for each run of public sanitary sewer not in a public right-of-way. The minimum easement shall be twenty (20) feet wide or as required by the Township. Copies of any required easements for private sanitary sewer leads/lines must also be provided to Union Township prior to construction.
15. The following notes shall appear on the plans:
 - a.) All construction and materials shall conform to the Standard Specifications and details.
 - b.) No connection receiving storm water or groundwater shall be made to sanitary sewer.
 - c.) All elevations shall be based on USGS or NGVD Datum.

16. Details of pipe bedding building sewers, drop connection, bulkheads manholes, manhole covers, and other appurtenances shall be submitted in accordance with the Standard Details.
17. Design criteria shall be included with all plans and specifications and a hydraulic profile shall be included for all wastewater treatment facilities. For sewer and lift station projects, information shall be submitted to verify adequate downstream sewer, pump station and treatment plant capacity.
18. Special detail drawings, made to scale to clearly show the nature of the design, shall be furnished to show the following particulars: All stream crossings and sewer outlets, with elevations of the stream bed and high, normal and low water levels.

SECTION 9 – EXISTING SYSTEMS

A. Alterations to Existing Systems:

1. General: No work shall be performed on existing public sanitary sewer Systems which would change the capacity of the system or would result in non-conformity with these regulations, except by written permission of the Township.
2. Manholes: When it is necessary to excavate adjacent to manholes or similar structures, the excavation shall extend around the entire perimeter except by permission of the Township.

B. Approval of Existing Systems as Public Sanitary Sewer Systems;

1. Sanitary sewer systems not having been previously approved as public sanitary sewers may be accepted as such sewers provided they meet all standards and specifications of the Township. Copies of all test required in accordance with the Standard Specifications must be submitted to the Township. These test must have been completed at the time of installation and be sealed by the design engineer.
2. Before acceptance of existing systems as public sanitary sewers, the Township shall cause such tests on the systems, as it deems necessary. Television inspection of the system may be required. All costs for performing such tests shall be borne by the owners of the facility.

SECTION 1

GENERAL REQUIREMENTS

1.01 PROJECT DESCRIPTION

Work includes the following major items:

1.02 DEFINITIONS

The intent of this section is to identify certain persons involved in the project.

DPW/Utility Department	The agency performing the system operations and maintenance typically identified as a Department of Public Works.
Engineer	Engineer who provided the sanitary sewage system and or water main design, plans and specifications for the owner.
Owner	Party who is having the sanitary sewage system and or water main facilities installed.
Contractor	Contractor is prime Contractor who is so identified by the Owner and is responsible for the sanitary sewage system and or water main facilities installation.
Township	The governing Township (Charter Township of Union).

1.03 PRECONSTRUCTION CONFERENCE

Prior to commencement of any construction activities involving the sanitary sewer system and/or water system, a principal member representing the Owner, the Contractor, the Design Engineer, the Township Engineer and the Township DPW/Utility Department shall meet at a pre-determined location and time to discuss the project. It shall be the responsibility of the Owner or his/her Design Engineer to organize this meeting. At that time, the Contractor schedule, as well as the Township Engineer's requirements, will be discussed to obtain a mutual understanding of the project and the Township's inspection process.

1.04 LINES AND GRADES FOR CONSTRUCTION

The Owner (his Contractor and/or Engineer) shall provide adequate lines and grades for construction of the sanitary sewer and/or water main prior to installing the utilities.

1.05 PROGRESS SCHEDULE

The Owner shall, as soon as practical, prepare and submit to the Township three (3) copies of the Progress Schedule regarding sanitary sewer and/or water main construction. This schedule shall show in a clear, graphical manner the proposed date for commencement, progress and completion of the work.

1.06 INTERFERENCE WITH EXISTING SEWAGE TREATMENT WORKS

No bypassing of untreated sewage will be allowed during the construction of this project other than that which normally takes place due to stormwater overflows, etc. The Contractor shall provide a plan of work to the Township for approval before starting work on any phases of the project which might involve existing sewage facilities.

1.07 RELATIONS TO OTHER CONTRACTORS AND UTILITY FORCES

The Contractor shall so conduct his operations as not to interfere with or injure the work of other contractors or adjacent force account work, and he shall promptly make good any injury or damage which may be done to such work by him or his employees or agents.

The Contractor shall grant to other contractors and forces necessary means of access to their work.

1.08 PERMITTING AGENCIES

The Contractor shall perform all work in accordance with any and all applicable permit requirements. The Owner or his Design Engineer shall present the Township with a copy of all documentation and calculations for the permit process. The Owner will obtain the necessary permit for construction/installation prior to commencement of any work.

1.09 ACCESS TO WORK

The Township shall have access maintained to all sanitary sewer or water main work at all times. Proper notification (48 hours) shall be given to the Township prior to the start of any construction or testing.

1.10 SHOP DRAWINGS

Shop drawings of all equipment shall be issued to the Design Engineer during the shop drawing review stage for his approval. The Design Engineer shall forward these (2 copies) to the Township for his review regarding compliance with the Township requirements. The Township will not perform a technical review. That shall remain the responsibility of the Design Engineer. The Contractor should supply a minimum of six (6) copies of all equipment shop drawings to the Design Engineer. Final record shop drawings shall be issued to the Township as part of the close-out procedure in accordance with the close-out section of these specifications.

1.11 STREAM CROSSINGS

Stream crossings shall be performed in accordance with all permit requirements of the regulatory agencies and Charter Township of Union Technical Specifications.

1.12 DUST AND NOISE REDUCTION

The Contractor shall keep dust and noise from construction operations to a minimum. A dust palliative shall be used on disturbed road sections prior to surfacing if so determined by the Township.

1.13 MATERIAL CERTIFICATION

Manufacturer's certification slips shall be submitted to the Township for all pipe, manholes, fittings, etc. used in the installation of sanitary sewer or water mains. This is to verify that the product meets applicable standard specifications required.

1.14 MAINTENANCE BOND REQUIREMENTS

The Contractor shall supply the Owner and Township with a maintenance bond for 50% of the cost of the installation of the sanitary sewer and/or water system that is to be turned over to the Township. The maintenance bond shall be effective from the date of Township acceptance for a period of one (1) year.

1.15 INSURANCE REQUIREMENTS

Where the contract involves construction in a public right-of-way, the Contractor shall provide proof of insurance in the type and amounts required by the Township prior to start of the construction. In addition to the Township, the Township DPW and Township Engineer shall be named as additional insured.

1.16 ESCROW FOR TELEMETRY REQUIREMENTS

When telemetry equipment is required, the owner of the project will be required to provide an account above and beyond the construction contract price to be determined prior to approval and installation of project for standard telemetry equipment. This equipment will be integrated into the Township DPW network of monitoring systems. The types of units this may apply to include submersible lift stations, well houses, water booster stations, and pressure reducing valve vaults.

SECTION 2

STANDARDS AND REGULATIONS

2.01 REFERENCE STANDARDS

- A. Throughout these specifications, reference is made to various standard specifications. Such reference gives the serial designation. The latest revised specification shall apply in all cases. These standard specifications, where applicable, shall be binding on all construction activities.

- B. The following specifications and standards form part of this specification to the extent indicated by reference thereto or for quality of workmanship and materials required under the contract.

American Society of Testing Materials	(ASTM)
American Water Works Association	(AWWA)
American National Standards Institute, Inc.	(ANSI)
Michigan Department of Transportation	(MDOT)
American Society of Mechanical Engineers	(ASME)
American Concrete Institute	(ACI)
National Concrete Masonry Association	(NCMA)
Truss Plate Institute	(TPI)
National Electrical Code	(NEC)
Michigan Department of Environmental Quality	(MDEQ)
National Fire Code	(NFC)
Underwriters Laboratories	(UL)
National Sanitation Foundation	(NSF)
International Plumbing Code	(IPC)

2.02 REGULATORY REQUIREMENTS

- A. All construction work, alterations, repairs or mechanical installations and appliances connected herewith shall comply with all the State Rules and Regulations and local ordinances and such other statutory provisions pertaining to this class of work. Such Rules and Regulations and local ordinances are to be considered a part of these specifications by reference.

- B. All electrical work shall be in accordance with the latest edition of the National Electrical Code, the National Electrical Safety Code and applicable state and local codes. This shall not be construed to permit a lower grade of construction where the plans and specifications require workmanship or materials in excess of code requirements. All electrical equipment, wiring, cable, pre-assembled electrical panels, and materials shall be listed by Underwriters Laboratories, Inc.

PROJECT CLOSE OUT

3.01 CLEANUP

Before final acceptance of the sanitary sewer system or water main system work, the Contractor shall remove all false work, excavated or useless materials, and rubbish, and restore to presentable condition per the restoration specifications and satisfactory to the Township, all property, both public and private, which may have been used or damaged during the installation of the sanitary sewer or water system work.

3.02 OPERATING AND MAINTENANCE DATA

The Contractor shall furnish written instructions for the operation and maintenance of the equipment furnished at the time of submittal of shop drawings. The instructions shall be short, easy to understand, with directions specifically written for this project, describing the various possible methods of operating the equipment. The instructions shall include procedures for tests required, adjustments to be made and safety precautions to be taken with the equipment. Maintenance instructions shall include test and calibration charts, exploded views of assembled components and spare parts lists. At least six (6) instruction booklets shall be furnished for each separate piece of equipment. These shall be transmitted to the Township as part of the close out of the project. Record drawings (1 set of reproducible mylars or vellums and one (1) digital copy in AutoCad format) shall be submitted to the Township along with hydrant and valve reports, water service lead reports, and sanitary sewer lead reports, as applicable to the project.

A. Pumps

Include the manufacturer's technical specification of the pump along with the application for the pump, the manufacturer's warranty certificate, installation instructions, serial numbers for all pumps, pump performance curve, pump trouble shooting guide and the pump efficiency rating.

B. Control Panel Operation and Maintenance Manual

Include the electrical panel legend, bill of material report, catalog cut sheets indicating make and model of all general accessories, installation instructions for the control panel, recommended spare parts, installation instructions for general accessories and a maintenance frequency chart.

C. Electrical Wiring

A color coded drawing of the as-installed electrical schematic shall be submitted for all electrical work performed as part of the project.

3.03 GUARANTEE

The Contractor shall guarantee all materials and equipment furnished and work performed for a period of one (1) year from the date of Township Acceptance. The Contractor shall warrant and guarantee for a period of one (1) year from the date of Township Acceptance of the system that the completed system is free from all defects due to faulty materials or workmanship. The Contractor shall promptly make such corrections, as may be necessary including the repairs of any damage to other parts of the system resulting from such defects. The Owner or Township, if they have taken over the system, will give notice of observed defects with reasonable promptness. In the event that the Contractor should fail to make such repairs, adjustments or other work that may be made necessary by such defects, the Owner or Township may do so and charge the Contractor the cost thereby incurred. Refer to the form Letter of Guarantee to be included with final close-out documents.

The Contractor shall supply a one (1) year maintenance bond per the "General" section of these specifications.

3.04 FINAL COMPLETION/ACCEPTANCE OF PROJECT BY TOWNSHIP

A. Township Projects

Final payment will not be made to the Contractor until all close out documents have been received and approved by the Township. These items are listed below:

1. Punch list items satisfactorily completed.
2. Maintenance bond.
3. Letter of guarantee (format provided by Township).
4. Affidavit of completion/consent of surety.

B. Private Projects

The Township will not accept the facility or allow connections to or use of the facilities until the following items have been received by the Township:

1. Punch list items satisfactorily completed.
2. Maintenance bond. (Valid for a period of one year from the date of Township acceptance of the system).
3. Letter of guarantee (format provided by Township).
4. Easement descriptions.

5. Descriptions of the facilities for a bill of sale.
6. Certification by the Engineer reviewing the installation.
7. Sanitary Sewer Lead Reports (as applicable).
8. Water Service Lead Reports (as applicable).
9. Water Valve Reports (as applicable).
10. Hydrant Reports (as applicable).
11. Operation and Maintenance Manuals
12. Record Drawings
- 12A. Record Drawings (as-constructed) must include three sets of 24" x 36" drawings and a digital copy (formats listed below) including a .pdf copy of each sheet.

Digital Submittal Format Requirements: The developer shall submit to the Township a digital copy of the Record Drawings (as described in Section 3.04.B Item 12B of the Technical Specifications) in one of the following formats:

a. Drawing Interchange File (.DXF) (DWG)

- 12B. Record Drawings: Record drawings shall consist of plan and profile. Sanitary sewer leads and water service leads shall be re-drawn in the new location along with the mainline structures and piping. Hydrant, valve and manhole numbering sequences shall be obtained from the Township. Each structure installed, such as manholes, water service leads, hydrants, valves, sewer leads, bends, tees, or other structures placed shall have three (3) physical measurements from structures which are shown on the plans and apparently not to be changed. Lead measurements are to be placed on the individual reports. Sanitary sewer profiles shall include manhole number, rim and invert elevations, distances between structures, size and type of pipe. Water main profiles shall include hydrant and valve numbers, all fittings, horizontal/vertical, and the accurate depth of placement. All profiles shall show conflict with existing utilities. Sanitary sewer lead and water service lead information shall be placed in a table format on the record drawings. Each plan sheet shall have a separate table for the type of lead shown on that sheet. See Table 3.1 and Table 3.2 for examples.

SECTION 3
PROJECT CLOSE OUT

Table 3.1

SEWER LEAD NUMBER	DISTANCE FROM DOWNSTREAM MANHOLE	DISTANCE FROM SEWER TO END OF LEAD AT PROPERTY LINE OR EASEMENT LINE	DEPTH BELOW GRADE

Table 3.2

WATER SERVICE LEAD NUMBER	DISTANCE FROM GATE VALVE OR FIRE HYDRANT. INCLUDE VALVE OR HYDRANT NUMBERS.	DISTANCE FROM WATER MAIN TO END OF LEAD AT PROPERTY LINE OR EASEMENT LINE

EXCAVATION, TRENCHING AND BACKFILLING

4.01 SCOPE OF WORK

The work covered by this section shall consist of furnishing all materials, equipment and labor for the excavating, trenching, backfilling, and bore and jack required to install or repair sanitary sewers, water mains and other structures as shown on the plans and referred to in these specifications.

4.02 MATERIALS

A. Backfill Material

All backfill material shall be free from cinders, ashes, refuse, sod, frozen lumps, vegetable or organic material, boulders, rocks or stones or other material which, in the opinion of the Design Engineer, is unsuitable. However, from 1" above the top of the pipe to the subgrade of the pavement, material containing stones up to 3" in their greatest dimension may be used.

Where the type of backfill material is not specified, the Contractor may backfill with the excavated material provided that such material meets the requirements described above. Where excavated material is to be used for backfill and there is a deficiency due to a rejection of part thereof, the Contractor shall furnish the required amount of sand, gravel or other approved material at no additional cost.

B. Bore and Jack Materials

1. Steel Pipe

Jacked in place steel pipe shall meet the requirements of either ASTM A53, Type E or S, Grade B or ASTM A139, Grade B.

The ends of all steel pipe to be jacked shall be prepared for field welding at joints.

The nominal outside diameter and minimum wall thicknesses of steel pipe to be jacked in place shall be as shown below. Minimum wall thickness for railroad crossings may be reduced by 0.063 inch if cathodic protection is provided per railroad specifications.

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Nominal Size	Nominal Outside Diameter (inches)	Minimum Wall Thickness Required (inches)	
		M.D.O.T.	Railroads
2"	2.375	0.154	0.251
4"	4.500	0.188	0.251
6"	6.625	0.188	0.251
8"	8.625	0.188	0.251
10"	10.750	0.188	0.251
12"	12.750	0.188	0.251
14"	14.000	0.250	0.282
16"	16.000	0.250	0.282
18"	18.000	0.250	0.313
20"	20.000	0.250	0.344
22"	22.000	0.250	0.375
24"	24.000	0.250	0.407
26"	26.000	0.312	0.438
28"	28.000	0.312	0.469
30"	30.000	0.312	0.469
34"	34.000	0.312	0.532

2. Grout:

Grout shall consist of a mixture of Portland cement and sand in any proportion which does not have more than 50% sand by volume.

4.03 EXECUTION

A. Excavation

Excavation includes clearing the site of the proposed work and removal of all materials to a depth which is sufficient to permit the construction of the structure or utility in accordance with the plans. Excavated materials may be temporarily stored along the trench in a manner that will not cause damage to trees, shrubbery, or other properties and that will not endanger the banks of the trench by imposing too great a load thereon.

B. Length and Width of Trench

Not more than 200' of open trench will be permitted at a time without approval from the Design Engineer and Township Engineer/Township Utility Department, unless pedestrian bridges are maintained at 200' intervals and vehicular crossings of at least one lane are maintained at 300' intervals.

Streets shall not be completely blocked without written permission from the Design Engineer and roadway officials. All fire alarm boxes and fire hydrants must be kept clear and accessible at all times.

The width of the trench shall be ample to permit the pipe to be laid and joined properly and the backfill to be placed and compacted as specified.

In order to limit excessive loads on the pipe, the maximum width of trench shall not be more than 2' greater than the nominal inside diameter of the pipe. This limitation shall apply to the width of the trench at the top of the pipe. Trenches shall be of such extra width, when required, as will permit the convenient placing of timber supports, sheeting and bracing and handling of special conditions.

C. Bracing, Sheeting and Shoring

Open cut trenches shall be sheeted and braced as required by any governing federal or state laws and municipal ordinances and as may be necessary to protect life, property or the work. When close sheeting is required, it shall be so driven as to prevent adjacent soil from entering the trench either below or through such sheeting. Where sheeting and bracing are used, the trench width shall be increased accordingly. An approved pipe laying trench box may be used in lieu of sheeting where safety of the workmen and/or protection of the work is the sole consideration, if allowed by governing authorities.

Sheeting and bracing left in place must be removed for a depth of 3' below the established finish grade or the existing surface, whichever is lower.

Trench bracing, except that which must be left in place, may be removed when the backfilling has reached the respective levels of such bracing. Sheeting, except that which has been ordered left in place, shall be removed as the backfilling progresses.

D. Pumping, Bailing and Draining

The Contractor shall provide and maintain adequate pumping and draining facilities for removal and disposal of water from trenches or other excavations. He shall provide pumping and draining facilities for bulk headed sewer sections and shall operate same until bulkheads have been removed or construction is completed, if bulkheads are to be left in place. The drainage system must be maintained until the pipe has been covered with sufficient backfill material to prevent floating of the installed pipe sections.

Where work is in ground containing an excessive amount of water, the Contractor shall provide, install and maintain a suitable dewatering system and shall so operate it to insure proper construction of the work. The determination of whether an excessive groundwater condition exists, that is, or might be detrimental to the sewer or water main construction will be made by the Design Engineer. Proper disposal of the dewatering discharge (necessary easements, permits, erosion control, etc.) shall be the responsibility of the Contractor. Contractor shall not discharge or allow any groundwater to enter existing sanitary sewage system. Any water which does enter the existing sewage system shall be the Contractor's responsibility and he will pay any and all transporting and treatment costs involved with this water according to the local municipal authority. Cost of pumping, bailing and draining shall be incidental to and included in the price of the pipe or structure placed in the excavation.

E. Excavation to Grade

The trench shall be excavated to the depth required so as to provide a uniform and continuous bearing and support for the pipe barrel. The Contractor shall excavate the last 4" of depth to grade using hand tools.

Any part of the bottom of the trench excavated below the specified grade shall be refilled with approved materials and thoroughly compacted to a minimum of 95% of the maximum dry density as determined by ASTM D698 or the Michigan Cone Method. The finished subgrade shall be prepared accurately by means of hand tools. Blocking to bring the pipe to grade will not be permitted. Bell holes in the subgrade must be provided to allow for continuous support of the pipe barrel when bell type pipe is used.

If, in the opinion of the Design Engineer (with concurrence of the Township Engineer), subgrade pipe support conditions at some locations are found to be unsatisfactory, he shall have the authority to order subgrade preparation at these locations in accordance with the provisions for special foundations in clay, rock or poor soils.

F. Special Foundation in Clay or Rock

Subgrade consisting of clay or rock shall be excavated to at least 4" and not more than 6" below the specified grade. Before the pipe is laid, the subgrade shall be prepared by backfilling with an approved granular material in 3" compacted layers. The layers shall be thoroughly tamped as directed by the Design Engineer so as to provide a uniform and continuous bearing and support for the pipe barrel with a minimum compaction of 95% of the herein defined maximum dry density. The Contractor will not be allowed extra compensation for this work.

G. Special Foundations in Poor Soil

Where the bottom of the trench at subgrade is found to consist of unstable material which will, in the opinion of the Design Engineer, not provide adequate pipe support, the Design Engineer shall have authority to require either the removal of the unstable material and replacement with approved materials or require the Contractor to construct a foundation for the pipe consisting of piling timber or other materials in accordance with plans prepared by the Design Engineer. The use of stone bedding by the Contractor to reduce dewatering requirements will not be paid as an extra.

H. Backfilling around Pipes/Hydrants

The Contractor shall use care as to not placing backfill materials on top of fire hydrants. During backfilling all fire hydrants should be "bagged" prior to backfilling around their perimeter.

From the bottom of the trench to a depth of 1' above the top of the pipe, the trench shall be backfilled by hand with sand or approved excavated materials and tamped to a minimum of 95% of the herein defined maximum dry density.

The Contractor shall use care in placing this portion of the backfill so as to make sure sufficient material has been worked under the pipe and also avoid injuring or moving the pipe. Backfilling around PVC pipe shall be done in accordance with ASTM D2321 "Standard Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe".

I. Backfilling to Natural Grade

From 1' above the pipe to the grade shown on the drawing or specified herein, the trench shall be backfilled by mechanical methods approved by the Design Engineer. A minimum compaction of 85% of maximum unit weight is required, unless otherwise noted.

Provide 30" of cover above the top of the pipe before application of wheel loading and 48" before use of heavy compactors.

J. Backfill under Structures

Where the excavation is made through or under existing or proposed pavement, curb, shoulders, driveways or sidewalks or where such structures are undercut by the excavation or where noted on the plans, the entire backfill to the subgrade of the structure shall be made with granular material. The granular material backfill shall be placed in layers

and compacted to 95% of the herein defined maximum dry density throughout. This requirement shall apply to any trench that is within a one-on-three slope beneath the road from the shoulder point or back of curb line. Extra compensation will not be allowed for this work.

Granular material is defined as a material meeting granular material Class II as defined in M.D.O.T. Standard Specifications.

K. Special Backfilling Requirements

The Contractor will be required to comply with the regulations of the State Highway, Municipal or County Road Engineering Departments with regard to backfilling in their respective right-of-ways and beneath the roads, and shall be responsible for determining these regulations prior to bidding.

L. Compaction Testing

Compaction testing may be periodically performed by a source and method approved by the Township to insure that compaction requirements are being met. Compaction percentage is based on the maximum dry density as determined by ASTM D1557 or the Michigan Cone Method.

M. Boring and Jacking

The following provisions apply to the construction of sewers, force mains, water mains and house leads which cross pavements under the control of the Michigan Department of Transportation, County Road Commission, or under railroads.

1. General

Steel pipes shall be jacked in place under highways as specified in the current standards published by the Michigan Department of Transportation. Pipe jacked in place under railroads shall meet the current standards established by the affected railroad. The Design Engineer shall incorporate bore and jack requirements into the contract documents. After the pipe has been installed in the steel casing pipe, the casing pipe shall be pressure grouted with an MDOT approved flowable fill or blown full of pea stone and the ends sealed with concrete.

2. Location of Jacking Pits:

a. State Highways

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The minimum distance of the jacking pit to the edge of pavement will be specified by the M.D.O.T. and placed on the plans or contract documents by the Design Engineer.

b. County Roads

On all highways, a minimum distance of 15' shall be provided from edge of pavement to the face of boring pits. Any variances from these distances will require tight sheeting and if a traffic hazard, permanent guard rail will be required.

c. Railroads

The location of the jacking pit will be specified by the Railroad and/or the Design Engineer.

3. The boring machine shall be capable of assuring a crossing with no voids.

- a. In solid clay soils the cutting head or the auger, if no head is used, may be allowed to within 1" of the front of the casing.
- b. In sandy soils the cutting head or the auger, if no head is used, must be inside the casing at least 1/2 the diameter of the casing.
- c. If the soil is both clay and sand, the same procedure as for sand shall apply.
- d. In wet, sandy or gravelly type soils that have a tendency to move or run, the cutting head and/or auger shall be pulled back to at least 3' from the front of the casing.
- e. When boring is used to facilitate jacking pipe in place, the minimum diameter of the lead auger section shall be 1/2" smaller than the inside diameter of the pipe being jacked.
- f. Trenchless pipe placement - methods such as trenchless pneumatic piercing tools utilized to perform horizontal bores must be approved by the Township prior to its use.

SECTION 5

CONCRETE WORK

5.01 SCOPE OF WORK

The work under this section shall include all materials, labor and equipment necessary to achieve a finished product, including but not limited to the items in these specifications and those shown on the working drawings. Work includes, but is not limited to building footings, floor slabs, sidewalks, curb and gutter, driveways, etc.

All procedures and materials shall be in accordance with the American Concrete Institute "Building Code Requirements for Structural Concrete" (ACI 318) and "Specifications for Structural Concrete" (ACI 301).

5.02 MATERIALS

- A. Cement: Portland cement shall conform to "Specification for Portland Cement" (ASTM C150).
- B. Aggregates: Concrete aggregates shall conform to "Specification for Concrete Aggregates" (ASTM C33). Maximum coarse aggregate size for all members less than 8" in thickness shall be $\frac{3}{4}$ ". For members with thicknesses greater than or equal to eight (8) inches, the maximum coarse aggregate size shall be 1- $\frac{1}{2}$ ".
- C. Mixing Water: All water used in concrete shall be from a potable water supply.
- D. Concrete Mix Proportions

ACI 318 shall be used for selecting concrete proportions. The Contractor shall furnish, for the Township's approval, all information necessary to show compliance with ACI 318.

ACI-318 shall be used for developing mixture portions. The Contractor shall furnish, for the Engineer's approval, all records to show that his concrete supplier is in compliance with all provisions of Section 4.3.1. If the concrete supplier is unable to furnish all records to comply with Section 4.3.1, Sections 4.3.1.2 and 4.3.2.2 can be used. If no records are available for any of the above ACI Sections, Section 4.3.3.2 shall be used to develop a concrete mix design.

5.03 EXECUTION

A. Concrete Quality

All concrete shall meet the requirements of ACI 318 be from an approved batch plant and shall have a minimum compressive strength of 2500 psi and a maximum water-cement ratio of 0.64.

Air entrainment shall be 5%, more or less, 1% for concrete with maximum aggregate size of 1-1/2" and shall be 6%, more or less, 1% for concrete with a maximum aggregate size of 3/4".

The concrete shall be of a consistency to work easily into corners, angles of forms and around reinforcement. The slump shall not exceed 4".

B. Mixing and Placing Concrete

1. Preparation of Equipment and Place of Deposit:

- a. Before placement, all equipment for mixing and transporting the concrete shall be cleaned and all debris and ice shall be removed from the places to be occupied by the concrete. Forms shall be thoroughly wetted (except in freezing weather) or oiled and masonry filler units that will be in contact with concrete shall be well drenched (except in freezing weather).
- b. Water shall be removed from place of deposit before concrete is placed. All latents and other unsound material shall be removed from hardened concrete before additional concrete is added.
- c. Expansion joint material shall be placed at all locations where concrete is placed against a structure.

2. Mixing:

- a. Ready Mixed Concrete shall be mixed and delivered in accordance with the "Specification for Ready Mixed Concrete" (ASTM C94). Mixing and transporting equipment shall be capable of providing concrete with meets the ASTM C94 requirements for uniformity.
- b. For job mixed concrete, the mixer shall be rotated at a speed recommended by the manufacturer. If mixer performance tests are not made, each batch of 1 cubic yard

or less shall be mixed for at least 1 minute after all materials are in the mixer. The mixing time shall be increased 15 seconds for each additional cubic yard or fraction thereof. The entire batch shall be discharged before the mixer is recharged.

3. Conveying:
 - a. Concrete shall be conveyed from the mixer to the place of final deposit by methods that will prevent separation or loss of materials.
 - b. Conveying equipment shall be of such size and design as to ensure a nearly continuous flow of concrete at the delivery point without separation of materials or loss of plasticity.

4. Depositing:
 - a. Concrete shall be deposited as nearly as possible in its final position to avoid segregation due to rehandling or flowing. Concrete shall be placed at such a rate that it is at all times plastic and flows readily. No concrete contaminated by foreign material shall be used nor shall retempered concrete be used unless approved by the Engineer.
 - b. When placing is started, it shall be carried on as a continuous operation until placement of a well defined section is completed.
 - c. All concrete shall be thoroughly consolidated during placement. It shall be thoroughly worked around embedded fixtures and into the corners of the forms.

5. Hot & Cold Weather Requirements:
 - a. Concrete placement during hot weather shall be in accordance with "Hot Weather Concreting" (ACI 305).
 - b. Concrete placement during cold weather shall be in accordance with "Cold Weather Concreting" (ACI 306). Adequate equipment shall be provided for heating concrete materials and protecting concrete during freezing or near freezing weather. No frozen materials or materials containing snow or ice shall be used.
 - 1) All reinforcement, forms, fillers and ground with which the concrete is to come in contact shall be free from snow and ice.

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- 2) Construction during cold weather shall be performed in accordance with ACI 306, "Recommended Practice for cold Weather Concreting", or as directed by the Engineer.

SECTION 6

SANITARY SEWER MAIN

6.01 SCOPE

The work covered by this section of the specifications consists of the furnishing of all plant, labor, materials, equipment and supervision and performing all operations involved in the construction of sanitary sewer mains in accordance with the provisions of the Township Plans and Specifications and subject to the terms and conditions of the Contract Documents.

Sanitary sewer leads and sewer appurtenances are covered under Section 7 of these specifications.

6.02 MATERIALS

A. Sewer Pipe

1. General

- a. Sewer pipe, unless otherwise indicated on the plans or authorized in writing by the Township, shall be new, unused material of the size and type shown on the plans and shall conform to the requirements of these specifications.
- b. Pipe, materials and accessories offered by the Contractor shall be the standard products of reputable manufacturers normally engaged in the manufacturing of the particular item in question. The Township shall have the final approval of a pipe manufacturer.

2. Sewer Pipe Selection

The sanitary sewer pipe used at a particular location shall be based on depth of bury as shown in Table

If the depth of cover over the sewer changes during construction or is different than the depths shown on the approved project plans, it shall be the responsibility of the Design Engineer to ensure that the correct material is utilized.

TABLE 6-1 Determination of Sanitary Sewer Pipe Material

Depth of Bury	Sanitary Sewer Pipe Allowed
0' to 16.00'	PVC SDR 35, Truss Pipe, Ductile Iron
16.01' & over	Truss Pipe, Ductile Iron

An entire sewer segment must be constructed of the same pipe material. If greater than 50% of the sewer pipe in a given segment has a depth of bury of 16.01' or greater, then the heavier pipe material shall be used.

3. PVC Sewer Pipe

PVC sanitary sewer pipe 15 inches in diameter and smaller shall meet the requirements of ASTM Designation D-3034 (latest edition), "Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings". The minimum wall thickness shall conform to SDR-35. Sewer lead pipe shall be Schedule 40 PVC.

PVC sanitary sewer pipe 18 inches to 27 inches in diameter shall meet the requirements of ASTM Designation F-679 (latest edition), "Standard Specification for Polyvinyl Chloride (PVC) Large Diameter Plastic Gravity Sewer Pipe and Fittings". The minimum wall thickness shall conform to ASTM Designation T-1.

The use of PVC sewer pipe requires special attention to proper subgrade and backfilling procedures as specified in Section 4 – Trenching, Excavation and Backfilling.. Failure of the Contractor to provide proper construction will result in probable excessive deflection of the PVC pipe and require replacement by the Contractor at no additional cost to the Owner.

4. Ductile Iron Pipe

Ductile iron pipe shall meet the requirements of ANSI A21-50 A21-51, and AWWA C151, and shall be of the design thickness classification as indicated on the plans.

5. Composite Sewer Pipe (Truss Pipe)

Composite sanitary sewer pipe shall meet the requirements of ASTM Designation D 2680 (latest edition). The thermoplastic linings may be ABS or PVC.

B. Pipe Joints

1. For PVC Sewer Pipe: PVC sewer pipe joints shall be elastomeric

gasket type, in accordance with ASTM D3212 (elastomeric gasket type).

2. For Ductile Iron Pipe: Ductile iron pipe joints shall conform to the following:
 - a. Flange joints shall meet ANSI B 16.1, Class 125.
 - b. Mechanical joints shall meet ANSI A21.11, and AWWA C111, or Federal Specification WW-P-421.
 - c. Rubber gasket joints shall be of a bell and spigot type "TYTON", "SUPER BELL-TITE" or equal.
3. For Composite Sewer Pipe (Truss Pipe): Composite Sewer Pipe (Truss Pipe) joints shall be bell and spigot type gasketed joints meeting ASTM D3212.

C. Pipe Fittings

Pipe fittings in sewer lines shall correspond in type, size, class, joints and all other respects with the type of pipe used as specified above including the applicable ASTM requirements. Where linings and coatings are specified for pipe, the fittings to be used in conjunction therewith shall have the same lining and coating.

Fittings shall be used in ductile iron pipe lines as required, whether specifically called for or not, according to the best practice in installation of these lines. A manhole water stop shall be provided at each manhole connection as shown in the standard details.

As approved by the Township, specifically designed adapters shall be used to connect pipes of different diameter or materials of construction. The adapters shall be constructed of flexible materials and clamped onto the pipe with stainless steel bands. Use mastic, solvent weld or rubber gasket seals and encase in concrete to prevent displacement.

6.03 EXECUTION

A. Excavation

As specified in "Excavation, Trenching and Backfilling".

B. Laying Sewer Main

Thermoplastic sewer pipe shall be installed per ASTM designation D 2321

(latest edition) unless otherwise indicated in these specifications. Rigid pipe types (DIP) shall conform to ASTM C12. Embedment material shall conform to ASTM D2321 standards unless otherwise indicated herein, or in the standard details.

Pipes located inside structures or above ground shall be rigidly supported as shown on the plans or as specified herein. The full length of each section of underground pipe shall rest solidly upon the prepared bed of undisturbed earth or compacted backfill with recesses only to accommodate pipe bells and joints. Any pipe which has its grade, alignment or joints disturbed after laying shall be taken up and re-laid. The interior of all pipe shall be thoroughly cleaned of all foreign matter before being lowered into the trench and shall be kept clean during laying operations.

The pipe shall not be laid in water or when trench or weather conditions are unsuitable for work. Water shall be kept out of the trench until the joints and backfilling are completed. When the work is not in progress, open ends of pipe and fittings shall be securely closed so that no water, earth or other foreign substances can enter the line.

All sanitary sewer main shall be laid using a pipe laser for alignment and grade. The Contractor shall be responsible for checking their work using the hubs, stakes, and/or benchmarks provided by the Owner and/or Design Engineer. Any sewer found to have a grade or alignment that varies by more than 10% from the plan grade or elevation will be considered deficient. Variations up to 10% will not be accepted if this variation results in a pipe that is below the minimum slope as defined for that pipe diameter in the latest version of Recommended Standards for Wastewater Facilities (Ten State Standards). The Design Engineer and Township will determine if the deficiency is serious enough to affect the objective of the project. The Contractor shall remove and re-lay any deficient sewer, if directed by the Design Engineer or Township, at no additional cost to the Owner or Township.

Any section of pipe found to be defective, either before or after laying, shall be replaced with new pipe at the Contractor's expense. If repairs are necessary, Fernco adaptors will not be allowed for main line pipe. The same pipe material must be used including a PVC sleeve for all repairs.

The Township shall be notified at least 48 hours prior to the start of laying sewer main.

C. Placement within Easements

Where sewer lines are shown crossing private property, the alignment of

the sewers shall be as shown on the plans and as directed by the Engineer and extra care must be taken to ensure that the work is done within the construction easements.

D. Handling

The sewer pipe shall be handled at all times in such a manner as to ensure delivery to the site and installation in a sound, undamaged condition. Any damaged or defective pipe or other materials will not be accepted. PVC pipe shall not be stored or handled in a manner which will permit exposure to sunlight for extended periods of time.

E. Horizontal and Vertical Separation

Sewers shall be laid at least 10' horizontally from any existing or proposed water mains. This distance shall be measured edge to edge. Should local conditions exist which do not allow for this separation, the crown of the sewer pipe shall be laid at least 18" below the invert of the water main - with the approval of the Township and the Michigan Department of Environmental Quality, Drinking Water Division.

Sewers crossing water mains shall be laid to provide a minimum vertical distance of 18" between the outside of the pipes. This shall be the case where the water main is either above or below the sewer. The crossing shall be arranged so that one full length of sewer pipe shall be centered with respect to the water pipe. Where a water main crosses a sewer, adequate structural support shall be provided to prevent damage. If the 18" isolation distance cannot be maintained due to site constraints, then approval from the MDEQ Water Division will be required for the special construction method proposed (casing, sleeving, etc.)

When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the sewer shall be designed and constructed equal to water pipe and shall be pressure tested to assure watertightness prior to backfilling.

In all cases, state and local permit requirements shall be adhered to.

F. Placement of Sewer Pipe

The pipe shall be placed as soon as possible after the trench excavation has been made. The pipe shall be carefully laid to the required grade in a prepared trench, up-grade from structure to structure, with the bell or groove end of the pipe upgrade. Each section shall have a firm bearing

throughout its length with recesses only to accommodate pipe bells and joints. Any pipe which has its alignment, grade or joints disturbed after laying shall be removed and re-laid. The joints and interior of all pipe shall be thoroughly cleaned of all foreign matter before being lowered into the trench and shall be kept clean during the laying operations. Starting sewer construction in the middle of a project must be approved in writing by the Township.

Water shall be kept out of the trench until the material of the joints has hardened and the trench partially backfilled to prevent floating of the pipe. When work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth or other foreign substance can enter the line.

G. Joints

Joints shall be of the material specified and shall be placed in accordance with the manufacturer's specifications.

H. Backfilling

As specified in "Excavation, Trenching and Backfilling".

I. Cleaning Sewers

The sanitary sewer main must be clean at the time of acceptance. If, at any time, there is an accumulation of earth or silt in the pipe, the Contractor shall clean out and remove such deposits at their own expense.

J. Acceptance Tests

1. Air Testing

All new sewers shall be subjected to air, infiltration or exfiltration tests or a combination of same prior to acceptance by the Owner. All tests for acceptance of the sewer line shall be witnessed by the Township. All sewers where the groundwater level above the crown of the sewer at the upstream manhole is over 7' shall be subjected to air tests or infiltration tests. If an exfiltration test is performed, the maximum exfiltration rate shall be the same as that permitted from infiltration. For the purposes of exfiltration testing, the internal water level shall be equal to the external water level plus 7' as measured from the crown of the pipe at the upstream manhole.

No sewer lines will be accepted until testing has been satisfactorily completed and approved. Testing shall be completed within 30 days of laying operations.

Where groundwater conditions require dewatering operations in order to construct sewers, the Contractor may, at his option, perform preliminary air tests after backfilling and while the dewatering equipment is still operating. After dewatering operations have ceased and the groundwater has stabilized at its normal level 7' or less above the sewer and if the preliminary air test was satisfactory, the preliminary air test may be accepted as final.

Maximum allowable infiltration shall not exceed 100 gallons per inch of diameter per mile of pipe per 24 hours for any individual run between manholes.

The procedure for air testing of rigid pipes such as DIP must conform to ASTM C828 (VCP) or ASTM C924 (concrete) as determined and approved by the engineer or as otherwise recommended by the pipe manufacturer.

The procedure for air testing of PVC (flexible/plastic pipe) sewers shall conform to ASTM F1417 and be as follows:

The sewer line shall be tested in increments between manholes. All leads and wyes shown on the plans must be in place prior to testing. The lines shall be cleaned and plugged at each manhole. Such plugs shall be designed to hold against the test pressure, be braced in place, and shall provide an air tight seal. There shall be no standing water in the pipe during testing operations. One of the plugs shall have an orifice through which air can be introduced into the sewer. An air supply line shall be connected to the orifice. The air supply line shall be fitted with suitable control valves and a pressure gauge for continually measuring the air pressure in the sewer. The pressure gauge shall have a minimum diameter of 3-1/2" and a range of 0-10 PSIG. The gauge shall have minimum divisions of 0.10 PSIG and an accuracy of ±0.04 PSIG.

The sewer shall be pressurized to 4 PSIG greater than the greatest back pressure caused by groundwater over the top of the sewer pipe. Greatest back pressure is determined by averaging groundwater depth over the top of the pipe averaged at each manhole and multiplying by 0.433 to obtain psi. At least two (2) minutes shall be allowed for the air pressure to stabilize between 3.5 and 4 PSIG. If necessary, air shall be added to the sewer to

maintain a minimum pressure of 3.5 PSIG during the stabilization period.

After the stabilization period, the air supply control valve shall be closed so that no more air will enter the sewer. The sewer air pressure shall be noted and timing for the test begun. The test shall not begin if the air pressure is less than 3.5 PSIG or such other pressure as is necessary to compensate for groundwater level.

The air test shall be performed for the duration shown in Table 6-2. The air pressure shall not drop over 1.0 psi during this test period.

TABLE 6-2 Required Test Time for Air Pressure Testing

Pipe Diameter In Inches	Duration of Air Test in Minutes per 100 ft. of Sewer Pipe Length
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5
21	10.5
24	11.5

If a sewer segment fails to pass the air pressure test, the Contractor shall determine the location of the deficiency, repair them and retest the sewer. The sewer will not be accepted until satisfactory results are obtained.

The actual groundwater level for sanitary sewers subject to air tests shall be determined by the Township.

The air test pressure shall be adjusted to compensate for the maximum probable groundwater level above the top of the sewer pipe that is being tested.

The method of testing and measurement shall be approved by the Township. The Contractor shall provide the necessary equipment and labor for making tests and the cost of same shall be included in the unit price bid for completed sewer.

Chemical grouting will be considered an acceptable method of repairing leaking pipe joints. Before this type of repair is undertaken, the Contractor shall obtain approval of the Township

Engineer to hire a pipe grouting firm for making such repairs. Additionally, if chemical grouting of pipe joints is necessary, this operation must be performed under the observation of the Township and a complete report of all grouting operations shall be furnished to the Township upon completion.

2. Deflection Testing of Thermoplastic Sewer Pipe

Thermoplastic sewer pipe shall be tested for vertical deflection. **Deflection tests shall be performed on 100 percent of the total footage of PVC sewer.**

Truss sewer pipe will also require testing for deflection.

This testing shall be carried out under the observation of the Township using a Go-No-Go device approved by the Township and furnished by the Contractor. The deflection testing shall be performed at least thirty (30) days after final backfill of the trench. The maximum allowable vertical deflection of the cross section of the pipe will be five percent (5%) of the actual internal pipe diameter. If the results show the deflection of any sewer to be in excess of allowable, then the Contractor shall make repairs by re-excavation and compaction or replacement prior to acceptance.

The deflection testing must be satisfactorily completed prior to final acceptance of the sewer. There will be no additional payment for deflection testing performed while the sanitary sewer is in service if the Township executes their right to utilize the sewer upon Substantial Completion. The Township shall be notified at least 24 hours prior to air testing of the sewer.

3. Television Inspection

All new sewers shall be inspected after installation by means of closed circuit television. Video taping equipment shall have a running footage indication for aiding in locating all wyes, defects, etc. which is displayed and permanently recorded on the video tape of the section being filmed. The complete system shall be permanently recorded using video tape along with handwritten documentation indicating all information such as wye location, defects, infiltration and cleanliness. Immediately upon completion of the filming, the finished DVDs shall be turned over to the Charter Township of Union Utility Department and/or Township Engineer. Wyes and laterals shall be in place prior to the television inspection. This television inspection work will be done under the direction and observation of the Charter Township of Union Utility

Department and/or Township Engineer. The Contractor shall notify the Charter Township of Union Utility Department and/or Township Engineer at least 48 hours prior to the television inspection.

The television inspection shall be completed prior to the final acceptance of the sewer section. The Township may exercise their option to use the sewer upon substantial completion. No additional payment will be made for televising the sewer under live conditions.

Any defect in the sewer construction observed during the television inspection such as poor grade, cracked or leaking pipe sections or excessive amounts of debris shall be corrected by the Contractor immediately. Sections with defects will have to be re-televised after the repairs are made.

4. Visual Observation

Any observed defects in the sewer or groundwater flowing in the sewer shall be repaired by the Contractor prior to final acceptance.

K. Certification

The manufacturer of pipe and fittings shall furnish a certification statement that all pipe and fittings furnished to the project have been inspected and tested in accordance with the applicable specifications. Pipe will be subject to inspection and approval upon delivery and no cracked, broken, damaged or defective pipe or fitting shall be laid in the work. Any piece that is found to be defective after it has been laid shall be removed by the Contractor and replaced by a sound and perfect piece. Material certifications must be received prior to final acceptance and/or final payment for the work.

SECTION 7

SANITARY SEWER APPURTENANCES

7.01 A. Scope of Work

The work covered in this section of the specifications consists in the furnishing of all plant, labor, materials, equipment and performing all operations involved in the construction of sewer appurtenances. This includes, but is not limited to, the following items:

1. Sewer Manholes
2. Connection to Existing Sewers
3. Sewer Wyes and Leads

B. General

The following provisions apply to this section of the specifications:

1. All materials, unless otherwise indicated on the plans or authorized in writing by the Engineer, shall be new and unused materials of the size and type shown on the plans and standard details and shall conform to the requirements of the specifications.
2. All materials offered by the Contractor shall be the standard products of reputable manufacturers normally engaged in the manufacturing of such materials. Certifications shall be provided on all materials prior to final acceptances.
3. The foundations of all structures shall be rigidly supported by undisturbed earth or compacted backfill. The interiors of all appurtenances shall be thoroughly cleaned of all foreign materials.
4. Where appurtenances are shown to be constructed on private property, the location of the structure shall be as shown on the plans. All work done within private property shall have an easement provided to the Township by the owner prior to turnover.

7.02 MATERIALS

A. Sanitary Sewer Manholes

Sanitary Sewer Manholes shall be constructed of pre-cast manhole units in accordance with ASTM C478. Unless otherwise indicated, all manholes shall be four (4) feet in diameter. Manholes shall be delivered to the project in an un-damaged condition. Any manhole which shows visible

signs of damage will not be accepted. Manholes shall be constructed to meet the dimensions shown on the Standard Details.

1. Manhole Waterstops: All manhole connections will be fitted with a waterstop assembly. The waterstop shall be of a design acceptable to the Engineer and the pipe manufacturer. Waterstops shall be KOR-N-SEAL as manufactured by National Pollution Control Systems; PRESS WEDGE II as manufactured by the Press-Seal Gasket Corporation; RES-SEAL as manufactured by Scales Manufacturing Corporation or equal.

The joint between the pipe and the manhole wall shall be flexible. Mortar and grout shall not be used to fill the space between the manhole wall and the pipe, except to form an adequate flow channel.

2. Manhole Waterproofing Material: All manholes shall be waterproofed on exterior.
 - a. Interior Manhole Waterproofing Material: The materials to be used for interior manhole waterproofing shall be "Drycon" as manufactured by IPA Systems, Inc., "Thoroseal" as manufactured by Standard Dry Wall Products Company or equal.
 - b. Exterior Manhole Waterproofing Material: The material to be used for exterior manhole waterproofing shall be a heavy fibered type waterproofing mastic conforming to Federal Specification SS-C-153 Type 1 or CS-206. The mastic shall be A.C. Horn (Grace), Flink Kote 710-23 or equal.
3. Manhole Steps: Manhole steps shall be cast iron or steel-reinforced plastic. Steps shall not be aligned over the pipe.
 - a. Cast Iron: Cast iron manhole steps shall fulfill the requirements of the ASTM Standard Specifications for "Gray Iron Castings", A-48, Class No. 30, minimum width 14". They shall be East Jordan Iron Works No. 8509, Neenah Foundry Co. R-1980 or equal.
 - b. Plastic: Polypropylene plastic, steel reinforced, manholes steps may also be furnished, minimum width 14". They shall be #PS2 manhole steps as manufactured by M.A. Industries, Inc., of Peachtree Township, Georgia or equal.

4. Manhole Bricks and Blocks: Manholes Bricks and Blocks shall meet current Michigan Department of Transportation Standard Specifications.
5. Cast Iron Frames and Covers: Manhole frames and covers shall be cast iron. Cast iron frames and covers for sanitary sewer manholes shall be a self-sealing lid with no holes extending all the way through the lid. The self-sealing lid shall fit into a precisely machined groove. A rubber gasket shall make contact with the frame to create a leak proof seal. The self-sealing lid shall include a concealed pickhole to facilitate the removal of the lid, but not allow any water to enter the manhole.

Manholes shall have a 24" opening with Type A solid cover or equal. These will include bolted covers with stainless steel bolts.

B. Sewer Wyes and Sewer Leads

Sewer leads shall be Schedule 40 Polyvinyl Chloride (PVC) with solvent welded joints as defined in ASTM D-3034 or Extra Strength Solid Wall, SDR 23.5 ABS as defined in ASTM D-1788. Sewer wye fittings shall be of the same material as the pipe, unless otherwise approved by the Township Engineer.

The fitting between the SDR 35 wye and the SCH 40 PVC lead shall be a 35/40 adapter. SDR joint shall utilize a slip joint (no rigid glue joint will be allowed).

C. Clean-Outs

Clean-outs shall consist of pipe and fittings of the same type as the sewer main materials they connect to as required to provide a clean-out installation as shown in the standard details. The maximum distance between clean-outs on leads is 75 lineal feet.

7.03 CONSTRUCTION METHODS

A. Excavation, Bedding and Backfilling

Excavation, bedding and backfilling for sewer manholes and clean-outs shall be in accordance with the Section 4, "Excavation, Trenching and Backfilling" of these specifications and applicable standard details.

B. Manholes and Pre-cast Structures

Manholes and precast structures shall be constructed only when the temperature is above 32 F. All work shall be protected against freezing.

Water shall be removed from the excavation during construction of the structure and during the time required for the concrete or mortar to develop sufficient strength to resist rupture by groundwater pressure.

Pre-cast O-ring sections shall be joined by first applying a lubricant as approved by the concrete manufacturer. The lubricant shall be placed on the O-ring and both faces of the sections to be joined. The pre-cast sections shall then be set evenly to provide a full seating of the O-ring within the grooves in the concrete sections. After the pre-cast sections have been placed, the interior joint surface shall be grouted smooth. Additional methods for joining two barrel sections must be approved by the Engineer.

C. Manhole Flow Channels

Manhole flow channels shall be formed as shown on the Standard Detail Plans by laying pipe through and cutting out the top portion before completion of the base of the manholes. Cut edges of pipe laid through the manhole shall be fully covered by concrete when the manhole invert is complete. The finished invert shall be smooth and true to grade. No mortar or broken pieces of pipe shall be allowed to enter the sewers. Pre-cast flow channels will be allowed. Submit certification and documentation to the Engineer for approval prior to acceptance and placement.

D. Drop Structures

All sanitary manholes with an invert drop in excess of 24" shall have a drop structure. The drop structure shall be built as shown on the Standard Detail Plans.

E. Manhole Waterstops

The joint between the pipe and the manhole wall shall be flexible. Mortar and grout shall not be used to fill the space between the manhole wall and the pipe, except to form an adequate flow channel.

F. Placing Castings

Castings with adjustment rings, if applicable, shall be set to the required elevation in full mortar beds. No more than 9" of adjusting concrete rings,

mortar and/or brick work, and mortar shall be used on any manhole between the pre-cast top section and the casting.

G. Connection to Existing Sanitary Sewer Systems

Connection to existing sanitary sewer systems shall be made in such a manner as to minimize the interruption of flow in those systems. The connection to an existing manhole shall be made by coring and the installation of a waterstop.

When a new manhole is to be installed over an existing line, it shall be initially placed without damaging the existing pipe. The existing pipe shall not be damaged until the new lines are ready to be placed in operation and the new flow channel is ready to be formed to connect with the existing flow lines.

H. Sewer Wyes and Leads

The wyes and sewer leads shall be constructed as shown on the Sanitary Sewer Standard Details in the plans.

The sewer lead is defined as the sewer pipe between the wye installation and to the property/easement line in the case of installation to an undeveloped parcel as indicated on the Standard Details for sewers. The sewer lead shall be brought to the property/easement line at a grade and location established before construction commences, based on a location document or as staked in the field by the Engineer or Resident Project Representative. If the proposed location of a sewer lead is not identified, it is the Contractor's responsibility to obtain the information from the Design Engineer/Resident Project Representative prior to the installation. If the lead location is not as per directed by the Resident Project Representative or Engineer, the relocation of the sewer lead shall be performed at the Contractor's expense.

After each sewer lead is installed, it shall be permanently marked at its termination (the property line or easement line) with a treated wood post 0.40 penetration for underground purposes. The post shall be 12 feet long \pm 1/2 inch, installed vertically and cut and painted as directed by the Design Engineer after record elevations off the top of the post have been obtained. For leads deeper than 12', use wood post that provides an 18" (\pm) projection above ground. Should the post location fall in a driveway or other area where its above ground projection might cause problems, the Contractor shall pre-cut the 12' post to some convenient full foot dimension below grade level and attach 3-1/2" x 3-1/2" x 1/4" metal plate to the top of the post. The Contractor shall immediately report same to the project inspector. The Contractor shall allow the Resident Project

Representative to obtain necessary record measurements on the lead installation prior to backfilling. If the sewer leads are backfilled without notification to a Resident Project Representative, the sewer lead shall be excavated, clearly showing the newly placed pipe, at the Contractor's expense. Sanitary sewer saddles shall be SDR-25 wye assembly with stainless steel straps and shall meet ASTM 3034 specifications. Use of saddles shall require approval by the Township prior to installation.

I. Sewer Cleanouts

Sewer cleanouts, if required, shall be constructed as shown on the Sanitary Sewer Standard Detail Sheet. Placement shall be as required by site conditions and local plumbing codes. Sanitary sewer cleanouts for sewer leads shall be placed every 75'.

J. Cleaning

All manholes, sewer leads and cleanouts shall be kept thoroughly clean of silt, debris and foreign matter and shall be free from such accumulations at the time of final acceptance.

K. Sanitary Sewer Manhole Waterproofing

The Contractor shall apply a waterproofing system to the inside or outside of all manhole walls. The material to be used for this operation shall be as specified in these specifications.

The waterproofing system shall be applied and allowed to dry in accordance with the manufacturer's directions. All steps, lids, frames and castings and sewer pipe entering or leaving the manhole shall be protected during application to prevent their being coated.

Interior Waterproofing

If any leaks in the manhole walls are detected twenty-four (24) hours after application of the first coat of the waterproofing system, they shall be sealed by application of a quick-set sealer. This sealer shall be a mixture of Portland Cement - Type One and "Ipanex R", "Waterplug", "Preco" or equal. The quick-set sealer shall be applied in accordance with the manufacturer's directions. After the patched areas dry, they shall be covered with another coat of the waterproofing and allowed to dry. If any leaks are apparent after that time, the Contractor shall repatch them. The above steps shall be repeated until all leaks are sealed.

After all leaks are stopped and there are no leaks apparent after twenty-four (24) hours upon application of the first coat of the waterproofing

system or twelve (12) hours after application of a patch, the Contractor shall apply over the dry surface a finish coat.

Exterior Waterproofing

The Contractor may elect to provide an exterior rather than interior manhole waterproofing to the manhole sections before installation.

The exterior surfaces of all manholes shall be thoroughly covered with mastic at a rate of one (1) gallon per twenty-five (25) square feet. The exterior surfaces shall be thoroughly cleaned before application of the mastic. The mastic shall be as specified in these specifications.

Should the exterior waterproofing fail to provide an adequate seal then the Contractor shall seal the interior of the manhole as specified above.

L. Defective Manholes

Any manhole that is defective, due to manufacturer or realignment of the pipe openings, should be returned to the manufacturer.

M. Acceptance Tests

1. Sanitary sewer manholes shall be visually inspected for leaks prior to acceptance of the manhole. There shall be no visible leakage of groundwater into the manhole. Patching, if required, shall be accomplished via the methods indicated in 7.03K.
2. Sanitary sewer wyes and sewer leads shall be tested for leakage after completion of construction. The testing shall occur in conjunction with the overall main sewer testing. Should it be necessary to test sewer wyes and leads independently after the main sewer has been tested it shall be performed using air and following the procedure outlined in Section 6.03J of these specifications.

8.01 SCOPE OF WORK

The work covered by this section of the specifications consists in the furnishing of all plant, labor, materials, equipment and/or in performing all operations necessary for the installation of the force mains, valves and fittings, complete.

8.02 MATERIALS

A. Pipe Materials

1. Ductile Iron Pipe and Fittings shall be designed in accordance with the latest revision of ANSI specifications A 21.50 and A 21.51. The pipe shall be designed to withstand a minimum working pressure of 150 psi and a minimum hydrostatic test pressure of 300 psi. The pipe shall also be designed for a minimum laying depth of six feet.

All ductile iron pipe and fittings shall be coated on the outside with a bituminous coating of either coal tar or asphalt base one mil thick at the point of manufacture in accordance with the specifications of the American Water Works Association. All ductile iron pipe shall be cement lined, standard thickness, in accordance with ANSI A 21.4. The spigot ends of all pipe lengths which have been cut in the field shall be ground to a smooth surface, tapered back about 1/8 inch at an angle of 30° with the pipe centerline, and painted with two coats of asphaltum metal protective paint.

Ductile iron pipe shall conform to the dimensions set forth in the table below. Tolerances permitted in ANSI specifications listed above will apply. Pipe classes shown on the plans shall control. Polyvinyl chloride (pvc) pipe shall be utilized for all force mains.

Pipe Size Nominal Inside Diameter <u>in Inches</u>	Outside Diameter in <u>Inches</u>	Pipe Barrel Thickness <u>In Inches</u>	Thickness <u>Class</u>
4	4.8	0.26	51
6	6.9	0.25	50
8	9.05	0.27	50
10	11.10	0.29	50
12	13.20	0.31	50
14	15.30	0.36	51
16	17.40	0.37	51
18	19.50	0.41	52
20	21.60	0.42	52

2. Polyvinyl chloride (PVC) pipe shall meet the requirements for Type 1, Grade 1 (PVC 1120) of ASTM Specification D-1784 and ASTM D-2241, Standard Specification for PVC pipe (SDR-PR). PVC pipe shall be a minimum rating of Class 200, SDR 21.
3. High Density Polyethylene Pipe and fittings shall be DR11, Class 3408 bluestripe pipe as supplied by Plexco, CSR Polypipe, KWH Pipe/Sclairpipe or equal. All HDPE (high density polyethylene piping) shall be butt welded as per the manufacturer's requirements. This pipe shall have a minimum rating of 160 psi.

B. Pipe Joints

1. Flanged joints shall be made with flanges, bolts, nuts, washers and gaskets, conforming to ANSI Standard B 16.1, Class 125. Bolts, nuts, and washers to be stainless steel.
2. Mechanical joints for cast and ductile iron pipe shall conform to ANSI Standard A21.11 or to Federal Specifications WW-P-421.
3. Rubber gasket joints for cast and ductile iron pipe shall be of a bell and spigot type conforming to ANSI Standard A21.11. These joints shall be similar to "TYTON" as manufactured by the U.S. Pipe and Foundry Co., "SUPER BELL TITE" as manufactured by James B. Clow & Sons, Inc. or equal.
4. Rubber gasket joints for PVC pipe shall be of bell and spigot type. The pipe shall be jointed by the means of rubber ring which shall be

an integral and homogeneous part of the pipe barrel. Rubber Ring Lube (AKA, Duck Butter), shall be used at all joints.

5. Fused joints for HDPE pipe shall be joined by the butt fusion method conforming to ASTM D2657 and the supplier's recommendations.

C. Valves and Appurtenances

1. Gate valves shall meet the requirements of AWWA C500 of the American Water Works Association. Valves shall be designed for not less than 150 psi working pressure and shall be tested for leakage and distortion under a hydraulic pressure of not less than 150 psi. Under such pressure, the valves shall show no leakage or distortion.

All gate valves shall be cast iron body, fully bronze mounted, bronze stem double disc gauge valves or resilient seated gate valves. Each valve shall have a clear waterway equivalent in area, when open, to that of the connecting pipe. Valves shall be made to close when turned to the right or clockwise. All valves shall be operated by non-rising stems and shall have square wrench nuts, or hand-wheel operators with an opening arrow cast in the metal.

All valves shall be furnished with a three piece adjustable valve box as specified herein unless the valve is housed in a manhole. Valves intended to be specifically used in fireline shall be designed and tested at minimum pressure of 200 psi.

2. Plug valves shall be lubricated round port valves. Valves shall be 100% port area type with semi-steel body. Valve bodies shall be suitably marked to indicate whether the valve is open or closed.

The seating surface of the rotating element shall be of material recommended by the manufacturer for sewage sludge service. Bearings at the top and bottom supporting the rotating element shall be permanently lubricated corrosion-resistant type, suitable for sewage plant service. Stem seals shall be O-ring type of the same material as the seating surface and designed so replacement can be accomplished without disassembly of the valve.

All plug valves shall be designed to operate with a pressure of 150 psi on either side of the valve without leakage.

3. Check valves shall be designed for a minimum working pressure of 150 pounds per square inch or as indicated. Valves shall have a

clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. Distinctly cast on the body of each valve shall be the manufacturer's name or initials or trademark by which he can be readily identified and the size of the valve, working pressure and the direction of flow.

Check valves larger than 2 inches shall be iron body, bronze mounted, shall have flanged ends and shall be the non-slam type. Flanges shall be the 125-pound type conforming to ANSI Standard B16.1. **All check valves shall be supplied with an external lever and weight.** Springs shall be applied to lever, if necessary, to create a non-slam condition.

4. Valve operators shall be provided for all sewage and sludge valves of a type as indicated on the plans. Valve operators shall be of sufficient size and strength to overcome expected maximum operating torque. Valve operators found to be inadequate strength will be replaced by the Contractor at no expense to the Owner or the Township.

All valves 8 inches and larger are to have a crank, handwheel, chain wheel or square nut for buried service, totally enclosed, weatherproof worm gear or traveling screw-type operators with indicators.

For automatic (if required by the drawings) operation, cylinder, rotary or similar types of electric or pneumatic actuators may be used regardless of valve size. Various accessories shall be used, depending on the application, such as positioners, limit switches, solenoid valves, speed controls and failsafe assemblies.

5. Butterfly Valves

Butterfly valves, as called out on the plans, shall be so designed and fabricated that they will conform to AWWA Specification C 504 for Class 150B valves. The rubber valve seat shall cover the entire interior surface of the valve body and the face of the body. The valve disc shall be streamlined, free of external ribs, keyed to the shaft, provided with suitable means for positioning and shall utilize wedge type closing against the rubber liner at a full close seating angle of 90 to the axis of the pipe. Valves shall be as manufactured by Dresser Manufacturing Division, Keystone International, Inc. or an approved equal.

All valves shall be furnished with a three piece adjustable valve box as specified herein unless the valve is housed in a manhole. Valves intended to be specifically used in fireline shall be designed and tested at minimum pressure of 200 psi.

All Butterfly valves shall be installed in a manhole per the Standard Detail Sheet.

6. Valve boxes shall be cast-iron, three piece, adjustable type with a 5-1/4 inch shaft. Covers shall be furnished with fingerholes and marked "SEWER". Valve boxes shall be similar to that as manufactured by the East Jordan Iron Works, Clow Corporation or equal.
7. Pipe supports, where required, shall be of the adjustable type made to support cast iron type pipe.

8.03 INSTALLATION OF PIPE AND FITTINGS FOR FORCE MAIN

All pipe and fittings shall be installed in strict accordance with the recommendations of the manufacturer. Piping and fittings for force mains shall be of the types and materials hereinbefore specified. The pipe and accessories shall be new and unused.

The interior of the pipe and fittings shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging the ends or other approved methods. When work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth, animals or other substance will enter the pipes.

No pipe or fittings shall be laid in water or when the trench or weather conditions are unsuitable for work, except by permission of the Engineer.

The full length of each section of pipe shall rest solidly upon the pipe bed with recesses provided to accommodate the bells and joints. Deflections from a straight line or grade, as required by vertical curves, horizontal curves or offsets, shall not exceed one inch per lineal foot of pipe for pipe less than 10 inches in diameter between the centerlines extended of any two connecting pipes. If the alignment requires deflections in excess of these limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide the angular deflection required.

When pipe is cut in the field (for ductile iron and PVC), the outside of the cut end shall be tapered back about 1/8" at an angle of 30° with the centerline of

pipe to remove any sharp, rough edges and painted with two coats of asphaltum (DI) metal protective paint.

Fittings at bends in the pipe line shall be firmly wedged against the undisturbed, vertical face of the trench to prevent the fittings from being blown off the lines when under pressure. Concrete thrust blocks shall be installed at all deflections as shown on the drawings or as directed by the Engineer. If directed by the Engineer restraining collars and rods will also be installed.

Fittings for HDPE pipe can either be the mechanical joint method with fused flange joints or fused fittings joined by the butt fusion method. Conforming to ASTM D2657 and the supplier's recommendations. The manufacturer shall provide fusion training. The installers and on site Resident Project Representative shall be trained by the manufacturer's authorized representative.

Force main installation methods shall follow the recommended procedures for installing High Density Polyethylene Pipe of the manufacturer's specifications. These procedures shall assure the quality of the installation to match the construction drawings. The design includes high points and low points. The contractor is responsible to construct and place this main at a gradual slope to meet the design criteria. The contractor must submit in writing the procedure for installing this HDPE pipe to the Engineer for approval.

Where pipe ends are left for future connections, they shall be valved, plugged or capped as called for on the drawings. Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings required to suit the actual conditions.

8.04 HYDROSTATIC TESTS FOR FORCE MAIN

The force main or sections thereof shall be tested by the Contractor in the presence of the Resident Project Representative and all leaks shall be made tight to meet the requirements below. The Contractor shall furnish all piping, bulkheads, pumps, gauges and other equipment required to carry out the testing.

The section of main to be tested shall be filled with water at least 24 hours prior to starting the test.

Testing for ductile iron/PVC pipe - testing for HDPE pipe shall be performed in strict accordance with the recommendations of the manufacturer for the application of sanitary sewer force mains. The testing method must be submitted to the Engineer for approval prior to the installation of the pipe.

SECTION 8
FORCE MAINS

At the start of testing, the main shall be pumped up to a pressure of 150 psi and the test period shall start immediately thereafter. The line shall then be maintained under this test pressure for a continuous period of two hours by pumping water into the line at frequent intervals. The volume of water so added shall be measured and considered to represent the leakage from the line under test during the interval. In calculating leakage, the Engineer will make allowance for added joints in the line over the normal for unit lengths of pipe. The leakage per hour under the conditions of test shall not exceed the values shown in the following table:

<u>Size of Pipe</u>	<u>Maximum Leakage Gallons Per Hour Per 100 Joints</u>
2"	0.34
3"	0.50
4"	0.67
6"	1.00
8"	1.35
10"	1.66
12"	2.00
14"	2.34
16"	2.65
18"	3.02
20"	3.32

In the event that the leakage exceeds the specified amount, the joints in the line shall be carefully inspected for leaks and repaired where necessary. Any pipes or special casting found to be cracked shall be removed and replaced by new pieces by the Contractor. After this work has been done, the test shall be repeated. Final acceptance of the lines will not be made until satisfactory tests have been passed.

8.05 MARKING PIPE

Each piece of cast iron pipe and each cast iron fitting shall have its weight and class designation conspicuously painted or cast on it. All other pipe materials shall have the class designation painted thereon. Where required, other designation marks shall be painted on the pipe or fittings to indicate correct location of the pipe section in conformity to a detailed layout plan.

8.06 PAINTING

All pipe, valves, bolts and any other portions of force main exposed inside manholes and other structures shall be painted per the table below. If necessary, heat shall be provided to maintain good drying conditions. All

items to be painted shall be dry and clean before application of the paint. Any rust or scale shall be removed by wire brushing or scraping. All piping (if applicable) must be painted prior to operating the system.

1 Coat - "Kopper's Plug Primer" or equal
(350 S.F./Gal.)

2 Coats - "Kopper's Rustamor 500" or equal
(500 S.F./Gal.)

8.07 THRUST BLOCKS

Concrete thrust blocks shall be poured on hand excavated, undisturbed soil bearing surfaces, of a minimum size as shown on the Standard Details, or increased in size according to the actual bearing values of the soil in each location, or as directed by the Engineer.

Thrust blocks shall be made of 3,000 psi concrete, wet mix. Concrete thrust blocks shall be placed at all 22-1/2 degree bends or greater, dead ends, tees, reducers, hydrants, and crosses as required. Pre-cast thrust blocks may be utilized for certain applications if approved by the Engineer. Retainer glands shall be utilized on all mechanical joint fittings.

8.08 EXCAVATION, TRENCHING AND BACKFILLING

Excavation, trenching and backfilling shall conform to these specifications.

8.09 PIPE LOCATOR

A continuous 1/4-inch diameter stainless steel cable shall be installed along with the plastic pipe for use as a locator wire on all directionally drilled projects. Contractor shall verify continuity of the locator wire prior to acceptance by the engineer. The 1/4" stainless steel cable locator wire shall be looped at 400' intervals and installed within a tracer wire access box. This tracer wire box shall be made of cast iron with a permanently attached 3"x12" ABS tube with a flared end to secure it in the ground. It shall be tamper resistant, with a cast iron locking lid and stainless steel terminal connections on the bottom side to which the tracer wires/cables are attached. Lid will open using a standard AWWA pentagon key. Tracer wire access box as distributed by USA Blue Book shall be utilized or equal. Located at each tracer wire access box a flexible rebounding marking post must be installed. This marking post must be able to snap back to its normal position when hit. It must extend at least 3' above ground for visibility and have a width of 4". This flexible brown rebounding marking post must have a permanent decal applied

indicating "Warning Force Main Pipeline". This marker size and type must be approved by the Township Engineer.

A tracer wire which meets the latest APWA specifications will be accepted in lieu of magnetic markers described above for force main installed using the open cut method. The tracer wire shall be buried for the full length of the force main at a depth prescribed by the manufacturer.

8.10 AIR RELEASE VALVES AND MANHOLES

Air release valves and manholes shall be constructed as detailed on the detail drawings.

8.11 FORCE MAIN CLEANOUTS

Force main cleanouts shall be constructed as shown on the detail drawings.

8.12 CERTIFICATION

The manufacturer of pipe and fittings shall furnish a certified statement that all pipe and fittings furnished by him have been inspected and tested in accordance with the applicable specifications. Pipe will be subject to inspection and approval upon delivery and no cracked, broken, damaged or defective pipe or fittings shall be laid in the work. Any piece that is found to be defective after it has been laid shall be removed by the Contractor and replaced by a sound and perfect piece at no additional cost to the Owner.

9.01 SCOPE OF WORK

The work covered by this section of the specifications consists of furnishing all plant, labor, materials, and equipment and in performing all operations for the installation of the watermains and appurtenances in strict accordance with these specifications.

9.02 MATERIALS

A. Pipe Materials

1. Ductile Iron Pipe and Fittings shall be designed in accordance with the latest revision of ASA specifications A 21.50 and A 21.51. The pipe shall be designed to withstand a minimum working pressure of 200 psi and a minimum hydrostatic test pressure of 300 psi. The pipe shall also be designed for a laying depth of a minimum of six feet.

All ductile iron pipe and fittings shall be coated on the outside with a bituminous coating of either coal tar or asphalt base one mil thick at the point of manufacture in accordance with the specifications of the American Water Works Association. All ductile iron pipe shall be cement lined, half thickness, in accordance with ASA specifications. The spigot ends of all pipe lengths which have been cut in the field shall be ground to a smooth surface, tapered back about 1/2 inch at an angle of 30° with the pipe centerline, and painted with two coats of asphaltum metal protective paint.

Ductile iron pipe shall conform to the dimensions set forth in the table below. Tolerances permitted to ASA specifications listed above will apply. (Design Engineer shall verify expected pressure range with Township during design phase).

Pipe Size

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<u>Nominal Inside Diameter in Inches</u>	<u>Outside Diameter Inches</u>	<u>Pipe Barrel Thickness in Inches</u>	<u>Thickness Class</u>
6"	6.90	.31	52
8"	9.05	.33	52
10"	11.10	.35	52
12"	13.20	.37	52
16"	17.40	.40	52
20"	21.60	.42	52

2. Polyethylene pipe for river crossings or wetland crossings shall be SDR 9, Class 3408 bluestripe pipe as supplied by Plexco or equal. All HDPE pipe shall be butt welded per manufacturer's requirements. All HDPE piping shall be NSF approved meeting AWWA C906-90. River crossing section shall be pressure tested independently of other watermain. This method and locations must be approved by the Township. Refer to standard details for the connection of ductile iron pipe to HDPE. This connection, a mechanical joint gate valve, 1" corporation (on the ductile iron) shall be enclosed in a pre-cast manhole. The size of the manhole will be determined by the Township. A standard EJIW 1000A shall be utilized for this structure.

Refer to MDOT specification BJ-2D, Special Provisions for Directionally Bored Pipe.

If bored pipe is specified larger than 6", it must be approved by the Township. Pipe must have and NSFPW seal.

3. Polyvinyle Chloride Pipe (PVC) 4" – 12" shall be designed in accordance with standards set forth in the latest revision of American Water Works Association Specifications (AWWA) C900 Standards, ANSI/NSF standards 14 & 61 and must bear NSF-PW identification. The pipe shall be designed to withstand a minimum working pressure of 150 psi and a minimum hydrostatic test pressure of 300 psi. The pipe shall also be designed for a laying depth of a minimum of six (6) feet.

Polyvinyle Chloride Pipe (PVC) shall conform to the dimensions set forth in the table below. Tolerances permitted in AWWA specifications listed above will apply.

Pipe size Nominal Inside Diameter in Inches	Outside Diameter In Inches	Pipe Barrel Thickness in Inches	Pressure Class
6"	6.90	.506	150
8"	9.05	.533	150
10"	11.10	.654	150
12"	13.20	.777	150

PVC Water main shall be John Manvilles’s “Blue Brute” or approved equal.

B. Joints for Water Main pipe shall conform to the following:

1. Flanged joints for ductile iron pipe shall be made with flanges, bolts, nuts, washers and gaskets conforming to AWWA Standard C110 and ANSI Standard B 16.1. Bolts, nuts, and washers to be stainless steele.
2. Mechanical joints shall conform to ANSI Standard AWWA Standards C 110 and C 111 along with ANSI Specifications A 21.10 and A 21.11. Rubber gaskets shall conform to manufacturer's standards.
 - a. Mega Lugs shall be utilized on all mechanical joint fittings.
 - b. Lead tip gaskets will not be allowed for providing metal to metal contact at joints.
3. Rubber gasket joints for ductile iron pipe shall be of a bell and spigot type which employs a single rubber gasket to effect the joint seal. These joints shall conform to AWWA Standard C 111 and ANSI Specification A 21.11. These joints shall be similar to "Tyton" as manufactured by U.S. Pipe and Foundry Co., "Bell-Tite" as manufactured by James B. Clow and Sons, Inc. or approved equal. Gasket lube shall be used at all joint.
4. Ball joints shall be cast iron, mechanical, flexible joint tube designed to withstand a working pressure of 200 pounds and a hydrostatic test pressure of 300 pounds. Joints shall be similar to "Molox" as manufactured by the American Cast Iron Pipe Company, "Usiflex" as manufactured by U.S. Pipe and Foundry Co., "River Crossing Pipe" James B. Clow & Sons, Inc. or an approved equal.

5. Field-Loc gaskets/Fast-Grip or equal are accepted for the use of tyton push on joints for fittings.

C. Gate Valves

Gate valves shall meet the requirements of AWWA C500 of the American Water Works Association. Valves shall be designed for not less than 150 psi working pressure and shall be tested for leakage and distortion under a hydraulic pressure of not less than 300 psi. Under such pressure, the valves shall show no leakage or distortion.

All gate valves shall be cast iron body, fully bronze mounted, bronze stem, double disc gate valves or resilient seated gate valves. Each valve shall have a clear waterway equivalent in area, when open, to that of the connecting pipe. Valves shall be made to open left (counter clockwise). All valves shall be connected to the pipeline by mechanical joints. All valves shall be operated by non-rising stems and shall have square wrench nuts.

All valves shall be furnished with a three piece adjustable valve box as specified herein unless the valve is housed in a manhole. Valves intended to be specifically used in fireline shall be designed and tested at minimum pressure of 200 psi.

D. Butterfly Valves

Butterfly valves, as called out on the plans, shall be so designed and fabricated that they will conform to AWWA Specification C 504 for Class 150B valves. The rubber valve seat shall cover the entire interior surface of the valve body and the face of the body. The valve disc shall be streamlined, free of external ribs, keyed to the shaft, provided with suitable means for positioning and shall utilize wedge type closing against the rubber liner at a full close seating angle of 90 to the axis of the pipe. Valves shall be as manufactured by Dresser Manufacturing Division, Keystone International, Inc. or an approved equal.

All Butterfly valves shall be installed in a manhole per the Standard Detail Sheet.

E. Valve Boxes

Valve boxes shall be cast iron, three-piece, adjustable type, with a 5-1/4 inch shaft. Covers shall be furnished with fingerholes and marked "WATER". Valve boxes shall be similar to that as

manufactured by the East Jordan Iron Works or an approved equal. Contractors shall be responsible for adjusting valve boxes to meet finish grades once finish grades are established.

F. Fire Hydrants

At the points indicated on the drawings, there shall be installed a hydrant assembly consisting of a hydrant, a six-inch gate valve, a cast iron valve box and all piping and fittings necessary for a complete job. All fire hydrants shall be serviced by piping that is at least 8" in diameter. Hydrant service leads shall be at least 6" in diameter and shall not consist of a run greater than 40'. Placement and piping size of all hydrants, hydrant leads, and valves are subject to approval by the Township. Gate valves shall be as specified above. Valves shall be located three feet, plus or minus, from the hydrant as shown on typical hydrant setting on drawings.

1. Hydrant barrel inside dimension to be 8-inches I.D. from top to bottom.
2. Nozzles to be on a removable head so that they may be rotated by changing the position of the top flange without removing the barrel.
3. Hydrant to be fully bronze mounted including top of operating stem where it passes through the double "O" ring seal in the bronze packing gland. Operating stem in base and valve seat of bronze.
4. The drain valve shall be plugged in all locations.

Hydrants furnished for this work shall meet the requirements of the American Water Works Association, Specification AWWA C-502-73 and any revision thereof. They shall be East Jordan Iron Works. Hydrants shall be designed for installation with six feet of cover over the connection. The diameter of the valve port in the hydrant shall be at least five inches. The hydrant shall be equipped with one four (4) inch pumper nozzles and two (2 1/2) inch pumper nozzles. Threads shall conform to national standard threads. Hydrant stems shall be built to open right (clockwise).

Hydrants shall be of the "break flange" type. The hydrant shall be so designed that all working parts, including valve and drip mechanism, may be removed from the hydrant through the barrel without the necessity of excavation. The hydrant shall be designed for a working pressure of 150 psi. Operating nuts shall be 1-3/4" size.

G. Water Service Connections

Water service connections are the water line connections which extend from the watermain to the property line or easement line of water system customers. A water service connection shall consist of a corporation stop and saddle in the watermain, a small diameter water line to the property line, a curb stop at the property line and curb box and cover. The Contractor shall place the water service connections where directed by the Design Engineer. The service line piping and fittings shall be either 1" or 2" copper tubing (CTS) size as called out on the plans. Water service connections cannot be placed under a driveway, approach, or any other obstruction.

The location and intended use of the water service connection shall be approved by the Township Utility Department prior to installation. Installation of the water service connection will be completed by the Township or a Township approved contractor.

1. Service Line Pipe and Fittings

Pipe material shall be one-inch (1") or two-inch (2") Polyvinyle Chloride Pipe (PVC), 200 psi (sdr9) Aqua Jet Tubing.

2. Corporation Stops

One-inch and two-inch corporation stops shall be Mueller or Ford for plastic. All corporation stops to be compression fittings. Corporation stops shall be in the "open" position after the service connection is complete.

3. Curb Stops

Curb stops shall be Mueller or Ford oriseal curb valves series H-10300 or equal. Curb stops shall be of the quarter turn, positive shut-off type.

4. Curb Boxes

Curb boxes shall be adjustable in height to allow for variable grade elevations. Curb boxes shall be all cast iron construction and coated inside and out with tar base enamel. A cast iron lid shall be furnished with house nut center plug and shall have "WATER" permanently stamped.

Curb boxes for one-inch (1") or two-inch (2") services shall be the threaded Minneapolis type with inch and a quarter (1 ¼") diameter shaft and arch pattern base equal to Mueller series H-10300-99002. Enlarged bases shall be included in installation, if so required, for the curb box to accommodate 2" curb stop.

5. Tracer Wire & Underground Caution Tape

Tracer wire must be brought up into all valve boxes, fire hydrant valve boxes, metering houses, metering pits, and all blow offs. All underground splices shall be butt spliced, sealed, and waterproofed. This will be done using the heat shrink method and electrical coating, or approved equal. Wire nuts and black tape will not be allowed. Underground caution tape must also be used. Must read "Caution Water Main Buried Below". This must be at a minimum depth of 1 foot and no more than two feet below finished grade.

H. Tapping Sleeve and Valve

Where shown on the plans or where a tee and valve are to be installed on an existing main under pressure, a tapping sleeve and drilling machine shall be used. After installing the sleeve and prior to drilling, the sleeve shall be pressure tested at 150 psi for five minutes. The Design Engineer and the Township of Union Department of Public Works shall be given at least 72 hours notice of all watermain live taps. All tapping sleeves shall be stainless steel with tapping valve (up style) directly bolted to sleeve.

I. Water Main Stubs

At the end of a stub, the last two pipe joints shall have Field-Loc gaskets/Fast-Grip gaskets or equal. The end of the stub shall not be tapped for flushing/sampling purposes. No galvanized pipe materials shall be allowed. A corporation shall be placed for the use of flushing and sampling. A blowoff and cap shall be installed at the Township and/or Engineers request.

9.03 INSTALLATION OF PIPE AND FITTINGS FOR WATERMAINS

All pipe and fittings shall be installed in strict accordance with the recommendations of the manufacturer. Piping and fittings for watermains shall be of the types and materials hereinbefore specified. The pipe and accessories shall be new and unused. Before installation, the pipe shall be inspected for defects and any section of pipe or fittings found to be

defective, before or after laying, will be rejected and replaced with sound pipe without additional expense to the Owner.

The interior of the pipe and fittings shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging the ends or other approved methods. When work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth, animals or other substance will enter the pipes. No pipe or fittings shall be laid in water or when the trench or weather conditions are unsuitable for work except by permission of the Township.

Ductile iron pipe and fittings used on ductile iron (except flanged pipe) shall be provided with three lead wedges at each joint, Fastite conductive (American Pipe) or equal, "Electro-bond" strips of "Cadweld" connectors or other means of providing metal-to-metal contact at the joint to allow an electric current to flow through the joint for thawing purposes.

The full length of each section of pipe shall rest solidly upon the pipe bed with recesses provided to accommodate the bells and joints. Deflections from a straight line or grade, as required by vertical curves, horizontal curves or off-sets, shall not exceed one (1) inch per lineal foot of pipe for pipe less than ten (10) inches in diameter between the centerlines extended of any two connection pipes. If the alignment requires deflections in excess of these limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide the angular deflection required. For pipes 12 inches in diameter up to 24 inches in diameter, the maximum deflection per joint shall not exceed 1/2 inch per lineal foot of pipe. If necessary, special bends or shorter bends furnished to provide the angular deflection are required. Pipe deflections for diameters in excess of 24 inches shall be per manufacturer's recommendation.

When pipe is cut in the field, the outside of the cut end shall be tapered back about 1/8 inch at an angle of 30 degrees with the centerline of the pipe to remove any sharp, rough edges. Exposed edges shall be coated with two coats of asphaltum metal protective paint.

Fittings at bends in the pipe line shall be firmly wedged against the undisturbed vertical face of the trench to prevent the fittings from being blown off the lines when under pressure. Concrete thrust blocks shall be provided as shown in the standard details or directed by the Township. Mega lugs shall be installed on all bolt ups and fittings. Restraining collars and rods shall be installed where deemed necessary by the Township and/or Engineer. Mega lugs may also be utilized for restraining. Thrust blocking must also be used with mega lugs. See section 9.14 for thrust blocking specifics.

Where pipe ends are left for future connections, they shall be valved, plugged, or capped as called for on the drawings. This includes the addition of one 20' length of water main which is plugged or capped. Where connections are made between new work and existing mains, the connections shall be made by using special pipes and fittings as required to suit the actual conditions.

9.04 SETTING HYDRANTS

Under each hydrant the ground shall be excavated to a depth of at least one (1) foot below the hydrant base and over an area approximately three (3) feet square. This excavation shall be filled up to the elevation of the hydrant base with well compacted, clean, coarse gravel or crushed stone. A block shall be installed under the hydrant as needed. Refer to the standard details. During construction and prior to placing hydrants in service a plastic bag shall be placed over the hydrant in order to signify that the hydrant is not in service as well as protect the hydrant finish during construction.

Each hydrant shall be set truly plumb and held firmly braced in this position. The connection of the hydrant to the branch shall be made by mechanical joint as herein specified under jointing. After the joining has been made, a concrete thrust block shall be poured on the side opposite the branch connection, from the hydrant to the solid undisturbed earth of the excavation wall. All hydrant valves shall be secured to the hydrant connection tee with approved mega lugs.

When the concrete has become sufficiently hard, an additional one foot depth of gravel shall be spread and tamped around the hydrant. When this has been done any area remaining around hydrant area will be filled with sand backfill and compacted, taking care at all times to avoid jarring the hydrant.

Wherever it is necessary to adjust the length of the barrel to meet variations in elevation of the ground surface over the watermain and at the hydrant location, suitable extensions shall be provided for the hydrant barrel and operating stem. In all cases, the break flange shall be located at grade.

Contractor shall remove all water from fire hydrants. Water left remaining in each fire hydrant assembly will be removed by pumping prior to acceptance by the Township of Union. Thawing and/or repair of frozen hydrants shall be performed by the Contractor at no additional expenses to the Owner.

9.05 CONNECTING TO EXISTING WATERMAINS

Where connections are made between new work and existing water mains, the connections shall be made by using special pipes and fittings as required to suit the actual conditions. No connections to existing mains shall be made until the new main has been pressure tested and chlorinated. This includes any connections made to existing water mains which are greater in size than two inches. Two consecutive passing samples must be taken in accordance with the Charter Township of Union Specifications must be taken. Copies of the sample results must be submitted to Union Township. This must be completed prior to placing into service. When making the connection, swab pipe and fittings with four percent chlorine solution. The Township shall witness all connections and shall be notified 48 hours prior to the connection of new pipe to existing pipe.

9.06 DIRECTIONALLY DRILLED WATERMAIN

A. Description

This work shall consist of constructing underground crossings of a wetland using the directional drilling method of placing pipe to serve as carrier pipe.

B. Depth of Bore

The minimum depth of drill using this method shall be six feet (6') of cover below existing grade, and a minimum depth of five (5') feet below any creek bottom or other body of water unless encased in a steel casing then the pipe must be at least three feet (3') under the bottom of the existing body of water.

C. Materials

Plastic Pipe: Section 9.02 A.2. Polyethylene Pipe.

D. Construction Method

This method consists of auguring or jacking a steerable rod under the wetland; then pulling back a cone that expands the soil or a wing cutter, which cuts a hole big enough to obtain the desired diameter. The diameter of the reamer or wing cutter is not to exceed the diameter of the pipe being placed plus two-inches (2").

A drilling fluid of water and bentonite may be used in all operations of a directional drill. The use of a polymer for lubrication in the drilling fluid is acceptable.

9.07 ACCEPTANCE TESTING WATERMAIN

A. General

Prior to connecting the new watermain to an existing watermain, the new main shall be flushed, chlorinated, and pressure tested as outlined herein.

The Township shall be notified at least 48 hours prior to the start of a pressure test to schedule an inspector. All acceptance testing shall be witnessed by the Township or Township Design Engineer.

A physical gap of at least three (3) feet must be left between the existing and new watermain until all testing results are satisfactory. The testing sequence shall be: 1) flushing, 2) pressure test, and 3) chlorination. Water for testing may be taken from a nearby hydrant or tee connection by using fittings to accommodate a standard fire hose connection. A reduced pressure zone device (RPZ) must be used on the 2-1/2 inch connection to the main being tested. All water used for flushing must be metered with an approved Township meter and backflow preventer. A bulk water permit must be obtained by the contractor from Union Township at least 48 hours prior to testing.

B. Flushing of Mains

The watermain shall be flushed clean of sand and debris. Flushing shall be done using the "poly-pig" method of flushing. The Contractor shall furnish foam "poly-pig" swabs to be used. Prior to pigging and flushing the watermain must be charged with water.

Contractor shall insert "poly-pig" swab in the end of the new main nearest the existing watermain (or where shown on the plans). The swab shall be passed through the new main using water pressure. The minimum flushing velocity for clearing debris from the water main prior to final disinfection is 3.0 ft/sec. The swab shall be recovered at the end of the main through the blow-off assembly.

C. Pressure Testing

The watermain or sections thereof shall be tested by the Contractor in the presence of the Township and all leaks shall be made tight to meet the requirements below. The Contractor shall furnish all water, piping, bulkheads, pumps, gauges and other equipment required to carry out the test and shall obtain Township approval of same prior to testing.

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The section of main to be tested shall be slowly filled with water at least 24 hours prior to starting the test. Expel air through corporation stops installed at high points in line. The Contractor shall make arrangements with the operation/maintenance personnel for obtaining water for testing. All water used shall be metered and quantities reported to the operation/maintenance personnel.

At the start of testing, the main shall be pumped up to a pressure of 150 psi and the test period shall start immediately thereafter. The line shall then be maintained under this test pressure for a continuous period of two hours by pumping water into the line at frequent intervals. The volume of water so added shall be measured and considered to represent the leakage from the line under test during the intervals. All water service leads shall be tested with the mainline pipe.

The leakage per hour under the conditions of test shall not exceed the values shown in the following table:

<u>Size of Pipe</u>	<u>Maximum Leakage Gallons Per Hour Per 1000 Feet of Pipeline</u>
6"	.50
8"	.66
10"	.83
12"	.99
14"	1.16
16"	1.32
18"	1.49
20"	1.66
24"	1.99

In the event that the leakage exceeds the specified amount, the joints in the line shall be carefully inspected for leaks and repaired where necessary. Any pipes or special casting found to be cracked shall be removed and replaced with new pieces by the Contractor. No repair clamps or bell clamps can be utilized for repairs on new construction. After this work has been done, the tests shall be repeated. Final acceptance of the lines will not be made until satisfactory tests have been passed.

Water service leads installed with mainline pipe will be included in the water main pressure test. Installed water service leads shall have a riser (extension of water service) placed at the downstream side of the curb box. For flushing, testing, and sampling, once all

tests are completed, this riser must be removed or buried 6' below grade.

Not more than 1,200 LF of water main shall be tested at one time, plus one set from the end of the line and at least one from each branch greater than one pipe length.

To calculate allowable leakage, compute the number of main line pipe joints including joints with valves, hydrants, and fittings. Corporation stops and service line fittings are not considered.

Where there is a considerable elevation difference in the section of watermain being tested, the test pressure shall average 150 psi over the length of main, but shall be not less than 140 psi at the highest elevation.

All main line valves and hydrant lead valves within the test section shall remain open during the pressure test.

After completion of the two hour pressure test, each valve shall be checked against test pressure.

D. Disinfecting Watermains

After completion of pressure testing and flushing of the watermain, the disinfection of the watermain shall be carried out in accordance with AWWA Standard C651.

A chlorine water solution, prepared by adding NSF approved hypochlorite to water, shall be applied to the watermain. The chlorine concentration in watermain shall be 50 mg/l (milligrams per liter). This will require the addition of the following quantities of chlorine solution.

Chlorine Solution Required to Produce
50 mg/l Concentration in
100 feet of Pipe

<u>Pipe Diameter</u>	<u>1% Chlorine Solutions (Gallons)</u>
4"	0.33
6"	0.73
8"	1.30
10"	2.04
12"	2.88

The chlorine solution shall be added to the pipeline at a measured rate along with water being supplied at a measured rate from the existing distribution system or other approved source of supply. The two rates shall be proportioned and closely monitored to assure that the water entering into the pipe is maintained at a minimum of 50 mg/l available chlorine. Chlorine application shall not cease until the entire main is filled with the chlorine solution (50 mg/l). The chlorinated water shall be retained in the watermain for at least 24 hours during which time all valves and hydrants shall be manipulated in order to disinfect the appurtenances. After this contact period, the main shall be flushed until the chlorine residual in the main is 0.5 mg/l or less. Chlorinated water shall be disposed of in a manner that will not damage vegetation, wildlife, or aquatic life. Under no circumstances shall chlorinated water be discharged into a natural waterway.

After flushing of the chlorine from the system is complete, the filled water main shall be allowed to stand for 24 hours.

The method of chlorination chosen for disinfection of the water main shall be one of the four (4) methods specified under Section 4.4 of AWWA Standard C651. Sampling requirements stipulated by the Charter Township of Union Water Department shall also be followed for new construction or extensive repair for all water systems that are operated and maintained by the Charter Township of Union Department of Public Works. This procedure is as follows:

a) After disinfecting, flush the system until the chlorine residual equals the source water and then allow the water to remain static for 24 hours before drawing the first sample. Submit the first sample which will then be tested using the Colilert procedure.

~~b) Option A samples are taken 16 hours apart and (2) option B-samples are taken 15 min apart after a 16-h rest period. The initial sample shall be done using the Collert procedure and the second shall entail two {2} samples from the same sample point, one of which will be tested using the Colilert procedure and the other using the Membrane Filter procedure. If both of the second samples are negative, authorization will be given to use the new construction or repair. If the second Colilert sample is negative but the Membrane Filter sample produces background growth, resampling for the Membrane Filter testing shall only be required until no growth occurs on the Membrane Filter sample.~~

Note: If the system is re-chlorinated or re-pigged the sampling procedure shall be started over as listed above in paragraphs "a}"

And "b}". When no growth occurs on the Membrane Filter, approval will be given to activate the system.

c) The Contractor shall discuss his proposed disinfection procedure and sample locations with the Township and have it approved prior to beginning the process.

d) The Contractor shall supply the chlorine, all necessary equipment and labor necessary for its application. The Contractor shall make suitable arrangements with the Township for bacteriological analysis and shall be responsible for all cost incurred from bacteriological testing. Bacteriological analysis shall conform to the requirements of the Michigan Safe Drinking Water Act and be performed by the Contractor and/or Township. Prior approval from the Township DPW must be obtained before an alternate State approved drinking water testing laboratory can be used.

e) One (1) sample shall be taken of the source water prior to connecting the new water main to the existing. The procedure and analysis shall be compliant with the Charter Township of Union Water Department requirements stated above.

~~f) Dechlorination: Contractor shall comply with AWWA C655 on proper dechlorination and disposal of heavily chlorinated water.~~

9.08 TRANSFER OF WATER SERVICES

Where water services are to be transferred from an existing water main to a new water main, as shown on the plans, Contractor shall provide corporation stop and necessary piping and fittings. Work shall be scheduled in such manners that transfer of service to any residence or water customer will result in the least possible interruption of water supply service. All services are one 1 inch (1") unless otherwise shown on the plans.

9.09 TRANSFER OF EXISTING HYDRANTS

Where indicated, existing hydrants are to be transferred from an existing main to a new main, as shown on the plans. Contractor shall excavate and reset the hydrant, as shown on Hydrant Assembly Detail, provide new

6-inch hydrant gate valve, 6-inch hydrant lead to new main and all fittings required for a complete installation.

9.10 HANDLING PIPE

All pipes and special castings shall be unloaded and distributed along the line of work in such a manner and with such care as will effectively avoid the cracking of any pipe or casting. Dropping directly from the truck will not be permitted. Care must also be exercised on the inside of the pipe. Wherever the outside coating may be found to have rubbed off, the part shall be thoroughly cleaned by brushing and shall then be recoated with an approved asphaltic paint or as may be required by the nature of the pipe coating. The Contractor shall keep on hand a supply of paint for such purposes.

9.11 MARKING PIPE

Each cast iron fitting shall have its weight and class designation conspicuously painted or cast on it. All other pipe materials shall have the class designation painted thereon. Where required, other designation marks shall be painted on the pipe or fittings to indicate correct location in the pipe section in conformity to a detailed layout plan.

9.12 PIPE TAPS

Pipe lines shall be tapped for corporation cocks where shown or required for testing of completed watermans. For ductile iron or steel pipe, cocks shall be threaded directly into the pipe.

9.13 BLOWOFF

Blowoffs shall be placed on all dead-end mains and shall be as shown on the plans. Permanent blow-off assemblies shall be cut off below grade after testing is complete. Standing water within the blowoff shall be pumped out of the riser, capped, bolted, and buried.

9.14 THRUST BLOCKS

Concrete thrust blocks shall be poured on hand-excavated, undisturbed soil bearing surfaces of a minimum size as shown on the standard details or increased in size according to the actual bearing values of the soil in each location, in accordance with the instructions of the Design Engineer.

Thrust blocks shall be made of 3,000 psi concrete, wet mix. Concrete thrust blocks shall be placed at all 22-1/2 degree bends or greater, dead

ends, tees, reducers, hydrants and crosses, as required. Pre-case thrust blocks may be utilized for certain applications, if approved by the Township Engineer/inspector. Mega lugs shall be utilized on all mechanical joint fittings. Thrust blocks must be utilized if a mega lug is used. Approval for correct usage of thrust blocks for mega lugs and retainer glands must be obtained from the Township inspector/engineer.

9.15 PAINTING

All pipes, valves, bolts and any other portions of watermain exposed inside manholes and other structures shall be painted. If necessary, heat shall be provided to maintain good drying conditions. All items to be painted shall be dry and clean before application of the paint. Any rust or scale shall be removed by wire brushing or scraping.

9.16 SHOP DRAWINGS

The Contractor shall furnish, as prescribed under Section "General Requirements" dimension and erection drawings and details of the watermain, valves, and other appurtenances furnished under this section. Complete details of all pipe deflections and ties to adjoining pipe shall be submitted to the Township Engineer for approval.

9.17 CERTIFICATION

The manufacturer of pipe and fittings shall furnish a certified statement that all pipe and fittings furnished by him have been inspected and tested in accordance with the applicable specifications. Pipe will be subject to inspection and approval upon delivery and no cracked, broken, damaged or defective pipe or fittings shall be laid in the work. Any piece that is found to be defective after it has been laid shall be removed by the Contractor and replaced by a sound and perfect piece.

DIRECTIONAL BORE WATERMAIN

1.01 SCOPE

This specification addresses the installation of water mains by guided boring, including connecting to existing water services or other water mains. All gate valve, gate well, and other appurtenances shall be installed using the general provisions and specifications for water main construction. The Contractor will provide all labor, components, materials, tools and appurtenances necessary or proper for the performance and completion of the contract. Inspection and payment will be by the method stipulated in the contract.

Guided boring is a method of trenchless construction using a surface launched steerable drilling tool controlled from a mobile drilling frame, and includes a field power unit, mud mixing system and mobile spoils extraction system. The drilling frame differs from microtunneling; auger boring or pipe jacking equipment. The drilling frame is set back from an access pit that has been dug at the location of a proposed gateway (or other appurtenances) and a high-pressure fluid jet tool head that uses a mixture of bentonite clay and water is launched and guided to the correct invert elevation and line required at the gateway. Using a real-time guidance system attached behind or within the tool head, which measures inclination, roll and azimuth, the tool head is guided through the soil to create a pilot tunnel. Tunneling may also be performed between proposed gateways or other appurtenances. Upon reaching the pit dug at the target location, the tool head is pulled back through the tunnel. A vacuum spoils extraction system removes any excess spoils generated during the installation. The gateways are then completed at both locations and the surface restored to the original condition.

1.02 QUALIFICATIONS

- A. Guided Boring Contractors shall have actively engaged in the installation of pipe using guided boring for a minimum of three years. The Contractor shall also have completed at least 5,000 feet of guided boring installations ranging from 6" to 24" inches in diameter, in the last year.
- B. Field supervisory personnel employed by the Guided Boring Contractor will have at least three years experience in the performance of this type of work.

1.03 SITE CONDITIONS

- A. Guided boring operations must not interfere with, interrupt or endanger the surface or activity upon the surface, and shall be located as called for on the project drawings.

- B Contractor must comply with all applicable jurisdictional codes and OSHA Requirements.
- C. When rock stratum, boulders, underground obstructions, or other soil conditions that impede the progress of drilling operations are encountered, the Contractor Project Engineer will review the situation and jointly determine the feasibility of continuing drilling operations, by making adjustments or switching to an alternate construction method.

1.04 MATERIALS

A. Pipe and Fittings

1. High Density Polyethylene Pipe (HDPE) and fittings shall be used in accordance with the material specifications. All additional appurtenances shall meet the material specifications. All additional appurtenances shall meet the materials specifications. The Engineer will specify the pipe wall thickness. The Contractor shall supply the pipe and fittings and shall include its price in the bid. All pipe installed by guided boring shall be joined by an approved butt fusion or, electrofusion technique according to the manufacturers specifications.
2. HDPE pipe shall be produced from resins meeting the requirements of ASTM D1248, designation PE3407, ASTM D3350 cell classification, PE34543C, and shall meet the requirements of AWWA C901 and C906. Material taken from HDPE pipe shall meet the minimum stability requirements as ASTM D3360. Pipe shall be blue in color or black with blue striping and be legibly marked at intervals of no more than five feet with the manufacturers name, trademark, pipe size, HDPE cell classification, appropriate legend such as SDR 11, ASTM DE035, AWWA C9091 or C9906, dates of manufacture and point of origin. The pipe shall be ductile iron pipe size. Pipe not marked as indicated above will be rejected. Pipe shall have a NSFPW seal.
3. Pipe used shall be DRISCOPIPE PRISMA, Series 4000 AWWA C906 or equivalent, with and SDR to be determined by the Engineer. The pipe shall be blue shelled on the exterior and black on the inside.

B. Drilling Fluid

1. Drilling fluid shall be a mixture of water and bentonite clay. The fluid shall be inert. The fluid should remain in the tunnel to ensure the stability of the tunnel, reduce drag on the pulled pipe, and provide backfill within the annulus of the pipe and tunnel.

2. Disposal of excess drilling fluid and spoils shall be the responsibility of the Contractor who must comply with all relevant regulations, right-of-way, work space and permit agreements., Excess drilling fluid and spoils shall be disposed at an approved location. The Contractor is responsible for transporting all excess drilling fluid and spoils to the disposal site and paying any disposal costs. Excess drilling fluid and spoils shall be transported in a manner that prevents accidental spillage onto roadways. Excess drilling fluid and spoils will not be discharged into sanitary sewers, storm drain systems, or waterways.
3. Drilling fluid returns (caused by fracturing or formations) at locations other than the entry and exit points shall be minimized. The Contractor shall immediately clean up any drilling fluid that surfaces through fracturing.
4. Mobile spoils removal equipment capable of quickly removing spoils from entry or exit pits and areas with returns caused by fracturing shall be present during guided boring operations to fulfill the requirements of paragraphs b and c above.
5. The Contractor shall be responsible for making provisions for a clean water supply for the mixing of drilling fluid. A permit to use water can be obtained from the Department of Public Works. No water may be taken from Township fire hydrants. The Contractor shall be responsible for complying with all the requirements of that permit.

1.05 EXECUTION

A. General

The Engineer must be notified immediately if any obstruction is encountered that stops forward progress of drilling operations. The Contractor and Engineer must review the situation and jointly determine the feasibility of continuing guided boring operations or switching to an alternative construction method. When it is determined that it is impossible to continue drilling operations, the Contractor will be directed how to proceed by the Project Engineer. Dewatering of pits and excavations must meet the general provisions and specification for water main construction in effect at Union Township. The type of dewatering method will be at the option of the Contractor. When water is encountered, the Contractor must provide a dewatering system of sufficient capacity to remove water, keeping any excavations free of water until the backfill operation is in progress. Dewatering shall be performed in a manner so that removal of soil particles is held to a minimum.

B. Preparation

Excavate required pits in accordance with the project drawings. The drilling procedures and equipment shall provide protection to workers, particularly against electrical shock. As a minimum, grounding mats, grounded equipment, hot boots, hot gloves, safety glasses, and hard hats will be used by crewmembers. The drilling equipment shall have an alarm system capable of detecting electrical current. Removal of trees, landscaping, pavement or concrete shall be as indicated on the Plans or as directed by the Engineer, and shall meet the general provisions and specifications of Union Township.

1. The Contractor is responsible for existing utilities, as stated under the Miss Dig System. All utilities that the boring operation may encounter shall be exposed to determine the actual depth and location. The costs of exposing utilities, whether shown on the plans or not, shall be the responsibility of the Contractor and included in the bid price for installing the new water main.

C. Guided Boring Operations

1. Equipment

- a) The drilling equipment must be capable of placing the pipe within the planned line and grade.
- b) The guidance system must have the capability of measuring inclination, roll and azimuth. The guidance system must have an independent means to ensure the accuracy of the installation. The Contractor shall demonstrate a viable method to eliminate accumulated error due to the inclinometer (pitch or accelerometer). The guidance system shall be capable of generating a plot of the borehole survey for the purpose of an as-built drawing. The guidance system must meet the following modifications.

Inclination:	Accuracy	0.06'
	Range	90°
	Repeatability	0.09
Roll:	Accuracy	0.1
	Range	0' to 360°
Azimuth:	Repeatability	0.1
	Range	0' to 360°

- D. The Contractor shall supply the Township with a log of the water main depth every 25' along the length of the pipe.

E. Pilot Hole Boring

1. The entry angle of the pilot hole and the boring process shall maintain a curvature that does not exceed the allowable bending radius of the product pipe.
2. Alignment Adjustments and Restarts
 - a) The Contractor shall follow the pipeline alignment as shown on the drawings, within the specifications stated. If adjustments are required, the Contractor shall notify the project Engineer for approval prior to making the adjustments.
 - b) In the event of difficulties at any time during boring operations requiring the complete withdrawal from the tunnel, the Contractor will be allowed to withdraw and abandon the tunnel by completely filling the void and begin a second attempt at a location approved by the Project Engineer; at the option of the Contractor and with the approval of the Engineer, the product pipe by trench method per the general provisions and technical specifications for construction. The number of access pits shall be kept to a minimum and the equipment must be capable of boring the following lengths in a single bore.
3. Installing Product Pipe
 - a) After the pilot hole is completed, the Contractor shall install a swivel to the reamer and commence pullback operations. Pre-reaming of the tunnel may be necessary and is at the option of the Contractor.
 - b) Reaming diameter shall not exceed 1.4 times the diameter of the product pipe being installed.
 - c) The product pipe being pulled into the tunnel shall be protected and supported so that it moves freely and is not damaged by stones and debris on the ground during installation.
 - d) Pullback forces shall not exceed the allowable pulling forces for the product pipe.
 - e) The Contractor shall allow sufficient length of product pipe to extend past the termination point to allow connections to adjacent pipe sections or gate valves. Pulled pipes shall be allowed 24 hours of stabilization prior to making tie-ins. The

length of extra product pipe shall be at the Contractor's discretion and cost.

- f) The Contractor shall install a Solid 10 gauge, blue in color, tracer wire at the same time as the product pipe. The tracer wire shall be connected to each hydrant at a bolt on the bottom of the hydrant barrel by use of a soldered connection, a crimped U-shaped connection, or a ring lug.
- g) The Contractor shall install a "Driscopipe AWWA C153 Mechanical Joint Adapter" type adaptor, per the manufacturer's requirements, for connecting the pipe to the specified valve and hydrant.

4. Water Service Connections

The Contractor is responsible for reconnecting existing water services as directed by the Engineer. All service leads will be to the size indicated in the plans and proposal. The service connections shall be tapped to the Main line in one of the following methods. The Method to be used shall be decided by Union Township.

- a) Mechanical Joint
 - i) The Contractor shall use a saddle clamp that is approved to be used with GDPE pipe, and shall be approved by the water superintendent.
 - ii) The saddle clamp shall be brass and must have a double strap. Single strap clamp will not be allowed.

1.06 TESTING

A. Pressure Testing Considerations

1. Guidelines for Test Methods

Leak testing shall be conducted as specified by the responsible Project Engineer or Owner. Joints may be exposed to inspect for leakage. Heat fusion joints must be properly cooled before pressure testing.

Testing may be conducted on the full system, or in sections. The test section size is determined by test equipment capability. If the pressurizing or pumping equipment is too small, it may not be possible to complete the test within allowable testing time limits. If so, higher capacity test equipment, or a smaller test section may be necessary.

Expansion joints and expansion compensators should be temporarily restrained, or isolated, or removed during the pressure test. The temperature of the test medium and the pipe test section should be the same, and should be at ambient temperature. Before applying test pressure, allow time for the test medium and the pipe test section to equalize. At temperatures above 100°F (38°C), test pressure must be reduced.

2. Test Pressure

Test pressure may be limited by valves, or other lower pressure rated components. Such components may not withstand the required test Pressure. They should be either removed, or isolated from the test section to avoid possible damage, or failure of these devices. Isolated equipment should be vented.

B. Hydrostatic Testing

1. General

Piping system pressure testing using hydrostatic procedures is recommended. The testing medium shall be clean water. The test section should be completely filled with water. Take care to bleed off any trapped air. While the test section is filling, venting at high points may be necessary to purge air pockets. Venting may be provided by loosening flanges, or by using equipment vents. Retighten any loosened flanges before applying test pressure.

2. Monitored Make-up Water Test

The test procedure consists of initial expansion, and test phases. During the initial expansion phase, the test section is pressurized to the test pressure by adding a measured amount of water. If the amount of makeup water added does not exceed Table 1 values on the facing page, leakage is not indicated.

3. Non monitored Make-Up Water Test

The test procedure consists of initial expansion, and test phases. For the initial expansion phase, make-up water is added as required to maintain the test pressure for three (3) hours. For the test phase, the test pressure is reduced by 10 psi. If the pressure remains steady) within 5% of the target value) for an hour, no leakage is indicated.

TABLE 1: TEST PHASE MAKE-UP AMOUNT

Make-Up Water Allowance (U.S. Gallon/100 ft. of Pipe)

Nominal Pipe Size (in.)	1 Hour Test	2 Hour Test	3 Hour Test
1 ¼	0.06	0.10	0.16
1 ½	0.07	0.10	0.17
2	0.07	0.11	0.19
3	0.1	0.15	0.25
4	0.13	0.25	0.40
5	0.19	0.38	0.58
5 3/8	0.21	0.41	0.62
6	0.3	0.6	0.9
7 1/8	0.4	0.7	1.0
8	0.5	1.0	1.5
10	0.8	1.3	2.1
12	1.1	2.3	3.4
13 3/8	1.2	2.5	3.7
14	1.4	2.8	4.2
16	1.7	3.3	5.0
18	2.2	4.3	6.3
20	2.8	5.5	8.0
22	3.5	7.0	10.5
24	4.5	8.9	13.3
26	5.0	10.0	15.0
28	5.5	11.1	16.8
30	6.3	12.7	19.2
32	7.0	14.3	21.5
34	8.0	16.2	24.3
36	9.0	18.0	27.0
42	12.0	23.1	35.3
48	15.0	27.0	43.0
54	18.5	31.4	51.7

SECTION 10

WATER WELL SUPPLY

10.01 SCOPE OF WORK

The work covered by this section of the specifications consists in furnishing all labor, equipment and material necessary to perform the installation of a Type I water supply well per these specifications, and most current Michigan Safe Drinking Water Act, 1976 PA 399, as amended, and the Administrative Rules promulgated thereunder (SDWA) and the Michigan Water Well Construction and Pump Installation Code, Part 127, of 1978 PA 368, as amended, and the Administrative Rules promulgated thereunder (Well Construction Code).

10.02 CONSTRUCTION OF NEW WELL

- A. Construct _____ new _____ well(s) capable of producing _____ gallons per minute at above ground discharge head of _____ feet. The well(s) shall be constructed where shown on the plans. This shall be well number(s) _____. The well construction shall strictly adhere to the requirements of the Michigan Department of Environmental Quality for public water systems and shall be performed by a state certified well driller.

The well pump assembly proposed by the well driller to be installed shall first be approved by the Design Engineer (with concurrence of the Township Engineer). Contractor shall submit performance curves and other related technical information per specifications Section 1.10.

B. Well Casing

The well casing(s) shall consist of steel with a minimum inside diameter of _____ inches and shall meet the requirements set forth in the most current Safe Drinking Water Act (P.A. 399) and the Well Construction Code. Pipe shall meet the standard thickness requirements according to the Great Lakes Upper Mississippi River Board of State Public Health and Environmental Managers Recommended Standards for Water Works as amended (Ten States Standards). The casing must meet the requirements of NSF International (NSF) Standard 61 and shall be new and watertight throughout its length and shall have welded or threaded joints in accordance with all applicable codes and standards.

C. Pitless Adapter

The pitless adapter(s) shall be new, shop fabricated from the point of connection with the well casing to the unit cap or cover, constructed of materials and weight equivalent and compatible with the casing, be of

watertight construction, frost proof, threaded or welded to the casing and utilize a contamination-proof entrance connection for electrical supply and conform to SDWA and the Well Construction Code. For well casings up to and including 12-inches in diameter, the pitless adapter shall possess an inside diameter equal to the inside diameter of the well casing. The pitless adapter shall be as manufactured by Baker, or approved equal.

- D. Well construction shall be performed in accordance with the Michigan Water Well Construction and Pump Installation code utilizing rotary boring or other approved method. The required open annular space outside of the outer casing shall be completely sealed with a neat cement grout or by an equivalent method.
- E. Grouting shall be neat cement weighing at least 15 pounds per gallon and shall be placed under pressure starting at the bottom of the casing. Grouting shall conform to the Department of Environmental Quality (DEQ) Water Division's (WD) Policy and Procedure DWRP-03-016, "Grouting of Community Water Supply Wells" and the Well Construction Code. Grouting shall be a continuous operation stopping only after the grout material flows from the ground at the top of the casing.
- F. Well Screen: The well screen shall be new, stainless steel as manufactured by Johnson Screen or approved equal. The slot size and configuration shall be determined by a recognized well screen manufacturer from soil samples extracted during the well drilling operation. The screen manufacturer shall submit his recommendations to the Design Engineer for approval.
- G. Disinfection: After the well has been completely constructed, it shall be thoroughly cleaned of all foreign substances, including tools, timbers, rope, debris of any kind, cement, oil, grease, joint dope and scum. The casing pipe shall be thoroughly swabbed using alkalis, if necessary, to remove oil, grease or joint dope. The well shall then be disinfected with a chlorine solution, and conform to the American Water Works Association (AWWA) Standard C654 and the Well Construction Code.

The chlorine solution used for disinfecting the well shall be of such volume and strength and shall be so applied that a concentration of at least 50 ppm of chlorine shall be obtained in all parts of the well. Chlorine solution shall be prepared and applied in accordance with the directions of, and to the satisfaction of the Township Engineer, but for at least two (2) hours.

In the event that the test pump is installed after the well has been disinfected, all exterior parts of the test pump coming in contact with the water shall be disinfected with chlorine solution.

After the contact period, the well shall be flushed until the chlorine residual is eliminated. Chlorinated water shall be disposed of in a manner that will not damage vegetation, wildlife, or aquatic life. Under no circumstances shall chlorinated water be discharged into a natural waterway.

After flushing of the chlorine from the well is complete, the well shall be allowed to stand for 24 hours. Samples will then be drawn from the well sample tap for bacteriological analysis. The well shall be allowed to stand for an additional 24 hours at which time a second sample shall be analyzed. Bacteriological analysis shall be performed by a state approved drinking water testing laboratory. Two consecutive negative (clean) samples are required for acceptance.

- H. Samples and Records: The Contractor shall keep an accurate record of the location of the top and bottom of each stratum penetrated. An accurate copy of the "Driller's Log" shall be submitted to the Township Engineer.

10.03 WELL TEST PUMPING FOR NEW WELL

- A. Well Development: The test well shall be thoroughly developed to remove all appreciable amounts of loose material from the formation. Development shall be done by the use of a close fitting surge block mounted on a drilling tool or pipe heavy enough to cause the surge block to sink rapidly. This assembly shall be operated in an up-and-down drilling motion by means of the well drilling machine at the rate of 30 to 40 strokes per minute. The material pulled into the well shall be bailed out periodically. The development operation shall continue until only a negligible amount of sand is pulled into the well.

The Contractor shall establish, by trial, the maximum pumping rate possible at or below the required maximum value, which can be maintained throughout test period without breaking suction.

- B. Test Pumping: Each proposed production well shall be test pumped separately for a period as outlined in 10.03C of these specifications. Test pumping shall conform to the DEQ WD's Policy and Procedure DWRP-03-003, Rev. #1 – 06/2002, "Aquifer Test Requirements for Public Water Supply Wells." The test pump measurements shall be taken and recorded per 10.03G of these specifications. The test pump shall be capable of producing at least the maximum gallon-per-minute rate specified. The pump test must start at a full condition of rest in the system; to achieve this it is advisable not to pump for one day prior to the test. The withdrawal rate should be held constant throughout the test.
- C. Duration of Pump Test: The duration of the pump test shall be twenty-four hours at a continuous and unvarying rate of flow unless otherwise

specified. The pump test shall be monitored by the Contractor with reports filed with the Design Engineer and Township Engineer.

- D. **Water Disposal:** If the production formation has 10' of clay cover, there is no concern regarding water entering the well. If less than 10', the waste water should be carried to the nearest body of open water, or to a distance of 350' from the well making use of any slope which will carry the water further from the well or its observation points. In all cases, water shall be disposed of in a manner so as to guard against damage to property.
- E. **Determination of Flow:** The rate of flow during the test shall be measured by the use of a circular orifice weir. A glass tube will be used to determine the head in the discharge pipe.

Other methods for measuring the rate of flow can be used only on approval of the Township Engineer.

- F. **Procedure in Determining the Water Level in the Well:** A water sensing electrode-type of water level indicator shall be used for this purpose.
- G. **Test Pump Measurement Intervals:** During the pump test referenced in 10.03B and 10.03C of these specifications, simultaneous readings of the pump rate and drawdown measurements in the observation wells and production well, to the nearest 0.01 feet, shall be made and recorded at the following intervals:

<u>ELAPSED TIME</u>	<u>FREQUENCY OF MEASUREMENT</u>
0 to 10 minutes	1 per minute
10 to 20 minutes	Every 2 minutes
20 to 60 minutes	Every 5 minutes
60 to 180 minutes	Every 15 minutes
180 to 360 minutes	Every 30 minutes
360 to completion	Every 60 minutes

(Elapsed time shall be from the beginning of the test pumping)

During the recovery period, which shall be 1/3 as long as the pumping test period, water level reading shall be taken in each observation well and the production well according to the schedule above.

- H. Remarks:

1. If there is a nearby lake or stream, hourly readings of its level should be made throughout the test.
 2. Breakdowns – Water Table Conditions: If a breakdown occurs during the first hour of pumping, rest one hour before starting again. Continue to take water levels during down period. Breakdown during second hour: 5 minutes may be tolerated – third hour: 10 minutes – fourth hour: 15 minutes. Add 5 minutes for each hour of pumpage thereafter for a maximum of 30 minutes. For more than 30 minutes, start over.
 3. Breakdowns – Artesian Conditions: Not over 5 minutes permissible during first 3 hours, nor more than 10 minutes for remainder of test.
- I. Observation Well: At least two (2) observation wells are required per P.A. 399 requirements. A production well may be used as one of the observation wells during the pump testing of another well as approved by the Township Engineer. Sections 10.03F and 10.03G shall apply to the observation wells.
- J. Water Samples: A one (1) gallon water sample shall be collected at six (6) hour intervals during the end of the pumping test (well efficiency test). These samples must be analyzed for organic and inorganic chemicals, including Phase II/V compounds (nitrates, nitrites, certain metals, organic chemicals, and radiochemicals), per MDEQ WD's requirements. The Contractor shall have a complete chemical analysis run on the last sample taken by a laboratory acceptable to both the Township Engineer and the Contractor. The remainder of the samples shall be retained by the Contractor for safekeeping.

10.04 NEW PUMP FOR EXISTING WELL

- A. The pump in the existing _____ inch well shall be removed and a new well pump shall be installed. The new well pump shall be capable of producing _____ gallons per minute at above ground discharge head of _____ feet. Depth of pump setting shall be at least _____ feet as shown on the attached drawing.
- B. Well driller shall submit data, performance curves, etc. on pump assembly he intends to install to the Design Engineer prior to proceeding.

The Design Engineer shall issue a set of this information to the Township Engineer for his review and approval.

- C. Turbine pumps shall be utilized for wells with proposed production rates greater than 1,000 GPM. No submersible turbine pumps will be allowed for this condition.

10.05 TURNOVER PACKAGE FOR TEST WELLS

Upon completion of production well test pumping, the Contractor shall submit to the Design Engineer the following items:

- A. Water Well and Pump Record (Driller's Log) for each well.
- B. Copies of shop drawings, including pump characteristic curves, for the production pump installed in each well, as prescribed under "General Requirements" section.
- C. Copies of the measurements recorded, to the nearest 0.01 feet, taken during the test pumping and recovery of each well (in tabular form).
- D. Copies of the complete chemical analysis for each water sample tested.
- E. Within thirty (30) days of receiving the Contractor's information, the Design Engineer shall submit to the Township Engineer for review the following information in a bound format:
 - 1. Well Logs for the production well(s).
 - 2. A drawdown vs. time plot of the test pumping data for each production well on semi-log paper including recovery.
 - 3. A summary of aquifer analysis results based on the information from each observation well obtained during the pump test for each production well. This summary shall include computations for coefficient of storage along with the average of these for each production well.
 - 4. A plot of the system head curve and pump curve for each production well.
 - 5. A location map showing each production well and the well cross section based on the well driller's log.
 - 6. Water quality analysis results from the requirements of Section 10.03J of these specifications.
 - 7. An overall water system map for the piping system utilizing the production wells.

10.06 PRODUCTION WELL PUMP INSTALLATIONS AND START UP

A. General

All equipment shall be installed in a neat, workmanlike manner, acceptable to the Design Engineer with concurrence of the Township Engineer and in conformance with all applicable Local, State and Federal codes and requirements.

B. Systems Start Up

It shall be the Contractor's responsibility to coordinate work between his subcontractors, equipment suppliers and utility companies to insure that all components of the system function properly as described herein. When the system or a major component of the system is entirely installed and ready for testing, the Contractor shall notify the Township Engineer and operation/maintenance personnel, in writing, of the time and date the start-up testing will be done. The Contractor, subcontractor, and equipment supplier's representatives shall be present for final start-up testing. During the start-up test, the Contractor shall operate all equipment in such a manner to demonstrate that all components are functioning properly.

If the equipment fails to perform, it will be the responsibility of the Contractor to arrange for repair or replacement of the defective parts and scheduling of a new start-up session.

Should the equipment pass its initial start-up testing but fails during the one-year guarantee period, the Contractor shall coordinate the necessary repairs or replacements with the subcontractors and suppliers.

10.07 ELECTRICAL WORK

A. Site Electrical Requirements

1. General

The Contractor shall supply and install all site electrical wiring and equipment necessary to operate the wells in accordance with all federal, state, and local requirements and as described in these specifications and shown on the plans.

Note: If the pump horsepower proposed by Contractor is greater than the maximum specified, then the cost to increase the electrical service of the wells shall be borne by the Contractor.

2. Contractor Responsibility

It shall be the Contractor's responsibility to have utility installations and hookups for electrical service.

10.08 OPERATION AND MAINTENANCE INSTRUCTIONS

Written instructions for the operation and maintenance of the production well pumps and associated equipment shall be furnished in quadruplicate for each piece of equipment in this section. The instructions shall be easy to understand with directions specifically written for this project describing the various possible methods of operating the equipment.

The instructions shall include procedures for tests required, pump curves, adjustments to be made, and trouble and safety precautions to be taken with the equipment.

Maintenance instructions shall include test and calibration charts, exploded views of assembled components, spare parts lists and wiring diagrams.

These instructions shall be submitted to the Design Engineer and Township Engineer for approval at the same time the shop drawings are submitted.

10.09 RECORD DRAWINGS

Any changes that are made in equipment, wiring, etc. from that shown in the plans and specifications shall be made only by approved shop drawings. After such changes are made, the Contractor shall submit to the Design Engineer and Township Engineer, record drawings which show these changes in equipment installation. Contractor shall supply "record" electrical schematic drawing to Design Engineer to be included in final close-out package delivered to the Township.

10.10 GUARANTEE

The Contractor shall furnish a manufacturer's guarantee covering all material and equipment that he furnishes. He shall guarantee his workmanship and material for a period of one year from the date of acceptance. Such guarantee shall provide for the replacement of defective workmanship, together with the restoration of any related materials or workmanship that are disturbed as a result of such imperfections in the work. All such replacements or repairs shall be done without expense to the Owner. All guarantees shall be in written form and submitted to the Owner in triplicate.

SECTION 10
WATER WELL SUPPLY

WELL HOUSE EQUIPMENT

11.01 SCOPE OF WORK

The work covered by this section of the specifications consists of furnishing all plant, labor, materials and appliances and performing all operations for the installation of piping and equipment as shown on the drawings and hereinafter specified.

11.02 PIPING AND FITTINGS

This work consists of furnishing all plant, labor, equipment and materials in performing all operations necessary to install the piping within the well house building or room as shown on the plans. All work to be performed as shown on the drawings and specified.

A. National Electrical Code (NEC):

All electrical work.

B. American Society for Testing Materials (ASTM):

A-72 Welded Wrought Iron Pipe.

A-120 Black and Hot-dipped Zinc-coated (Galvanized)
Welded and Seamless Steel Pipe for Ordinary Uses.

C. NSF International:

NSF -14 Plastic Potable Water System Components

NSF – 60 / 61 Potable Water System Components and Chemical
Additives

D. Materials

The following items of materials installed within the well house or room shall be furnished by the Contractor and shall conform to the various requirements as hereinafter specified.

1. Ductile Iron Pipe: Conform to the requirements of ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51, Class 150. Inside surfaces of pipe to be cement mortar lined per the requirements of ANSI/AWWA C104/A21.4. No exterior coating.

2. Ductile Iron Fittings: Standard fittings shall conform to the requirements of ANSI/AWWA C110/A21.10, Class 150. Compact or short body fittings shall conform to the requirements of ANSI/AWWA C153/A21.53, Class 150. All fittings to be cement mortar lined per ANSI/AWWA C104/A21.4. No exterior coatings.
3. Galvanized Steel Pipe: Conform to ASTM A538.
4. Brass Pipe and Fittings: Conform to current ASTM Standards.
5. Gate Valves: Conform to AWWA C515, Class 150. All valves shall open right, or clockwise. All valves shall be equipped with hand wheel operators.
6. Butterfly Valves: Shall be so designed and fabricated that they will conform to AWWA Standard C504 for Class 150B valves. The rubber valve seat shall cover the entire interior surface of the valve body and the face of the body. The valve disc shall be streamlined, free of external ribs, keyed to the shaft, provided with suitable means for positioning and shall utilize wedge type closing against the rubber liner at a full close seating angle of 90° to the axis of the pipe. Valves shall be manufactured by Dresser Manufacturing Division Keystone International, Inc. or an approved equal.
7. Water Check Valves
 - a) Valves 3" and larger shall have a cast iron body with a minimum non-shock W.O.G. working pressure of 150 psi. Seats shall be Buna-N mounted on the disc and shall provide leak-proof closing. The disc shall consist of one bronze disc which is spring loaded to prevent slam, pivoting at a stainless steel hinge pin. The spring shall be 316 S.S.
 - b) Valves shall be wafer type for mounting between ANSI 125 pound standard drill flat faced flanges unless otherwise specified or shown on the drawings.
8. Wall Castings and Sleeves shall be installed in all concrete work where pipes, wires, or other equipment pass through. Wall castings for 4" diameter or larger pipe shall be of cast iron having an anchor flange located in the center of the concrete wall or floor. Castings and sleeves shall be similar to those as manufactured by the East Jordan Iron Works or approved equal. Joint between pipe and sleeves shall be sealed with "Link-Seal" fittings or approved equal.

9. Pressure Gauges

The gauges shall be 3" diameter (minimum) and read pump discharge pressure in "feet of water". Liquid filled gauges shall incorporate a flexible diaphragm seal between the water discharge line and the pressure gauge. The diaphragm seal shall be either the inline-saddle type design with a minimum diaphragm surface of five (5) square inches or the complete flow-thru type design with flange connection. Inline-saddle diaphragms and housing parts exposed to the water shall be 316 ss. The flexible cylinder protecting the sensing liquid on the flow-thru design shall be Buna N and the flanges shall be 316 ss. The inside diameter of the flow-thru assembly shall be the same as the adjacent discharge piping. Use Model R or RP by Ametek, Model Iso-Spool (flanged) or Iso-Ring (wafer) by Ronninger-Peter or equal. Gauge shall be mounted on a tap equipped with a valve to allow complete isolation and removal of the gauge without wellhouse shut down.

E. Installation of Piping Valves and Fittings

1. Cement Lined Ductile Iron Class 52 or Cast Iron Valves and Fittings shall be used for all piping 4" diameter and larger. Flanged piping, valves and fittings shall be used for all interior exposed piping unless otherwise approved by the Township Engineer. Pipe, valves and fittings shall be carefully laid to line and grade. Care shall be taken to keep the pipe clean and free from dirt and other foreign materials. "Victaulic" fittings shall be considered as an acceptable equivalent, subject to the approval of the Township Engineer.

Piping laid in the ground shall have bearing over its entire length. Piping along floors, walls, or ceiling shall be adequately supported by saddles, posts, wall brackets, pipe hangers, or other approved devices. The exact location, number and design thereof shall be subject to the approval of the Design Engineer. "Uni-Flange" type fittings shall be rodded.

2. Galvanized Steel Pipe shall be used for all interior piping less than 4" in diameter or as approved by the Township Engineer.

F. Disinfection

All piping and equipment shall be disinfected in accordance with AWWA C651-05, and Section 9, Water Main Specifications.

11.03 PRESSURE TANKS

A. General

The Contractor shall furnish and install pressure tanks as shown on the plans and as hereinafter specified.

B. Pressurized Bladder Vessels

The Pressurized Bladder Vessels shall have a fiberglass-wound and epoxy resin sealed outer tank, one-piece high density polyethylene inner cell, heavy mil ethyl-vinyl-acetate (EVA) air cell, reinforced polypropylene upper and lower flanges, reinforced polypropylene base, stainless steel service steel, brass body, Schrader core assembly air valve, and high density polyethylene weather cap. The air cell shall be capable of being removed and replaced while the tank is installed.

C. Hydro-Pneumatic Tank

The hydro-pneumatic tank shall be designed and constructed in accordance with "A.S.M.E. Code for Unfired Pressure Vessels" for 150 psi working pressure. The tank shall be enclosed within the well house or as approved by the Township Engineer.

The tank shall be equipped with a water level sight gauge mounted on the end of the tank as shown on the plans.

The tank shall also be equipped with a pressure gauge, air pressure relief valve and air volume control mechanism and all tank couplings required to install these items.

The tank shall be coated on the inside with enamel application as appropriate for potable water systems. Outside of tank shall be coated with factory primer prior to delivery.

D. Air Volume Control

The air volume control mechanism for the pressure tank shall utilize an air compressor, mounted within the well house, liquid level probe and pressure switches for operation. This unit shall operate automatically and independently from the pumps and shall maintain a constant air charge in the tank. See Section 11.06 for coordination with pump operating sequence.

11.04 FLOW METER

- A. Flow meter shall be a electromagnet flow meter (Mag-Meter) where Primary unit to be a minimum ANSI 150 carbon steel flange sized to match pipe diameter. Mag-Meter shall be supplied with two properly sized Hastalloy-C grounding rings.
1. Liner material shall be manufactured of Tefzel and to be compatible with Sodium Hypo Chlorite.
 2. Electrodes shall be manufactured of Titanium and to be compatible with Sodium Hypo Chlorite.
 3. Classification shall be non-hazardous NEMA 4X.
 4. Primary shall be rated for temporary submergence for a minimum of 30 minutes if installed above grade, and total submergence if installed below grade.
 5. Grounding rings shall be used on all applications and connected electrically to the Mag-Meter per manufactures specifications.
- B. Flow meter converter shall be a remotely mounted unit with the following specifications.
1. Converter shall be type rated NEMA 4X die-cast Aluminum enclosure.
 2. Converter shall be UL or FM listed
 3. Converter shall operate on 120Volts AC 1Ø power.
 4. Converter shall supply a minimum of 2 dry contact outputs rated at a minimum of 3 VA. One for scaleable pulsed flow output, one for reverse flow.
 5. Converter shall supply one 4-20 ma signal output, scalable to current flow rate.
 6. Meter shall have a scalable display where current flow and total flow can be displayed simultaneously.
 7. Total flow display must be scalable so as to read in kgl while current flow can be read in gpm.

8. Meters under 12" in diameter shall have an accuracy of 0.25% of rate from 0.67' per second to 30' per second.
- C. Meter shall be installed according to the manufactures specifications and in a direction so as to measure forward flow in the normal flow direction when water is moving through the line under normal flow conditions.
1. Converter shall be mounted in a location where meter production data can be easily accessed and seen.
 2. Electrical connections shall be made in accordance with manufactures specifications.
 3. Electrical connections shall be a minimum of NEMA 4 to the meter utilizing manufactures seals and compounds to form necessary water tight connections.
 4. Supplier shall provide proper start up and calibration services.
 5. Supplier shall provide a minimum of one year warranty on all parts and labor.
 6. Supplier shall provide a minimum of 50' of manufactures meter cable or as specified on drawings where there shall be no splices between converter and primary unit. All cable shall be protected in conduit unless specified differently by manufacture.
- D. Acceptable Manufacturer:
- ABB Part Number 10DX3111 with 50XM1000 converter or approved equal.

11.05 PRESSURE RELIEF VALVE/SURGE ANTICIPATOR

- A. The valve shall be hydraulically operated, single diaphragm-actuated and globe or angle pattern, flanged. The valve shall consist of three major components: the body with seat installed, the cover with bearings installed, and the diaphragm assembly. This equipment must be approved for application by the Charter Township of Union DPW and/or Township Engineer.
1. Diaphragm Assembly: The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve separating operating pressure from line pressure. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the main valve or pilot controls.

2. Main Valve Body: No separate chambers shall be allowed between the main valve cover and body. Valve body and cover shall be ductile iron. The valve shall contain a resilient, synthetic rubber disc, with a rectangular cross-section contained on three and one-half sides by a disc retainer, forming a tight seal against a single removable seat insert. The main valve seat and the stem bearing in the valve cover shall be removable.
3. Pilot Control System: The pressure relief pilot shall be an adjustable, spring-loaded, normally closed diaphragm control designed to permit flow when upstream pressure exceeds the control setting. The low-pressure pilot shall be an adjustable, spring-loaded, normally open diaphragm control designed to open when the sensed pressure falls below the control setting and close when pressures are normal. The pilot system shall contain an adjustable hydraulic limiter to limit valve travel during low-pressure opening without affecting high-pressure relief valve travel. The contractor shall connect the sensing/pilot supply connection to the main discharge header with minimum ¾" pipe or tubing.
4. Products: Subject to compliance with requirements, provide from the following manufacturer:
 - a. Cla-Val Model No. 52-03/652-03

11.06 PUMP OPERATIONAL CONTROLS

A. General

The Contractor shall furnish and install pressure switches, complete, as outlined herein.

Pressure switches shall be mounted in the well house to operate the well pump based on the water pressure. The pressure switches shall be adjustable from ___ to ___ psi.

The operation of the _____ well pump(s) shall be controlled based on the pressure within the system and, in the case of a hydro-pneumatic tank, the water level within the tank. The operating sequence shall be as follows:

USING A PRESSURIZED BLADDER VESSEL

The lead pump shall operate until the pressure at the well house reaches PSIG. Should the pressure continue to drop with the lead pump operating, and the pressure reaches _____ PSIG, the lag pump shall engage. Both pumps shall operate until the pressure at the well house reaches _____ PSIG.

USING A HYDRO-PNEUMATIC TANK

The lead pump shall operate until one of two (2) conditions are met:

1. The pressure at the well house reaches ____ PSIG.
2. The tank water level reaches the high water probe.

If the tank water reaches the high water probe prior to achieving a pressure of _____ PSIG, the compressor will engage and operate until the pressure increases to _____ PSIG and the pressure switch is reset.

Should the pressure continue to drop with the lead pump operating, and the pressure fall to ____ PSIG, the lag pump shall engage. Both pumps shall operate until one of the two (2) conditions listed above are met.

The alternating sequence shall be accomplished by means of an alternator in the electrical circuitry at the well house. A selector switch shall be located at the well house pump panel to allow manual selection of the pumps to be included in the alternating sequence.

All pumps shall be capable of being operated manually as well as automatically by lever selection of a hand-off-automatic switch at the well house. If one (1) pump is switched off for repairs, the other pump(s) shall be able to operate normally in an automatic mode.

Each pump shall have its own completely independent control system so that the failure of any components in one (1) pump will not affect the automatic or manual operation of the other pump(s).

Each well pump shall be equipped with an hour run meter mounted in the pump control panel.

11.07 ELECTRICAL WORK

A. Factory Wiring and Equipment

1. General

The wellhouse control panel shall be completely wired in accordance with National Electrical Code and carry an Underwriters Laboratory certification. It shall be adjusted and ready for operation. All wiring in the panel shall be color coded and

numbered as indicated on the wiring diagram portion of the shop drawings. All wiring outside the panel shall be in rigid conduit. It is the Contractor's responsibility to ensure that electrical equipment complies with all federal, state, and local requirements.

(A large, clear, color coded and numbered wiring diagram shall be provided in triplicate with each unit. Wiring diagram shall comply with the latest Township requirements).

2. Control Panel

The control panel shall include a circuit breaker and magnetic starter for each pump motor. The magnetic starters shall be Square "D" and have thermal overload protection on all three phases. The control assembly shall provide a convenient means to operate each pump manually or automatically. When operated in the automatic mode, the control assembly shall automatically alternate the position of the "lead" and "lag" pumps after each pumping cycle.

Control panel shall be equipped with a step-down transformer to supply 120/240 volts for control and auxiliary circuits, as applicable. Primary side of auxiliary power transformers shall be protected by a thermal/magnetic air circuit breaker specifically sized to meet power requirements of the transformer. A 120-volt, 20-amp, duplex receptacle shall be provided with ground fault circuit interruption.

Pump run indicator lights shall be mounted on the control panel.

The control panel shall also incorporate an hour meter to register the elapsed running time for each pump. Meters shall be resettable and utilize a digital readout.

A time delay relay shall be provided for the pump motor controls to insure that both motors will not start at the same time.

Controls for the pump motors shall be designed to protect the electric motors from low line voltage, single phase start-up and phase reversal. A phase sequence and under voltage relay shall be installed in the control panel. The unit shall be connected to the wellhouse alarm circuitry to provide a 0.5 second time delay to prevent nuisance tripping of the relay caused by a momentary transient drop in the line voltage. Upon resumption of normal line conditions, the unit shall automatically restore the motors to a running condition.

3. Alarm Contacts for Rapid Telemetry (or Alarm Monitoring) and Exterior Alarm Light

The wellhouse shall be provided with alarm contacts terminal board control panel by the control panel manufacturer for energizing of the telemetering relays.

a. Telemetering (dry) contacts shall be provided for the following conditions:

1. Well Pump No. 1 on.*
2. Well Pump No. 2 on.*
3. Low pressure.
4. High pressure.
5. Power Failure
6. Security.
7. Flow meter.

*Additional contacts shall be installed for additional wells.

4. Telemetry Equipment

Telemetry equipment will be supplied and installed by the agency performing operation and maintenance for the facility. Battery back-up must be included.

5. Temporary Power Supply

The wellhouse shall be provided with a means to accommodate temporary power supply including transfer switch. The type of power supply (permanent or portable power generation) shall be dependant upon wellhouse size and importance and shall be determined by the Township. It is the Contractor's responsibility to ensure that equipment is properly sized for electrical loads into wellhouse, compatibility with Charter Township of Union DPW equipment, and complies with all federal, state, and local requirements.

B. Site Electrical Requirements

1. General

The Contractor shall supply and install all site electrical wiring and equipment necessary to operate the wellhouse in accordance with all federal, state, and local requirements and as described in these specifications and shown on the plans.

2. Contractor Responsibility

It shall be the Contractor's responsibility to have utility installations and hookups for electrical service.

11.08 EQUIPMENT INSTALLATIONS AND START UP

A. General

All equipment shall be installed in a neat, workmanlike manner, acceptable to the Design Engineer with concurrence of the Township Engineer and in conformance with all applicable Local, State and Federal codes and requirements.

B. Factory Trained Start-Up Personnel

The Contractor shall furnish the services of an experienced factory trained field representative to start up all equipment. He shall be employed by the Contractor in such capacity to interpret the manufacturer's installation guide and instructions, to supervise the installation and start-up of such equipment and to instruct the operating and maintenance personnel for a reasonable period of time. (A minimum of four (4) hours of instruction.)

The representative of the equipment supplier shall be responsible to insure that all equipment, controls, alarms, wiring, flow meter and all associated components are properly installed and functioning properly.

C. Systems Start Up

It shall be the Contractor's responsibility to coordinate work between his subcontractors, equipment suppliers and utility companies to insure that all components of the system function properly as described herein. When the system or a major component of the system is entirely installed and ready for testing, the Contractor shall notify the Township Engineer and operation/maintenance personnel, in writing, of the time and date the start-up testing will be done. The Contractor, subcontractor, and equipment supplier's representatives shall be present for final start-up testing. During the start-up test, the Contractor shall operate all equipment in such a manner to demonstrate that all components are functioning properly.

If the equipment fails to perform, it will be the responsibility of the Contractor to arrange for repair or replacement of the defective parts and scheduling of a new start-up session.

Should the equipment pass its initial start-up testing but fails during the one-year guarantee period, the Contractor shall coordinate the necessary repairs or replacements with the subcontractors and suppliers.

11.09 SHOP DRAWINGS

- A. The Contractor shall submit, as prescribed under "General Requirements" section, complete shop drawings and details of all equipment to be furnished under this section. These shop drawings shall be submitted and approved by the Design Engineer with concurrence of the Township Engineer prior to installation.
- B. A large, clear, color coded and numbered wiring diagram shall be prepared showing the as-built wiring of the complete wellhouse installation including all control and alarm wiring. Provide four (4) copies.

11.10 OPERATION AND MAINTENANCE INSTRUCTIONS

Written instructions for the operation and maintenance of the wellhouse equipment shall be furnished in quadruplicate for each piece of equipment in this section. The instructions shall be easy to understand with directions specifically written for this project describing the various possible methods of operating the equipment.

The instructions shall include procedures for tests required, pump curves, adjustments to be made, and trouble and safety precautions to be taken with the equipment.

Maintenance instructions shall include test and calibration charts, exploded views of assembled components, spare parts lists and wiring diagrams.

These instructions shall be submitted to the Design Engineer and Township Engineer for approval at the same time the shop drawings are submitted.

11.11 RECORD DRAWINGS

Any changes that are made in equipment, controls, wiring, etc. from that shown in the plans and specifications shall be made only by approved shop drawings. After such changes are made, the Contractor shall submit to the Design Engineer and Township Engineer, record drawings which show these changes in equipment installation. Contractor shall supply "record" electrical schematic drawing to Design Engineer to be included in final close-out package delivered to the Township.

11.12 GUARANTEE

The Contractor shall furnish a manufacturer's guarantee covering all material and equipment that he furnishes. He shall guarantee his workmanship and material for a period of one year from the date of acceptance. Such guarantee shall provide for the replacement of defective workmanship, together with the restoration of any related materials or workmanship that are disturbed as a result of such imperfections in the work. All such replacements or repairs shall be done without expense to the Owner. All guarantees shall be in written form and submitted to the Owner in triplicate.

11.13 PAINTING

All pipes, valves, flow meters, and any other portions of water main or ferrous metals exposed inside of the well house shall be painted. If installed, the hydro-pneumatic tank shall be painted. If necessary, heat shall be provided to maintain good drying conditions. All items to be painted shall be dry and clean before application of the paint. Any rust or scale shall be removed by wire brushing or scraping. Painting system shall be:

1 coat (350 sf/g) Pug Primer
2 coats (500 sf/g) Rustamor 500

SUBMERSIBLE SEWAGE PUMPING STATION

12.01 SCOPE OF WORK

The work covered by this section of the specifications consists of furnishing all parts, labor, materials and appliances and performing all operations for the installation of submersible sewage pumping station(s), the details of which are shown on the Standard Plans.

12.02 GENERAL

The Contractor shall furnish a duplex heavy duty submersible non-clog sewage pumping system as manufactured by Hydr-O-Matic, Flygt, or an approved equal. The principal items of equipment shall include submersible, motor driven, non-clog sewage pumps, valves, internal piping, central control panels with circuit breakers, motor starters, liquid level control with explosion proof relays, all internal and external wiring, alarm controls, concrete wet well, concrete pad and electric service as hereinafter specified. All pumping stations furnished shall be of the same manufacturer. Backfilling around pumping stations shall be in accordance with these specifications.

12.03 SUBMERSIBLE SEWAGE PUMPS

Each pump shall be motor driven, heavy duty, ball bearing, non-clog sewage and trash pump. All openings must be large enough to permit the passage of a sphere of 3" in diameter.

Pumps furnished shall be so designed to accommodate a larger impeller in order to meet the future pumping condition indicated. For each pump, two (2) pump impellers shall be furnished, one (1) shall enable the pump to meet the initial condition and one (1) to meet the future pumping condition. The pump casing, pump and motor shaft, conduit, wiring and controls shall be sized to meet the future condition. The pump motors shall be designed to be non-overloading throughout the entire pump range for the future pumping condition.

Each pump shall have the necessary characteristics and be properly selected to perform under the following conditions:

<u>Initial Condition</u>	<u>Pump Station #</u>
Pump Capacity (GPM)	_____
Total Dynamic Head (Ft.)	_____
Pump Speed (RPM)	_____
Minimum Pump Efficiency (%)	_____
<u>Future Condition</u>	
Pump Capacity (GPM)	_____
Total Dynamic Head (Ft.)	_____
Pump Speed (RPM)	_____
Minimum Pump Efficiency (%)	_____
Minimum Horsepower	_____
Maximum Horsepower	_____
Motor Voltage	____ V ____/

Note: If the pump horsepower proposed by Contractor is greater than the maximum specified, then the cost to increase the electrical system of the pump station shall be borne by the Contractor.

A. Impeller

The impeller is to be corrosion resistant and of the enclosed type. The impeller is to be made of close-grained cast iron and be dynamically and hydraulically balanced before assembling in the pump. A wear ring shall be installed at the inlet of the pump to provide protection against wear to the impeller.

B. Casing

The casing shall be made of high strength cast iron and shall be large enough at all points to pass any size of solid which can pass through the impeller. Wear rings shall be installed.

C. Shaft

The pump shaft shall be constructed of solid 31655 or 17-4 PH (high grade stainless steel). Shaft sleeves are not acceptable.

D. Seals

Each pump shall be provided with a tandem double mechanical seal. The seals shall require neither maintenance nor adjustment and shall be easily replaceable. The lower mechanical seal shall be protected by a minimal shaft over-hang and pressure reducing vanes on the back of the impeller.

E. Base

The volute casing shall have feet to support the impeller entrance the proper distance above the bottom of the wet well unless otherwise approved by the Design Engineer.

F. Finish

The pump shall have a painted or enamel finish as standard with the manufacturer.

G. Nameplates

Each pump shall have a standard nameplate securely affixed thereto in a conspicuous place and also mounted in the electrical panel showing the serial number and the name of the manufacturer. In addition, the nameplate for each pump shall show the model or figure number, the capacity in gallons per minute at rates of speed in revolutions per minute and total dynamic head in feet. Care shall be taken to be legible at all times.

H. Guiding Rail Connection System

A guiding bracket shall be an integral part of the pump itself. This bracket will slide along a guide rail(s). The guide rails will be furnished and shall be of standard weight Sch 40 stainless steel pipe. The pump shall have a machined connecting flange which will connect to a discharge flange mounted on the wet well floor. Sealing of the connecting flange to the discharge flange is to be accomplished by a guided downward motion, without the use of nuts or bolts. Guiding rail connection system shall allow pump removal and replacement without personnel entering or dewatering the wet well or disconnecting any piping in the wet well. Individual pump and motor removal shall not interfere with continued operation of remaining pump(s).

I. Motor

The pump motor shall be housed in an oil or air filled, watertight casing and shall have Class F insulated squirrel cage windings. Pump motors shall have a cooling system capable to allow for continuous operation in

even non-submerged condition. The pump should be able to run dry under full load continuously for extended periods of time without damage. The motor cable shall be properly sealed at its entry into the motor so as to allow no moisture into the motor housing. The pump motor shall be capable of at least 10 starts per hour on the average. The pump motor shall be supplied with a moisture sensing device capable of relaying its signal to the control panel. The pump motors and power supply must be explosion proof and suitable for use in NEC—Class 1, Division 1, Group D locations.

J. Tools

For the pumps, special tools necessary for maintenance and repair of pumps shall be furnished by the Contractor.

K. Pump Characteristic Curves

Pump characteristic curves shall be furnished showing capacities, heads, efficiencies, and brake horsepower throughout the entire range of pumping. These shall be submitted as part of the shop drawing submitted to the Design Engineer.

L. Spare Pump and Motor

The Contractor shall supply one pump and one motor in addition to the two supplied for the installation into the wet well for each pumping station. The pump and motor shall be the same make, model, and size as those supplied for installation into the wet well for each pumping station. Additionally one spare mechanical seal kit and wear rings per pump shall be provided.

12.04 WET WELL

A. General

1. A concrete wet well shall be built in conjunction with each pump station as shown on the plans.
2. A pump station module, one piece molded fiberglass product mounted to a concrete wet well may be used as a substitution to the field built pump station, as approved by the Township. The module shall conform to all applicable Grand Traverse County Standard Details and include:
 - a. Wet well access compartment
 - b. Valve vault compartment

B. Pre-cast Concrete Units

The wet well structure shall be made of pre-cast reinforced concrete of the size shown on the plans and shall conform to ASTM C-76, Class 2. Joints shall be of the rubber "O-Ring" design and provide integral (one piece) pre-cast bottom section.

C. Sanitary Sewer Wet Well Waterproofing

The Contractor shall apply a waterproofing system to the inside and outside of the concrete wet well. The material to be used for this operation shall be as specified in these specifications.

The waterproofing system shall be applied and allowed to dry in accordance with the manufacturer's directions. All steps, lids, frames and castings and sewer pipe entering or leaving the wet well shall be protected during application to prevent their being coated.

Interior Waterproofing

If any leaks in the wet well walls are detected twenty-four (24) hours after application of the first coat of the waterproofing system, they shall be sealed by application of a quick-set sealer. This sealer shall be a mixture of Portland Cement - Type One and "Ipanex R", "Waterplug" or equal. The quick-set sealer shall be applied in accordance with the manufacturer's directions. After the patched areas dry, they shall be covered with another coat of the waterproofing and allowed to dry. If any leaks are apparent after that time, the Contractor shall repatch them. The above steps shall be repeated until all leaks are sealed.

After all leaks are stopped and there are no leaks apparent after twenty-four (24) hours upon application of the first coat of the waterproofing system or twelve (12) hours after application of a patch, the Contractor shall apply over the dry surface a finish coat.

Exterior Waterproofing

The exterior surfaces of the wet well shall be thoroughly covered with mastic at a rate of one (1) gallon per twenty-five (25) square feet. The exterior surfaces shall be thoroughly cleaned before application of the mastic. The mastic shall be as specified in Section 7.02 A2 of these specifications.

D. Waterstops

A waterstop shall be installed in the wall of the wet well for all piping connections. This includes inlet sewer piping and outlet discharge piping. The waterstops shall be a Kor-N-Seal as manufactured by National Pollution Control Systems or equal.

E. Vents

The intake and outlet vents shall be cast iron or ductile iron pipe constructed as detailed on the plans.

F. Hatch Covers shall be duplex door covers and a pre-fabricated integral part of the unitized assembly where installer will not be required to perform on site adjustments or hatch door assembly.

G. Electrical

The electrical components of the wet well level control and alarm system shall be 24 volts, corrosion proof, water proof and explosion proof, Class I Division 1 Rated.

12.05 PUMPING STATION PIPING, VALVES AND FITTINGS

A. The piping shall conform to the sizes and configurations shown on the plans and the following materials specifications.

1. Cast Iron Fittings

Cast iron fittings shall be designed in accordance with the standards set forth in ASA Specifications A21.2, A21.6, A21.8 or to Federal Specification WW-P-421.a. The pipe shall be designed to withstand a minimum working pressure of 150 psi and a minimum hydrostatic test pressure of 300 psi. The pipe shall also be designed for a laying depth of six feet.

2. Ductile Iron Pipe and Fittings

Ductile iron pipe shall be in accordance with the latest revision of ASA Specifications A21.50 and A21.51. The pipe and fittings shall be designed to withstand a minimum working pressure of 150 psi and a minimum hydrostatic test pressure of 300 psi.

3. Galvanized Steel Pipe

Galvanized steel pipe shall meet the requirements of ASTM Specification A120. Standard weight galvanized pipe and standard weight malleable iron fittings or American Standard 125 pound cast iron fittings shall be furnished unless otherwise specified.

4. Brass Pipe and Fittings

Conform to current ASTM Standards.

5. Valves

The specification for gate valves, knife valves, plug valves, ball valves, butterfly valves, pinch valves and standard check valves is located under Section 8, Force Mains.

6. Valve Operators and Valve Boxes

The specification for valve operators and boxes is located under Section 8, Force Mains.

7. Pipe Supports

Pipe supports shall be used to support all piping and valves. Pipe supports shall be of the adjustable type designed to support cast iron pipe.

8. Pressure Gauges

Pressure gauges shall be installed in the discharge line of each pump within the valve chamber. The gauges shall be 3-inch diameter (minimum) and read pump discharge pressure in "feet of water". Liquid filled gauges shall incorporate a flexible diaphragm seal between the sewage discharge line and the pressure gauge. The diaphragm seal shall be either the inline-saddle type design with a minimum diaphragm surface of 5 square inches or the complete flow-thru type design with flange connection. Inline-saddle diaphragms and housing parts exposed to the sewage shall be 316 ss. The flexible cylinder protecting the sensing liquid on the flow-thru design shall be Buna N and the flanges shall be 316 ss. The inside diameter of the flow-thru assembly shall be the same as the adjacent discharge piping. Use Model R or RP by Ametek, Model Iso-Spool (flanged) or Iso-Ring (wafer) by Ronninger-Peter or equal. Gauge shall be mounted on a tap equipped with a valve to allow complete isolation and removal of the gauge without station shut down.

B. Installation of Piping, Valves and Fittings

1. Cast Iron or Ductile Iron Piping, Valves and Fittings

Cast iron or ductile iron piping, valves and fittings shall be used for all piping larger than 4-inch diameter from the pumps until the pipe exits the valve chamber. Cast iron flanged piping, valves, and fittings shall be used for all interior exposed piping unless otherwise approved by the Engineer. Pipe, valves and fittings shall be carefully laid to line and grade. Care shall be taken to keep the pipe clean and free from dirt and other foreign materials. Piping laid in the ground shall have bearing over its entire length. Piping along floors, walls or ceilings shall be adequately supported by saddles, posts, wall brackets, pipe hangers or other approved devices. The exact location, number and design thereof shall be subject to the approval of the Engineer.

2. Galvanized Steel Pipe and Fittings shall be used for all interior piping less than 4" in diameter or as approved by the Township Engineer.
3. Pipe Taps

Wherever indicated or required, pipe or fittings shall be tapped to receive small pipe or special fittings

12.06 SEWAGE FLOW METER

A. Flowmeter

The Contractor shall furnish and install where shown on the plans and in accordance with these specifications, an ultrasonic flow measuring device complete with flow transmitter, indicating, recording and totalizing capable of 4-20 milliamp output. The flow meter must be suitable for use in NEC, Class 1, and Division 1 locations and be UL listed.

The ultrasonic level measuring device shall be installed through the side of the wet well at the top.

The ultrasonic level measuring device shall be capable of providing pump on/off signals, wet well levels, and high/low alarms to the control panel and be manufactured by Endress-Hauser

B. Transducer

The Contractor shall furnish and install where shown on the plans and in accordance with these specifications, an submersible flow measuring device complete with flow transmitter, indicating, recording and totalizing

capable of 4-20 milliamp output. The transducer must be suitable for use in NEC, Class 1, and Division 1 locations and UL listed.

The level measuring device shall be installed within wetwell within stilling well as indicated on the drawings and shall be capable of providing pump on/off signals, **wet well levels, and high/low alarms** to the control panel and be manufactured by Endress- Hauser.

1. Level Transducer shall be an SS submersible intrinsically safe level transducer with build level 1 lightning suppression. Sensor shall be rated for low voltage 2 wire operation and compatible with UL698A intrinsic protection.
2. Level Transducer shall measure Level from 0-15 psi scaled to 0-34' to measure the wet well depth at a maximum of 27' TDH of Water.
3. Transducer shall be supplied with 50' cable for panel termination.
4. Sensor and sensor scaling shall be supplied with package and be factory pre-calibrated prior to shipment.

C. Mercury Float Type Switch

The contractor shall furnish and install where shown on the plans and in accordance with these specifications, switches that shall consist of suspended plastic watertight casings, internally weighted float switches. All level control circuits in the wet well shall be intrinsically safe 24 volt and in explosion-proof housings.

12.07 ELECTRICAL WORK

A. Factory Wiring and Equipment

1. General

The pumping station control panel shall be completely wired at the factory except for the power feeder lines in accordance with National Electrical Code and carry an Underwriters Laboratory certification upon delivery. It shall be adjusted and ready for operation. All wiring in the station shall be color coded and numbered as indicated on the wiring diagram portion of the shop drawings. All wiring outside the panel shall be in rigid conduit. It is the Contractor's responsibility to ensure that electrical equipment complies with all federal, state, and local requirements.

(A large, clear, color coded and numbered wiring diagram shall be provided in triplicate with each unit. Wiring diagram shall comply with the latest Township requirements).

All conduit ends are to be sealed to eliminate water and/or gases moving from one section of the pump station system to another; i.e., wet well to pump control panel.

2. Pump Motors

Pump motors shall be supplied with the pump by the pump manufacturer as an integral part of the pump assembly. The horsepower shall be such that the motor will be non-overloading throughout the entire pump range. The motors shall have squirrel cage windings and rated at 240 or 460 volts, 60 cycle, 3 phase and shall be NEMA Code "G" design or better. Motors shall be as manufactured by U.S. Motors, General Electric, Westinghouse or equal. Each motor shall have a nameplate showing the motor serial and identification numbers, manufacturer's name, horsepower, voltage, etc.

3. Pump Controls and Alarms

a. Control Panel

The electrical control equipment shall be mounted within a NEMA 4 dead front enclosure.

The control panel shall include a circuit breaker and a variable frequency drive (VFD) for each pump motor actuated by the ultrasonic level control system. The magnetic starters shall be Square "D" and have thermal overload protection on all three phases. The control assembly shall provide a convenient means to operate each pump manually or automatically. When operated in the automatic mode, the control assembly shall automatically alternate the position of the "lead" and "lag" pumps after each pumping cycle.

Control panel shall be equipped with a step-down transformer to supply 120/240 volts for control and auxiliary circuits. Primary side of auxiliary power transformers shall be protected by a thermal/magnetic air circuit breaker specifically sized to meet power requirements of the transformer. A 120-volt, 20-amp, duplex receptacle shall be provided with ground fault circuit interruption.

Pump run indicator lights shall be mounted on the control panel.

The control panel shall also incorporate an hour meter to register the elapsed running time for each pump. Meters shall be resettable and utilize a digital readout.

A time delay relay shall be provided for the pump motor controls to insure that both motors will not start at the same time.

Controls for the pump motors shall be designed to protect the electric motors from low line voltage, single phase start-up and phase reversal. A phase sequence and under voltage relay shall be installed in the control panel. The unit shall be connected to the pump station alarm circuitry to provide a 0.5 second time delay to prevent nuisance tripping of the relay caused by a momentary transient drop in the line voltage. Upon resumption of normal line conditions, the unit shall automatically restore the motors to a running condition.

b. Wet Well Level Control and Alarm System

Controls for pump operation for wet well level control and alarm system shall be furnished and installed to perform as described herein. It shall be the contractors responsibility to install a pressure transducer in a still well as well as a float backup in case of transducer failure. The Wet Well Level Control and Alarm System is required to meet Class 1, Division 1, Group D requirements. The transducer will be the primary liquid level sensor for operation of the pumps. For back-up, floats shall be installed.

At the normal High Water Level, one of the two pumps will start. Pumping will continue until the fluid level has lowered to the normal Low Water Level when the pumps will stop. The High Water Level shall utilize the pressure transducer with a backup signal actuated by a mercury float type switch.

When the fluid level has again reached the normal High Water Level, the other pump will start and complete its cycle in the same manner as the first pump. In the case of suction, lift stations pump alteration shall be conducted automatically on a daily cycle not every pump cycle.

If the fluid level continues to rise above the normal High Water Level and reaches the Standby Pump On Level, the

second or standby pump will start and both pumps will continue to run until the fluid level descends to the normal Low Water Level. If the fluid level continues to rise above the Standby Pump On Level, a High Water Alarm Level will indicate an abnormal condition. High Water Level, Low Water Level, and Standby Pump On Level shall utilize the **pressure transducer**. The High Water Alarm Level shall utilize the ultrasonic level control system with a backup signal actuated by a mercury float type switch.

Conversely, if the pumps should continue to run so as to drop the fluid level below the Low Water Level, the Low Water Alarm Level will indicate the abnormal condition and the operating pump(s) will stop. The pump controls will automatically be restored to normal operation if the fluid level again rises. The Low Water Alarm Level shall utilize the ultrasonic level control system with a backup signal actuated by a mercury float type switch.

The mercury float type switches shall consist of suspended plastic watertight casings, each containing a mercury switch, so arranged that the buoyancy of the rising fluid causes them to lie on their sides thus activating the mercury switch. All level control circuits in the wet well shall be 24 volt and in explosion-proof housings.

4. Alarm Contacts for Rapid Telemetry (or Alarm Monitoring) and Exterior Alarm Light

The pump station shall be provided with alarm contacts terminal board control panel by the pump station manufacturer for energizing of the telemetering and alarm light relays.

- a. Telemetering (dry) contacts shall be provided for the following conditions:

- High Water Alarm Level
- Low Water Alarm Level
- Seal Fail**
- Power Failure
- Sewage Pump No. 1 On/off
- Sewage Pump No. 2 On/off
- Security
- AMPS**
- Pump Hours**
- Volts**
- Power Factor**

Flow Meter
Pump Speed
Floats/level sensor
Surge Protection
Dry Well Flood – can stations only
Pump motor overload (thermal)

- b. Exterior alarm light and horn contacts shall be provided and the light and horn energized for the following conditions:

High Water Alarm Level
Low Water Alarm Level
Dry Well Flood – can stations only

- c. Remote Telemetry (SCADA) shall be supplied by the contractor. Contractor shall be responsible to coordinate with the Township and the Township's chosen integrator.

5. Electric Heater

A single-phase electric heater shall be provided in the pump panel with an adjustable thermostat.

6. Telemetry Equipment (Radio Control)

Telemetry equipment will be supplied and installed by the contractor and shall include 12 hour 24 DC battery backup via Gel cell type battery to keep alarm system and scada system operational.

7. Temporary Power Supply

The lift station shall be provided with a means to accommodate temporary power supply including transfer switch. The type of power supply (permanent or portable power generation) shall be dependant upon lift station size and importance and shall be determined by the Township. It is the Contractor's responsibility to ensure that equipment is properly sized for electrical loads into the lift station, compatibility with Grand Traverse County DPW equipment, and complies with all federal, state, and local requirements.

B. Site Electrical Requirements

1. General

The Contractor shall supply and install all site electrical wiring and equipment necessary to operate the facilities of the sewage pumping station in accordance with all federal, state, and local requirements and as described in these specifications and shown on the plans.

2. Contractor Responsibility

It shall be the Contractor's responsibility to have utility installations and hookups for all electrical service and equipment requiring electrical service.

3. Exterior Station Alarm

An exterior station alarm shall be supplied to provide a visual alarm indication activated by contacts in the lift station control panel. It shall be mounted within the exterior electrical enclosure. A vapor tight, 100-watt light fixture with red globe and guard shall be mounted on the top of the exterior electrical enclosure to indicate visually when an alarm condition exists.

12.08 FACTORY TESTS

The submersible sewage pumps shall be given running tests to check for proper motor and pump operation, correct shaft and impeller rotation and watertightness. Pump shall be run submerged for 30 minutes, simulating actual service conditions after which the motor housing will be checked for moisture either visually if plugs are present, or through the use of a moisture probe, if plugs are not present.

A certificate of factory testing shall be provided to the Design Engineer and Township Engineer.

12.09 SHOP DRAWINGS

The Contractor shall submit, as prescribed under Section "General Requirements", six (6) copies of complete shop drawings including the shop drawing for the control panel and color coded electrical schematic drawings (ladder diagrams) for all electrical components and details of all equipment to be furnished under this section. These shop drawings shall be submitted and approved by concurrence of Township Engineer before installation of these items.

12.10 OPERATION AND MAINTENANCE INSTRUCTIONS

Written instructions for the operation and maintenance of the pump station equipment shall be furnished in quadruplicate for each piece of equipment in this section. The instructions shall be easy to understand with directions specifically written for this project describing the various possible methods of operating the equipment.

The instructions shall include procedures for tests required, pump curves, adjustments to be made, and trouble and safety precautions to be taken with the equipment.

Maintenance instructions shall include test and calibration charts, exploded views of assembled components, spare parts lists and wiring diagrams.

These instructions shall be submitted to the Design Engineer and Township Engineer for approval at the same time the shop drawings are submitted.

12.11 RECORD DRAWINGS

Any changes that are made in equipment, controls, wiring, etc. from that shown in the plans and specifications shall be made only by approved shop drawings. After such changes are made, the Contractor shall submit to the Township Engineer record drawings which show these changes in equipment installation.

12.12 AS-BUILT WIRING DIAGRAM

A large, clear, color coded and numbered wiring diagram shall be prepared showing the as-built wiring of the complete pump station installation including all control and alarm wiring. Provide four (4) copies for each pump station.

12.13 EQUIPMENT INSTALLATION AND START UP FOR SEWAGE PUMP STATIONS

A. General

All equipment shall be installed in a neat, workmanlike manner, acceptable to the Design Engineer with concurrence of the Township Engineer and in conformance with all applicable local, State and Federal codes and requirements.

B. Factory Trained Start-Up Personnel

The Contractor shall furnish the services of an experienced factory trained field engineer representing the pump station supplier to start up all equipment. He shall be employed by the Contractor in such capacity to interpret the manufacturer's installation guide and instructions, to supervise the installation and start-up of such equipment and to instruct

the operating and maintenance personnel for a reasonable period of time. (A minimum of four (4) hours of instruction per pump station.)

The representative of the pump station supplier shall be responsible to insure that all pumps, motors, equipment, controls, alarms, wiring, flow meter and all associated components are properly installed and functioning properly.

C. Systems Start Up

It shall be the Contractor's responsibility to coordinate work between his subcontractors, equipment suppliers and utility companies to insure that all components of the system function properly as described herein. When the system or a major component of the system is entirely installed and ready for testing, the Contractor shall notify the Township Engineer and operating/maintenance personnel, in writing, of the time and date the start-up testing will be done. The Contractor, subcontractor, and equipment supplier's representatives shall be present for final start-up testing. During the start-up test, the Contractor shall operate all equipment in such a manner to demonstrate that all components are functioning properly.

If the equipment fails to perform, it will be the responsibility of the Contractor to arrange for repair or replacement of the defective parts and scheduling of a new start-up session.

Should the equipment pass its initial start-up testing but fails during the one year guarantee period, the Contractor shall coordinate the necessary repairs or replacements with the subcontractors and suppliers.

12.14 GUARANTEE

In addition to the Contractor's guarantee, the Contractor shall also furnish the manufacturer's guarantee(s) covering all material and equipment furnished. Such guarantees shall be in written form and furnished to the Owner. The guarantees shall be for a one year period commencing on the date of acceptance of the completed sewage pumping station(s) as determined by the Design Engineer with concurrence of the Township Engineer. The guarantee(s) shall cover the structure and all equipment, materials and workmanship of the pump station and all associated components as specified herein. The guarantee shall provide for the replacement of defective materials and/or workmanship, together with the restoration of any related materials or workmanship that are disturbed as a result of such imperfections in the work. All guarantees shall be submitted in triplicate.

REPLACEMENT AND CLEANUP

13.01 SCOPE OF WORK

Under this item, the Contractor will restore all lawns, trees, gardens, landscape plantings, sidewalks, ramps, trails, fences, commercial signs, water courses and sand, gravel, dirt, asphalt and concrete roads, catch basins, storm sewers, building sewers, water services, water valve boxes, meter vaults, property markers (such as concrete monuments, irons, stakes, pipes, etc.), mailboxes and other items which may be damaged during the course of construction. All replacement and cleanup work will be incidental to the project except those items of work that are delineated in the bid proposal.

All restoration work shall attempt to return the existing facilities to their original condition. Substitutions, such as gravel instead of grass, will not be allowable.

The Contractor shall pay special attention to the requirements of Act 347, "Soil Erosion and Sedimentation Control". In all construction work the Contractor shall take all precautions necessary to prevent erosion and to conform to the requirements of Act 347. Should erosion occur within the guarantee period, the Contractor shall regrade and reseed the disturbed area at no additional cost to the Owner.

Replacement and cleanup operations shall follow immediately behind the construction work. The Contractor shall make every effort to keep the job site clean and free of trash and miscellaneous building materials. The Contractor shall pay special attention in order to restore commercial signs, fences, etc. and to patch and repair pavement, driveways and sidewalks immediately after the construction work. In the event that replacement and cleanup work does not proceed in a satisfactory manner, the Owner may withhold periodic payments or close the construction area until such time as the replacement and cleanup is satisfactory. An exception may be made if there are physical limitations which do not allow for immediate replacement and cleanup.

13.02 PAVEMENT RESTORATION

A. General

All permanent pavement restoration shall be done over compacted backfill and a minimum 6" thick compacted M.D.O.T. 22A gravel base. The gravel base shall be placed and maintained in accordance with the M.D.O.T. Standard Specifications. All patches shall have square, neat, saw cut edges regardless of the final surfacing method planned for that section of the pavement restoration.

No patching work shall be started until the subgrade has been properly prepared. Prior to laying the bituminous patch, the adjacent road surfaces shall be swept clean of all foreign materials and the patch area and pavement primed with Michigan Department of Transportation's approved prime coat.

A bituminous bond coat shall be placed between successive lifts of the bituminous patch and bituminous surfacing. Each lift shall be thoroughly compacted before adding the next lift. This includes running the compaction roller longitudinally along the entire length of the joints between the patch and the existing pavement.

The bituminous mixture to be furnished under these specifications shall be delivered to the paver at a temperature no lower than 285 F. Any mixture that has a temperature below 285 F at the time of "laying" shall be rejected and hauled from the project.

Temporary road patches shall be gravel or bituminous cold patch. The patches shall be maintained in a smooth condition until final repairs are made.

The Design Engineer, Township Engineer and the County Road Commission shall be notified at least two (2) working days prior to the placement of any and all final pavement overlays.

Aggregate for mixes shall conform to the Isabella County Road Commission and the Union Township current standards.

B. Bituminous Patching

Existing asphalt roads and driveways shall be patched using the current Road Commission standards. All patches shall be placed in two lifts of 165 pounds per square yard for the first course and 110 pounds per square yard for the second course or match existing thickness. A bituminous prime coat of 0.25 gallons per square yard and a tack coat of 0.10 gallons per square yard shall be used for all bituminous patches. Shoulders shall be restored to their original width and depth in accordance with M.D.O.T. Standard Specifications using M.D.O.T. 23A gravel.

C. Gravel Roads, Driveways and Shoulders

All gravel roads shall be restored in accordance with M.D.O.T. Standard Specifications using 6" of M.D.O.T. 22A gravel. Shoulders shall be restored to their original width and depth in accordance with 1984 M.D.O.T. Standard Specification 3.09 using M.D.O.T. 23A gravel.

Shoulders shall be raised on the side opposite of sewer construction to match new pavement surfaces.

D. Concrete Pavement, Sidewalk and Driveways

Concrete for restoring pavement, sidewalks, and driveways shall attain a 28-day strength of 3,500 pounds per square inch. Neat edges of patch areas shall be obtained by the use of a concrete saw. Concrete mixing aggregates and curing methods shall conform to Concrete section. Concrete patches shall match the original width and depth and in no case, a depth less than 4". Sidewalks shall have contraction joints a distance apart equal to the width of the slab.

13.03 GRASS AREA

Grass areas shall be considered as two types: A) Type 1, areas which had lawns before construction, and B) Type 2, open fields or ditches not adjacent to established lawns. The plans may specifically call for Type 1 mixtures in which case the plans will govern. If there is a question as to which mixture to use, the Design Engineer shall make the final decision.

Terraces, lawns, ditches, open fields and other grassy areas shall be topsoiled, fertilized, seeded and mulched in such a manner that a grass approximately equal in type and density of the original is obtained. Slopes between 1:3 and 1:2 shall be sodded and staked or receive seed with mulch blankets.

A. Topsoil

Topsoil furnished shall consist of dark brown or black loam, clay loam, silt loam, or sandy loam surface of fertile, friable humus soil of mineral organics, not including peat or muck. Soil shall be screened topsoil, free of stones, roots, sticks and any other extraneous materials. All topsoil furnished shall be approved by the Design Engineer. Type 1 areas shall be topsoiled to a depth of 4" and Type 2 areas to a depth of 2".

B. Seeding and Fertilizing

Areas to be seeded and fertilized shall be carefully raked to even surfaces and all stones, sticks and other debris removed.

The area to be seeded shall be fertilized with agricultural fertilizer 12-12-12 analysis, Davco or Agrico or equal, applied on the prepared surface at the rate of 20 pounds per 1,000 square feet. Fertilizer shall be harrowed or raked into the soil to a depth of not less than 1".

Seeds shall be furnished in durable bags. On each bag of seed, the vendor shall attach a tag giving name, lot number, net weight of contents,

purity and germination. All seed shall be thoroughly mixed and sown in a method which will ensure uniform distribution. Seeding during high winds or inclement weather will not be permitted. All seed is to be raked in and compacted. The seed shall be sown at the rate of five (5) pounds per 1,000 feet. The seeding mixtures shall be composed of certified seed of the purity, germination and proportions by weight as specified in the following table:

Kind	SEEDS		MIXTURES	
	Minimum Purity	Minimum Germination	Type I	Type 2
Perennial Rye Grass	98%	90%	20%	50%
Kentucky Blue Grass	90%	75%	60%	15%
Creeping Red Fescue	98%	80%	20%	35%

C. Mulching

Immediately after seeding all seeded areas, Type 1 and Type 2 shall be mulched with unweathered small grain straw or hay spread uniformly at a rate of 100 pounds per 100 square feet (two tons per acre). Hydroseeding method with similar application rate will be allowed.

D. Mulching Anchoring

All mulch shall be anchored using one of the following methods. The Contractor may use either method unless otherwise shown on the plans.

1. Method "A": The straw mulch shall be anchored by applying one of the following asphalt products at the rate shown. The asphalt may be blown on with the mulch or sprayed on immediately after the mulch is spread.

<u>Asphalt Product</u>	<u>Application Rate</u>
Liquid Asphalt R.C. 1, 2 or 3; M.C. 2 or 3	0.10 gal. per S.Y.
Emulsified Asphalt R.S. 1 or 2; M.S. 2; or S.S. 1	0.04 gal. per S.Y.

2. Method "B": A "Terra-Tak" mulch binder may be used in lieu of asphalt. Mixing and application shall be done in accordance with the manufacturer's recommendations.

3. Method "C": In areas with slopes greater than 10% or where shown on the plans, the Contractor shall place mulch netting or excelsior blanket mulch.
 - a. Mulch Netting: Mulch shall be anchored by the use of mulch netting. The light weight fibrous netting shall be properly placed over the mulch and secured to the ground using wire staples, spaced per manufacturer's recommendations.
 - b. Excelsior Blanket Mulch: An excelsior blanket shall be used in lieu of other mulch. The excelsior blanket shall be a consistent thickness of evenly distributed wood excelsior fibers, 80% of which are 6" or more in length. The top side of the blanket shall be covered with a coarse net of twisted Kraft paper or biodegradable extruded plastic mesh. Ends and sides shall be securely butted and stapled with U-shaped wire staples of a size and length suited to the soil conditions.

13.04 DITCHES

Ditches which have been grassed and maintained by the abutting property owner shall be restored to the pre-construction conditions.

Ditches in which culverts or drain tile have been installed shall have the same tile replaced, if in good condition, or a tile satisfactory to the Design Engineer installed in its place at the original line and grade.

Catch basins shall be reconstructed, if removed or damaged.

13.05 FENCE REPLACEMENT

- A. Chain Link Fence shall be replaced according to current M.D.O.T. specifications.
- B. Other Fences shall be replaced equal to and of the same type as existing.
- C. Salvaged material, if approved by the Engineer, may be used for replacement.
- D. Right-of-way fences shall be repaired/replaced as indicated on the construction drawings.

13.06 COMMERCIAL SIGNS

Commercial signs, which must be removed by the Contractor in order for work to proceed, shall be replaced and reconstructed to original condition. It is very important that replacement follow immediately behind the construction work.

13.07 BUILDING SEWERS

Building sewers shall include any and all parts of private residential, commercial or industrial sewage disposal system such as sewer pipe, septic tanks, drainfield, etc. Whenever the service of any such facility is interrupted because of the Contractor's operations, he shall provide such interim methods of sewage disposal as are required to maintain a safe, nuisance free, non-polluting construction operation.

13.08 OTHER DEBRIS

The Contractor shall remove, at his own expense from the site, any and all broken pipe, bricks, blocks, lumps of concrete, broken machinery, cans, containers, and other trash and debris.

13.09 TREES

The Contractor shall endeavor to save as many trees as possible. Cut trees, including stumps, shall be disposed of by the Contractor. Any elm tree which is removed must be burned. Tree branches which become broken shall be removed by cutting off flush with trunk and the cut on the trunk shall be painted with an approved tree paint. Where removal of a stump would result in damage to existing utilities, the stump may be removed by chipping to a depth of at least one foot below the finished ground surface.

Trees removed by the Contractor and where approved by the Engineer shall be replaced with a reasonably sized tree of the same variety. Trees along the State Highways and County Roads that fall on the property line or in the road right-of-way shall be replaced at a new location off the right-of-way.

Replacement trees of the deciduous or hardwood type shall be furnished from nursery stock, at least 2" to 2½" in diameter, and shall have the roots contained in a ball of soil and wrapped in burlap.

Replacement trees of the evergreen type may be furnished from either nursery or native stock, at least 8' – 10' in height, and shall have roots contained in a ball of soil and wrapped in burlap.