PART 1 GENERAL

1.01 SUMMARY

A. These specifications apply to low pressure sewers from 1.25 inches to 12 inches in diameter.

B. These specifications are intended to technically describe the nature of the materials, equipment and workmanship required to complete the low pressure sewers and appurtenances shown on the plans.

C. All labor, tools, and materials necessary to excavate, place, join, backfill, and finish the low pressure sewers and appurtenances to provide a complete and operative system shall be considered as part of the low pressure sewer system construction.

D. Low pressure sewers shall be considered to mean pressure pipe as called for on the plans, complete with specials, fittings, valves, valve wells, valve boxes, and connections to existing sewer systems.

1.02 PRICE AND PAYMENT PROCEDURES

A. Unless indicated otherwise, low pressure sewers of the diameter specified will be paid for at the contract unit price per linear foot, measured in place along the center line of pipe, which price shall be payment in full for furnishing all materials including specials and fittings, necessary excavation, sheeting or bracing, draining, laying, directional drilling, jointing, normal bedding, special bedding and any undercut of unsuitable bedding soils and replacement of undercut, connections to existing sewer system, tracer wire, testing, water and other materials used in testing, backfilling, including excavated material and replacement of unsuitable excavated material with imported material, groundwater control, including well points and deep wells, disposal of surplus excavated materials, replacement of any damage caused by the Contractor including, but not limited to, pavement, sprinkler systems, fences, culverts, underground utilities, and animal control wire, landscape features, trees and shrubs and final cleanup and restoration, and all other work incidental to the construction of the low pressure sewer. Measurement for low pressure sewer will be taken from end to end and through structures with no reductions for fittings and valves. Special structures or sections for which either lump sum or unit price bids have been taken will be deducted from the total length of low pressure sewers and will be paid for at the prices bid therefore.

B. Unless indicated otherwise in the proposal, any undercut over three feet in depth ordered by the Engineer due to poor existing ground conditions shall be paid for at the contract unit price for undercut. Trench undercut and stone refill less than three feet deep shall be incidental to the Contract. Stone placed in the trench by the Contractor in conjunction with, and/or in lieu of, dewatering the trench and not ordered by the Engineer will not be considered stone refill and will be at the Contractor's expense. (See EXCAVATION and PIPE SUPPORT.)

C. Unless indicated otherwise in the proposal, flushing connections and air/vacuum release assemblies will be paid for at the contract unit price per each, furnished and installed.

D. Unit price for flushing connections and air/vacuum release assemblies shall include all of the following unless separate prices are required and indicated in the contract documents: connection to the low pressure sewer, valves, clean-out assemblies and other equipment indicated, manhole enclosure, frame and cover, adjusting rings, valve boxes, excavation, sheeting and bracing, shoring, dewatering, normal or special bedding, backfill, disposal of excavated material, clean-up, restoration, and all other work incidental to the installation of the flushing connection or air/vacuum release assemblies.

E. Unless indicated otherwise in the proposal, service valve and redundant check valve will be paid for at the contract price per unit. Price shall include all labor, material and equipment required for furnishing and installing redundant check valve and service valve as one unit.

1.03 REFERENCES

A. Oakland County Water Resources Commissioner General Specifications.

B. Michigan Department of Transportation (MDOT) Standard Specifications for Construction.

C. Road Commission for Oakland County Permit Rules, Specifications, and Guidelines.

D. ASTM D 1505: Standard Test Method for Density of Plastics by the Density-Gradient Technique.

E. ASTM D 1238: Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.

F. ASTM D 790: Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

G. ASTM D 638: Standard Test Method for Tensile Properties of Plastics.

H. ASTM F 1473: Accelerated method to determine or predict failure time in polyethylenes.

I. ASTM D 2837: Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe.

J. ASTM D 1603: Standard Test Method for Carbon Black Content in Olefin Plastics.

1.04 RELATED REQUIREMENTS

A. HORIZONTAL DIRECTIONAL DRILLING – SECTION 33 05 23.13

B. PACKAGED SEWAGE GRINDER PUMPING UNITS – SECTION 33 32 16.13

1.05 SUBMITTALS

A. The following information shall be submitted in accordance with the provisions for submittals in other sections of the contract documents.

1. Manufacturer's product data, cut sheets, and other literature that can be used to verify that the required equipment and materials meet the specifications described herein. This information shall be submitted for all items used/installed for the project and specified under PART 2 PRODUCTS below.

2. Manufacturer's cut sheets and brochures.

3. Manufacturer's instructions for joining high density polyethylene (HDPE) pipe and fittings.

4. Manufacturer's instructions for installing HDPE pipe.

5. Allowable pulling force for HDPE pipe.

6. Qualifications of pipe joiner.

7. List of all pipe, fittings, specials and valves to be supplied.

8. Certificates of Intent of Compliance from each equipment/material supplier. Certificates shall certify that all materials supplied for the work will be manufactured, tested and inspected in accordance with the contract documents. Each Certificate shall include the following: suppliers name and mailing address, project title, a description of the material(s) supplied, a statement that all materials will be (or have been) manufactured, tested and inspected in accordance with the contract documents for the project. Certificates shall be signed and notarized. Certificates shall be provided prior to material delivery.

9. Manufacturer's product data for tracer/locator wire.

10. A method description and brochures/cut sheets for equipment to be used for continuity testing of tracer wire (See TRACER WIRE CONTINUITY TESTING).

PART 2 PRODUCTS

2.01 HIGH DENSITY POLYETHYLENE PIPE, TUBING, AND FITTINGS

A. Pipe and tubing used for low pressure sewer under this specification shall be of high density polyethylene (HDPE) and shall be of the nominal diameter indicated on the plans. Fittings shall be of HDPE unless specified otherwise.

B. HDPE plastic pipe and fitting material shall have a Material Designation Code of PE 3408/3608 and shall be Class PE345464C in accordance with ASTM D 3350 (Standard Specification for Polyethylene Plastics Pipe and Fitting Materials).

C. For reference, the properties and corresponding values for Material Class PE345464C per ASTM D 3350 are listed in the table below.

Property	Cell Class	ASTM Test Method	Value	Unit
Density	3	D 1505	> 0.940 - 0.955	g/cm^3
Melt Index	4	D 1238	< 0.15	....
Flexural Modulus	5	D 790	110,000 - <160,000	psi
Tensile Strength at Yield	4	D 638	3,300 - < 3,500	psi
Slow Crack Growth Resistance - Pennsylvania Notch Test (PENT)	6	F - 1473	100	hours
Hydrostatic Design Basis	4	D 2837	1,600	psi
Color and UV Stabilizer	C	D 1603	...	...

D. Grinder Pump Discharge Lines

1. All HDPE pipe and tubing for grinder pump discharge lines shall have a wall thickness based on a Standard Dimension Ratio (SDR) of 9 or as otherwise specified on the drawings or elsewhere in the contract documents.

2. HDPE pipe and tubing of nominal diameter from ½ inch through 2 inches used for grinder pump discharge lines shall be manufactured based on copper tube size (CTS) to allow for the use of commonly available fittings. HDPE pipe and tubing of nominal diameter from ½ inch through 2 inches used for grinder pump discharge lines shall be manufactured, dimensioned, sampled, tested, inspected, and marked in accordance with ASTM D 2737 (Standard Specification for Polyethylene (PE) Plastic Tubing).

E. Mainline Force Mains

1. All HDPE pipe for mainline force mains shall have a wall thickness based on a Standard Dimension Ratio (SDR) of 11 or as otherwise specified on the drawings or elsewhere in the contract documents.

2. HDPE pipe of nominal diameter from 1/2 inch through 2 inches in diameter used for mainline force mains shall be manufactured based on iron pipe size (IPS). HDPE pipe of nominal diameter from 1/2 inch through 2 inches in diameter used for mainline force mains shall be manufactured, dimensioned, sampled, tested, inspected, and marked in

accordance with ASTM D 3035 (Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter).

3. HDPE pipe of nominal diameter from 3 inches through 24 inches in diameter used for mainline force mains shall be manufactured based on iron pipe size (IPS). HDPE pipe of nominal diameter from 3 inches through 24 inches used for mainline force mains shall meet the shall be manufactured, dimensioned, sampled, tested, inspected, and marked in accordance with ASTM D 3035 (Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter) or ASTM F 714 (Standard Specification for (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter).

2.02 HDPE PIPE FITTINGS

A. General

1. HDPE pipe fittings to be used with pipe that is joined by the electrofusion method shall manufactured, dimensioned, sampled, tested, inspected, and marked in accordance with ASTM F 1055 (Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing).

2. HDPE pipe fittings to be used with pipe that is joined using the butt fusion process shall be manufactured, dimensioned, sampled, tested, inspected, and marked in accordance with ASTM D 3261 (Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing).

3. HDPE pipe fittings to be used with pipe that is joined using the saddle fusion process shall be manufactured, dimensioned, sampled, tested, inspected, and marked in accordance with ASTM D-2683 (Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing).

4. Fitting water pressure ratings shall match or exceed pipe water pressure ratings identified in the applicable ASTM standard for the pipe (i.e. 200 psi @ 73° F for SDR 9 pipe and 160 psi @ 73° F for SDR 11 pipe).

5. Fittings provided shall be fabricated with ends to match line pipe.

6. HDPE pipe provided under this specification shall receive solid green striping for identification as sewage piping.

7. Pipe SDR value, dimensions, and pipe material shall be specified in the manufacturer's product data required under SUBMITTALS.

8. Compliance with the requirements of this section shall be certified in writing upon request. In addition, the pipe manufacturer shall provide, upon request, an outline of quality control procedures performed on polyethylene system components.

2.03 DUCTILE IRON PIPE

A. General

1. Ductile iron pipe for transitions at structures shall be Thickness Class 54 in accordance with ANSI/AWWA C151/A21.51 and double-cement-lined and seal coated in accordance with ANSI/AWWA C104/A121.4.

2. Outside coating on flanged ductile iron pipe shall be a 1-mil thick factory-applied asphaltic coating in accordance with ANSI/AWWA C151/A21.51.

3. All ductile iron pipe, fittings, and valves through structures shall be flanged. Flanges shall be in accordance with ANSI/AWWA C115/A21.15 and ANSI/AWWA C110/A21.10.

4. Nuts and bolts for joining flanged ductile iron pipe shall be carbon steel with a minimum 60,000 psi strength conforming to ASTM A307 (Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength) Grade B. Bolts shall be standard ANSI B1.1, Class 2A coarse threads. Nuts shall conform to ASTM A563 and be standard ANSI B1.1, Class 2A coarse threads. All bolts and nuts shall be heavy hexagonal for greater bearing area. Identification on the bolt shall be A307B. Bolts shall be factory-coated with a blue fluoropolymer coating for corrosion resistance.

5. Flange gaskets for ductile iron pipe shall be of synthetic rubber, full-faced, and 1/8-inch thick. Gaskets shall conform to the dimensions specified in table A.1 ANSI/AWWA C115/A21.15.

2.04 MECHANICAL JOINT ADAPTERS FOR HDPE PIPE

A. Mechanical joint adaptors used for joining HDPE mainline forcemain to ductile iron pipe transitions through structures shall consist of the HDPE mechanical joint adaptor with stainless steel insert/stiffener, metal gland/gland ring, gasket, and attachment bolts and nuts. Adapters shall be pressure rated to the SDR rating of the HDPE mainline force main. Mechanical joint adapter shall be butt fused to the main line HDPE pipe. Mechanical joint adaptors must be AWWA compliant.

B. Gaskets for mechanical joints and mechanical joint couplings shall comply with ANSI/AWWA C-111/A21.11 for vulcanized styrene butadiene rubber (SBR) gaskets.

C. All mechanical joints T-bolts and nuts supplied with fittings and appurtenances shall conform to ASTM A242 Weathering Steel. All T-bolts and nuts shall be factory coated with a blue fluoropolymer coating for corrosion resistance.

D. Mechanical joint adaptors shall be “DIPS & IPS MJ Adapter With Kit” by Independent Pipe Products or approved equal.

2.05 PIPE TAPS

A. New pipe connections to existing low pressure sewer or force main shall be made with tapping saddles or tapping sleeves and valves compatible with the existing pipe materials. Saddles and tapping sleeves must be approved by the Engineer prior to installation.

B. Grinder pump discharge lines shall be connected to existing HDPE force mains/pressure sewers using HDPE electrofusion tapping saddles.

C. All tapping fittings shall be approved by the Engineer prior to construction.

2.06 GATE VALVES

A. 2-Inch Through 12-Inch

1. Gate valves from 2 inches to 12inches shall be resilient wedge type rated for 250 psig cold water working pressure. All ferrous components shall be ASTM 536 (Standard Specification for Ductile Iron Castings) ductile iron. Valves from 2 inches to 12 inches shall be in full compliance with AWWA C515 (Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service). The words “D.I.” or “Ductile Iron” shall be cast on the valve. The wedge shall be ductile iron encapsulated with EPDM rubber. The wedge shall be symmetrical and seal well with the flow in either direction.

2. The gate valve stem and wedge nut shall be copper alloy in accordance with Section 4.4.5.1 of AWWA C515. The NRS stem must have an integral thrust collar in accordance with Section 4.4.5.3 of AWWA C515. Two-piece stem collars are not acceptable. The wedge nut shall be independent of the wedge and held in place on three sides by the wedge to prevent possible misalignment. Valves shall be certified to NSF Standard 61.

3. Nuts and bolts for joining valves to flanged ductile iron pipe shall be carbon steel with a minimum 60,000 psi strength conforming to ASTM A307 (Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength) Grade B. Bolts shall be standard ANSI B1.1, Class 2A coarse threads. Nuts shall conform to ASTM A563 and be standard ANSI B1.1, Class 2A coarse threads. All bolts and nuts shall be heavy hexagonal for greater bearing area. Identification on the bolt shall be A307B. Bolts shall be factory-coated with a blue fluoropolymer coating for corrosion resistance.

4. Metric socket head cap screws are not allowed.

5. The operating nut shall be constructed of ductile iron and have four flats at stem connection to ensure even input torque to the stem.

6. All gaskets shall be pressure energized O-rings. Stem shall be sealed by three O-rings. The top two O-rings shall be replaceable with the valve fully open and while subject to full rated working pressure. O-rings set in a cartridge are not allowed.

7. Valve shall have thrust washers located with one above and one below the thrust collar to ensure trouble-free operation of the valve.

8. All internal and external surfaces of the valve body and bonnet shall have a fusion bonded epoxy coating, complying with ANSI/AWWA C550 (ERTA Protective Interior Coatings for Valves and Hydrants), applied electrostatically prior to assembly.

9. Valve shall have class 125 flanged ends in accordance with ANSI/AWWA C110/A21.10 (ASME/ANSI B16.1 Class 125).

10. Gate valves shall be American Flow Control, Series 2500 Ductile Iron Resilient Wedge Gate Valves or approved equal.

2.07 TAPPING SLEEVES

A. Tapping sleeves shall be of ductile iron construction meeting ASTM A536. Side flange seals shall be O-ring type of either round, oval, or rectangular cross sectional shape.

B. All sleeves shall include the end joint accessories and split glands necessary to assemble sleeve to pipe. No special tools are required other than a standard socket wrench.

C. Sleeve shall be coated with NDF-61 certified asphaltic varnish.

D. Tapping sleeves shall be 2800-C Series by American Flow Control or approved equal. .

2.08 BALL VALVES

A. Ball valves (except for those specified separately under SERVICE VALVES) shall be full-port with NPT threaded ends. Valve body shall be of bronze. Ball and stem shall be of ASTM A 276 Type 316 stainless steel. Thrust washer shall be of reinforced PTFE, and packing shall be of PTFE. Ball valves shall be rated for 600 PSI non-shock cold working pressure and 150 PSI saturated steam.

B. Ball valves shall be Model T-585-70-66 by Nibco, Inc. or approved equal.

2.09 TRACER/LOCATOR WIRE

A. All HDPE piping installed under this specification shall be installed with two tracer/locator wires insulated with high molecular weight polyethylene (HMWPE) specifically for use in direct burial applications.

B. Tracer wires shall be 6-gauge solid or stranded annealed or hard copper per UL83 (Thermoplastic Insulated Wires and Cables) and ASTM requirements including ASTM B1 (Standard Specification for Hard-Drawn Copper Wire), B3 (Standard Specification for Soft or Annealed Copper Wire), and B8 (Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft).

C. Tracer wire shall be insulated. Insulation shall be for 600-volt applications and shall be a minimum of 45 mils thick. The minimum thickness at any point shall not be less than 90% of the specified average thickness in compliance with UL 83. The tracer wire shall have the UL 83 specification shall be clearly marked on the wire insulation. The insulation shall be colored green for sanitary sewer applications.

D. Two tracer wires shall be attached to the sewer pipe at five foot intervals or as approved by the Engineer. Attachment to pipe shall be made with plastic cable ties or equivalent. (Tape shall not be used.) One wire each shall be attached at the 3:00 and 9:00 locations.

E. Splices shall be for direct burial and in accordance with manufactures recommendations. Splice shall then be attached to pipe with ties and shrink-wrapped in place to re-establish insulation across spliced length. All splices shall require testing of the entire length of wire for continuity from structure to structure.

F. A minimum length of six feet of wire shall be coiled and left accessible under the cover of all manholes, service valve boxes and other structures as directed by the Engineer and in accordance with details in the plans. The tracer wire shall be attached to the outside of the manhole directly above the pipe and shall enter the manhole between the manhole cover frame and adjustment material.

G. For testing of tracer wire, see PART III EXECUTION.

2.10 AIR/VACUUM RELEASE VALVES

A. Air/vacuum release valves shall be specifically manufactured for use with sewage. Valves shall vent large volumes of air when the sewage line is filled and allow air to re-enter when draining to prevent vacuum or column separation from occurring. Valves shall discharge accumulated air (gases) from the system while it is under pressure and operating.

B. Valves shall have inlets and outlets sized appropriately according to the line size.

C. Valves shall have body, seal plug assembly, and base of reinforced nylon. The O-ring assembly inside the valve shall be of Viton.

D. Air/vacuum release valves shall be Combination Air Valve Model D-025 by A.R.I. Flow Control Accessories Ltd. or approved equal.

2.11 AIR RELEASE VALVE STRUCTURES

A. Structures containing air/vacuum release valves shall be a minimum of 6 feet in diameter as shown on the Low Pressure Sanitary Sewer Details.

B. Minimum clearance above air release valves shall be 18 inches.

C. Air release valves shall be installed in such a manner so as not to restrict/impede entrance into the structure by service personnel.

2.12 CHECK VALVE ON GRINDER PUMP DISCHARGE LINES

A. Check valves on grinder pump discharge lines shall provide a full-ported passageway when open and shall be designed to withstand a minimum working pressure of 150 PSI. The check valve shall be of heavy duty brass and shall be the gravity-operated flapper-type.

B. The check valve shall be placed immediately upstream of the service valve/curb stop.

C. Check valves shall be sized appropriately for line size.

D. Connections of check valves to plastic piping shall be made using a brass pack joint coupling. (See PACK JOINT COUPLINGS below.)

E. The check valve shall be Model 2050T Swing Check Valve by A.Y. McDonald Manufacturing Co., Model or approved equal.

2.13 SERVICE VALVE/CURB STOP

A. Brass service valves shall conform to the material requirements of ASTM B-62 (Standard Specification for Composition Bronze or Ounce Metal Castings) and ASTM B-584 (Standard Specification for Copper Alloy Sand Castings for General Applications) and UL classified to ANSI/NSF Standard 61.

B. Connections of service valves to plastic piping shall be made using a brass pack joint coupling. (See PACK JOINT COUPLINGS below.)

C. Service valves shall be sized appropriately for line size.

D. The service valve/curb stop shall be a Ford Model B11-666-M-K Brass Ball Valve Curb Stop or approved equal.

2.14 SERVICE VALVE/CURB BOX

A. All service valves shall be located within a cast iron curb box. The curb box shall be a Minneapolis pattern with a two-hole style base. Curb box base shall accommodate valve size. The lid shall be flush with the finished grade and marked “SEWER”.

B. Curb boxes shall be Ford Minneapolis Pattern Curb Box Model EM1-60-47 or approved equal.

2.15 PACK JOINT COUPLINGS

A. Couplings used to connect service valves and check valves to plastic piping shall be of brass conforming to the material requirements of ASTM B-62 and ASTM B-584 and UL classified to ANSI/NSF Standard 61.

B. Coupling shall be Ford Pack Joint Coupling Model C84-66-K or approved equal.

2.16 PIPE STANDS

A. Piping and valves inside manholes shall be adequately supported using adjustable pipe stands in accordance with the drawings. Pipe stands shall be constructed of Type 304 Stainless Steel.

B. Pipe stands shall be Standon Adjustable Pipe Supports as manufactured by Material Resources, Inc. (Standon Model C92 Saddle Clamp Support) or approved equal.

PART 3 EXECUTION

3.01 GENERAL

A. Construction procedure will generally be left to the discretion of the Contractor, so long as satisfactory progress is made and good workmanship is produced unless a specific procedure is specified in this section other section(s) of the contract documents or drawings.

3.02 UNLOADING, HANDLING, AND STORING PIPE

A. Lifting and handling of the pipe shall be in accordance with the manufacturer's recommendations. 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 effectually avoid the cracking of any pipe. Dropping pipe or fittings directly from the truck will not be permitted. No wire rope, chains or hook shall be used for the handling of HDPE pipe. Slings of rubber or fabric belting shall be used for this purpose. Stringing of pipe along the line shall be done so as to require a minimum of handling of the pipe.

B. Pipe shall be stored on a flat surface so that the barrel is evenly supported. Pipe shall not be stored in piles higher than 4 feet. When HDPE pipe is stored outside and exposed to sunlight, it must be covered with a canvas or other opaque material and must be provided with air circulation under the cover. Deflection of any particular amount of HDPE pipe shall not exceed 5%.

3.03 JOINING HIGH DENSITY POLYETHYLENE PIPE , TUBING AND FITTINGS

A. Pipe must be joined in strict conformance with the pipe and fitting manufacturer's instructions for the methods and connections described below.

B. HDPE pipe and fittings shall be joined using the electrofusion techniques described in ASTM F 1290 (Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings) or the heat fusion processes described in ASTM F 2620 (Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings).

C. Electrofusion couplings must handle the same or a higher pressure rating than the pipe or fitting being joined.

D. The pipe supplier shall be consulted to obtain machinery and expertise for the joining of HDPE pipe and fittings by electrofusion and heat fusion methods.

E. No pipe or fittings shall be joined by fusion by any Contractor unless he/she is adequately trained and qualified in the techniques involved.

F. Mechanical compression couplings and slip fittings may be used for joining HDPE pipe and tubing between ½ inch and 2 inches nominal diameter when it is impractical or impossible to use electrofusion or heat fusion methods. These fittings, when used, must be approved by the Engineer.

G. Mechanical joint (MJ) flange adaptors as described herein may be used for connections with pipe and fittings of different material, valves, and other appurtenances.

H. HDPE pipes of the same outside diameter but different wall thickness shall be joined by means of a flange assembly as designated above.

I. When in-line valves or other special fittings are called for on the plans, the Contractor shall install those fittings during pipe installation. Failure to do so may cause expansion/contraction complications that will require rework at the Contractor's expense.

3.04 DEFECTIVE PIPE AND FITTINGS

A. No pipe or fitting that is known to be defective 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. If the major part of a defective pipe is sound, the good end may be cut off and used. Every such cut shall be square and ground smooth.

3.05 INSTALLATION OF HDPE PIPE BY OPEN-CUT METHODS

A. Excavation

1. Excavation shall include clearing of the site of the work and the removal and disposal of all materials necessary to be removed in the construction of all work under this Contract.

2. Excavation shall be to depths indicated on the plans and as necessary to provide cover of five feet over the top of pipe, unless otherwise noted on the plans.

3. Excavation shall precede the pipe laying by a safe distance, with no more than 50 lineal feet of trench being open at one time, unless authorized by the Engineer. Excavation shall be of sufficient widths and depths to provide adequate room for construction bedding and installation of the work to lines, grades, and dimensions called for on the plans. Trench width, from the invert to a height of twelve (12") inches above the top of the low pressure sewer, shall not be greater than thirty (30") inches. If the maximum trench width as specified above is exceeded, the Contractor shall install, at his own expense, such other bedding as is approved by the Engineer to support the added load of the backfill.

4. Where, through the Contractor's construction procedure, or because of poor existing ground conditions, it is impossible to maintain alignment and grade properly, the Contractor shall install, at his own expense, MDOT coarse aggregate 6A in order to insure that the pipe, when laid, will maintain correct alignment and grade.

5. Excavated materials may be temporarily stored along the trench in a manner that will not cause damage to trees, shrubs, fences, or other property, and that will not interfere with traffic or endanger the bank of the trench by imposing too great a load thereon.

6. Open cut excavations for shafts or other structures shall be adequately braced and/or sheeted, to prevent caving or squeezing of the soil. All excavations shall be completely dewatered prior to construction of the low pressure sewer or other structures, and adequate provisions shall be made to prevent water from flowing through or over newly placed concrete or brickwork. Drainage shall be carried to sumps from which the water may be pumped.

B. Control and Disposal of Water

1. The Contractor shall remove by well points, pumping, bailing or other acceptable method, any water that may accumulate or is found in the trenches or other excavations. Contractor shall make all necessary provisions to keep trenches and excavations entirely free of water during construction of pipelines and structures.

2. Contractor shall have on site, at all times, sufficient pumping equipment ready for immediate use to carry out the intent of this section. All costs for dewatering trenches shall be incidental to the Contract. Pumping or draining from trench excavations shall be made on either side of the pipeline and not into the waters of the State. It shall be the Contractor's responsibility to secure the necessary approval of private landowners before discharging water from the trench excavation onto private lands. Water shall be discharged in such a manner as to cause no pollution or erosion. Contractor shall dewater to existing storm sewer systems wherever possible. Disposal methods shall be approved by the Engineer.

3. Discharge water from dewatering methods shall be sediment free or discharged through an Engineer-approved sediment entrapment basin or bag device.

4. At no time will silt or similar materials generated as a result of dewatering operations be permitted to enter a lake or natural watercourse. In situations where dewatering flow passes over the ground and enters a storm sewer or temporary piping system connected to a natural watercourse or lake, a silt retention structure shall be built at the point of entry to said storm sewer or temporary piping system. Silt retention structures may consist of several straw bales adequately anchored and placed as directed by the Engineer. Any eventual silt or solids retained in the area of these structures shall be removed prior to removal of the structure.

C. Pipe Support

1. Stone Refill:

a. In locations where the soil at the bottom of the trench is unstable, when ordered by the Engineer, the Contractor shall excavate below the trench bottom to suitable soils and refill with MDOT coarse aggregate 6A or other stone material as directed by the Engineer.

D. Placing of Pipe

1. All pipe shall be carefully placed to line and grade called for on the Drawings. Each pipe, as placed, shall be checked by the Contractor for line and grade to ensure that this result is obtained.

2. Immediately before laying, each section of pipe or fitting shall be thoroughly cleaned of all debris, dirt or other foreign material. It shall be inspected for damage to pipe material and repairs made where required. Care shall be taken to keep the interior of the pipe clean and free from dirt and other foreign materials. Bulkheads or other means shall be used at the open ends of the pipe for this purpose.

3. After the pipe is laid, (open cut only) the bedding shall be carefully compacted under the haunches of the pipe, and the trench shall be backfilled to twelve-inches above the pipe as specified under “Bedding and Backfilling”. Sufficient backfill shall be placed after each joint is made along the sides of the pipe to offset conditions that might tend to move the pipe off line or grade. Any pipe found off grade or out of line shall be re-laid properly by the Contractor.

E. Bedding and Backfilling

1. General:

a. Bedding and backfilling shall be in accordance with the pipe manufacturer’s recommendation if found to be more conservative than the requirements outlined herein.

b. Where minimum soil compaction percentages are specified, maximum density shall be determined in accordance with the Modified Proctor Test, ASTM D 1557 (Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).

c. Care shall be taken during compaction to avoid distorting the shape of the pipe or damaging its wall. Mobile equipment shall not be used over the pipe trench until forty-eight (48) inches of cover has been placed.

d. Bedding beneath the bottom of the pipe shall consist of 6 inches of sand, tamped in place that is free of stones or hard particles larger than ½ inch. Bedding shall be

mechanically tamped in place for compaction to 90% of maximum density as defined in ASTM D 1557. Compaction shall be increased to 95% under streets and roads.

e. Initial backfill from the bottom of the pipe to a minimum of 12 inches above the pipe shall be sand. The particle size shall not exceed one-half inch for pipes 2 to 15 inches in diameter. Initial backfill shall be compacted to a minimum of 90% of maximum density as defined in ASTM D 1557. Compaction shall be increased to 95% under streets and roads. (Approval may be given to alternate materials and methods to achieve standard bedding.)

f. Flooding of the trench to consolidate bedding shall not be used.

g. Selected excavated material for use in backfill is defined as soil that is capable of meeting identified compaction requirements and is free of large or frozen lumps, asphalt, concrete, rubble, boulders, blue clay, topsoil, peat, marl, wood, debris, vegetation, or other extraneous materials as determined by the Engineer. Stones shall not exceed 8 inches.

h. Zone-of-influence is defined as a one to one (1 horizontal to 1 vertical) slope from the edge of pavement to the trench bottom.

i. The bottom of the trench shall be excavated neatly to the required grade prior to filling with six (6") of sand bedding as described above and thoroughly compacted by tamping before the pipe is laid. Wherever compaction is required, it shall be by suitable mechanical compaction equipment approved by the Engineer. Blocking under pipe is prohibited.

j. After the pipe is laid, initial backfill material as described above shall be thoroughly compacted in place, to a level twelve (12") inches above the top of the pipe. Particular care shall be taken to assure filling all spaces around and above the top of the pipe.

k. It is essential that it be recognized that the successful use of flexible pipe requires bedding that provides unyielding side support and complete bedding contact under pipe haunches. Bedding material must be properly placed and compacted to provide lateral restraint against deflection in the pipe diameter. Pipe must be bedded to true line and grade throughout its length.

l. Where unstable bottoms are encountered, the contractor shall provide a foundation consisting of an approved graded processed angular stone or filter fabric to act as an impervious mat to impede migration or vertical movement of unstable soils or bedding materials. Where trench sheeting, plates, or a trench box are used due to severe ground conditions, all voids to the side and below the top of the pipe caused by the sheeting, plates or box withdrawal shall be completely filled or the supports left in place below the top of the pipe.

m. The backfill from twelve (12") inches above the pipe shall be placed into the trench according to one of the methods specified below as determined by location of the edge of trench nearest the existing pavements. As previously stated Where minimum soil compaction percentages are specified, maximum density shall be determined in accordance with the Modified Proctor Test, ASTM D 1557 (Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).

n. Frozen material may not be used for trench backfill.

1) Within Road Right of Way:

a) If within the road right-of-way, backfill and compaction requirements shall be in conformance with the Road Commission for Oakland County Permit Rules, Specifications, and Guidelines, or other applicable agency.

2) Under Concrete and Asphalt Pavements, Sidewalks, Driveways and Parking Areas:

Trench Location	Backfill Requirements
A. Under concrete and asphalt surfaces and within the zone-of-influence.	Backfill shall be in accordance with the detail sheet with mechanically tamped sand or gravel in 6" layers, loose measure, with each layer compacted to not less than 95% of maximum dry density as determined by the ASTM D 1557 Compaction Standard.
B. Outside the zone of influence and within road right-of-way.	Backfill material shall be placed into trench in 6" layers, loose measure, with each layer compacted to not less than 90% of maximum dry density as determined by the ASTM D 1557 Compaction Standard. Selected excavated material may be used provided compaction requirement can be met.

3) Under Gravel Roads, Driveways, and Parking Areas:

Trench Location	Backfill Requirements
A. Within the zone-of-influence and within road right-of-way.	Backfill materials shall be placed into trench in 6" layers, loose measure, with each layer compacted to not less than 90% of maximum dry density as determined by the ASTM D 1557 Compaction Standard. Selected excavated material may be used provided compaction requirement can be met. The Contractor shall immediately restore all roads, driveways, and parking areas with (MDOT 21AA natural gravel) or slag aggregate, or approved

	equal, to match original aggregate, at least 8 inches thick and shall maintain them in good, dust-free condition during the life of the Contract. Additional aggregate shall be added if settlement occurs. Before final acceptance of the road, driveway, or parking area, it shall be top-dressed with approved material to match the original surface treatment. Gravel shall be suitably stabilized with calcium chloride.

o. Open Fields & Lawn Areas:

1) Backfill material shall be placed into trench in 12” layers, loose measure, with each layer compacted to not less than 90% of maximum dry density as determined by the ASTM D 1557. Selected excavated material may be used provided compaction requirement can be met. Compaction will be tested at the inspector’s discretion.

2) Contractor shall re-grade as necessary during the life of the Contract. For restoring lawn and landscaped areas see the Oakland County Water Resources Commissioner’s General Specifications Section 8, "Final Cleanup and Restoration”. No frozen materials are permitted.

p. Special Backfill:

1) Where called for on the plans or where required by Road Permits, the Contractor shall backfill trenches in accordance with the requirements of said plans or Road Permits.

2) Where "Special Backfill Requirements" are called for along highways under the jurisdiction of the State of Michigan, the Road Commission for Oakland County, or the local unit of government, the Owner will employ an independent testing laboratory to make compaction tests and the costs of the tests will be paid for by the Contractor.

3) Backfilling around all structures shall be placed in compacted one-foot layers, in a manner that will not cause unequal pressure or damage to any exterior coatings or plastering.

3.06 INSTALLATION OF HDPE PIPE BY DIRECTIONAL DRILLING

A. Refer to Specification Section SECTION 33 05 23.13 HORIZONTAL DIRECTIONAL DRILLING

3.07 HYDROSTATIC TESTS

A. Following pipe laying and backfilling, the Contractor shall complete all work necessary to perform hydrostatic testing. If, in the opinion of the Engineer, work has not progressed in a reasonable manner, he shall have the right to direct the Contractor to proceed with the work, or any portion thereof, immediately. The Contractor shall perform all necessary preliminary hydrostatic tests and shall make all necessary repairs, including the repair of all visible leaks and cracks, and retest with his own forces to ready the low pressure sewers for final hydrostatic inspection and testing which will be witnessed by the Engineer. Immediately after the low pressure sewers have passed such preliminary tests, the Contractor shall submit a written request to the Engineer for final hydrostatic inspection and test.

B. Prior to and during the hydrostatic test, the new main cannot be connected to low pressure sewers or pump stations installed in other Contracts, except as specified herein.

C. The Contractor shall furnish all necessary personnel, temporary timber bracing, plugs, test pumps, and all other necessary apparatus for conducting the test. All gauges and meters used for testing shall be rated at or above required test pressure. Test gauges will be 3 1/2 or larger readable in one or two pound increments. Meters and gauges shall be calibrated every six months. Calibration will be to an accuracy of ±1% or better. Verification of calibration shall be furnished to the Engineer prior to start of test.

D. Before applying test pressure, all air shall be expelled from the pipe. If necessary to accomplish this, taps shall be made at points of highest elevation in the pipe, and such opening subsequently closed prior to test.

E. Test pressure shall be maintained at one 150 lbs. pounds per square inch at the point of highest elevation in the test section by pumping water from an approved source into the pipe for a period of at least two hours, and in all cases long enough to permit assurance of a satisfactory test. Allowable leakage shall not exceed 50 gallons per inch diameter of pipe per mile of pipe for 24 hours.

F. Maximum length of main line pipe shall not exceed 2,000 linear feet for any one test.

G. 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 castings found to be cracked shall be removed and replaced with 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.

3.08 TRACER WIRE CONTINUITY TESTING

A. The Contractor shall test the continuity of the tracer wire from structure to structure using equipment approved by the Engineer (See SUBMITTALS).

B. Copies of tests reports shall be submitted to the Engineer.

C. At least one wire must pass the continuity testing requirement.

END OF SECTION