

CITY OF MARQUETTE
CHAPTER 6
STANDARD SPECIFICATIONS

6.01 WATER MAIN CONSTRUCTION

6.01.01 Scope of Work

A. Scope of Work

This work will be subject to the General Requirements and Covenants of the Contract, requirements contained herein, and details shown on the plans. The Contractor shall provide all the labor, material, tools, equipment, accessories and services necessary to install the items called for on the contract documents, and will be responsible for producing a complete and workable installation in keeping with the intent of the Contract.

B. Applicable Standards

Unless otherwise specified herein, materials and methods for the construction of the water main will conform to the standards set forth by the American Water Works Association (AWWA), the American National Standards Institute (ANSI), and the Recommended Standards for Water Works prepared by the Great Lakes- Upper Mississippi River Board of State and Provincial Public Health and Environmental Mangers, including the latest revisions of any of those standards.

C. Work Included under this Section

The work shall consist of furnishing and installing water mains, valves, hydrants, and fittings and other connections, of the type and size specified and at the locations shown on the plans. The work shall also include the necessary excavation, pipe bedding, backfill, compaction, testing, and sterilization.

D. Shop Drawings

The Contractor shall furnish to the Engineer, as prescribed under the General Requirements, shop drawings of the various pieces of equipment to be incorporated into the work. Shop drawings will indicate design details of the items to be furnished, their location and function in the project, finish, operating details and other such information as will indicate to the Engineer their suitability for use under this Contract. The Engineer will approve shop drawings, or request revisions of resubmittals as necessary to assure that a particular item is acceptable and conforms to the specifications.

E. Certification and Inspection

The manufacturer of pipe and other such items shall furnish a statement that all materials provided by him have been inspected and tested in accordance with the applicable standards. Each piece of pipe and each fitting shall have its weight and class designation conspicuously cast or painted on it. All other pipe materials shall have the class designation painted thereon. Where required, other designation marks shall be painted on pipe and fittings to indicate correct location in the pipeline to conform to a detailed layout.

Upon delivery of pipe and other materials to the job site, it will be inspected and approved by the Engineer or his representative, at which time the Engineer will receive a copy of the manufacturer's certified statement. No cracked, broken, damaged or otherwise defective pipe or fittings will be incorporated into the work. Any item that is found to be defective after it has been laid in the work shall be removed by the Contractor and replaced with a non-defective item.

F. Use of Public Water Supply

Unless specifically authorized by the Engineer or special provisions elsewhere in this document, the Contractor shall not take water from an unmetered connection for use in the course of his work. Where water is to be drawn from the City fire hydrants, the Contractor shall make application with the Department of Public Works for a permit and issuance of a hydrant meter. The Contractor will be billed for water used according to the latest current billing schedule contained in Chapter 56 of the City of Marquette Ordinances.

G. Equipment and Material supplied by the City

The Contractor shall not seek to purchase equipment or materials for use under this contract from the City Water Department, unless special provisions have been made elsewhere in this document for the purchase of specific items from City supplies.

H. Traffic Maintenance and Control

Streets shall not be completely closed to traffic without prior authorization of the City Engineer. When an opening or excavation is made in any street, or a street must be closed to traffic, the Contractor shall provide such notification and signing as are required by the City Engineer's Administrative Guides for Traffic Control and the 2011 Manual on Uniform Traffic Control Devices.

6.01.02 Materials for Water Main Construction

A. General

The allowable types of pipe, fitting joints, and other items for water main construction are specified herein. All pipes shall have clear inside diameters not less than the dimensions called for. Wall thickness, class designation, and material of construction shall conform to these requirements and other such standards as are called for in these specifications.

B. Pipe Material

1. Ductile Iron Pipe (DIP)

Class 52 ductile iron pipe for water main construction shall meet all the requirements of the American National Standards Institute (ANSI) Specification A21.51 and the American Water Works Association Specification C151, Class 52 or the latest revisions thereof. Pipe shall be designed for a minimum working pressure of 150 pounds per square inch (psi), and shall be double cement-lined 1/8" (3mm) and seal coated inside and out in accordance with ANSI A21.4 and AWWA C 104 specifications, or the latest revision thereof.

C. Joints for Pipes

Joints for use with ductile iron pipe shall be of the types enumerated below and shall be furnished with the pipe for use at the locations shown on the plans or otherwise listed in the Contract Documents. All necessary joint materials, gaskets, bolts, lubricant, and other such items as are necessary to make a completed joint shall be furnished with the pipe or fitting.

1. Slip On (Push-On) Joints

Slip on joints shall conform to ANSI Specification A21.11. Rubber gaskets and lubricant as specified by the pipe manufacturer shall be furnished with the pipe in sufficient quantity to complete all joints in the pipeline.

2. Mechanical Joints

These joints shall conform to ANSI A21.11. Rubber gaskets shall be according to the manufacturer's standard. Mechanical joint pipe shall be required for use when watermain is to be enclosed in a casing pipe.

3. Flanged Joints

Flanged joints will be made using ANSI 125-pound pattern flanges and shall include all necessary bolts, nuts, washers and gaskets in accordance with ANSI B16.1.

4. Ball Joints

These joints shall be cast iron, mechanical, flexible jointed tube, designed to withstand a working pressure of 200 psi and a hydrostatic test pressure of 300 psi. Joints shall be similar to those produced by the following companies:

"FLEX-LOK" by American Cast Iron Pipe Company

"USIFLEX" by U.S. Pipe and Foundry Company

"River Crossing Pipe" by James B. Clow and Sons, Inc.

5. Locking Gaskets

Joint restraint for mechanical joint pipe and fittings shall be the MJ FIELD LOK® Gasket or approved equal. The restraint system shall be completely integral to the gasket, requiring only standard mechanical joint assembly techniques. The restraining system for ductile iron shall be pressure rated to 350 psi in sizes up to and including 16" and pressure rated to 250 psi for sizes 18"-24". The restraining system shall be rated in accordance with the performance requirements of ANSI/AWWA C111/A21.11. Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

D. Valves

Valves of the required type shall be furnished and installed at the locations shown on the plans. Valves supplied shall be compatible with the type of pipe material and joints called for on the plans. Valves for Use with Ductile Iron and Cast Iron Pipe shall conform to the requirements listed below.

1. Gate Valves

Gate valves shall be designed to withstand a working pressure of 150 psi for valves 16 inches and larger and 200 psi for valves sized 3" through 12" and will conform to AWWA Specification C500. All valves shall be of cast iron construction, fully bronze mounted, with a bronze stem, "O"-ring stem seal, and shall have a clear waterway opening, when

fully open, equal in area to that of the connecting pipe. All gate valves will be made to open when turned to the right, or clockwise, and shall have non-rising stems.

2. Butterfly Valves (3" – 72")

Butterfly valves shall conform to AWWA Standard C504-74, or the latest revision thereof. Valves shall be class 150B, shall have cast iron bodies, necks and top pieces, and shall have discs of ni-resist cast iron, bronze or stainless steel. They shall be supplied with "O" ring type stem seals. Valve seats and stem seals shall be of Buna-N or Hycar. Valves shall be painted with asphalt varnish or zinc chromate in accordance with Section 15 of AWWA C504. All valves shall be supplied with manual operators as an integral part of the valve assembly, unless otherwise specified or called for on the plans. Operators shall be made to open the valve when turned to the right, or clockwise.

3. Swing Check Valves

Swing check valves for water main construction shall conform to AWWA C508-76 or latest revision thereof. Swing check valves shall be designed for horizontal installation, shall have bronze seating, and shall be supplied with flanged end connections conforming to ANSI B16.1, Class 125. Discs on valves smaller than 10" shall be solid bronze, and on sizes larger than 10", they shall be cast iron with bronze facings. Two coats of an asphalt varnish made to comply with Federal Specification TT-V-51e shall be applied to interior and exterior ferrous surfaces, except for bearing or finished surfaces.

4. Tapping Valves

Tapping valves shall conform to the requirements outlined in Section A., above, for gate valves, except that joints shall consist of a flanged joint inlet end for mating with the tapping sleeve and a restrained mechanical joint outlet. Oversize seat rings may be provided to permit entry of tapping machine cutters. Tapping valves shall be similar to the F-6106 Mechanical Joint Tapping Valve as manufactured by the Clow Company, or an approved equal.

5. Resilient Seated Gate Valves, 3" – 12"

Resilient seated gate valves shall conform to AWWA Standard C509-80, or the latest revision thereof and shall be furnished with the following detailing:

- a) Open right, or clockwise
- b) 2" square wrench nuts, where applicable
- c) Bronze stem
- d) Wedge rubber bonded to ductile iron wedge
- e) Symmetrical seating about stem centerline
- f) No depressions or cavities in seat area
- g) Body and bonnet of valve to be fusion bonded epoxy coated inside and out.
- h) Double "O" ring seal

Valves shall be designated as follows:

TYPE	APPLICATION	OPERATOR	TYPE JOINTS*
RA	Direct Burial	2" Square Wrench Nut	Mechanical
RB	In Vault	2" Square Wrench Nut	Flanged
RC	In Vault or Structure	Handwheel	Flanged

*Other type joints or combinations of joints may be specified on the plans.

Valves shall be similar to the Waterous Series 2500, American –Darling “80 CRS”, Clow F-6100, or an approved equal.

E. Valve Boxes

Valve boxes for use with buried gate valves or butterfly valves shall be three piece, screw type adjustable, cast iron boxes with a 5 ¼” diameter shaft. Covers shall be furnished with finger holes and shall be marked "WATER". Valve boxes shall be similar to Tyler/Union 6860, ej 8560, or an approved equal. Valve box will be adjusted to final grade in the asphalt pavement using a self-leveling valve box riser. Riser will be similar to ej 8555 or approved equal.

F. Standard Fittings

Fittings to be used for water main construction shall be of a type and material compatible for use with the type of pipe being used, and shall meet the following requirements:

Fittings for ductile iron pipe shall meet the requirements of ANSI/AWWA C153/A21.53 with the exception of dimensions and thickness as specified by the manufacturer. Working pressure shall be a minimum of 350 psi. Fittings shall have a nominal wall thickness of CL 54 ductile iron pipe. Cement lining and seal coating shall be in accordance with ANSI/AWWA C104/A21.4. Certification and marking shall be as specified therein. This standard shall apply to fittings with push-on or MJ joints.

G. Special Fittings

Fittings called for on the plans which are not addressed in AWWA Standard C110 shall, nonetheless be constructed and certified by the manufacturer thereof to be compatible with fittings for ductile iron water main. Such Special Fittings shall comply insofar as practicable with the provisions of AWWA C110 with regard to workmanship, durability, and material of construction, they shall be designed to withstand the same working and test pressures as prescribed for the watermain and its appurtenances, and shall be built to such other standards as are commonly accepted as normal practice within the waterworks industry.

H. Fire Hydrants

Fire hydrants shall be of the dry-barrel type and shall meet the requirements of AWWA Standard C502-80, including any revisions thereto and the hydrants must be UL listed. In addition, the standard fire hydrant for use in the City of Marquette will be supplied with the following details:

1.	Bury Length	7' 0"
2.	Outlet Details:	
	Hose Bibs	2 ea, 2 ½" Diameter, 2 ½" Nat'l Sed.
	Steamer	1 ea, 4 ½" Diameter, Thread 4 ½" 4.5-4NH, 4 ½" Nat'l Sed.
	Nozzle Elevation	National Standards 21" to 24" above Grade line
3.	Main Valves	5" min. Diameter
4.	Inlet Connection	6" Mechanical Joint (Restrained)
5.	Direction to Open	Left (Counter Clockwise)
6.	Finish	Paint chrome yellow above grade line; asphalt varnish per AWWA below grade
7.	Shut-Off	Closes with pressure
8.	Drain Outlet	Plugged or eliminated
9.	Nozzle Cap	Rocker – Lug Type
10.	Operating Nut	1 ½" Nat'l Sed. Penta-Nut
11.	Stem Seal	"O" Ring
12.	Traffic Flange	Breakable

Hydrants shall be: Waterous Pacer Model WB67-DDP, or ej BR-250, or approved equal.

I. Continuity Conductors

Electrical continuity in water mains shall be provided through the use of continuity conductors where fittings continuity shall be provided through the use of "Electro-Bond" strips, "Cadweld" connectors, or similar devices as approved by the Engineer. Lead tipped gaskets may not be used.

J. Bedding and Covering Pipe Material

The bedding materials and materials covering the pipe, in general, shall be in accordance with the Michigan Department of Environment, Great Lakes, and Energy standards of a Class IIIA material. The Class IIIA material will be placed 12 inches above the top of pipe.

K. Backfill Material

Unless otherwise called for on the plans, or when directed by the Engineer, earth excavated from the trench may be used for backfill, provided that it consists of sand, loam, or other suitable material. Unstable materials containing peat or other organics, or materials which contain large amounts of refuse, broken pavement, boulders, roots, stumps, or other debris, shall not be incorporated into the backfill.

L. Stone Backfill

Stone used for backfill trench undercuts or for trench stabilization shall meet the requirements for 25A Stone, per Michigan Department of Transportation (MDOT) Standard Specifications for Construction, latest revision thereto.

6.01.03 Construction Methods

A. General

The Contractor will be responsible for assuring that his methods of construction are in reasonable accord with generally accepted industry practices, standards as set forth by the American Water Works Association and the Michigan Occupational Safety and Health Administration the requirements set forth herein, and determinations made by the Engineer. Unless specifically stated otherwise on the plans, or at the discretion of the Engineer, the following general rules will apply.

1. Handling and Storage of Materials

Materials delivered to the job site for incorporation into the work shall be handled and stored in such a manner as to prevent damage to the materials. Such materials shall be neatly placed along or near the site so as to minimize inconvenience to the public and property owners, and with due regard to the safety of the general public. Construction materials shall not be placed or stored closer than 20' from any fire hydrant, crosswalk, or intersection.

2. Sequence of Operations

As a rule, the following sequence will be followed by the Contractor:

- a) Pipe laying
- b) Pressure & Leakage Testing
- c) Electrical Continuity Test
- d) Cleaning and Flushing
- e) Sterilization
- f) Bacteriological Testing
- g) Connection to Existing System
- h) Put Main in Service
- i) Tap and Install Services

Deviation from this sequence may be permitted by the City Engineer, provided that prior approval is obtained from him and that such deviation is warranted.

3. Minimum Depth of Bury

All water main constructed within the City of Marquette shall be buried with a minimum of 6.5' of cover between the top of the pipe or fittings and the surface of the ground. When a proposed surface grade is shown on the plans, it shall serve as the datum for determining depth of burial; otherwise depth of burial shall be measured from the existing surface. In the instance where a permanent high ground water table is encountered, the Engineer, at his option, may reduce those requirements in lieu of the added expense of dewatering the trench.

4. Isolation from Sewers

Any water main constructed parallel to a sanitary sewer shall be separated by a distance of at least 10 feet, measured horizontally, from the edge of the sewer to the edge of the watermain. Water main which crosses a sanitary sewer shall be separated by a distance of 18", measured from the outside of each pipe, at their closest points.

5. Notification of Utility Customers

When the Contractor's schedule of work includes shutting down all or parts of a watermain, or other operation, which will disrupt service to customers of the water utility, the Contractor shall be responsible for notifying affected customers in advance. Businesses shall have at least 24 hours advance notice, and contact shall be made

personally or by telephone with the manager or other person in charge of the business. Private residences shall be notified as soon as practical in advance of any shutdown, and mass media communication may be used.

B. Excavation

The contractor shall proceed with trench excavation with due regard for life, health, and property. Appropriate equipment shall be used to perform the work and, where necessary, measures such as the use of sheathing, shoring, trench boxes and dewatering systems shall be employed. Excavation shall proceed in the direction of pipe laying and shall be in reasonable conformity to the line and grade established on the plans or by the Engineer.

1. Protecting Other Utilities

No excavation work shall commence until owners of other utilities have been notified and they have had an opportunity to mark the location of any equipment, pipeline, conduits, or other works located within the project area. Excavation within close proximity to underground utilities shall proceed cautiously and final uncovering shall be done with hand shovels in order to protect such utilities from damage. Where excavation work uncovers conduit, pipelines, bases for utility poles, or similar structures, the Contractor shall make arrangements to shore up, guy, support, or otherwise protect such utilities from damage caused by cave-ins or settlement in the trench.

2. Removal of Surfacing

When excavation will take place within or through an improved street, roadway, driveway, or sidewalk, the pavement or surfacing shall be cut straight and square at the edges of the trench, using suitable equipment. The surfacing material shall then be removed and disposed of before excavation of the trench begins. Cuts for removal of surfacing shall be made equidistant on either side of the pipe centerline and no further apart than the allowable trench width, as provided in Section 4, below.

3. Length of Open Trench

Not more than 200 linear feet of trench may be open at one time. Under unusual circumstances, the Engineer may authorize more than 200 linear feet of trench to be open, provided that pedestrian and driveway crossings are maintained at intervals of not more than 200 linear feet and that not more than one street intersection is closed to traffic.

4. Trench Width

The maximum trench width at the top of the pipe shall not exceed the outside diameter of the pipe being laid, plus 24". This width may be increased to allow for stringers and sheeting when they are required. At least 6" of clearance shall be maintained between the outside face of the pipe barrel and the trench wall or sheeting. The trench width at the ground surface shall be in accordance with MIOSHA standards. The Contractor shall use sheeting and shoring, dewatering system, or other such measures as are consistent with maintaining a safe trench and safeguarding adjacent properties.

5. Trench Undercut & Backfill

When unstable soil conditions are encountered in the trench bottom, such as peat, muck, or saturated soils, the Engineer shall investigate and determine whether Trench Undercut and Backfill shall be used to provide a suitable foundation for pipe laying. The Contractor shall have the trench dewatered where necessary in order that the Engineer

may investigate and make a determination. Trench undercutting shall be performed within the limits determined by the Engineer, and all excavated material from the undercut will become the property of the Contractor. The undercut shall then be backfilled, using stone backfill material as specified in Chapter 6, up to the elevation of the bottom of the pipe.

Where the depth to stable soil is excessive, the Engineer may, at his option, order other types of bedding or foundation to be constructed. Such other types of bedding or foundation will be considered as an extra, and details of construction and methods of payment shall be mutually agreed to before commencing with such construction.

6. Rock Excavation

Where rock is encountered in the trench, the trench will be fully opened for at least 30 feet in advance of the pipe, and all loose or friable material will be excavated or otherwise removed from the rock surface before the Engineer takes measurements for the rock excavation. The Contractor will then proceed with excavating the rock to a neat line 6" below the proposed pipe grade and 12" on either side of the pipe. Rock excavation shall extend far enough beyond any structures to provide room for placement of forms and other such operations. When blasting is necessary, it shall be carried out with due regard for the life, health, and property of the public in general. The Contractor shall secure a permit from the City Manager in accordance with Chapter 41.01 of the Marquette City Code of Ordinances prior to any blasting operations. He shall also secure approval, in advance, from the Engineer concerning scheduling, method of covering blasts, and the general procedure to be used.

Rock, for the purpose of this specification, shall include preglacial ledge rock or similar igneous or metamorphic materials which can be removed most practically by blasting, barring, wedging, or some other method of quarrying solid rock. It shall also include solid boulders of ½ cubic yard or more in volume, and concrete or similar structural materials which cannot be removed with earth excavating equipment. Rock shall not include fragile, friable or disintegrated materials which can be removed with greater facility by earth excavating equipment, rather than by blasting, barring or wedging.

C. Pipelaying

The Contractor shall have adequate and sufficient equipment at the work site for lowering pipe and fittings into the trench and effecting their installation without damage. Under no circumstances will pipe or fittings be dropped into the trench. Any scratches or damage to coatings will be repaired, and all mud or accumulations of dirt will be removed from pipe or fittings prior to their installation.

1. Line and Grade

The pipe shall be laid in the trench in reasonably close conformity to the line and grade shown on the plan. The Contractor will be responsible for a dumpy level and automatic or self leveling levels or other methods of measurement as will assure that the pipe is to correct line and grade, based on the plans, directions of the Engineer, and layout controls as the Engineer may establish. In general, pipe in the trench will be laid with a tolerance of plus or minus 3" for grade, and plus or minus 12" for line. At structures or fittings, alignment shall be sufficiently precise to assure that no undue misalignment or stress is placed upon fittings or structures.

2. Direction of Laying

Unless otherwise directed, the pipe shall be laid with bell ends facing the direction of laying. When the grade exceeds 2 percent, the bell ends shall face upgrade.

3. Bedding Pipe

All pipes shall be bedded around the bottom one-quarter of its circumference with material meeting the requirements of Chapter 6, Bedding Material. Care shall be exercised to ensure that a minimum of 4" of bedding material, free of rocks, sticks, or boulders, is placed below the pipe. Where the natural material in the trench bottom meets the requirements for bedding material, the pipe may be laid directly on the trench bottom and bedding material placed and compacted around its circumference. The pipe shall be uniformly supported along its entire length, and no loose spots or voids are to be tolerated. If Trench Undercut and Backfill has been used, sufficient bedding material shall be placed to assure that the pipe is uniformly supported. Where trench excavation is in rock, a minimum of 6" of bedding material will be placed between the neat line and the bottom of the pipe.

4. Covering Pipe

Once the pipe has been properly laid and jointed, it shall be covered with material meeting the requirements of bedding material. The cover material shall be carefully placed by hand or other means to prevent inclusion of rock, frozen lumps, or other deleterious material, and to ensure that the pipe will not be dislocated in the trench. The cover material will be placed and compacted, free of loose spots or voids, around the side of the pipe and up to a depth of 6" above the top of the pipe. No backfilling of the trench will be done until the pipe is properly covered.

5. Joining Pipe

The interior of all pipe and fittings will be kept clean during the laying and joining operations. If necessary, the Contractor shall plug or cover the ends of pipe and fittings until they have been lowered into the trench and just before the joint is made. The spigot ends of pipe shall be carefully centered in the bell of the previous piece and forced home. The pipe shall then be brought to line and grade. Every precaution shall be taken to prevent dirt from entering the joint space or damage to gaskets. All joints shall be made in strict accordance with manufacturers recommended practice, with particular attention given to maximum allowable deflections.

After the joint is made and the pipe has been brought to line and grade, it shall be sufficiently anchored with bedding and cover material to prevent its being dislodged by placement of the next piece.

6. Restraining Joints

All joints with deflections greater than ten (10) degrees, all tees, hydrant leads, end caps, plugs and similar fittings subject to axial thrust from water pressure shall be suitably restrained against movement or blowing off. The method of joint restraint shall be designed to withstand, at a minimum, the test pressure to be applied to the watermain. The Contractor shall submit details of proposed joint restraints, showing type and location, to the Engineer for approval.

The following methods of joint restraint, and their applications, will be acceptable:

a) Pipe Restraint Schedule

PIPE SIZE IN INCHES	RESTRAINED PIPE LENGTH IN FEET (1)								
	HORIZONTAL BENDS				DEAD ENDS (2)	45° VERTICAL BENDS		REDUCER ONE SIZE REDUCTION	REDUCER TWO SIZE REDUCTION
	TEE, 90°	45°	22-1/2°	11-1/4°		UPPER	LOWER		
4	23	9	5	2	55	23	8	-	-
6	32	13	6	3	77	32	11	21	-
8	40	17	8	4	100	41	14	21	49
12	56	23	11	6	141	58	20	40	81
16	71	29	14	7	181	75	25	41	96
20	84	35	17	8	218	90	30	42	94
24	96	40	19	10	253	105	35	42	106
30	112	47	22	11	303	125	41	59	117

b) Retainer Glands

When mechanical joint pipe and fittings are used, mechanical joint retainer glands shall be installed on a sufficient number of joints each side of a bend or fitting to adequately restrain the pipe. Extreme care shall be used in tightening set screws to assure that they are tightened uniformly, and in proper sequence, to the torque specified by the manufacturer. A calibrated torque wrench shall be used to achieve all recommended torques. Retainer glands shall be similar to Megalugs or approved equal.

c) Thrust Blocks

Thrust blocks shall be used at joints and deflections in push-on joint pipe. Thrust blocks shall be placed against undisturbed earth in the trench wall and shall be sized adequately to restrain the pipe and fittings. Concrete used in thrust blocks shall reach a compressive strength of 2000 psi after 28 days.

d) Strapping and Lugging

Where it is not practical to use thrust blocks to restrain push-on joints, as at point of vertical deflection in a pipe, strapping and lugging of the joints may be used. A sufficient number of joints shall be restrained each side of the joint so as to prevent movement or blow-off of the joints or fittings. Strapping and lugging systems shall be of a suitably corrosion resistant material and shall be approved by the Engineer before use.

e) Locking Type Gaskets

A sufficient number of joints shall be restrained each side of the joint so as to prevent movement or blow-off of the joints or fittings. Locking type gaskets may be used per the material requirements of this specification and shall be approved by the Engineer before use.

7. Field Cutting Pipe

When cutting pipe in the field, suitable equipment shall be used which will not damage the pipe, its lining, or coatings. Cuts shall be perpendicular to the long axis of the pipe,

and the end of the cut shall be beveled back about 1/8" at an angle of 30 degree to the pipe centerline.

8. Protected Open Pipe Ends

Open ends of all pipe shall be protected against the intrusion of dirt, water, and other contaminants during the pipe laying operation. Pipes which have been filled with dirt or mud shall be cleaned to the satisfaction of the inspector prior to continuation of the pipe laying operation. When pipe laying work is suspended for any period of time, a watertight plug shall be inserted in the end of the last pipe laid.

D. Valves and Hydrants

Valves and hydrants shall be installed at the locations indicated on the plans and in accordance with requirements elsewhere in these documents concerning depth of bury and types of joints.

1. Installing Valves

All valves will be installed with valve boxes unless they are to be located in a vault or structure as indicated on the plans. The valve shall be set with the stem plumb and shall be set on wood blocking adequate to prevent settling. Care shall be exercised in aligning the valve with its mating pipe so that no load or stress is placed on the valve body due to misalignment or improper bedding of the pipe. Bedding material shall be carefully placed and compacted up to the level of the bottom of the valve box after the valve has been properly installed and all joints secured.

2. Installing Valve Boxes

Valve boxes shall be centered over the valve operating nuts and set on a valve adaptor. The valve box shall then be plumbed, and the top adjusted to rough grade. During backfilling, approved material shall be placed around the valve box in 1-foot lifts and compacted per the material requirements. The valve box shall be adequately braced to prevent its shifting. Any valve box which is knocked substantially out of plumb, or which is dislodged from its center over the operating nut, shall be re-excavated, plumbed up and recentered over the valve. After the leveling HMA course has been placed, and prior to the placement of the HMA top course, the valve box will be adjusted to the finished grade and slope using a self-leveling valve box riser. The self-leveling riser will be placed per the manufacturers recommendations and will sit level with the HMA top course surface. Ensure that sufficient HMA is placed under the valve box top to prevent it from resting directly on the base and that the valve box lid is flush with HMA top course.

3. Installing Hydrants

Hydrants shall be set on a firm bed of undisturbed earth or stone backfill material which has been cut properly to grade. The grade ring of the hydrant shall be at the finished surface grade at the hydrant location, and the barrel of the hydrant shall be plumb within 1" from top to bottom. The shut-off gate for the hydrant, and a connecting piece of 6" water main between the hydrant and the gate valve, shall have been installed, connected to the hydrant lead, and suitably restrained against thrust as prescribed in section 6.01.03 C. Care will be exercised that there is no misalignment between the pipe, valve and hydrant.

4. Cutting In Valves

When the plans call for cutting a valve into an existing water main, the Contractor shall make arrangements at least 48 hours in advance with the City Water Department to shut down the section of main involved. The work may have to be scheduled at night in order to minimize service disruptions. Excavation and equipment will comply with applicable parts of Chapter 6. After the outside of the pipe has been cleaned of scale and loose rust, a valve of the type called for on the plans shall be installed, along with a cutting-in sleeve. A special cutting-in valve and sleeve unit may be used, provided that the valve is of the required type and conforms to the specifications in Chapter 6. Joints on the valve and sleeve shall be mechanical joints and shall be furnished with retainer glands. When a valve is to be cut into sand cast pipe, a mechanical joint transition coupling and short piece of ductile iron pipe shall be installed on the side of the valve opposite the cutting-in sleeve. Joints shall be restrained with mechanical joint retainer glands. No machining of the O.D. of sand cast pipe in order to make valves fit directly will be allowed.

5. Installation of Tapping Sleeves

Installation of tapping sleeves shall be in accordance with the manufacturer's recommendations and these specifications. A calibrated torque wrench shall be used to achieve all recommended torques.

After excavating the water main and immediately prior to installing the sleeve, remove all dirt, grease, oil and foreign material from the outside of the water main. The water main shall then be then rinsed thoroughly with water.

Install the tapping sleeve with particular attention to position of gaskets, "O" rings, and seals. Bolts shall be drawn up and torqued to manufacturer's specifications in a uniform and accepted pattern.

The tapping valve shall be installed on the flange, as recommended by the valve manufacturer.

The downstream flange of the valve shall be blocked temporarily so as to accept the weight of the valve and the tapping machine.

The sleeve and valve installation shall be air tested for leaks prior to installing the tapping machine. The sleeve shall be pressurized with water through the test coupling to at least 100% of the system working pressure at the point of the tap. Care shall be taken to insure that working pressure is maintained in the water main for the duration of the test. The testing equipment shall be fitted with an appropriate gauge. After test pressure is achieved, the complete installation shall be inspected visually for leaks. Then, all joints shall be tested with a solution of soap and water. The test pressure shall then be maintained on the gauge without any further aid from the pressure source, for a period of 10 minutes without any perceivable decline in pressure. If the pressure declines, the visual test shall be repeated. The water main shall not be tapped if a leak is present. If the tapping valve is the suspected source of leakage, the valve shall be replaced and the test repeated.

The tap shall be performed in accordance with the tapping machine manufacturer's recommendations. The tapping machine shall be supported and blocked so as to reduce strain on the sleeve, valve, or water main.

The coupon shall be removed with the tapping machine. If, for whatever reason, the coupon is not recovered with the machine, the Contractor shall be responsible for coupon retrieval from the system and shall cooperate fully with directions given by the Engineer while locating and removing the coupon.

Upon removal of the tapping machine, the entire tapping sleeve and valve assembly shall be inspected for water leaks. All visual leaks shall be repaired. The valve shall be opened enough to flush any shavings, chips, and debris from the water main.

E. Grade and Direction Changes

1. *By Deflection of Joints*

Changes in grade or direction to produce a gradual curve in the pipeline or for minor corrections of alignment shall not, in general, exceed 3 degree at any one joint unless the manufacturer warrants that a larger deflection is permissible.

2. *By Use of Bends & Fittings*

Where a large change in direction is required in a short distance, such as to go around or under obstacles, appropriate fittings with the correct angle shall be used. Additional deflection of the pipe at the fitting joint shall not exceed 3 degrees or manufacturer's recommendations. Joint restraint shall be provided on all bends or fittings.

3. *Obstructions in Line or Grade*

When an obstruction is encountered in the path of the watermain such as a culvert, manhole, or other utility, the watermain shall be deflected around or under the obstruction using a series of four 45 degree bends. A minimum of 18" of clearance between the watermain and its crossing of another utility will be provided, and where the watermain must cross under a stream or culvert, 3 feet of clearance will be provided. All bends or fittings shall be restrained.

F. Connections to Existing Water Main

Connections to the existing water distribution system will be made only after the new section of main has been tested and approved by the Engineer in accordance with Chapter 6. Where service to the existing distribution system must be disrupted in order to cut-in tees or do similar work, arrangements will be made at least 72 hours in advance with the City Water Department to shut down the required portion of the distribution system. This work may have to be done at night in order to minimize disruption of service to utility customers. Connections shall be made at the required location using fittings as detailed on the plans. Any tees, couplings, or cutting-in sleeves used shall be provided with restrained mechanical joints. Where sand cast pipe or pipe of another material is encountered which has a different outside diameter from ductile iron pipe of the same nominal size, a mechanical joint transition coupling shall be used to make the connection. Machining the outside diameter of sand cast pipe to mate with ductile iron will not be authorized.

G. Backfilling

Once the requirements of Section 6.01.03 C. have been met and the water main has been properly covered with bedding material, backfilling may commence. Except as indicated below, backfill material shall meet the requirements of Section 6.01.02 K.

- 1.** Excavated materials from the trench may be used as backfill if it meets the requirements of Section 6.01.02K and provided that details on the plans do not call for other materials for subbase under a roadway.
- 2.** Where excavated trench material is found to be unsuitable, borrow material meeting the requirements of Section 6.01.02 K. or other details shown on the plans shall be furnished by the Contractor. Surplus excavated material shall become the property of the Contractor and shall be disposed of by him.

3. The backfill material shall be placed carefully in the trench by hand or by machine. Care shall be exercised so as not to shift or dislodge pipe, valve boxes, hydrants and other such items.

4. The backfill shall be placed in 12" lifts and compacted to 95% density as measured by the Michigan Cone Test. The Engineer may require other compaction densities under roadways or for other special circumstances. Unless otherwise agreed to, density tests shall be performed by the Engineer or other agents of the City of Marquette.

5. The upper limits of backfill shall be top of subgrade under roadways and final grade in other areas.

H. Removal and Abandonment

Where the plans call for the removal or abandonment of watermain or associated item, the Contractor shall not proceed with work until the Engineer has ascertained that all associated work has been completed and the item may safely be removed or abandoned. The Contractor shall make arrangements with the City Water Department at least 72 hours in advance to arrange for shutting down portions of the distribution system as may be required. Some work may have to be done at night in order to minimize disruption of service to utility customers. Excavation, backfill, surface restoration, and related items shall be done in accordance with the conditions contained in other portions of these specifications.

1. Removing Valves

Removing valves where the plans call for removal of a valve, the Contractor shall excavate and remove the valve and valve box. These items shall be delivered to the City Water Department warehouse unless otherwise directed. Removal of the valve may be accomplished by cutting the water main as near as practical on either side of the valve, unless cutting-in or other fittings exist which would facilitate removal. Where the portion of water main is to be abandoned, the Contractor shall plug the ends of the pipe on both sides of the valve with masonry which shall extend into the pipe at least one pipe diameter. If the pipe is to remain in service, a cutting-in sleeve and other fittings or short lengths of pipe as may be necessary shall be installed to replace the valve.

2. Removing Fittings

Fittings shall be removed in such a manner as to avoid damaging the pipe or fittings. The Engineer shall decide whether such fittings are to be reused. The Contractor shall then plug or cap the pipe from which the fitting was removed or prepare it for the connection of other fittings as may be called for on the plans.

3. Removing Hydrants

Hydrants which are removed shall be delivered intact to the City Water Department Warehouse. Disassembly of the hydrant unit will not be allowed. Removal of the hydrant shall also include removal of the gate valve on the hydrant lead unless it is located more than 10 feet away from the hydrant or is otherwise impractical to remove. If the gate valve cannot be removed, it shall be abandoned in accordance with this Chapter. When the hydrant lead is connected to a water main which is to be abandoned, the lead shall be abandoned by installing a masonry plug in the end of the pipe. The plug shall extend at least one pipe diameter into the pipe. If the hydrant lead is connected to a water main which is to remain in service, the Contractor shall excavate the tee or connection at the main, cut out a portion of the hydrant lead and install a

plug in the tee or connection. The plug shall be suitably restrained against thrust. The cut end of the hydrant lead shall be plugged with masonry.

4. *Removing Pipe*

Where the plans call for removal of pipe, the Contractor shall excavate, remove, and dispose of the pipe as directed by the Engineer. Any connections to other water main which are to remain in service shall be plugged or capped and suitably restrained. Any services connected to the pipe being removed shall be cut off in the trench and the ends peened over or plugged with masonry.

5. *Abandoning Valves*

Valves to be abandoned, if still operable, shall be closed off tight unless otherwise directed by the Engineer. The Contractor shall then excavate and remove the top 3 feet of the valve box. Any remaining lower portion of the valve box shall be backfilled by tamping backfill material into the box.

6. *Abandoning Water Main*

Where water main or portions thereof are to be abandoned, the Contractor shall physically separate the water main from the rest of the system at such points as are indicated on the plans or directed by the Engineer. The abandoned water main shall be drained and the open ends plugged with masonry. The masonry plug shall extend at least one pipe diameter into the pipe. Water drained from the pipe shall be pumped into the nearest storm sewer or other safe discharge point. At the point where the abandoned water main is to be separated from the rest of the system, the Contractor shall either plug the fitting on the side of the system which is to remain in service or cut and cap the water main as described in this Chapter.

7. *Cut and Cap Water Main*

The Contractor shall excavate the existing water main at the location indicated, cut and remove a sufficient length of the pipe, and install a mechanical joint end cap coupling on the portion of main which is to remain in service. The end cap shall be suitably restrained against thrust from water pressure. The remaining pipe shall be removed or abandoned as called for on the plans or directed by the Engineer.

I. *Miscellaneous Items*

1. *Relocating Hydrants*

When the plans call for relocating a hydrant, the hydrant and its shut-off gate shall be removed from its old location in accordance with the provisions of this Chapter. The hydrant and gate valve shall then be reinstalled at the new location as shown on the plans or as directed by the Engineer. Hydrant and valve installation shall follow the requirements of Chapter 6, and the Contractor shall be responsible for furnishing any new bolts, gaskets, or other items required to complete the installation. Any parts damaged or destroyed by the Contractor shall be repaired or replaced at his expense.

2. *Provision for Future Connections*

Where plans call for providing for future connections, the end of the pipe, tee, or fittings shall be plugged and suitably restrained in accordance with Chapter 6.

3. Field Painting

All pipes, bolts, valves and other portions of the water main which are exposed inside manholes, vaults, or other structures, shall be painted with two coats of approved paint. If necessary, heat shall be provided to assure good drying conditions. Adequate ventilation shall be maintained until the paint is surface dry. All items to be painted shall be dry and free of loose paint, dirt, rust, or other deleterious materials. Pipe and fittings which are received from the manufacturer with a tar or asphalt base paint finish shall receive two coats of field primer before being painted. Field primer shall be Koppers Co. "Tar Stop," Mobil Co. Sealer No. 13-A-1, or an approved equal. Finish coats for field painting shall be Koppers Ponkote 300 Enamel, Tnemec High Build Epoxoline Series, Mobil Val-Chem Epoxy Enamel Series 84, or an approved equal. All pipe and potable water devices shall be painted a shade of medium blue, color subject to Engineer's approval.

J. Dewatering System

When called for in the contract or with the approval of the Engineer, the Contractor will lower the ground water table in the area of excavation by pumping in order to provide dry laying conditions for the pipe, and also to prevent cave-ins and unnecessarily large excavations. The Contractor shall have available adequate equipment to perform the work of dewatering necessary for the timely and safe progress of the work. When the water table is near the bottom of the pipe, the Engineer may allow over-excavation and placement of stone backfill as an alternate to use of a dewatering system. The following regulations will be adhered to in using and operating a dewatering system:

1. Use of Storm Sewer System

Whenever it is possible to do so, the Contractor is to discharge drainage from his dewatering operation into the nearest storm sewer inlet or manhole. He will obtain the approval of the City Engineer as to the location and adequacy of the storm sewer prior to commencing operations.

2. Restoration of Sewers

It will be the responsibility of the Contractor to assure that silt, sand, mud, or similar materials are not discharged into the storm sewers such as would cause damage to, or siltation of, the storm sewer system or its outlet. Any cleaning or repairs occasioned by the dewatering operation shall be undertaken by the Contractor, at his own expense, within ten (10) working days of the occurrence of such damage.

3. Other Discharge Points

Overland discharge of water across private property or into areas where localized flooding or soil erosion might occur will not be permitted. If, in the opinion of the Engineer, discharge of water into a ditch which is well stabilized, and having an outlet to a storm sewer or receiving body of water, may be safely accomplished, he may authorize the Contractor to so proceed. The Engineer may also require that a sediment trap be constructed to remove silts and other materials from the water before it is discharged to the receiving point. The Contractor shall repair or restore any areas damaged by these operations, and shall dispose of any silts accumulated in sediment traps after the dewatering operation is completed.

4. Use of Sanitary Sewers

Because of the cost of collection, pumping, and treatment of sanitary sewage, as well as potential damage to sewers, use of the sanitary sewers as a discharge point is strictly

prohibited. The Engineer may, however, authorize their use in an emergency.

5. Propriety of Equipment and Operations

Equipment used by the Contractor for dewatering shall be of a size and type adequate to perform the job of dewatering and shall be operated in such a manner as to create as little nuisance to the public as possible. In particular, on operations which require continuous pumping over prolonged periods of time, noise becomes a significant factor and the Contractor should do everything possible to reduce noise from pumps, generators, and other equipment.

6. Control of Operations

The Contractor shall monitor his dewatering operation at all times to ensure that the method used does not undermine pipe bedding, place nearby utilities in jeopardy, or cause subsidence or damage to adjacent properties.

K. Surface Restoration

All streets and other areas, including all lawns, driveways, pavements, sidewalks, shoulders, curbs and roadway slopes, shall be restored to original condition or better after completion of the work. The Contractor shall be responsible for restoration, at his own expense, of any private or public properties outside the project limits which have been damaged by his operations or by negligence of his employees. Unless otherwise detailed on the plans, materials used for restoration work, and their application, shall conform to requirements of the Michigan Department of Transportation Standard Specifications for Construction, Edition of 2020, and any revisions thereto. Such materials include, but are not limited to, the following:

ITEM	APPLICABLE MDOT SPECIFICATION
Bituminous Aggregate Pavement	501
Aggregate Base, 21A	302
Granular Material, Class II	902
Concrete, Grade 3500	1004
Sidewalk	803
Aggregate Surface Course	306
Concrete Curb & Gutter	802
Topsoil Surface	816
Seeding	816
Mulching	816

6.01.04 Cleaning, Testing, Sterilization

A. General

Cleaning, testing, and sterilization of water mains shall comply with the requirements of AWWA Standards C651-14 and C655 and the requirements contained herein. The sequence of operations shall follow that outline in Section 6.01.03 A., unless otherwise approved by the Engineer for good reason. The water main or portion thereof shall be tested by the Contractor in the presence of the Engineer, and all leaks or other deficiencies corrected prior to acceptance by the Engineer. The Contractor shall furnish all piping, bulkheads, pumps, gauges, water, and other materials required to clean, sterilize and test the water main.

B. Cross Connections

The Contractor shall take every pre-caution necessary to assure that a cross connection does not exist between the public water supply and the water main being cleaned, tested, or sterilized. For the purposes of this specification, a cross connection shall be any connection between the new water main and the public water supply, or any operation by the Contractor, which could potentially introduce non-potable water, contaminated water sterilizing chemicals, mud, dirt, or other objectionable or hazardous materials into the public water supply. Particular attention shall be paid to the following areas:

1. During pressure testing or other operations where the new main is at higher pressures than the water in the distribution system, any hose, pipe, or other connections used to obtain water from the public water supply shall be physically disconnected.
2. When portions of the existing distribution system must be shut down in order to complete a connection of the new main or do similar work, any open pipe ends, tees, tapping valves or similar items shall be bullheaded after the pipe is drained and safeguarded against inclusion of dirt, trench water or other contaminants until after the connections are completed.
3. Any corporations and attached water tubing installed for the purpose of chlorinating or flushing shall be shut off and capped after final use in order to prevent groundwater or other contaminants getting into newly cleaned mains.

C. Pressure and Leakage Testing

The Contractor shall have adequate pumps, monitoring gauges, and other such equipment to properly perform the test. The main shall be pressure tested in convenient lengths, with a minimum test pressure of 150 psi, measured at the highest point in the pipe, maintained throughout the test. The following procedures shall be followed:

1. Pressure Test

- a) All gates or valves at the boundaries of the test section shall be closed.
- b) The test section shall be slowly filled with water and all air bled out of the test section through hydrants, blow-offs, or other connections.
- c) Any hose or connections to the public water supply, used for filling the test section, shall be disconnected for the duration of the test.
- d) The high-pressure pump shall be connected to the main at the test point and the main brought up to test pressure and held there.
- e) During the pressure test, all exposed pipe, fittings, valves, hydrants, and joints will be examined for leakage, distortion, or other failures. If any damage or defective parts are discovered, they shall be replaced, and the pressure test repeated.

2. Leakage Test

- a) The leakage test shall commence immediately after successful completion of the pressure test and while the main is at the minimum test pressure of 150 psi.
- b) All main line valves and hydrant lead valves within the test section shall remain open during the leakage test.
- c) If the pressure gauge shows any drop-in pressure at the end of the two-hour test, the Contractor shall carefully pump the test section up to the **exact** pressure documented at the beginning of the test. Then slowly the Contractor shall bleed water from the test section into a container with the volume markings that is acceptable to the Engineer. Once the pressure is lowered to the reading found at the end of the two-hour test, the volume in the container shall be noted. This volume of water shall be considered equal to that which leaked out of the main during the test.
- d) The allowable leakage shall be computed by the formula:

$$L = \frac{SD\sqrt{P}}{148,000}$$
 where L is the allowable leakage in gallons per hour; S is the length of pipe tested in feet; D is the nominal pipe diameter in inches; and P is the average test pressure during the leakage test in psi gauge.
- e) An additional leakage of 0.0078 gallons per hour per inch of nominal valve size will also be allowed for each closed valve at the boundary of the test section, including hydrant valves.
- f) The following tabulated values may be used where applicable:

Allowable leakage per 1000 ft. of pipeline (1 hour test, 150 PSI pressure)

NOMINAL PIPE OR VALVE SIZE	ALLOWABLE LEAKAGE (GALLONS/2 HOUR)	ADDITIONAL ALLOWABLE LEAKAGE FOR EACH VALVE
6"	1.0	0.1 gal
8"	1.3	0.1 gal
10"	1.7	0.2 gal
12"	2.0	0.2 gal
14"	2.3	0.2 gal
16"	2.6	0.3 gal

Note that a test section may contain different pipe sizes, hydrant leads, etc. and the leakage of each of which must be combined for the test section.

- g) In the event that leakage exceeds the specified amount, the main and all fittings, valves, and other appurtenances will be inspected until the leak is found and repaired. After repair of any leaks the section shall be retested. Final acceptance of the water main will not be made until all sections thereof have been successfully tested.
- h) After successful completion of the two-hour pressure test, each valve within the test section including gates on hydrant leads, shall be checked against test pressures as follows:

1.	Close valve furthest from test point
2.	Vent main on non-pressure side of valve being tested
3.	Observe pressure gauge at test point: allowable pressure drop shall not exceed 10 psi in 5 minutes
4.	Close next closest valve toward test point
5.	Open valve previously tested
6.	Repeat procedures a) through e) progressively back toward test point until all valves within the test section have been tested
7.	Any valve which shows excessive leakage by this test shall be repaired or replaced by the Contractor and retested

D. Cleaning

After successful completion of the pressure and leakage testing, and prior to sterilization, the Contractor shall clean the main and all hydrant leads by flushing with potable water. A minimum velocity of flow of 3.0 feet per second shall be maintained to ensure that all heavy debris is removed from the main. Flushing shall continue until the water runs clear, or until a volume of water equal to twice the volume of the pipe has been flushed through. This requirement for cleaning shall not absolve the Contractor of responsibility for assuring that pipe is not contaminated during construction. As a guide to determining required flushing rates the following table may be used:

Required flow and openings (either taps or hydrants) to flush pipelines at 3.0 ft/sec (40 psi residual pressure in water main)*

Pipe Diameter	Flow Required to Produce 3.0 ft/sec (approx.) Velocity in Main	Size of Tap Used, <i>in.</i>			Number of Hydrant Outlets	
		1	1½	2		
<i>in.</i>	<i>Gpm</i>	Number of Taps Required on Pipe†			2½-in.	4½-in.
4	120	1	—	—	1	1
6	260	—	1	—	1	1
8	470	—	2	—	1	1
10	730	—	3	2	1	1
12	1,060	—	—	3	2	1
16	1,880	—	—	5	2	1

*With a 40-psi pressure in the main with the hydrant flowing to atmosphere, a 2½-in. hydrant outlet will discharge approximately 1,000 gpm; and a 4½-in. hydrant outlet will discharge approximately 2,500 gpm.

†Number of taps on pipe based on 3.0-ft/sec discharge through 5 ft of galvanized iron (GI) pipe with one elbow.

*All hydrant leads and connecting pipe within the section shall be flushed clean.

E. Sterilization

Upon completion of the flushing operation, the main shall be sterilized by chlorinating in accordance with AWWA Standard C651-14 and C655. The following rules shall apply:

1. Potable water shall be used.
2. As the main is filled with water for disinfecting, a chlorine solution shall be added or injected so as to completely mix with the water and distribute throughout the main.
3. Initial chlorine solution strength in the main being chlorinated shall be 50 parts per million.
4. The chlorine solution shall be allowed to stand in the main for a period of 24 hours, at the end of which time the chlorine concentration shall not be less than 25 parts per million throughout the length of the main.
5. During the contact period, all mainline valves and hydrant gates shall be operated in order to disinfect them.
6. Chlorine in tablet form may not be used.
7. At the end of the contact period, the highly chlorinated water shall be flushed from the main until the chlorine concentration leaving the main is no higher than that prevailing in the distribution system, or less than one (1) part per million.
8. After the final flushing, and before the main is put into service, not less than two (2)

consecutive water samples for bacteriologic analysis shall be collected. The first sample shall be drawn 24 hours after final flushing; the second sample shall be drawn 24 hours after the first sample.

9. Bacteriological sample shall not be drawn from hydrant outlets. The Contractor may take samples for corporations installed in the main from sampling, or corporation installed for the purpose of flushing.
10. If the samples do not show results which meet State of Michigan safe drinking water standards, the main shall be re-sterilized and new samples taken as prescribed above. Final acceptance of the main will not be made by the Engineer until bacteriologic sampling shows safe results.
11. Upon acceptance of the test results, the Contractor may proceed with installing services and making connections to the distribution system. All short pieces of pipe, tapping valves, and other items used in final connection shall be field chlorinated by swabbing with a 4% chlorine solution.

F. Continuity Testing

The pipeline and hydrants shall be tested for electrical continuity and current capacity. The test shall be made after hydrostatic testing is completed and while the line is at normal operating pressure. A direct current of 200 amperes, plus or minus 10%, shall be passed through the section under test for a period of five minutes. Current flow shall be continuously monitored with a suitable ammeter. Insufficient current, excessive fluctuation, or arcing shall be indicative of defective electrical contact, and the cause shall be isolated and corrected. The section shall be retested until it passes the conductivity test.

6.01.05 Measurement and Payment for Water Main

A. General Description

General items described and installed according to Section 6.01 shall be measured and paid for at the contract unit price as prescribed herein. Payment at the contract unit price shall be full compensation for all tools, materials, equipment, labor, dewatering and other incidentals required to construct or install the particular item as described.

B. Water Main

Ductile iron pipe water main of the size specified shall be measured by the linear foot, along the centerline of the pipe from centerline to centerline of valves and fittings. No deduction will be made for lengths of valves or fittings within the section being measured. Payment shall be made at the contract unit price per linear foot, and shall be compensation in full for those items listed in A, above, as well as handling and storage, laying and joining pipe, excavating, disposal of surplus excavation, field cutting, bedding, restraining joints, cleaning, sterilizing, backfilling, sheeting, shoring and bracing.

C. Valves & Boxes

Gate Valve and Box, Resilient Seated Gate Valve & Box, and Butterfly Valve and Box. Measurement and Payment shall be by the unit each and shall include the installation of the valve, box, valve adaptor, self-leveling valve box riser, all labor, tools, equipment and material required to install the valve box and valve adaptor as shown on the plans and in accordance with the water main specifications.

D. Tapping Valve & Box

Measurement and Payment for Resilient Seated Tapping Valve and Box shall be by the unit each and shall include the installation of the valve, box, valve adaptor, self-leveling valve box riser, all labor, tools, equipment and material required to install the valve and box as shown on the plans and in accordance with the water main specifications.

E. Fittings

(All M.J. Tapping Sleeves, Cutting In Sleeves, Transition Sleeves, Tees, Crosses, Bends, M.J. Reducers, Plugs and Hydrant Extensions).

Fittings shall be measured by the unit each of the type and size fittings specified on the plans or as directed by the Engineer. Payment at the contract unit price each shall be compensation in full for installing the type and size fitting at the location shown on the plans, including gaskets, bolts, retainer glands and joint restraints where required.

F. Hydrants

Hydrants shall be measured by the unit each for each hydrant properly installed at the location shown on the plans. Payment shall be at the contract unit price each and shall be full compensation for cost of excavation, placing the hydrant assembly, connecting to the hydrant lead, adjusting to grade, painting, plugging drain hole, and installing thrust block or other restraint system. The auxiliary valve and hydrant lead (D.I.P.) are not part of this pay item.

G. Removing Existing Water Main

Removing existing water main shall be measured by the lineal foot of pipe removed as shown on the plans or as directed by the Engineer. Payment shall be at the contract unit price per lineal foot and shall be compensation in full for excavating, cutting, removing, backfilling, closure of abandoned services and connections and disposal of the pipe as directed by the plans or the Engineer. Cutting and capping live water main is not part of this pay item.

H. Removing Existing Gate Valve & Box

Removing valves shall be measured by the unit each for each valve removed as shown on the plans, or as directed by the Engineer and delivered to the City Water Department. Payment shall be at the contract unit price each and shall cover the cost of excavating and removing the valve and valve box, cutting and abandoning the water main and backfilling. Not included in this pay item are additional fittings or closure pieces which may be required to cap the water main.

I. Removing Existing Hydrant (Salvage)

Removing of hydrants shall be measured by the unit each for each hydrant removed and delivered to the City Water Department. Payment shall be at the contract unit price each and shall cover the cost of excavating and removing hydrant and valve (within 10 feet), cutting, abandoning or capping the hydrant lead at the main, and backfilling.

J. Abandon Existing Valve

Abandoned valves shall be measured by the unit each. Payment at the contract unit price shall be full compensation for closing of the valve, removing the remaining gate valve box, backfilling with sand and compacting.

K. Cut and Cap Existing Water Main (4"-6")

Cut and cap water main shall be measured by the unit each for cutting and capping the size of watermain as shown on the plans or directed by the Engineer. Payment shall be at the contract unit price each and shall cover the excavation, cutting and removing a section of pipe, installing an end-cap coupling, and restraining it against thrust, any abandoning of mains, and backfilling. This pay item pertains to only the water main to be left in service.

L. Connect to Existing Water Main (4"-16")

The pay item of connect to existing water main shall apply only to dry connections. There shall be no payment for the connection of a wet tap (tapping sleeve, valve, etc.). The work of connecting to an existing water main shall include all necessary items to shut off water service to the existing main while the mechanical connection (dry tap-cutting in sleeve, fitting etc) for the new water main to the existing watermain is made. Before the connection is made (either wet or dry), it shall be the Contractor's responsibility to excavate the connection area to determine if the proposed fittings will be adequate for the existing field conditions. All fittings and piping within 10 feet of the dry tap connection will be incidental to the pay item "Connect to Existing Water Main".

M. Relocate Hydrant

Hydrant relocation shall be measured by the unit each for each hydrant removed from the existing location and reinstalled at another location as shown on the plans. Payment shall be at the contract unit price each and shall be full compensation for all excavation work, removal of the hydrant and auxiliary valve (if located within 10 feet of the hydrant), abandonment or capping of the old hydrant lead, reinstallation of the hydrant, auxiliary valve and box at the new location, and all backfilling. Not included in this item are the new hydrant lead and installation of a new auxiliary valve, if one is required

N. Remove Fittings

Removal of fittings will be measured by the unit each for each fitting removed and disposed of as shown on the plans and as directed by the Engineer. The salvaged fittings will be delivered to the City Water Department. Payment at the contract unit price each shall be full compensation for excavating and removing the fitting, abandoning the water main as necessary, and field cutting the pipe.

Pay Item	Pay Unit
Water Main, DI, _ Inch, CL 52 Tr Det _	Ft
Butterfly Valve and Box, _ Inch	Ea
Gate Valve and Box, _ Inch	Ea
Resilient Seated Gate Valve and Box, _ Inch	Ea
Resilient Seated Tapping Valve and Box _ Inch	Ea
Bend, _ Inch, _ Deg. (M.J.)	Ea
Cutting In Sleeve, _ Inch	Ea
Cross, _ Inch x _ Inch, (M.J.)	Ea
Hydrant Extension	Ea
Plug, _ Inch (M.J.)	Ea
Reducer, _ Inch x _ Inch (M.J.)	Ea
Tee, _ Inch x _ Inch (M.J.)	Ea
Tapping Sleeve, _ Inch	Ea
Transition Sleeve, _ Inch	Ea
Hydrant	Ea
Water Main, Rem	Ft
Gate Valve and Box, Rem	Ea
Hydrant, Salvage	Ea
Gate Valve and Box, Abandon	Ea
Cut & Cap Exist. W.M., _ Inch	Ea
Connect to Existing Water Main	Ea
Hydrant, Relocate	Ea
Fitting, Rem	Ea

6.02 AUXILIARY WATER MAIN

A. General Description

This section provides for construction of an auxiliary watermain along the project in order to facilitate the construction of all other underground utilities and abandonment of the existing water main.

1. Furnish all materials for and install an auxiliary water main as approved by the Engineer. The contractor shall submit shop drawings and materials listings for the proposed auxiliary water main. The contractor shall propose the materials and layout of the auxiliary water main system. Anticipated size of the feeder lines to the buildings is ¾” to 2” (depending on demand) and will be PVC, PE, or approved material.

The normal size of sub main is 2” diameter. However, the sub main servicing building service lines shall be appropriate for system demand.

2. Installation and operation of the auxiliary water main will be governed by the specifications for water main and watermain laterals concerning all placement, testing, disinfections, operations and all other associated work.

3. Contractor is responsible for the maintenance of the auxiliary watermain. Since it is constructed on top of the ground surface, precautionary measures must be taken to prevent vandalism, joint blow offs, leaks, damage from pedestrians, vehicles, or other sources.

4. Installation plan is to have the auxiliary water main placed upon the project for the sections planned for underground construction in advance of the construction activities. The placement is to facilitate the underground construction activities. The shut off in the building is to be closed and the hose bib or alternate connection turned on at the time of relocation of service.
5. Use of the auxiliary water main does not relieve the contractor from the need to take precautions when encountering utility lateral services in underground construction. The auxiliary system provides the opportunity to disconnect the existing water service lateral or main as necessary during the underground construction operations.
6. Upon completion of the use of the auxiliary water main (i.e.; completion of the installation of the new water main and placement into service), the auxiliary system can and shall be removed by the contractor for utilization elsewhere on the project or removal from the project. The materials provided for the auxiliary water main will remain the property of the contractor following the completion of construction.
7. The contractor will be responsible for the new notification to the residents or businesses that will be affected by water main disruptions or shutdowns. The contractor will make every effort to contact the said residents or businesses that will be experiencing water disruptions on shutdowns either by verbal, written communication, or a combination of both. Notification is incidental to the auxiliary water main installation and building connections.
8. All auxiliary water main connections will be made at a cut and cap on an existing water main. Connections to hydrants will not be allowed.
9. Movement of a previously operational auxiliary water main to another phase of the project will be governed by the specifications for water main and water main laterals concerning all placement, testing, disinfections, operations, and all other associated work.

B. Measurement and Payment

1. Auxiliary Water Main

The item of Auxiliary Water Main shall be measured by the lineal foot along the length of main required to be installed. Measurement and payment shall include payment in full for all plant, equipment, labor and materials required to provide for the installation, disinfection, leak prevention, repairs, connections at the ends of the main, intermediate connection, taps to existing main for connections, connection of feeder lines, operation and maintenance of system and disassembly.

2. Auxiliary Water Main Building Connection

The item of Auxiliary Water Main Building Connections shall be measured by the unit each. Measurement and payment shall include payment in full for all plant, equipment, labor and materials required for the installation of feeder lines from the main to the buildings, connection to the buildings via the hose bib or alternate connection approved by the Engineer, closing of the existing shutoff in the building, opening of the hose bib or alternate connection, and coordination of the opening and closing of valves.

Pay Item	Pay Unit
Auxiliary Water Main	Ft
Auxiliary Water Main Bldg. Connect	Ea

6.03 WATER SERVICES LINES, 3/4" – 2"

6.03.01 General Description

This work shall consist of installing a water service line between the City water main and a building water system. Items included in the work will be: tapping of the water main and installation of a corporation stop, laying of the service line piping, installation of a curb stop and box, and termination at the property. Termination at the property will include either capping the service pipe for future use or connection to an existing building piping system, as appropriate. Also included in the work are the necessary excavation, backfilling, compaction, dewatering of trenches, provision of labor, materials, equipment, and other incidentals necessary to complete the work and test the installation for its suitability for use.

6.03.02 Materials

Materials to be incorporated into the work shall meet the requirements outlined below for service lines 3/4" through 2" diameter, and shall comply with the provisions of AWWA C800, latest revision, as regards composition and style of thread.

Brass goods furnished under this specification shall be new and unused. All fittings shall conform to ANSI/AWWA Standard C800, latest revision. All brass components in contact with potable water must be made from either CDA/UNS Brass Alloys C89520 or C89833 with a maximum lead content of .25% by weight. Brass alloys not listed in ANSI/AWWA C800 Paragraph 4.1.2 are not approved. Brass saddles shall be made from CDA/UNS C83600.

All service fittings shall be certified as suitable for contact with drinking water by an ANSI accredited organization in accordance with ANSI/NSF Standard 61, Drinking Water Systems Components – Health Effects.

All fittings shall be stamped or embossed with a mark or name indicating that the product is manufactured from the low-lead alloy. Stamps shall either be EBII for EnviroBrass (C89520) or FD for Federalloy (C89833).

A. Corporation Stops

Corporation Stops shall be constructed of red brass, per AWWA C800, latest revision, shall have the standard tapered inlet thread and a flared outlet or compression joint outlet for use with copper water tube. Acceptable brands shall include the Mueller H 15000N for flared-type, Mueller P 15008N for compression type, and Ford F1000-NL for compression type, or approved equal.

B. Curb Stops

Curb Stops shall have flared or compression connectors for both inlet and outlet ends and shall be of red brass as per AWWA C800, latest revision. Acceptable brands shall include the Mueller H 15204N for flared type, Mueller P 15209N for compression type, and Ford B44-444NL for compression type or an approved equal.

C. Service Piping

Service piping shall be type "K" soft annealed seamless copper tubing conforming to the requirements of ASTM B-88.

D. Service Boxes (Curb Boxes)

Service Boxes (curb boxes) shall be of cast iron, screw thread adjusted, and painted inside and out with a suitable asphalt varnish. Boxes shall be "Buffalo" style and shall be designed for a 6.5-foot depth of bury. They shall be Tyler 6500-101F, Sigma VB701F, or approved equal for 3/4" though 1 1/2" diameter and a standard valve box for 2" diameter.

E. Miscellaneous Fittings

Miscellaneous Fittings shall be of red brass conforming to ANSI/AWWA Standard C800, latest revision and shall have flared or compression fittings for all connections to copper tubing. Where connection must be made to existing service lines of differing materials, threaded or compression joints, as applicable, may be provided. In all cases, provision for electrical conductivity will be made at all joints and fittings.

6.03.03 Construction Methods

A. Trench Excavation

The Contractor shall proceed with trench excavation with due regard for the protection of life, health and property. Appropriate equipment shall be used to perform the work and, where necessary, measures such as the use of sheeting or shoring shall be used. The following shall be observed in excavating trenches:

1. Excavation shall not proceed until the location of nearby utilities have been ascertained and clearly marked by their owners.
2. Excavation in close proximity to other utilities shall be done by hand in order to protect them from damage.
3. Trenches shall be excavated in reasonably close proximity to the lines and grades on the plans or as established by the Engineer. Special attention shall be given to requirements for depth of burial.
4. The trench shall be of sufficient width to provide free access for completing the work.
5. Rock or hardpan shall be excavated to a depth of 4" below the bottom of the pipe and replaced with granular bedding material acceptable to the Engineer.
6. Where unstable soil conditions are encountered, the Engineer may authorize the use of trench undercut and backfill. 4" of granular bedding material will be placed over the trench backfill.
7. Where work is within a paved roadway, the pavement will be cut and removed prior to excavation. Payment will be incidental to the replaced item.
8. If high ground water levels are encountered, an appropriate dewatering system shall be employed in order to prevent unnecessarily wide excavations and damage to adjacent properties.
9. Excess excavated material shall become the property of the Contractor.

B. Tapping Water Main

Tapping water main shall be accomplished using a tapping machine which is capable of tapping the main and inserting the corporation stop while the main is under pressure and in service. Under no circumstances will a water main be taken out of service to perform a

tap without the Engineer's prior approval. Taps shall be made at the location shown on the plan, or as directed by the Engineer, and the following specifications will be observed:

1. Corporations will be installed on the main in as nearly a horizontal position as possible (i.e.; at three o'clock or nine o'clock positions on the main). In no case will they be installed at a location above 22-1/2 degrees measured from the horizontal, or on top of the main. A pipe wrench with serrated teeth on its jaws shall not be used to turn the corporation to its final location. A smooth jaw wrench will only be allowed.
2. Corporations may not be installed diametrically across from one another, but must be spaced at least 2' apart, measured along the longitudinal axis of the water main.
3. Corporations installed on the same side of the main as each other shall be separated longitudinally on the main by at least 2'.
4. Corporations may not be installed closer than 2' from any joint in the main, measured from the lip of the bell of the joint.

C. Installing Service Piping

1. Pipe Handling

During handling and installation of service piping, care shall be exercised to prevent denting or kinking pipe or contaminating pipe through the inclusion of mud, dirt or debris inside the pipe. Defective or damaged pipe will not be incorporated into the work. Any large pieces of dirt or debris will be removed prior to making joints.

2. Laying Conditions

After the trench bottom has been excavated to a uniform line and grade, the service piping will be laid on a bed of clean sandy material, at least 4 inches thick. The service pipe bedding shall be free of rocks, sticks, and other debris which could dent or otherwise damage the pipe.

3. Depth of Burial

All service piping shall be buried with a minimum of 6.5 feet of earth cover over the top of the pipe. Where shown on the plans, or when directed by the Engineer, depth of burial will be determined by future or proposed street grades. Otherwise, existing conditions at the time of installation shall determine depth of burial.

4. Alignment and Position

In general, service piping will be installed in a straight line and, at the point of connection to the corporation stop, will be at right angles to the long axis of the water main. Where changes in direction are required, they will be accomplished by bending smooth, uniform radii in the tubing or by the use of appropriate bends or fittings. In no case shall a bend in a pipe have a radius smaller than ten (10) times the diameter of the pipe. Any pipe which becomes kinked or dented from bending shall be replaced with a new piece of pipe. If water service piping is to be installed in or near the same trench as a sanitary sewer lateral, the centerline spacing between the service pipe and the sewer lateral shall be a minimum of 18" and an effort will be made to keep the service pipe at least 12" higher than the sewer lateral, where consistent with depth of burial requirements.

5. Piping Lengths

Copper service piping 1 ¼" in diameter or less shall be installed without any couplings or joints between the corporation stop and the curb stop, except as permitted by the Engineer. Service piping 1 ½" and 2" in diameter shall be installed in lengths of 20 feet or more, except for one short closure piece which may be permitted ahead of the curb stop.

6. Joining Pipe

Copper service piping shall be joined by the use of flare type or compression type couplings providing direct metal to metal contact. Use of pipe jointing compounds or teflon tape will not be allowed. Under no circumstances will solder type joints be used

in water service piping. All ends shall be cut squarely, and rough edges or burrs removed. The flared or flanged end copper tube which is to be joined shall only be formed with the proper size and type of flange tool.

A pipe wrench with serrated teeth on its jaws shall not be used to tighten the compression type fittings. A smooth jaw wrench will only be allowed.

7. Clearance

Where other pipes, structures, or like obstructions are encountered in the work, the service pipe shall be bent to go under or around such obstructions in the most practical manner. Bends shall be made as described, above. A minimum clearance of at least 6" shall be maintained between the service pipe and the obstruction and the space in between filled with clean sand, compacted, and free of rocks, sticks or other debris which could cause pipe damage. Minimum cover over the service pipe shall be maintained, unless otherwise directed by the Engineer.

8. Termination

Unless otherwise shown on the plans or directed by the Engineer, the service piping shall terminate at the property line with the curb stop. In those cases where the service is intended for future use and there is no existing building piping, the customer side of the curb stop shall be capped by inserting a suitable non-metallic disc or plug inside the flare nut and installing the flare nut tight on the curb stop. In the case where there is a building or premise with an existing service line, the existing service line shall be cut as near to the property line as possible and the new service line connected there.

D. Installing Curb Stop & Box

The curb stop and box will be located at the property line, or right-of-way line, at the point determined by the Engineer. The curb stop shall be connected to the service pipe in a horizontal position with the valve stem vertical, as measured along the pipe and across the pipe. A pipe wrench with serrated teeth on its jaws shall not be used to turn the curb stop to its final location. A smooth jaw wrench will only be allowed.

After all testing and connection at the service piping has been completed, and prior to final backfilling, the curb box shall be carefully centered over the curb stop. The legs of the curb box shall rest firmly upon pieces of hardwood board and clearance shall be provided so that the box does not rest on the service piping. The curb box shall be sufficiently plumbed and braced so that it stays vertical and centered over the curb stop during backfilling. Curb box covers shall be placed $\frac{1}{4}$ inch below the surface of the natural ground. The Contractor will ensure that covers located in areas within the finished asphalt or concrete surface are $\frac{1}{4}$ inch below the finished paved surface. Covers out of $\frac{1}{4}$ inch tolerance (plus or minus $\frac{1}{4}$ inch) will be adjusted during or after the paving operations at the Contractor's expense. No "dishing" of the asphalt will be allowed around the curb box covers on the finished paved surface. Asphalt areas cut out and removed for the repair shall be placed back in a seamless condition.

E. Connections to Existing Service

When a new water service is being installed to replace an existing water service, the existing service pipe shall be cut-off at least 3 feet beyond the new curb stop and a closure piece consisting of the appropriate size copper service pipe installed between the curb stop and the cut end of the existing service line. Connection to the existing line shall be made by attaching a flare-type or compression-type fitting to the closure piece, and assembling such reducers, adapters, or couplers as are needed to make a firm, pressure tight connection to

the existing service line. If a "Dresser" or other type coupling is used which does not provide for electrical continuity, a bonding strap shall be installed across the coupling to provide such continuity.

F. Testing & Cleaning

Prior to completing the termination of the service line and backfilling, it shall be cleaned and tested by the following method: the curb stop shall be opened, and then the corporation stop at the water main, until a full flow of water is obtained. After sufficient time has elapsed to assure that the new line has been flushed and that the flowing water is clean, the curb stop only shall be shut off. All joints under pressure shall then be observed for at least 15 minutes for leaks. During this time, the termination or connection to existing service piping may be made. When the connection to an existing service has been completed, the curb stop shall again be opened, restoring service to the customer. At this point it will be necessary to flush air and any loosened pipe scale from the customer's building piping. The connection to the existing service piping shall be observed for a period of fifteen (15) minutes to assure that there are no leaks prior to backfilling.

G. Backfilling Trench

Backfill material, free of rocks, sticks, and other debris, shall be placed by hand to a depth of 6 inches over the service piping and compacted. Machine backfilling may then proceed by placing and compacting 12" lifts of suitable material up to subgrade elevations (95% density Standard Proctor test). No muck, peat, stumps, roots, boulders or other large debris will be included in the backfill in any part of the trench. Where the trench is within a roadway, backfill and subgrade material as required by the plans or other parts of this document shall be used, unless otherwise directed by the Engineer.

H. Surface Restoration

Upon completion of backfilling operations up to the required subgrade elevation, the surface will be restored in kind to the same or better condition as existed prior to excavation, unless otherwise directed by the Engineer.

I. Coordination with Property Owners

The contractor will make every effort to coordinate with the property owner and the property owner's plumbing contractor on the installation of the new water service. Coordination will include the new service location, approximate day of said installation, and length of time the trench will be open at the curb stop location. The contractor will make every effort to contact the said property owner on coordination activities either by verbal, written communication, or a combination of both. Coordination is incidental to the water service installation and its appurtenances.

6.03.04 Measurement & Payment

A. Service Tap, ¾” through 2” diameter

Measurement and payment shall be by each corporation stop, ¾” through 2” diameter, successfully tapped and inserted into the main. Payment shall be compensation in full for the use of all labor, tools, equipment and materials required to tap the main and install the corporation stop at the contract unit price each.

B. Water Lateral, ¾” through 2” diameter

Measurement shall be by the linear foot, measured horizontally along the pipe from the centerline of the water main at the point where the tap was made to the termination of the new service, at the curb stop. Payment by the linear foot shall be full compensation for all labor, tools, equipment and materials needed to install the service line and shall include the following:

1. Water service piping, material and installation
2. Excavation
3. Testing and cleaning
4. Backfilling trench

C. Curb Stop & Box, ¾” through 2” diameter

Measurement shall be by the unit each for all curb stops and boxes placed. Payment shall be compensation in full for all labor, tools, equipment and materials required to place the curb stop, make the connections, install the curb stop box, and test the operation of the valve. It shall also be full compensation for flushing dirt and air from the customer's meter and building plumbing, where this becomes necessary, due to the Contractor's negligence.

D. Water Service Repair or Relocation, ½” through 2” diameter

Where the Contractor during construction operations breaks or cannot protect existing water services that cannot be left in place in the opinion of the Engineer, the Contractor will be paid for the repair or relocation of the existing water service at the contract unit price per linear foot. The price shall include all necessary fittings and appurtenances, pipe, labor tools, equipment and other materials required to accomplish the work. All repair methods must be approved by the Engineer before the work is completed.

E. Abandon Existing Water Services

Payment for abandonment of an existing water service shall be by the unit each. Water service abandonment will only be used in cases in which the water main is not being abandoned. All existing corporations shall be abandoned following connection and acceptance of the new building service. Payment shall be full compensation for closing the valve, cutting the existing lateral near the corporation and removing and disposing of the top 3 feet of the valve box. All leaks will be stopped on the existing corporation before acceptance of the abandonment.

F. Connect to Existing Service

Payment for this item will be by the unit each. Payment shall be full compensation for all labor, tools, equipment, and material including miscellaneous fittings required to connect the new water lateral to the existing service lateral.

Pay Item	Pay Unit
Service Tap, _ Inch	Ft
Water Lateral, _ Inch Copper, Type K	Ea
Curb Stop & Box, _ Inch	Ft
Water Service, Repair or Relocate, _ Inch	Ft
Exist. Water Service, Abandon	Ea
Connect to Existing Service	Ea

6.03.05 Insulation of New Service Lines and New Water Mains – 2” thickness

A. General Description

Under this item of work, the contractor shall install insulation lapping all joints a minimum of 6”. Refer to Figure 6.1. This work shall be done only as directed by the Engineer when minimum bury cannot be obtained.

B. Materials

Insulation shall be high density, closed cell, rigid polystyrene with a rating of R-5 per inch or greater. It should be the type which is suitable to being buried without loss of its insulating value.

C. Measurement & Payment

Measurement shall be by the lineal foot measured along the center line of the water line. Payment shall be full compensation for all labor, tools, equipment, and materials needed to install the insulation.

Pay Item	Pay Unit
Insulation, _ Inch	Ft

6.03.06 Additional Insulation per 1” thickness

A. General Description

This work shall only be done when additional insulation is required due to the lack of depth of cover. Figure 6-1 details the recommended thickness per depth of cover.

B. Materials

Materials shall be as per section 6.03.05.

C. Measurement & Payment

Measurement shall be by the lineal foot measured along a 2 foot wide center line per 1 inch of thickness. Payment shall be only for the additional insulation. This item will be paid in conjunction with pay item 6.03.05 as directed by the Engineer.

Pay Item	Pay Unit
Insulation, _ Inch	Ft

6.03.07 Insulation of Existing Service – 2” thickness

A. General Description

Under this item of work, the contractor shall excavate the existing water service and bury a minimum of 6.5 feet or insulate as described in section 6.02.05.

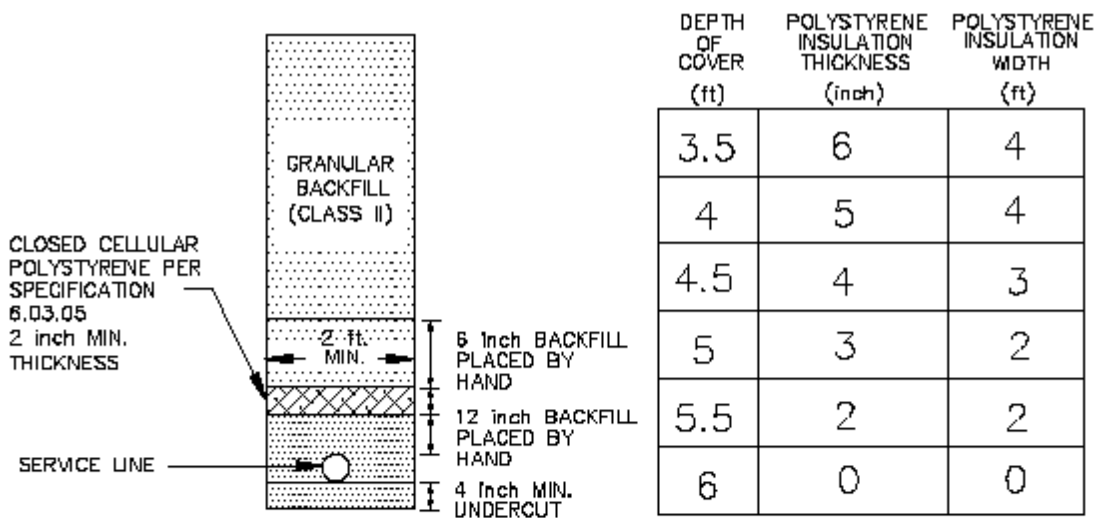
B. Materials

Materials shall be as per section 6.02.05.

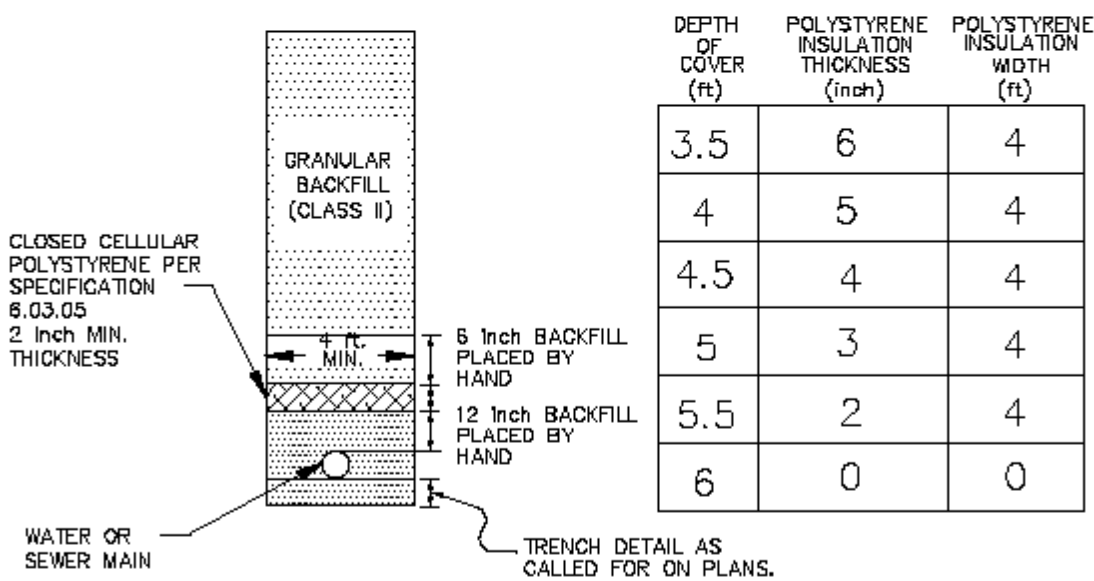
C. Measurement & Payment

Measurement shall be by the lineal foot measured along the center line of the water lines. Payment shall be full compensation for all excavation, labor, tools, 2” insulation, and equipment needed to do the described work. Restoration will be paid at unit prices.

Pay Item	Pay Unit
Insulation, _ Inch	Ft



INSULATING SERVICE LINE - TYPICAL



INSULATING WATER OR SEWER MAIN - TYPICAL

FIGURE 6.1

6.04 ABANDON EXISTING CURB STOP

A. Measurement & Payment

Payment for abandonment of existing curb stop shall be by the unit each. All existing curb stops and others as directed by the Engineer shall be abandoned following connection and acceptance of the new building service. Payment shall be full compensation for closing the valve, removing, and disposing of the top 3 feet of the valve box. This pay item pertains only to existing curb boxes not in the same trench as the new service.

Pay Item	Pay Unit
Exist. Curb Stop, Abandon	Ea

6.05 SANITARY SEWER CONSTRUCTION

A. Scope of Work

The work covered by this section of the specifications consists of the furnishing of all tools, labor, materials, equipment and supervision, and performing all operations involved in the construction of sanitary sewers, drains and facilities as required by this Contract in strict accordance with the provisions of the Plans and Specifications and subject to the terms and conditions of the Contract.

B. General Description

The following miscellaneous provisions apply to this section of the Specifications:

1. Pipe, unless otherwise indicated on the plans or authorized in writing by the Owner, shall be new and unused material of the size and type shown on the plans and shall conform to the requirements of the Specifications.
2. 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.
3. 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 refill, 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 have been 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 substance can enter the line. Any section of pipe found to be defective either before or after laying, shall be replaced with new pipe at the Contractor's expense.
4. 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 the work shall be done within the construction easements provided by the Owner.
5. **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 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 piece.

C. Materials for Sanitary Sewer Construction

Unless otherwise specified, shall be of the type and quality specified below:

1. Pipe and Fittings

Sanitary Sewer from the size 4" to 12" inch shall be PVC sewer pipe. Sanitary sewer larger than 12" may be PVC sewer pipe or C 76-III concrete pipe.

- a) PVC Sewer Pipe: PVC sanitary sewer pipe shall meet the requirements of ASTM Designation D3034 "Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fitting". The minimum wall thickness shall conform to SDR-26.
- b) Concrete Sewer Pipe: Shall conform to the requirements of ASTM C-14 for non-reinforced pipe and ASTM C-76 for reinforced pipe.
- c) PVC Composite Pipe: The Contractor shall obtain written product approval from the engineer for the use of PVC Composite Pipe Manufacturer approved instructions for construction shall govern construction methods.

2. Joint Materials

- a) For PVC Composite Pipe: PVC Composite pipe shall have chemical welded joints. Only chemical solvent approved by the pipe manufacturer shall be used.
- b) PVC Sewer Pipe: PVC Sewer Pipe shall have an O-ring bell gasket joint or the same interspersed with solvent welded joints. Only chemical solvents approved by the pipe manufacturer shall be used.
- c) Joints for Concrete: Shall be O-ring design and conform to ASTM C-443.

D. Construction Methods

1. Excavation

As specified in the Standard Water Main Specifications for the City of Marquette.

2. Handling

The sewer pipe shall be handled in such a manner as to insure delivery on the site and final installation in a sound undamaged condition. Any damaged pipe or other materials shall be replaced by the Contractor at his expense.

3. Pumping and Bypassing

When pumping/bypassing is required, the Contractor shall supply the necessary pumps, conduits and other equipment to divert the flow of sewage around the manhole section in which work is to be performed. The bypass system shall be of sufficient capacity to handle existing flows plus additional flow that may occur during peak periods. The Contractor will be responsible for furnishing the necessary labor and supervision to set up and operate the pumping and bypassing system. If pumping is required on a 24-hour basis, all engines shall be equipped in a manner to keep the pump noise at a minimum.

- 4. Primary line and grade will be furnished by the Owner and will be established by the Engineer. The Contractor must bear sole responsibility for the correct transfer of

all construction lines and grades from the primary line and grade points, and for the correct alignment and grade of the finished structures, based upon the primary line and grade established by the Engineer. Laser devices shall be used to maintain proper grades.

5. Pipe Bedding

As specified in the Standard Water Main Specifications for the City of Marquette.

6. Laying Sewer Pipe

The pipe shall be laid as rapidly as normal working hours and weather conditions permit 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 taken up 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.

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 enter the line.

7. Joints

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

8. Backfilling

As specified in the Standard Water Main Specification for the City of Marquette.

9. Dewatering

As specified in the Standard Water Main Specifications for the City of Marquette.

10. Visual Acceptance

At the time of final acceptance, if on inspection, it is found that there is an accumulation of earth or silt in the pipe, the Contractor shall clean out and remove such deposits at his own expense.

11. Connect to Existing Sanitary Sewer Main

Connections to the existing sanitary sewer system shall be made only after the new section of main has been tested or approved by the Engineer. Connections shall be made at the locations as shown on the plans with approved fittings. The Contractor shall be responsible to excavate the connection area to determine if the proposed grade will be adequate for the existing field conditions.

12. Abandoning Sanitary Sewer

Where the sanitary sewer or portions thereof are to be abandoned, the Contractor shall physically separate the sanitary sewer from the rest of the system at such points as indicated on the plans or directed by the Engineer. The abandoned sanitary sewer shall be drained and pumped to an existing live sewer. The work shall consist of plugging ends of sanitary mains and then pumping the line full of concrete.

E. Inspection and Testing

1. Acceptance Tests

All sewers shall be subjected to air, infiltration or exfiltration tests, deflection testing, television inspection, or a combination of same, prior to acceptance by the Owner, except in those cases where the sanitary sewer cannot be tested because the Engineer requires

the sanitary sewer to be put in service as the sewer main is installed. In such cases the contractor shall secure the services of an independent sewer televising firm and then televise in the Pipeline Assessment and Certification Program (PACP) format to verify the pipe is laid true, that there are no structural defects, and there are no leaks. Any defects found during the televising shall be promptly repaired by the contractor. The contractor shall complete televising prior to final street and surface restoration, but after backfilling and after groundwater has returned to its normal level (when dewatering systems are used).

All sewers, where the ground water level is above the top of the sewer by more than 7 feet, shall be subjected to infiltration tests. All sewers, where the ground water level above the top of the sewer is 7 feet or less, shall be subjected to air tests or exfiltration 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 feet as measured from the top of the pipe.

Within five (5) working days following pipe-laying and backfilling of each manhole to manhole Section, the Contractor shall complete all leak testing. Should the workmanship employed, or pipe material selected fail to meet the test requirements, the Contractor shall select a different material or utilize different techniques to achieve the desired result.

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 groundwater has stabilized at its normal level, 7 feet 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.

SCHEDULE SANITARY SEWER INFILTRATION (EXFILTRATION)
ALLOWABLE LIMITS BASED ON 100 gal. PER inch OF DIAMETER OF PIPE
PER mile OF PIPE PER 24 HOURS

4"	=	0.00315 gal/ft/hr
6"	=	0.00475 gal/ft/hr
8"	=	0.00630 gal/ft/hr
10"	=	0.00790 gal/ft/hr
12"	=	0.00950 gal/ft/hr
15"	=	0.01185 gal/ft/hr
18"	=	0.01420 gal/ft/hr
21"	=	0.01660 gal/ft/hr
24"	=	0.01890 gal/ft/hr

The procedure for air testing of sewers shall be as follows:

The sewer shall be pressurized to 4 psig greater than the greatest back pressure caused by groundwater over the top of the sewer pipe. At least two (2) minutes shall be allowed

for the air pressure to stabilize between 3.5 psig and 4 psig. If necessary, air shall be added to the sewer to maintain a pressure of 3.5 psig or greater. 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 ground water level.

The time required for the air pressure to decrease 1.0 psig during the test shall not be less than the time shown in the following table:

SPECIFICATION TIME REQUIRED FOR A 1.0 psig PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015
Specification Time for Length (L) Shown (min:sec)

Pipe Diameter (Inches)	100 ft.	200 ft.	300 ft.	400 ft.
4	3:46	3:46	3:46	3:46
6	5:40	5:40	5:40	5:42
8	7:34	7:34	7:36	10:08
10	9:26	9:26	11:52	15:49
12	11:20	11:24	17:05	22:47
15	14:10	17:48	26:42	35:36
18	17:00	25:38	38:27	51:16
21	19:50	34:54	52:21	69:48
24	22:47	45:34	68:22	91:10

If a sewer fails to pass any of the previously described tests, the Contractor shall determine the location of the leaks, repair them and retest the sewer. The tests shall be repeated until satisfactory results are obtained.

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

For minor leaks where no structural damage has occurred in the pipe, 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 Engineer to hire a pipe grouting firm for making such repair. Additionally, this operation must be performed under the observation of the Engineer, and a complete report of all grouting operations shall be furnished to the Engineer after completion.

Where structural failures of the pipe have occurred, the broken pipe sections shall be removed and reconstructed.

2. Deflection Testing of PVC Sewer Pipe

In addition to leakage tests, PVC sewer pipe shall be tested for vertical deflection.

Deflection testes shall be performed on all PVC sewer pipe of 8" in diameter and larger. This testing shall be carried out under the observation of the Engineer using GO-NO-GO device approved by the Engineer and furnished by the Contractor.

The cost for such testing will be included I the Contractor's bid price for sewer pipe. The deflection testing shall be performed after the final backfill has been in place at least thirty (30) days to permit stabilization of the sail-pipe system.

The maximum allowable vertical deflection of the circular cross section of the pipe will be limited to five percent (5%) of the actual internal pipe diameter. If the results of the testing show the deflection of any sewer to be in excess of the maximum allowable, then the Contractor shall make repairs by re-excavation and compaction or replacement at

no additional expense to the Owner. The Engineer will require additional deflection testing to be made on sections of repaired sewer at the Contractor's expense.

F. Measurement & Payment

1. Sanitary Sewer: 6", 8", 10", 12", 15", 18", 21", 24", 30" and 36"

Sanitary sewer main of the diameter, depth, slope (% grade) and type specified shall be measured by the linear foot, along the centerline of the pipe from centerline to centerline of adjacent manholes (appurtenances). No deduction will be made for wyes or saddles. Payment shall be at the contract unit price per linear foot and shall be compensation in full for all tools, materials, equipment, labor, excavation, handling and storage, pumping and bypass, laying and joining pipe, field cutting, bedding, disposal of surplus excavation, testing, televising, sheeting, shoring and bracing, backfilling dewatering. The connection of the new sanitary main sewer to an existing main sewer shall be included in the payment for sanitary sewer.

2. Remove Existing Sanitary Sewer

The work shall include all necessary excavation, cutting of existing sewer, and removal. The work shall be paid for at the contract unit price per linear foot and shall include all labor, tools, equipment, material, excavation and backfill required to remove the existing sanitary sewer. Payment shall include the placement of masonry plug at the removal limits as directed by the Engineer.

Sanitary sewer removed within trench excavation limits for new sanitary sewer shall be incidental to the placement of new sanitary sewer.

3. Abandon Existing Sanitary Sewer

Measurement and payment for "Abandon Sanitary Sewer" shall be by the contract unit price per lineal foot. The work shall consist of plugging ends of sanitary mains and then pumping the line full of concrete. Payment shall be full compensation for all labor, material, equipment, excavation and backfilling required to perform the work. Abandoning sewers will be performed on sewers that are 12" in diameter and larger.

Pay Item	Pay Unit
Sewer, Sanitary, _ Inch, Tr Det _	Ft
Exist. Sanitary Sewer, Rem	Ft
Exist. Sanitary Sewer, Abandon	Ft

6.06 SANITARY SEWER CONSTRUCTION - 4" & 6" LATERALS

6.06.01 Scope of Work

This work will consist of constructing a sanitary sewer lateral between the City's sanitary sewer main and a building sewer at the property line, or other point of termination, as directed by the Engineer. Included in the work will be tapping of the sewer main, excavation, pipe laying, cleanouts, connection to building sewer or other termination point, backfilling, and the provision of all necessary labor, tools, materials and equipment to complete the work and test the acceptability of the installation..

6.06.02 Materials

Materials to be used for construction of sanitary sewer laterals shall be as listed below, unless another, equally suitable material is authorized for use by the Engineer. Fittings, saddles, and other connections shall, in general, be of the same material and have the same type of joints as the pipe material itself.

A. Pipe Fittings

1. PVC Pipe shall conform to ASTM 1785-83 Schedule 40 or equal
2. In areas of new PVC sanitary main construction, the new lateral material shall be of the same composition as the new main sewer.

B. Monument Boxes

1. Monument boxes required for concrete or bituminous surfaced locations shall be ej 2970 as manufactured by ej or approved equal.

6.06.03 Construction Methods

A. Excavation

as specified in the Standard Water Main Specifications for the City of Marquette

B. Connection to an Existing Main Sewer

Where practical to do so, a new lateral will be connected to existing main sewer at an existing wye-branch or tee, using suitable jointing materials or couplers (such as "Fernco" fittings). Where no wye-branch or tee exists, the Contractor will make a sewer tap by one of the following methods:

1. Concrete, Vitrified Clay, and Asbestos Cement Main Sewers

A circular hole of the required diameter shall be cored from the side of the main sewer using a mechanically powered hollow cylindrical bit. No "break-in" connections will be allowed. A fitting approved for use by the Engineer, and which has a hub or appropriate joint to match the sewer lateral, shall be firmly secured and sealed to the main sewer.

2. PVC and ABS Main Sewer

Saddles shall be secured to the main sewer and a hole cut or cored into the main sewer. Saddles shall be secured by solvent welding, and two stainless steel bands or clamps.

3. Alternate Method

At the discretion of the Engineer, the Contractor may be allowed to remove a section of the main sewer and replace it with a new section containing a wye-branch. The new section shall be of the same size and material as the original section and shall be installed using appropriate joints or couplers to affect a leak tight seal at the ends of the section.

C. Connections to New Main Sewer

Saddles shall be secured to the main sewer and a hole conforming to the manufacturer's pattern cut or cored into the main sewer. Saddles shall be secured by solvent welding, and two stainless steel bands or clamps. The wyes shall be of the same composition and have

the same type of joints as the new main sewer. Saddles shall be used in areas of sanitary main sewer replacement.

D. Pipe Laying

Pipe laying shall commence at the main sewer and proceed upstream toward the property line. The pipe shall be laid true to line and grade and shall be bedded in at least 4" of an acceptable granular material, free from rocks, sticks, and other debris.

The following shall also apply:

1. Changes in direction and grade shall be accomplished by using one or more fittings (bends) with an angle of deflection no greater than 45 degrees.
2. Minimum grade for laterals shall be ¼" rise per foot of run, unless otherwise directed or approved by the Engineer.

E. Cleanouts

A cleanout shall be constructed at the property line. A cleanout shall consist of a wye-branch installed in the laterals, a 45 degree bend, section of riser pipe, a threaded pug, installed at grade level, and a magnet marker (Bernsten, Depp-1 or equal) shall be taped to the side of cleanout 7" below grade. Cleanouts shall be 4" and of the same type of material as the sewer lateral.

F. Monument Boxes

Monument boxes shall be placed at the cap to the cleanouts installed in concrete, bituminous, or gravel surfaces. Monument box covers shall be placed 4 inches below the surface of the natural ground. The Contractor will ensure that covers located in areas within the finished asphalt or concrete surface are ¼ inch below the finished paved surface. Covers out of ¼ inch tolerance (plus or minus ¼ inch) will be adjusted during or after the paving operations at the Contractor's expense. No "dishing" of the asphalt will be allowed around the monument box covers on the finished paved surface. Asphalt areas cutout and removed for the repair shall be placed back in a seamless condition.

G. Termination

The sanitary sewer lateral will terminate at the property line with the cleanout in the case where there is no existing building sewer, or at the point of connection to an existing building sewer. When there is no existing building sewer, the open end of the wye-branch at the cleanout shall be plugged with a suitable plug or cap which will prevent the entry of dirt and water into the sewer lateral. If connection is to be made to an existing building sewer, a closure piece consisting of a minimum 12" piece of sewer pipe and the necessary fittings and couplers shall be installed between the clean-out and the end of the building sewer.

H. Backfilling

As specified in City of Marquette Standard Water Main Specifications.

I. Dewatering

As specified In City of Marquette Standard Water Main Specifications.

J. Coordination with Property Owners

The contractor will make every effort to coordinate with the property owner and the property owner's plumbing contractor on the installation of the new sanitary sewer lateral. Coordination will include the new lateral location, approximate day of said installation, and length of time the trench will be open at the cleanout location. The contractor will make every effort to contact the said property owner on coordination activities either by verbal, written communication, or a combination of both. Coordination is incidental to the sanitary sewer lateral installation and its appurtenances.

6.06.04 Inspection and Testing

A. Before backfilling the trench the completed sewer lateral, its joints, connections and tap at the main sewer shall be inspected by the Engineer or his representative. The Engineer may order testing done to check that all joints are secure and water tight, or may order all or part of the installation re-laid to correct any deficiencies.

6.06.05 Measurement & Payment

A. Saddle Installation

Saddle installation will be paid for at the contract unit price each, which price shall be payment in full for all excavation, backfilling, furnishing all materials, labor and equipment necessary to install the size Saddle to the limit as detailed on the plans.

B. Cleanouts 4"

Sewer cleanouts will be paid for at the unit price each, which price shall be payment in full for excavation, backfilling, furnishing all labor, materials, and equipment necessary to install the cleanout to the limit as specified and detailed on the plans.

C. Monument Boxes

Payment at the contract unit price each, shall be compensation in full for all labor, tools, equipment and materials necessary for the installation complete.

D. Sewer Laterals, 4" and 6"

Payment shall be full compensation for excavation, backfilling, labor, materials including risers and equipment necessary to install the lateral and will be paid for at the contract unit price per linear foot. Measurement shall be measured horizontally from the centerline of the sewer main to the center of the cleanout wye.

E. Sanitary Lateral Repair or Relocation, 4" and 6"

Where the Contractor during construction operations breaks an existing sewer lateral, the Contractor will be paid for the repair or relocation of the existing sewer lateral at the contract unit price per linear foot. The price shall include all necessary fittings and appurtenances, pipe required, and all labor, tools, equipment and other materials required to accomplish the work. All repair methods must be approved by the Engineer before the work is completed.

F. Connect to Existing Sanitary Sewer Lateral, 4” and 6”

Payment for this item will be by the unit each. Payment shall be full compensation for all labor, tools, equipment, and material including miscellaneous fittings required to connect the new sanitary sewer lateral from the cleanout wye to the existing sewer lateral.

<u>Pay Item</u>	<u>Pay Unit</u>
Sanitary Saddle, _ Inch x _ Inch	Ea
Clean-out, Sanitary Sewer, _ Inch	Ea
Monument Box	Ea
Sanitary Lateral, _ Inch	Ft
Sanitary Lateral, Repair or Relocation, _ Inch	Ft
Connect to Existing Sanitary Lateral	Ea

6.07 SANITARY SEWER APPURTENANCES

6.07.01 Scope of Work

The work covered in this section of the Specifications consists of the furnishing of all tools, labor, materials, equipment and supervision and performing all operations involved in the construction of sewer appurtenances as required by this contract in strict accordance with the provisions, of the Plans and Specifications and subject to the terms and conditions of the Contract.

6.07.02 General Description

The following provisions apply to this section of the Specifications:

- A.** 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 standards details, and shall conform to the requirements of the Specifications.
- B.** All materials offered by the Contractor shall be the standard products of reputable manufacturers normally engaged in the manufacturing of such materials.
- C.** 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.
- D.** Where appurtenances are shown to be constructed on private property, the location of the structure shall be as shown on the plans. All work shall be done within the construction easement provided by the Owner.

6.07.03 Material for Sanitary Sewer Appurtenances

A. Precast Reinforced Concrete Manhole Units

These units shall be circular with circular reinforcement and shall conform with the requirements of ASTM-C478-70. All manhole joints shall be of the rubber O-ring design or butyl rubber joint compound meeting Federal Specifications SS-S-210 and SS-S-210A and AASHTO M-198 (i.e. Butyl Tite as manufactured by Blue Ridge Rubber or equal).

B. Manhole Covers

Cast Iron Frames and Covers for Manholes: Shall be ej 1040 frame or equal with a solid cover (M.D.O.T. Type Q).

C. Manhole Steps

Cast iron manhole steps shall be furnished and set by the Contractor. They shall conform to the requirements of ASTM Standard Specifications for "Gray Iron Castings", A-48, Class No. 30, minimum width 14 inches. (ej No. 8509 or approved equal). Polypropylene plastic, steel reinforced, manhole steps may also be furnished. They shall be #P52 manhole steps as manufactured by M.S. Industries, Inc. of Peachtree City, Georgia or equal. In the event FRP manholes are used Armco manhole steps shall be furnished.

D. 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 Corp., or equal.

E. Flow Line (Inverts)

3500 PSI concrete or equal.

F. INFRA-RISER® Adjustment Risers, Riser Rings by ej, or Pro-Ring by Cretex will be used for cover/casting adjustments instead of the concrete adjustment rings. Failure of the system will require the removal of the casting and proper placement of the casting and rim to grade.

G. Self-Leveling Assembly

All manhole castings will be adjusted to final grade in the asphalt pavement by use of a self-leveling assembly by ej (1040 ADT) or approved equal.

6.07.04 Construction Methods

A. As specified in Section 403, 2020 MDOT Standard Specifications, and typical details on plans.

B. Inlet and Outlet Pipes

Pipes placed in the masonry for inlet or outlet connections shall extend through the walls and beyond the outside surface of the walls a sufficient distance to allow for connections. When required, drops shall be installed according to details shown on the plans.

C. Drop Manholes

All sanitary manholes with an invert drop in excess of 2 feet shall have a drop structure. The drop structure shall be built as shown on the plans and standard details.

D. Tap Existing Manhole

As specified in Section 403.03E, 2020 MDOT Standard Specifications.

E. Backfilling

As specified in standard Water Main Specification for the City of Marquette.

F. Placing Cast Iron Frame and Cover

The manhole frame, cover and self-leveling assembly shall be centered over the structure opening. After the leveling HMA course has been placed, and prior to the placement of the HMA top course, the manhole frame and cover shall be adjusted to the finished elevation and slope using the self-leveling manhole assembly. The self-leveling assembly will be placed per the manufacturer’s recommendations such that the manhole cover is sitting level with the HMA top course surface. Ensure that sufficient HMA is placed under the upper frame to prevent it from resting directly on the guide frame and the lid is flush with the HMA top course. Frames and covers not centered over the manhole structure shall be re-excavated, regraded, and centered over the manhole structure during or after the paving operations at the Contractor’s expense. Asphalt areas cut out and removed for the repair shall be placed back in a seamless condition.

G. Flow Channel

The flow channel straight through a manhole should be made to conform as closely as possible in shape to that of the connecting sewers. The slope of the flow channel will be equal to the slope of the sanitary main rounded up to the highest percent but not less than 2 percent. The channel walls should be formed or shaped to the full height of the crown of the outlet sewer in such a manner to not obstruct maintenance, inspection or flow in the sewers. Voids between the pipe and the pre-manufactured flow channel/bench area will be filled with grout to provide a smooth transition.

When curved flow channels are specified in manholes, slopes will at a minimum be 2 percent. Changes in direction of flow through the manhole shall be made with a smooth continuously curved channel utilizing the maximum radius possible.

H. Bench

A bench shall be provided on each side of any manhole channel when the pipe diameter(s) are less than the manhole diameter. The bench should be sloped towards the channel no less than ½ inch per foot (4 percent). No lateral sewer, service connection, or drop manhole pipe shall discharge onto the surface of the bench.

6.07.05 Acceptance Tests

A. Manholes on sanitary sewer are to be subjected to an exfiltration test. All incoming and outgoing sewer lines shall be plugged and the manhole filled with water up to +/- 6” of the manhole cover. If the water loss exceeds the maximum allowable as shown below, the manhole shall have failed the test.

Depth of Manhole	Maximum Allowable Water Loss
0-8 feet	1 inch/5 minutes
Over 8 feet	1/8 gal/vertical foot/5 minutes

All manholes which fail the above test shall be inspected as to the source of the problem, corrected, and retested.

6.07.06 Measurement & Payment

A. Sanitary Manholes

1. Measurement

- a) Manholes from 0 to 8 feet will be measured as units. The depth shall be measured vertically in vertical feet from the invert of the effluent sewer to the top of masonry.
- b) Manholes greater than 8 feet shall be measured in vertical feet for that portion of the manhole more than 8 feet in depth.

2. Payment

- a) Manholes from 0 to 8 feet depth shall be paid for at the contract unit price each. Payment shall be full compensation for all excavation, backfilling, base, sections, cone, O-rings, steps, water stop, flow line, furnishing materials, labor, and equipment necessary to install and complete all items.
- b) Manholes greater than 8 feet shall be paid for at the contract unit price per manhole plus contract price per vertical foot greater than 8 feet.
- c) Drop manholes shall be paid for at the contract unit price per manhole. Payment shall be full compensation for all excavation, backfilling, base, sections, cone, O-rings, steps, water stop, flow line, piping for drop connection, piping encasement in concrete, furnishing materials, labor, and equipment necessary to install and complete all items.

B. Manhole Cover

The installation of manhole frames and covers shall be paid for at the contract unit price which shall include installation of an M.D.O.T. Type Q manhole frame, cover, and self-leveling assembly. The work shall include all labor, tools, equipment, and materials necessary to place the frame and cover on the manhole as per these specifications.

C. Tap Existing Sanitary Manhole

The work shall be measured and paid for at the contract unit price each and shall include a manhole waterstop to assure a watertight connection approved by the Engineer. Payment shall be full compensation for all tools, materials, and labor required to complete the work.

D. Remove Existing Sanitary Manhole

The work shall be measured and paid for at the contract unit price each. Payment shall be full compensation for all labor, equipment, materials, bulk heading, excavation, and backfilling necessary to remove and dispose of the manhole. The frame and cover shall remain the property of the Owner and transported to a location determined by the Engineer. Payment shall include the placement of a masonry plug in adjacent sanitary lines as directed by the Engineer.

E. Abandon Existing Sanitary Manhole

The work shall be measured and paid for at the contract unit price each. To abandon manholes the cover shall be removed and the masonry broken down to an elevation at least 3 feet below the pavement surface, within the area of the roadbed and elsewhere to an elevation at least 1 foot below the finished roadway.

Existing live sewer connections shall be rebuilt and properly reconnected through the abandoned area, and service shall be maintained during such construction operations. Payment shall be full compensation for all labor, equipment, materials, excavation, bulk heading, disposal, and backfilling (including structure) required to accomplish this work. The frame and cover shall remain the property of the Owner and shall be transported to a location determined by the Engineer. Payment shall include the placement of a masonry plug in adjacent sanitary lines as directed by the Engineer.

F. Salvage Sanitary Manholes

Salvage Sanitary Manhole shall be measured by the unit each for each 4’ concrete manhole removed from the existing location in sections and delivered to the Public Work Garage. The existing structures are precast 4’ concrete, the contractor shall remove concrete plugs and lift section by lift holes. Payment shall be at the contract unit price each and shall be full compensation for all labor, materials and equipment necessary to accomplish the work. Payment shall include the placement of a masonry plug in adjacent sanitary lines as directed by the Engineer.

<u>Pay Item</u>	<u>Pay Unit</u>
Sanitary Manhole, _ Ft. Dia. (0-8 Ft.)	Ea
Sanitary Manhole, _ Ft. Dia. (Greater than 8 Ft.)	Ft
Sanitary Drop Manhole, _ Ft Dia. (0-8 Ft.)	Ea
Sanitary Drop Manhole, _ Ft Dia. (Greater than 8 Ft.)	Ft
Sanitary Manhole, Tap, _ Inch	Ea
Sanitary Manhole, Rem	Ea
Sanitary Manhole, Abandon	Ea
Sanitary Manhole, Salvage	Ea

6.08 PRESSURE SANITARY SEWER RESIDENTIAL USE- SINGLE FAMILY

6.08.01 General Description

A. The contractor shall furnish all labor, materials, and equipment required to construct a pressure sewer and necessary appurtenant work as herein specified. The sewer shall be installed in the locations as shown on the Plans and shall meet the line acceptance tests.

6.08.02 Testing

A. General

1. Furnish all equipment and personnel to conduct system acceptance tests as specified herein. All tests shall be conducted under the supervision of the Engineer. No acceptance tests shall be conducted until the entire system is constructed and has been installed and backfilled for not less than 30 days.
2. All pressure sewers, cleanouts, and valves shall be pressure tested.
3. Should the results of any test fail to meet the criteria established in this Specification, the CONTRACTOR shall at his own expense, locate, repair and retest until it is within specified allowance.

4. Provide all labor, supervision, pumps, measuring devices, power and water necessary for conducting of hydrostatic tests on all piping.

B. Preparation

1. After the pipe has been laid and backfilled as specified, the CONTRACTOR shall fill the line, or a valve section thereof, to be tested with water in such a manner as to expel all air from the pipe. This may be done through cleanouts, air release valves, or, if no valve is available at such point, the CONTRACTOR shall make the taps necessary to accomplish the expulsion of all air. At the close of the test, all taps shall be satisfactory plugged with brass plugs.

C. Pressure Test

1. All pipe laid under this item shall be subjected to a hydrostatic pressure of 150 psi based on the elevation of the lowest point in the system. The line shall be maintained under the test pressure for minimum continuous period of two (2) hours by pumping potable water into the line at frequent intervals. The volume of water so added shall be measured and considered to represent the leakage of the main. No pipeline installed will be accepted until the leakage measured over a 1 hour period is less than 160 gallons/inch diameter of the pipe per 1000 feet. Any cracked or defective pipe, fittings, valves or cleanouts discovered shall be removed and replaced with sound material at the CONTRACTOR's expense and the test repeated to the satisfaction of the ENGINEER and OWNER. Maximum length of pressure sewer to be tested at one time shall be 1500 feet.

6.08.03 Polyvinyl Chloride Pipe and Fittings

A. PVC Pipe

1. Schedule 80 PVC (ASTM D1785) pipe: PVC pipe shall be extruded from one of the following materials.

a) Type 1, Grade 1 or 2 with hydrostatic design stress of 2,000 PSI for water at 73.4 °F, designated as PVC 2116 or PVC 4116 Schedule L1 Solvent Weld pipe.

2. The pipe shall be homogeneous throughout and free from cracks, holes, foreign inclusions or other defects. The pipe shall be as uniform as commercially practical in color.

3. Pipe shall be jointed with solvent welds unless otherwise noted or specified.

4. The workmanship, pipe dimension and clearances, outside diameters, wall thickness, eccentricity, sustained pressures, burst pressures, flattening, extrusion quality, marking and all other requirements of Commercial Standards CS 256 shall be conformed to within all respects.

5. The PVC pipe shall bear the National Sanitation Foundation (NSF) seal of approval.

6. Schedule 80 PVC pipe shall conform in all respects to the Commercial Standards CS 207-60.

7. The pipe shall be shipped with one coupling factory applied. Pipe shall have a ring painted around the uncoupled end in such a manner as to allow field checking of setting depth of pipe in the socket.

8. Pipe must be delivered to the job site by means which will adequately support it, and not subject to undue stresses. In particular, the load shall be so supported that the

bottom rows of pipe are not damaged by crushing. Pipe shall be unloaded carefully and strung or stored as close to the final point of placement as is practical.

9. PVC must be stored so as to be protected from prolonged heat or direct sunlight. Any protective covering may be used which will not absorb much heat and which will deflect the direct rays of the sun. Ventilation should be provided with any type of cover used.

B. PVC Fittings

1. Fittings shall be of the same material as the pipe, and in no case shall have thinner walls than that of the pipe furnished. All fittings must be made of NSF approved material.

2. The dry fit of fittings and coupling sockets must be snug. If the fit is such that is loose, the pipe and/or fittings will be rejected as faulty because of improper size. Building up the joint to overcome a loose fit with multiple layers of filler solvent will not be permitted.

3. PVC Couplings. – ½” and ¾”

PVC couplings may be of the molded type. The 1” through 4” shall be of extruded type, designed to be interference fit for at least half of the socket depth. They shall have a beveled entrance to prevent the wiping off of the solvents on male ends while being installed. The wall thickness of the PVC pipes shall be equal to the pipe SDR or shall be ¼” thick, whichever is greater. Elbows shall be long radius bends with minimum walls equal to that of the pipe coupling or shall be ¼” thick, whichever is greater. Tapered welding sockets shall be equal to those required for couplings.

C. PVC Welding Solvents

1. The solvent cement shall meet all the requirements of ASTM Specification for Solvent Cement Polyvinyl chloride (PVDC) Plastic pipe and Fittings ASTM Designation: D2564.

2. PVC welding solvent shall be compounded to conform with the socket fit and the weather conditions at the beginning of installation and be such as to assure minimum installation cost and a weld of maximum strength.

3. Since PVC welding solvent is engineered and formulated to perform with a given joint design, all solvent must be purchased from the manufacturer of the pipe.

4. PVC solvent cements should be stored in a cool place except when actually in use at the job site. These cements have a limited shelf life when not stored in hermetically sealed containers.

6.08.04 Gate Valves

Gate valves shall be full ported, constructed of bronze, with a rated pressure of 200 psi provided with threaded connections.

6.08.05 Air and Vacuum Release Valves

Air and vacuum release valves when specified shall be designed to operate under a maximum operating pressure of 300 psi and capable of venting or adding 20 CFFAS (cubic feet of free air per second). Valves shall be cast iron with bronze internal parts and Type 304SS float.

6.08.06 Curb Stop

Curb stops shall be Mueller, Ford or equal. All parts shall be cast in bronze. Each stop shall have an inverted key stop.

6.08.07 Curb Boxes

Curb boxes used for service connections shall be the "Buffalo" type. All curb boxes shall have a screw type adjustment and shall be furnished complete with lid. All curb boxes shall be coated inside and out with a tar base enamel. The word "SEWER" shall be cast into the lid.

6.08.08 Check Valve

A. The valve shall be 1 ¼" and of the gravity operated, flapper-type. The check valve will provide a full ported passageway when open and shall introduce a friction loss of less than 6" of water at maximum rated flow. Working parts will be made of a 300 series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability and fatigue strength. A non-metallic hinge shall be an integral part of the flapper assembly providing maximum degrees of freedom for assured seating at a very low back pressure.

B. The valve body shall be a high glass, injection molded part made of PVC Type I-II with hub and socket compatible with 1 ¼" PVC solvent weld system. Dimension for hub and socket shall be in accordance with Commercial Standards C5-272-65.

6.08.09 Cleanouts

Cleanouts shall be constructed as detailed on the plans.

6.08.10 Gatewells

A. Reinforced concrete gatewells shall conform to the latest revision of ASTM Specifications for Precast Reinforced Concrete Manhole Sections, Serial Designation C478, with rubber gasket joints.

B. Steps shall be plastic coated steel. They shall be M.A. Industries PSI-PF, or equal.

C. Frames and covers shall be cast iron conforming to the Standard Specifications Castings, Serial Designation A48, or the latest revision thereof, Neenah No. R-1642, with type C solid cover or ej No. 1040 with type Q cover or equal. They shall have machined bearing surfaces and suitable notches for convenient removal of the cover. Covers shall have the letters "Sanitary Sewer" cast integrally with the cover. All frames and covers shall be coated at the point of manufacturer with coal tar pitch varnish or other approved asphaltum coating.

6.08.11 Semi-Positive Displacement Type Grinder Pump Stations

A. General Description

The contractor shall furnish complete factory-built and tested Grinder Pump Station(s) each consisting of grinder pump(s) suitably mounted in a basin constructed of fiberglass or high density polyethylene (DDPE), pump removal system, shut-off valve, anti-siphon valve, and check valve assembled within the basin, electrical alarm/disconnect panel, and all

necessary internal wiring and controls. For ease of serviceability, all pump, motor/grinder units shall be of like type and horsepower through the system.

Grinder pump station shall be Environment One Extreme D-Series or Barnes Engineered Pressure Sewer Basins UltraCAV SGPC with integrated controls or approved equal.

B. Shop Drawings

Before receipt of notice to proceed, the Contractor shall furnish a minimum of four (4) sets of shop drawings detailing the equipment to be furnished including dimensional data and material of construction. The ENGINEER shall promptly review this data and return one (1) copy as accepted, or with requested modifications.

C. Manufacturer

The equipment specified shall be a product of a company experienced in the design and manufacture of grinder pumps for specific use in low-pressure sewage systems. The company shall submit detailed installation and user instructions for its product; submit evidence of an established service program including complete parts and service manuals, and be responsible for maintaining a continuing inventory of grinder pump replacement parts. Also if requested by the Engineer, The MANUFACTURER shall provide a reference and contact list from three of its largest contiguous grinder pump installations.

D. Operating Conditions

The pumps shall be capable of delivering 15 GPM against a rated total dynamic head of 0 feet (0 PSIG), 11 GPM against a rated total dynamic head of 92 feet (40 PSIG), and 7.8 GPM against a rated total dynamic head of 185 feet (80 PSIG). The pump(s) must also be capable of operating at negative total dynamic head without overloading the motor(s). Under no conditions shall in-line piping or valving be allowed to create a false apparent head.

E. Warranty

The grinder pump MANUFACTURER shall provide a part(s) and labor warranty on the complete station and accessories, including, but not limited to, panel and redundant check valve, for a period of twenty-four (24) months after notice of OWNER'S acceptance, but no greater than twenty-seven (27) months after receipt of shipment. Any defects found during the warranty period will be reported to the MANUFACTURER by the OWNER.

6.08.12 Grinder Pump Station Materials

A. Pump

The pump shall be a custom designed, integral, vertical rotor, motor driven, solids handling pump of the progressing cavity type with a single mechanical seal. The rotor shall be through-hardened, highly polished, precipitation hardened stainless steel. The stator shall be of a specifically compounded ethylene propylene synthetic elastomer. The material shall be suited for domestic wastewater service. Its physical properties shall include high tear and abrasion resistance, grease resistance, water and detergent resistance, temperature stability, good aging properties, and outstanding wear resistance.

B. Grinder

The grinder shall be placed immediately below the pumping elements and shall be direct-driven by a single, one-piece stainless steel motor shaft. The grinder impeller shall be securely fastened to the pump motor shaft. The grinder will be of the rotating type with a stationary hardened and ground stainless steel shredding ring and stainless steel cutter bar(s). This assembly shall be dynamically balanced and operate without objectionable noise or vibration over the entire range of recommended operating pressures. The grinder shall be constructed so as to eliminate clogging and jamming under all normal operating conditions including starting. These requirements shall be accomplished by the following, in conjunction with the pump.

1. The grinder shall be positioned in such a way that solids are fed in an upward flow direction.
2. The impeller mechanism must rotate at a nominal speed of no greater than 1800 rpm.

The grinder shall be capable of reducing all components in normal domestic sewage, including a reasonable amount of "foreign objects", such as a paper, wood, plastic, glass, rubber and the like, to finely divided particles which will pass freely through the passages of the pump and the 1 ¼" diameter s/s discharge piping.

C. Electrical Motor

As a maximum, the motor shall be a 1HP, 1750 RPM, 240 Volt 60 Hertz, 1 Phase, capacitor start, ball bearing, squirrel cage induction type. Inherent protection against running overloads or locked rotor conditions for the pump motor shall be provided by the use of an automatic-reset, integral thermal overload protector incorporated into the motor. This motor protector combination must meet the requirements of Underwriters Laboratories, Inc. for the application.

D. Mechanical Seal

The core shall be provided with a mechanical shaft seal to prevent leakage between the motor and pump. The seal shall have a stationary ceramic seat and carbon rotating surface with faces precision lapped.

E. Tank and Integral Access Way

The tank shall be made of high density polyethylene or fiberglass. All seams created during tank construction are to be welded and factory tested for leak tightness. Tank wall and bottom must withstand the pressure exerted by saturated soil loading at maximum burial depth. All station components must function normally when exposed to maximum external soil and hydrostatic pressure.

Tank capacities shall be as shown on the contract drawings.

The ACCESS WAY shall be an integral extension of the wet well assembly and a tamper-proof cover assembly providing low profile mounting and watertight capability.

All discharge piping shall be constructed of 304 series Stainless Steel and terminate outside the ACCESS WAY bulkhead. The discharge piping shall include a ball valve rated for 150 psi. The bulkhead penetration shall be factory installed and warranted by the manufacturer to be watertight.

The ACCESS WAY shall include penetrations warranted by the manufacturer to be watertight.

The ACCESS WAY shall also include a vent to prevent sewage gases from accumulating in the tank.

F. Check Valve

The pump discharge shall be equipped with a factory installed, gravity operated check valve built into the stainless steel discharge piping. The check valve will provide a full-ported passageway when open and shall introduce a friction loss of less than 6" of water at maximum rated flow. Working parts will be made of a 300 series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability and fatigue strength.

Each grinder pump station shall also include one separate check valve for installation in the service lateral between the grinder pump station and the sewer main, preferably next to the curb stop.

G. Controls

All necessary controls shall be located in the top housing of the core unit. The top housing will be attached with stainless steel fasteners.

Grinder pump package shall have controls to automatically turn pump on and off at prescribed levels. The package shall also have either of the two following capabilities:

1. The ability of the pump and motor to run at zero head without overloading the motor, or
2. ***RUN DRY PROTECTION***

In order to guarantee that the pump will not be run in a dry condition, each station shall be equipped with a low level detection device that will interrupt the operation of the pump in the event that the water level falls below the normal off level. Pump operation shall be automatically restored when the water level is raised above the low level detection setting.

H. Alarm Disconnect Panel

Each grinder pump station shall include a NEMA 4X, Panel suitable for wall or pole mounting. The enclosure shall include a hinged, padlockable cover, secured dead front and component knockouts.

The Alarm/Disconnect Panel shall include the following features: audio & visual alarm, push to run switch. The alarm sequence is to be as follows:

1. When liquid level in the sewage wet well rises above the alarm level, visual and audio alarms will be activated. The contacts on the alarm switch will close.
2. The audio alarm may be silenced by means of the externally mounted, push to silence button.
3. Visual alarm remains illuminated until the sewage level in the wet well drops below the "off" setting of the alarm switch.

The visual alarm lamp shall be inside a red fluted lens. Visual alarm shall be mounted to the enclosure.

I. Serviceability

The grinder pump core unit shall have a lifting system to facilitate easy core removal when necessary. All mechanical and electrical connection must provide easy disconnect

accessibility for core unit removal and installation. A push-to-run feature will be provided for field trouble shooting.

J. Safety

The Grinder Pump shall be free from electrical and fire hazards as required in a residential area. The Grinder Pump Station shall meet U.L. requirements for its intended use. The Grinder pump shall meet accepted standards for plumbing equipment for use in or near residences, shall be free from noise, odor, or health hazards, and shall have been tested by an independent laboratory to certify its capability to perform as specified in either individual or low pressure sewer system applications.

6.08.13 Testing and Installation

A. Factory Test

Each grinder pump shall be submerged and operated for 5 minutes (minimum). Certified test results shall be available upon request showing the operation of each grinder pump at two (2) different points on its curve. The ENGINEER reserves the right to inspect such testing procedures with representatives of the OWNER at the GRINDER PUMP MANUFACTURER'S facility.

B. Delivery

All Grinder Pump units will be delivered to the job site, 100% completely assembled, including testing, ready for installation.

C. Installation

Earth excavation and backfill requirements are specified under MDOT 2020 Standard Specifications for Construction Section 206 and are also to be done as part of the work under this section, including any necessary sheeting and bracing.

The CONTRACTOR shall be responsible for handling ground water to provide a firm, dry subgrade for the structure, and shall guard against flotation or other damage resulting from general water or flooding.

The Grinder Pump Stations shall not be set into the excavation until the installation procedures and excavation have been approved by the ENGINEER.

Remove packing material. Users' instructions MUST be given to the OWNER. Hardware supplied with the unit, if required, will be used at installation. Appropriate inlet piping must be used. The basin may not be dropped, rolled or laid on its side for any reason.

Installation shall be accomplished so that 1" to 4" of access way, below the bottom of the lid, extends above the finished grade line. The finished grade shall slope away from the unit. The diameter of the hole must be large enough to allow for the concrete anchor.

A 6" (minimum) layer of naturally rounded aggregate, clean and free flowing, with particle size of not less than 1/8" or more than 3/4" shall be used as bedding material under each unit.

A concrete anti-flotation collar, as detailed on the drawings, and sized according to the manufacturer's instruction, shall be required and shall be pre-cast to the grinder pump or poured in place. Each Grinder Pump Station with its precast anti-flotation collar shall have a minimum of three (3) lifting eyes for loading and unloading purposes.

The unit shall be leveled, and filled with water, to the bottom of the inlet, to help prevent the unit from shifting while the concrete is being poured. The concrete must be manually vibrated to ensure there are no voids. If it is necessary to pour the concrete to level higher

than the inlet piping, an 8" sleeve is required over the inlet prior to the concrete being poured.

The electrical enclosure shall be furnished, installed and wired to the Grinder Pump Station by the CONTRACTOR. An alarm device is required on every installation; there shall be NO EXCEPTIONS. It will be the responsibility of the CONTRACTOR and the ENGINEER to coordinate with the individual property owner(s) to determine the optimum location for the "Alarm/Disconnect Panel."

The CONTRACTOR shall mount the alarm device in a conspicuous location, as per national and local codes.

D. Start-up and Field Testing

The CONTRACTOR shall provide the services of qualified factory-trained technician(s) who shall inspect the placement and wiring of each station, perform field tests as specified herein, and instruct the OWNER'S personnel in the operation and maintenance of the equipment before the stations are accepted by the OWNER. All equipment and materials necessary to perform testing shall be the responsibility of the INSTALLING CONTRACTOR. This will include, as a minimum, a portable generator (if temporary power is required) and water in each basin.

The services of a trained factory-authorized technician shall be provided at a rate of one (1) - four (4) day week for each 100 grinder pump stations supplied. Each day shall be ten (10) person hours in duration.

Upon completion of the installation, the authorized factory technicians will perform the following test on each station:

1. Make certain the discharge shut-off valve is fully open. This valve must not be closed when the pump is operating. In some installations, there may be a valve(s) at the street main that must also be open.
2. Turn ON alarm power circuit.
3. Fill the wet well with water to a depth sufficient to verify the high level alarm is operating. Shut off water.
4. Turn ON pump power circuit. Initiate pump operation to verify automatic "on/off" controls are operative. Pumps should immediately turn ON. Within one (1) minute alarm light will turn OFF. Within three (3) minutes the pump will turn OFF. Upon completion of the start-up and testing, the CONTRACTOR shall submit to the ENGINEER the start-up authorization form describing the results of the test performed for each Grinder Pump Station. Final acceptance of the system will not occur until authorization forms have been received for each pump station installed.

6.08.14 Operation and Maintenance

A. Spare Care

The CONTRACTOR will supply one (1) spare grinder pump for every 25 grinder pump stations installed.

B. Manuals

The CONTRACTOR will supply four (4) copies of Operation and Maintenance Manuals to the OWNER.

6.08.15 Forced Sewer Main Service Lateral Accessories

A. General Description

The CONTRACTOR shall furnish and install a curb stop with box and a check valve on the units force main. All fittings and valves shall be rated for 150 psi service.

6.08.16 Pipe Installation

A. Any pipe damaged in transport or handling shall be rejected and removed from the site of the work.

B. All pipe and fittings shall be carefully lowered and moved into position in the trench or vault in a controlled manner such as will prevent damage to the pipe and its coating and lining.

C. To prevent trench water from entering the pipe, joints which for any reason may not be completed as the pipe is laid shall be thoroughly packed with approved material, in a manner to make them watertight. Open ends of fittings shall be tightly closed with approved plugs and well packed, as shall the end of the last pipe laid whenever work is not in progress.

D. Each pipe shall be laid accurately to the line and grade shown on the plans. The CONTRACTOR will set all grade and line stakes which the CONTRACTOR must maintain and keep uncovered so they may be examined at any time. Whenever it is necessary to deflect pipe from a straight line, either in the horizontal or vertical plan, to avoid obstructions, or where ling radius curves are permitted, the amount of deflection allowed shall not exceed that required for satisfactory jointing and shall be reviewed by the ENGINEER.

E. The CONTRACTOR shall not be entitled to any additional compensation because depth is more than specified at certain locations or due to clearances at manholes, or due to unforeseen obstacles, or occasioned in order to avoid undue changes in grade.

F. The trench shall be backfilled closely behind the pipe laying. Unless otherwise directed or permitted by the Engineer, the backfilling shall follow at least two lengths behind pipe laying and shall be completed to the top of the trench not more than ten lengths behind pipe laying.

G. Manhole structures, fittings and piping shall be constructed where shown on the plans and shall be constructed in accordance with the details shown on the plans.

H. Cleanouts are to be constructed in accordance with the details shown on the plans.

6.08.17 Excavation and Backfill

All excavation and back fill above the pipe shall conform to specifications as called out in the MDOT 2020 Standard Specifications for Construction.

A. Compacted granular bedding shall be placed beneath, around and on top of the pipe as detailed on the plans and compacted with mechanical tampers to 95% density.

B. Where ground water is encountered, aggregate material shall be substituted for granular bedding and placed to the same dimensions as detailed on the plans.

6.09 STORM SEWER

A. Section 402 of the Michigan Department of Transportation Standard Specifications shall be supplemented herein to further define the work of storm sewer removal, placement, temporary connections and required joints along with an allowance for placement of “Flat Top” masonry tops to sanitary and storm drainage structures.

B. Construction Methods

1. The item of Remove of Existing Storm Sewer is hereby added to the specifications in order to provide measurement and payment for removal of storm sewer. All existing storm sewer shown on the plans and not intended to remain in place shall be removed unless approved by the Engineer for leaving in place or abandonment. Storm sewer to be left in place is noted on the plans and shall be protected from damage or displacement. Removal shall include all excavation, backfill, removal, stockpiling and disposal required as approved by the Engineer.

2. The unit item bid for storm sewer of the size specified shall include placement with joints specified in the section 401.03 of the 2020 MDOT Standard Specifications as follows:

a) 12” to 36” Storm Sewer shall have Compression-Type Pipe Joint Sealer

3. The unit item bid for storm sewer and sanitary sewer drainage structures and manholes shall include the placement of “Flat Top” masonry tops if necessary. The contractor shall provide a summary of those drainage structures proposed for flat top construction to the Engineer for review and approval. It is the contractor’s responsibility to make determinations of the necessity of use for “Flat Tops” in the construction of drainage structures and manholes, subject to the Engineer’s approval.

4. The unit item bid for storm sewer of the size specified shall include the work necessary to provide temporary connections between the new sewer and the existing at the end of each day’s construction activities, or more frequently if required, in order to maintain storm sewer flow along the project.

5. The unit item bid for drainage structure covers (MDOT Type L or type K) shall be ej Cat. No. 7056 or equal and shall not include the standard curb box casting (refer to sheet 3 of MDOT Standard Details R-15-D and R-16-D) but shall be replaced with a “Kryptane Urethane Catch Basin Back, 93A Black (Part #MM-CM-2201) Argonics, 520 9th St., Gwinn, MI. Argonics catch basin head will be inscribed with “Dump No Waste Drains Into Lake Superior”.

The unit item bid for drainage structure covers (MDOT Type B) shall be ej Cat. No. 1040 with a Type B vented cover or equal. The unit time bid for drainage structure covers (MDOT Type E) shall be ej Cat. No. 1040, Type 02 or equal.

6. All storm sewer placed over eight feet in length between structures will be cleaned and televised per the City of Marquette televising specifications. This will be considered incidental to the placement of the sewer piping and structures.

C. Drainage Structure Cover Placement

1. Placing Cast Iron Frame and Cover

The drainage structure frame, cover and self-leveling assembly shall be centered over the structure opening. After the leveling HMA course has been placed, and prior to the placement of the HMA top course, the drainage structure frame and cover shall be adjusted to the finished elevation and slope using the self-leveling structure assembly. The self-leveling assembly will be placed per the manufacturer’s recommendations such

that the drainage structure cover is sitting level with the HMA top course surface. Ensure that sufficient HMA is placed under the upper frame to prevent it from resting directly on the guide frame and the lid is flush with the HMA top course. Frames and covers not centered over the drainage structure shall be re-excavated, regraded and centered over the drainage structure during or after the paving operations at the Contractor's expense. Asphalt areas cut out and removed for the repair shall be placed back in a seamless condition.

INFRA-RISER® Adjustment Risers, Riser Rings by ej, or Pro-Ring by Cretex will be used for cover/casting adjustments instead of the concrete adjustment rings. Failure of the system will require the removal of the casting and proper placement of the casting and rim to grade.

Wood shims will not be allowed for the adjustment of the structure castings.

D. Measurement & Payment

1. Remove Existing Storm Sewer

Measurement and payment shall be by the foot basis. Said payment shall be payment in full for all plant, labor, equipment and materials required to excavate and remove the storm sewer (regardless of size), backfill with approved materials, stockpile and dispose of as approved by the Engineer.

2. Temporary Storm Sewer Connections

All costs associated with the provision of plant, labor, equipment, and materials required for the construction of temporary connections of the new storm sewer with the existing as specified above shall not be paid for separately but shall be considered as included with the unit item bid for the particular size of storm sewer.

3. Drainage Structure covers, Type K and Type L

The pay unit will be for each standard type of cast iron cover at the unit price bid.

4. Drainage Structure Covers, Type B

The pay unit will be for each standard type of cast iron cover at the unit price bid.

5. Drainage Structure Covers, Type K, Modified, Mountable

The pay unit will be for each standard type of cast iron cover at the unit price bid.

The installation of drainage structure frames and covers shall be paid for at the contract unit price which shall include installation of frame, cover, and self-leveling assembly. The work shall include all labor, tools, equipment and materials necessary to place the frame, cover, and self-leveling assembly on the manhole structure as per these specifications.

Pay Item	Pay Unit
Storm Sewer, Rem	Ft

6.10 SANITARY AND STORM SEWER CLEANING & TELEVISIONING

6.10.01 Scope of Work

A. The work required by this project shall consist of furnishing all labor, equipment, materials, supervision, liquid industrial waste transportation, manifest documentation, transporters registration, insurances, and the permit issued to haul

liquid industrial waste in the State of Michigan, and performing all work necessary to clean, televise, and remove roots in accordance with the following Technical Specifications. The work shall consist of, but not necessarily be limited to, performing the following work tasks where specified:

1. Line Cleaning-Root Removal/Liquid Industrial Waste Transportation and Manifest Documentation.
2. Flow Control
3. Contractor must perform a quality inspection utilizing a digital sewer pipe inspection system that can operate at a high rate of inspection speed while providing superior imagery as compared to traditional CCTV.

The quality of all work specified in this section shall meet or exceed the requirements of the National Association of Sewer Service Companies (NASSCO) Recommended Specifications for Sewer Collection System Rehabilitation (latest edition), except as described in this section. Applicable portions of this section that inadvertently fall below those standards shall be corrected and maintained at the NASSCO standards as a minimum requirement, at no additional cost to the City.

Information concerning depths of flow, manhole depths, air quality in the sewers, accessibility of manholes, traffic conditions, and other safety considerations are to be the sole responsibility of the Contractor to obtain and to incorporate the necessary provisions into the overall contract price to complete the specified work under the conditions existing in the sewer to be inspected.

6.10.02 Requirements

A. Sewer Line Cleaning shall be performed by hydraulically propelled or mechanically operated cleaning equipment. Selection of equipment shall be based on such field conditions as access availability to manholes, type of debris to be removed, depth of sewer flow, etc.

B. Sewer Flow Control shall be accomplished as required and at the direction of the Owner's Representative.

C. The inspection camera system must be 100% digital and in color. Any analog or NTSC video camera will be deemed unacceptable. All inspection video shall be captured and saved with the ability to virtually pan, tilt and view in an unfolded format. With approval from the Engineer, exceptions may be made for either MPEG or Windows Media Video (.WMV) file format. All files shall be saved on the portable hard drive with a USB 2.0 connection for submittal with each inspected mainline sewer reach, referenced manhole to manhole, and each sewer lateral connection referenced from the manhole. digital photographs (.JPG files), inspection reports (.PDF files), and any handwritten inspection logs or field maps shall accompany the video inspections for reach sewer reach (manhole-to-manhole or lateral inspected).

D. Contractor shall provide inspection video, data, and reports in accordance with the requirements specified herein. Contractor shall provide all video on a portable hard drive as specified. All work will conform to the current NASSCO Pipeline Assessment Certification Program (PACP) coding conventions and all software used by the Contractor will be PACP compliant. An electronic database will be provided by the Contractor in a PACP exported format approved by the City.

E. Submit ESRI geodatabase files of televising and inspection records. The Engineer will provide spatially referenced geodatabase feature files of manhole and sewer lines for use by the Contractor. The contractor will provide ESRI geodatabase files to the Engineer that shall include points along the mainline sewer indicating the location of factory taps, roots, failed joints, or any other feature where a MACP or PACP code is recoded as a part of the sewer inspection. The geodatabase files shall include the following information: manhole number, observation date, observation time, PACP/MACP Code, PACP/MACP score, remarks or notes, name and certification number of the inspector, report sheet number, video number, and Client name/location. In addition, pipe reports, screenshots, or photos of the observation (factory taps, joints, plugs, etc), and videos shall be hyperlinked to the features in the ESRI geodatabase files.

F. Contractor shall maintain a copy of all inspection records including video files, photographs, database, and reports for a minimum of 3 years after completion of the inspection work.

G. The contractor shall provide comments as necessary to fully describe the existing conditions of the sewer on the inspection forms.

H. Contractor shall be responsible for modifications of equipment and/or inspection procedures to achieve report material of acceptable quality.

I. No work shall commence prior to the approval of the submitted material by the City. Once accepted, the report material shall serve as a standard for the remaining work.

6.10.03 Sewer Line Cleaning

A. Intent

The intent of sewer line cleaning is to remove foreign materials from the lines. Since the success of the other phases of work depends a great deal on the cleanliness of the lines, the importance of this phase of the operation is emphasized. It is recognized that there are some conditions such as broken pipe and major blockages that prevent cleaning from being accomplished or where additional damage would result if cleaning were attempted or continued. Should such conditions be encountered, the Contractor will not be required to clean those specific manhole sections. If in the course of normal cleaning operations, damage does result from preexisting and unforeseen conditions such as broken pipe, the Contractor will not be held responsible.

B. Sewer Cleaning

The designated sanitary sewer sections shall be cleaned using mechanically powered, hydraulically propelled, or high-velocity sewer cleaning equipment, as specified. Selection of the equipment used shall be based on the conditions of the lines at the time the work commences. The equipment and methods selected shall be satisfactory to the Owner's representative. The equipment selected for cleaning shall be capable of removing dirt, grease, rocks, sand, and other deleterious materials and obstructions from the sewer lines and manholes. If cleaning of an entire section cannot be

successfully performed from one manhole, the equipment shall be re-setup on the other manhole and cleaning again attempted. If again, successful cleaning cannot be performed or the equipment fails to traverse the entire manhole, it will be assumed that a major blockage exists, and the cleaning effort shall be abandoned.

Large Diameter Cleaning (Greater Than 30 Inches): For cleaning large diameter sewer, storm, or combination pipes, consideration should be given to a combination hydraulic high-volume water and solids separation system. The flow from the sewer will provide water for the pump operation so no potable water is necessary and treatment costs are not a factor. Water volume of up to 250 gpm at 2000 PSI+ will move solids to the downstream manhole in high flow conditions. The separation system will dewater solids to 95% (passing a paint filter test) and transfer them to a dump truck for transport to a sewage treatment plant or approved landfill. Sewer water will be filtered to a point where it can be used in the pump for continuous cleaning. No by-passing of sewer flows will be necessary. The unit shall be capable of 24-hour operation and the unit shall not leave the manhole until a section is fully cleaned.

C. Material Removal

All sludge, dirt, sand rocks, grease, and other solid or semi-solid material resulting from the cleaning operation shall be removed at the downstream manhole of the section being cleaned. Passing material from manhole section to manhole section which could cause line stoppages, accumulations of sand in wet wells, or damage to pumping equipment shall not be permitted.

D. Disposal of Materials

All solids or semi-solids resulting from the cleaning operations shall be removed from the site and disposed of in a manner and at a site designated by the Owner. All materials shall be removed from the site no less often than at the end of each workday. Under NO circumstances will the Contractor be allowed to accumulate debris, etc., on the site of work beyond the stated time, except in totally enclosed containers and as approved by the Owner.

E. Liquid Industrial Waste Transportation and Manifest Requirements

The contractor shall be in compliance with the State of Michigan Department of Great Lakes and Energy and the Environmental Protection Agency regarding the transportation and manifest reporting requirements for liquid industrial waste. The contractor shall provide to the City of Marquette copies of all completed manifest forms for liquid industrial waste transportation and designated site deliveries. The contractor shall provide a copy of the transporter's registration, insurances, and the permit issued to haul liquid industrial waste in the State of Michigan. The contractor shall coordinate with the City of Marquette Waste Water Treatment Plant for liquid industrial waste deliveries and fees associated with these deliveries. The contractor can refer to the "Natural Resources and Environmental Protection Act 451 part 121 and 111 of 1994" for information and guidelines for the State of Michigan.

F. Cleaning Precautions

During all sewer cleaning operations, satisfactory precautions shall be taken to protect the sewer lines from damage that might be inflicted by the improper use of cleaning equipment. Whenever hydraulically propelled cleaning tools, which depend upon water pressure to provide their cleaning force or any tools which retard the flow of water in the sewer line are used, precautions shall be taken to ensure that the water pressure created does not cause any damage of flooding to public or private property being served by the manhole section involved. The flow of sewage in the sewer lines shall be utilized to provide necessary pressures for hydraulic cleaning devices whenever possible. When additional quantities of water from fire hydrants are necessary to avoid delay in normal working procedures, the water shall be conserved and not used unnecessarily. No fire hydrant shall be obstructed in case of a fire in the area served by the hydrant nor shall a hydrant be used for the purpose described unless a vacuum break is provided.

G. Root Removal

Roots shall be removed in sections where root intrusion is a problem. Special precautions should be exercised during the cleaning operation to assure the almost complete removal of visible roots from the joint area. Procedures may include the use of mechanical devices such as rodding machines, expanding root cutters, porcupines, and hydraulic procedures such as high-pressure jet cleaners. Televising after root removal will be required to ensure all roots have been removed.

H. Final Acceptance

Acceptance of this portion of the work shall be made upon the successful completion of the television inspection and shall be to the satisfaction of the Owner's representative.

I. Cleaning Equipment

1. Hydraulic Cleaning Equipment

The equipment used shall be of a movable dam type and be constructed in such a way that a portion of the dam may be collapsed at any time during the cleaning operation to protect against flooding of the sewer. The movable dam shall be the same diameter as the pipe being cleaned and shall provide a flexible scraper around the outer periphery to ensure total removal of the grease. If sewer cleaning balls or other such equipment, which cannot be collapsed instantly, are used, special precautions against flooding of the sewers and public or private property, shall be taken.

2. High-Velocity Hydro-Cleaning Equipment

All velocity sewer cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a selection of two or more high-velocity nozzles. The nozzles shall be capable of producing a scouring action from 15 degrees to 45 degrees in all size lines designated to be cleaned. Equipment shall also include a high-velocity gun for washing and scouring manhole walls and floor. The gun shall be capable of producing flows from a fine spray to a long-distance solid stream. The equipment shall carry its own water tank, auxiliary engines, pumps, and hydraulically driven hose reel. All controls shall be located so that the equipment can be operated above the ground.

3. Mechanical Cleaning Equipment

Bucket machines shall be in pairs with sufficient power to perform the work in an efficient manner. Machines shall be belt operated or have an overload device. Machines with direct drive that could cause damage to the pipe will not be allowed. A power rodding machine shall be either a sectional or continuous type capable of holding a minimum of 750 feet of rod. The rod shall be specifically treated steel. To ensure safe operation, the machine shall have a fully enclosed body and an automatic safety throw-out clutch or relief valve.

6.10.04 Sewer Flow Control

SCOPE OF WORK

A. When sewer line flows at the upstream manhole of the manhole section being worked are above the maximum allowable requirements for television inspection, joint treating, or joint sealing, the flows shall be reduced to the levels shown in section B by manual operation of pump stations. Plugging/Blocking of the flows or by Pumping/Bypassing of the flows, as specified.

B. Each sewer to be televised shall be suitably isolated to eliminate or control flow during Video inspection or panoramic inspection to allow for the entire circumference of the pipe to be viewed.

C. Plugging or Blocking

A sewer line plug shall be inserted into the line at a manhole upstream from the section being inspected and/or sealed. The plug shall be so designed that all or any portion of the sewage flows can be released. During the inspection, testing, or sealing portion of the operation, flows shall be shut off or reduced to within the maximum flow limits specified in B. After the work tasks have been completed, flows shall be restored to normal.

D. Pumping and Bypassing

When pumping/bypassing is required, the Contractor shall supply the necessary pumps, conduits, and other equipment to divert the flow of sewage around the manhole section in which work is to be performed. The bypass system shall be of sufficient capacity to handle existing flows plus additional flow that may occur during periods of a rainstorm. The Contractor will be responsible for furnishing the necessary labor and supervision to set up and operate the pumping and bypassing system. If pumping is required on a 24-hour basis, all engines shall be equipped in a manner to keep the pump noise at a minimum.

E. Flow Control Precautions

Whenever flows in a sewer line are blocked, plugged, or bypassed, sufficient precautions must be taken to protect the sewer lines from damage that might be inflicted by excessive sewer surcharging. Further, precautions must be taken to ensure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved.

6.10.05 Television Inspection

A. The designated manhole sections cleaned are to be visually inspected by means of closed-circuit television. The inspection will be done one manhole section at a time and the flow in the section being inspected will be suitably controlled, as specified in Section 6.01.04. The work is intended to assist the owner in determining the condition of the pipe run per NASSCO grade analysis. In addition, the work will assist the owner in determining any necessary repairs needed for the existing system and an accurate record of all lateral connections.

B. Closed Circuit Television Camera

The television camera used for the inspection shall be one specifically designed and constructed for sanitary sewer inspection. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100 percent humidity/submerged conditions. The CCTV camera equipment will provide a view of the pipe ahead of the equipment and of features to the side of the equipment through turning and rotation of the lens. The camera shall be capable of tilting at right angles along the axis of the pipe while panning the camera lens through a full circle about the circumference of the pipe. The lights on the camera shall also be capable of panning 90-degrees to the axis of the pipe. The radial view camera must be solid state color and have remote control of the rotational lens. The camera shall be capable of viewing the complete circumference of the pipe and manhole structure, including the cone section or corbel. Cameras incorporating mirrors for viewing sides or using exposed rotating heads are not acceptable. The camera lens shall be an auto-iris type with remote-controlled manual override. If the equipment proves to be unsatisfactory, it shall be replaced with adequate equipment. The camera unit shall have sufficient quantities of line and video cable to inspect two complete, consecutive sewer reaches with access approximately 750 feet apart. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the City. The television camera, electronic systems, and monitor shall provide an image that meets the following specifications, or approved equal:

- 1.** The grayscale shall show equal changes in brightness ranging from black to white with a minimum of five stages.
- 2.** With the monitor control correctly adjusted, the six colors - Yellow, Cyan, Green, Magenta, Red, and Blue, plus black and white shall be clearly resolved with the primary colors in order of decreasing luminance. The grayscale shall appear in contrasting shades of gray with no color tint.
- 3.** The picture shall show no convergence or divergence over the whole of the picture. The monitor shall be at least 13 inches diagonally across the picture tube.
- 4.** The live picture on the CCTV monitor shall be capable of registering a minimum of 470 lines horizontal resolution and be a clear, stable image with no interference.
- 5.** The inspection camera system must have two independently or simultaneously controlled digital cameras, one facing in the forward direction and one facing in the rear direction. Each camera must have a minimum of a 185-degree field of view.
- 6.** Lighting intensity shall be remote controlled and shall be adjusted to minimize reflective glare. Lighting and camera quality shall provide a clear, in-focus picture of the entire inside periphery of the sewers and laterals for all conditions except submergence. Under ideal conditions (no fog in the sewer) the camera lighting shall

allow a clear picture up to five pipe diameter lengths away for the entire periphery of the sewer. The lighting shall provide uniform light free from shadows or hot spots.

7. The inspection camera system must illuminate the interior of the pipeline using a xenon strobe light. The light shall be positioned 360 degrees around the camera lens to distribute the light evenly onto the pipe walls. The lighting must be able to illuminate pipe from 8" to 48" in diameter without the need for any auxiliary lighting. Any systems not using strobe light technology will be deemed unacceptable due to motion blur during imaging recording.

8. The inspection camera system must provide a minimum of 3000 lines of vertical resolution in the side view and a minimum of 500 lines in the perspective view.

9. The inspection system shall produce individual images or frames with no more than 0.001 inches of tractor movement during image or frame exposure to produce crisp, clear images.

10. The monitor and software shall also be able to capture and save screen images of typical sewer details and all defects. Screen images shall be embedded into the pipe inspection report document submitted with the inspection video.

11. The video camera shall be capable of displaying on-screen data as specified in section 6.01.10. Depth gage: The camera shall have a depth gage or approved method to measure deflection in the pipe and joint separation approved by the County.

12. The camera shall have zoom capabilities to be able to view the entire depth of a 20-foot deep manhole from the bottom during the inspection.

13. The inspection system must be able to collect all necessary data in either the forward or reverse tractor direction. Systems collecting data only in the reverse direction will be deemed unacceptable.

C. Video Capture System

The video and audio recordings of the sewer inspections shall be made using digital video equipment. A video enhancer may be used in conjunction with, but not in lieu of, the required equipment. The digital recording equipment shall capture sewer inspection on hard drives, with each sewer reach inspection recorded as an individual movie file (.MPEG, .MPG, or .WMV) or approved equal. The video files will be named in accordance with the City file naming convention contained in section 6.01.10.

- 1.** The video file names will be referenced in the inspection database and in an inspection report generated in PDF format. The pipeline collection and real-time video capture and data acquisition systems shall be provided.
- 2.** The system shall use the most current PACP compliant application software and shall be fully object oriented or approved equal. It shall be capable of printing pipeline inspection reports with captured images of defects or other related significant visual information on a standard color printer.
- 3.** The imaging capture system shall store digitized color picture images and be saved in digital format on a hard drive, or approved equal. Also, this system shall have the capability to supply the City with inspection data reports for each line segment.
- 4.** The contractor shall have the ability to store the compressed video files in industry standard and approved City format and be transferable with the PACP compliant inspection database.
- 5.** The contractor's equipment shall have the ability to "Link". "Linking" is defined as storing the video time frame code with each observation or defect with the

ability to navigate from/to any previously recorded observation or defect instantaneously.

- 6.** The system shall be able to produce data reports to include, at a minimum, all observation points, and pertinent data. All data reports shall match the defect severity codes in accordance with PACP naming conventions.
- 7.** The data-sorting program shall be capable of sorting all data stored using generic sort key and user-defined sort fields.
- 8.** Camera footage, date & manhole numbers shall be maintained in real-time and shall be displayed on the video monitor as well as the video character generators illuminated footage display at the control console.
- 9.** Digital video shall be defined as ISO-MPEG Level 1 (MPEG-1) coding having a resolution of 352 pixels (x) by 240 pixels (y) (minimum) and an encoded frame rate of 29.97 frames per second. The digital recording shall include both audio and video information that accurately reproduces the original picture and sound of the video inspection. The video portion of the digital recording shall be free of electrical interference and shall produce a clear and stable image. The audio portion shall be sufficiently free of background and electrical noise so as to produce an oral report that is clear and discernible.
- 10.** Contractor is responsible for reviewing collected data, coding observations, and completing a full PACP evaluation of each inspected pipeline. However, the City must have the ability to view the digital film file in the way that the contractor can view them, including full control of the virtual pan and tilt.
- 11.** The digital film files must include an unfolded view of the pipeline with a minimum of 3000 lines of vertical resolution.
- 12.** The digital film files must include an unfolded view overview of the entire pipeline to view the entire pipe segment at one time.
- 13.** The digital file files must include a distortion-free virtual pan and tilt allowing the review and the City to view 100% of the pipe wall from any perspective. The virtual pan and tilt must be able to view 360 degrees in any direction while maintaining an always-upright image. The virtual pan and tilt must consist of views from the front and rear camera, any virtual pan and tilts that artificially create this view from a single camera will be deemed unacceptable due to distorted images on the direct side viewing and inability to view into laterals and other observations.
- 14.** The virtual pan and tilt and forward/reverse direction of the images must be able to be controlled from a computer mouse.
- 15.** The virtual pan and tilt and unfolded views must be able to be viewable by the City without the need of purchasing additional software. Film files must be able to be integrated into City's other databases.
- 16.** The Contractor must use digital panoramic compatible software with PACP templates for feature and defect coding. The panoramic module must also be used to ensure that film files are properly reviewed with the highest accuracy possible.
- 17.** Inspection software shall be PACP compliant versions of CUES Granite XP, WinCam, Flexidata, MuniXS, ITpipes, or approved equal.
- 18.** The CCTV equipment/software shall be capable of producing digitized images of all sewer line defects, manhole defects, and sewer line service connections in .jpeg format. CONTRACTOR shall plan to take digital still images of each defect, construction features, and service connection to clearly depict it. More images may be necessary depending upon the condition of the pipe.

D. Documentation of television results shall be as follows:

The CCTV system shall be capable of printing pipeline inspection reports with pipeline schematics and captured images of defects and other related significant visual information. The system shall have the ability to display any combination of the following formats and features simultaneously.

The following information is required for all pipe inspections. Inspection Information – Refers to the area of pipe to be inspected between two manholes.

PACP Field No	Description	Mandatory	Required for This Project
1	Surveyed By (Operator/Surveyor's Name)	X	
2	Certificate Number	X	
4	Reviewer Certificate Number		X
11	Date	X	
13	Sheet Number		
14	Weather		X
15	Pre-Cleaning	X	
17	Flow Control		X
18	Purpose of Survey		X
19	Direction of Survey	X	
21	Inspection Status	X	
26	Street (Name and Number)	X	
27	City	X	
28	Location Code		X
30	Pipe Use	X	
31	Height (Diameter)	X	
32	Width	X	
33	Shape	X	
34	Material	X	
35	Lining Method		X
37	Pipe Joint Length		X
39	Length Surveyed		X

42	Upstream Manhole (MH) Number	X	
43	Upstream MH Rim to Invert		
49	Downstream Manhole (MH) Number	X	
50	Downstream MH Rim to Invert		
59	Additional Information		X

H. Observation Data

Refers to the portion of pipe where an observation is discovered. Observations shall be noted by text descriptions and observation or defect codes number using PACP codes, still frame pictures and video clips captured and recorded. Each observation shall include the following:

1. Actual Observation footage:
2. Video reference:
3. Location of defect; clock position:
4. Code (Group/Description/Modifier/Severity)
5. Whether it is a continuous defect
6. Whether the defect occurs at a joint
7. Severity level:
8. Final footage:
9. Video clip ID for each observation
10. Image reference (file name of photos)
11. Remarks (as appropriate or needed)
12. PACP defect score for pipe run

I. Formats

Standard and/or custom-designed reports shall have the following formats available and shall be able to be produced in hard copy or viewed on the monitor.

1. Site Observation

Displays detailed site observation reports in landscape or portrait views.

2. Directory Report

Displays a list of all the projects sorted by pump station number and manhole number.

3. Picture Reports

Displays site data and include full-size single photos or half-size double photos of discrepancies.

4. Pipe Run

Displays a graphical display of the site indicating footage, observations, and comments.

5. Project Data

Displays the project, client, and contractor information.

6. Custom Sort

Creates user-defined reports of selected site, project, and observation data.

6.10.06 Pipe Inspection Execution

A. Prior to inspection the CONTRACTOR shall obtain pipe and manhole identification numbers from the City of Marquette to be used during inspections. Inspections performed using identification numbers other than the Cities assigned numbers will be rejected.

B. Inspection shall not commence until the sewer section to be televised has been completely cleaned in conformance with Section 6.01.03.

C. Inspection of newly installed sewers (not yet in service) shall not begin prior to completion of the following:

- 1.** Pipe air testing
- 2.** All manhole work, including installation of inverts
- 3.** Installation of all lateral services
- 4.** Vacuum tests of all manholes
- 5.** Deflection Testing

D. After the sewer main and/or lateral cleaning operation is completed, the line sections shall be visually inspected internally by means of color closed-circuit television. The television inspection shall be performed one line section at a time.

E. CONTRACTOR shall perform sewer televising work within 24 hours of said sewer being cleaned. If said sewer is not televised within the required 24-hour time limit, the sewer shall be re-cleaned prior to televising at no additional expense to the City.

F. The depth of each manhole shall be measured to the nearest 1/10 of a foot and documented on the inspection forms. Estimates of manhole depths will not be accepted.

G. The CCTV camera shall be positioned as close to the spring line as possible while maintaining the required equipment stability.

H. Wherever possible, the inspections shall be performed in the upstream to downstream direction. All sewer segments shall be recorded in a logical order in the same direction they are cleaned and televised.

I. In the event that access to some manholes is restricted, permission may be granted by the City to direct the camera through the sewer in an upstream direction against the flow.

J. When sewer conditions prevent forward movement of the camera, the camera shall be withdrawn, and the CONTRACTOR shall televise the line from the opposite direction.

K. The camera shall be directed through the sewer in a downstream direction, with the flow, at a uniform, slow rate. In no case will the video camera record while moving at a speed greater than 30 feet per minute. If during the course of the project, the inspection is rejected due to camera speeds exceeding 30 feet per minute, the inspection recordings shall be redone, at no additional cost to the City.

L. If a new manhole is discovered in the field that was not on current maps, the CONTRACTOR will contact the City in order to obtain a new manhole identification number. The data/video files shall then be re-named to include the new MH ID, and a new CCTV inspection shall be started from the new MH ID.

M. Flow levels within existing sewers to be inspected shall not exceed 5% of the pipe diameter. If water levels prevent adequate televising of the sewer, then conducting the work during low flow periods or other methods like plugging and bypass pumping shall be implemented.

N. For inspection of new sewers (not yet in service), the CONTRACTOR shall introduce clean water into the upstream manhole and keep water flowing until flow is observed at the downstream manhole location.

O. The survey unit shall be slowed, stopped, or backed up to perform detailed inspections of significant features. The camera shall be stopped at all defects, changes in material, water level, size, side connections, manholes, junctions, or other unusual areas. When stopped at the defect or feature, the operator shall pan the camera to the area and along the circumference of the pipe.

P. The camera unit shall be paused long enough at areas suspected of leaking to determine if a leak exists currently or if deposits have occurred.

Q. The operator shall also record audio of the type of defect or feature, clock position, footage, extent, or other pertinent data.

R. Digital photographs or screen captures shall be taken of all laterals, defects and general condition photographs shall be taken at least every 200 feet.

S. At the contractor's discretion or direction of the owner, the camera shall be stopped or backed up (when conditions allow) to view and analyze conditions that appear to be unusual or uncommon for a sound sewer. The lens and lighting shall be readjusted, if need be, in order to ensure a clear, distinct, and properly lighted feature. Stopping points of interest will include:

U. Video recordings shall include a continuous video display/readout of similar information, as described in section 6.01.07. A separate digital video file shall be made for each pipe reach inspected.

V. CONTRACTOR shall coordinate with ENGINEER prior to commencement of work to ensure the inspection is accomplished in a manner acceptable to the ENGINEER.

W. If the video and/or audio recording is of poor quality, the ENGINEER has the right to require a re-submittal of the affected sewer sections and no payment will be made until an acceptable video and audio recording is made, submitted to, and accepted by the ENGINEER.

X. Measurement for the location of defects and actual length of pipe shall be by means of a calibrated meter on the camera with a digital readout on the video monitor. This readout shall be included in the video recording. Marking on cable, or the like,

which would require interpolation for depth of manhole, will not be allowed. Measurement will be accurate to one foot per 100 feet of inspected pipe.

Y. The CONTRACTOR inspection units shall be equipped with adequate backup equipment and spare parts so field repairs to equipment can be made and downtime is minimized.

Z. The contractor shall be responsible for all traffic control measures required to perform the work.

6.10.07 CCTV Camera and Monitor Display Requirements

A. Linear Measurement

The CCTV camera location footage counter shall be zeroed at the beginning of each inspection. The survey unit location entered on the footage counter at the start of the inspection shall allow for the distance from the accepted start of the length of the sewer to the initial point of observation of the camera (pre-set footage). In the case of resuming an inspection at an intermediate point within a sewer reach, the footage counter shall be set to start at the distance from the upstream maintenance hole to that point, as previously recorded by the counter. The CONTRACTOR shall ensure that the footage counter starts to register immediately when the survey unit starts to move.

Prior to commencing inspections, the CONTRACTOR shall demonstrate compliance with the linear measurement tolerance specified below:

1. The equipment shall measure the location of the camera unit in 1-foot increments from the beginning (upstream end) of each continuous section. This footage location must be displayed on the CCTV monitor and recorded on the videotapes.
2. The accuracy of the measured location shall be within +0.05% of the actual length of the sewer reach being surveyed, or 1 foot, whichever is greater.

B. CCTV Monitor Display

The images displayed on the CCTV monitors will be a view of the pipe above the water surface as seen by the CCTV camera as the unit is conveyed through the sewer. The camera lighting shall be fixed in intensity prior to commencing the survey and the white balance set to the color temperature emitted. In order to ensure color constancy, no variation in illumination shall take place during the survey. The video equipment shall be checked using an approved test card with a color bar prior to commencing each day's survey. The camera shall be positioned centrally and parallel to the test card at a distance where the full test card just fills the monitor screen. The card shall be illuminated evenly and uniformly without any reflection.

C. Data Displays

The CCTV images shall include an initial data display that identifies the sewer reach being surveyed and a survey status display that provides continuously updated information on the location of the survey unit as the survey is being performed. These

data displays shall be in alphanumeric form. The size and position of the data shall not interfere with the main subject of the monitor picture.

The on-screen display should be white during inspections where the background behind the display is dark and, conversely, black where the background is light.

At the beginning of each reach of sewer being inspected, the following information shall be electronically generated and displayed on the CCTV monitors:

1. Date of Survey
2. Inspection company name and inspector
3. Street name or location
4. Manhole number to manhole number (in order of inspection)
5. Direction of survey (upstream or downstream)
6. Time of start of the survey

During inspections, the following information shall be electronically generated, automatically updated, and displayed on the CCTV monitors:

1. Survey unit location in the sewer line in feet and tenths of feet from adjusted zero
2. Sewer diameter
3. Upstream and downstream manholes reference numbers as per City manhole identification numbers

D. Photographs

During CCTV inspections, screen captures will be taken from the monitor images and saved electronically by the in-sewer inspection crew of typical conditions every 200 feet and at all defects, construction features, manholes, and laterals. The screen capture shall have the pipe reach (identified by the upstream and downstream manholes), survey direction, footage, and date when the photograph was taken. The annotation shall be clearly visible and in contrast to its background, shall have a figure size no greater than 1/4-inch, and shall be type-printed. The annotation shall be positioned on the front of the photograph so as to not interfere with the subject of the photograph. Photograph files shall be named by the video capture system and automatically referenced to the logged defect.

The image of the sewer shall fill the photographic image. Photographs must clearly and accurately show what is displayed on the monitor, which shall be in proper adjustment. Where significant features exist within 6-feet of each other, one photograph shall be made to record these features. Where there is a continuous feature, photographs shall not be taken at intervals of less than 6-feet unless absolutely necessary to show a change in the feature.

The images shall be kept electronically, copied to a hard drive, and submitted with the inspection videos, database, and reports.

6.10.08 Deliverables

A. The CONTRACTOR will be required to submit the following deliverables at the completion of the inspection. Inspection Reports to include:

1. Inspection session header information (see required fields above)
2. Defect log report including photo captures from CCTV video
3. Schematic drawing of pipe showing defects

4. Format:

Adobe Acrobat PDF files – 1 report PDF per pipe run
Main sewer inspection report file name: <upstream MH ID>_<downstream MH ID>_<Date (year_mo_day format)>.PDF
Example: 2045_2046_2013_06_15.pdf

B. Inspection video files on a portable hard drive, typed labels shall be attached to the face of each hard drive. The typed index labels shall include the following information:

1. Content (CCTV)
2. Contractor name
3. Purpose of Survey
4. Reaches included (from Manhole Number # to Manhole Number #)
5. Date of Survey
6. Contract Number

C. Main sewer video files shall be MPEG, Windows Media File, or approved equal named according to the following standard:

<Upstream MH ID>_<Downstream MH ID>_<Inspection>_<Date (year_month_day)>.wmv
Example: 2045_2046_2013_07_15.wmv

In instances where a reverse setup is necessary to perform or complete the inspection, the file name shall incorporate an “R” at the end of the file name to indicate “reverse” direction. Using the file example above, if the inspection from the upstream end was halted due to an obstruction and the pipe was televised from the opposite end, the video file from the downstream to upstream direction would be assigned the following filename:

2045_2046_2013_07_15_R.wmv

D. Lateral connection inspection video files shall be MPEG, Windows Media File, or approved equal named according to the following standard:

<Upstream MH ID>_<footage>_<clock position>_<L or R>_<date (year_mo_day format)>.wmv
Example: 2045_138_10_L_2013_07_25.wmv

E. At a minimum, all photographs shall be named consisting of the following standard:

<Upstream MH ID>_<footage>_<clock position>_<L or R>_<date (year_mo_day format)>.jpeg
Example: 2045_138_10_L_2013_07_25.jpeg

F. Electronic Inspection Data stored and exported in a NASSCO Pipeline Assessment and Certification Program (PACP) compliant Microsoft Access database (.MDB) version 4.4 or newer delivered on portable hard drive.

G. Inspection photograph digital files (jpeg) indexed to NASSCO PACP compliant database.

H. Acceptable media for the video recordings portable hard drive.

I. Contractor Quality Control report detailing data validation performed, pipe inspection records reviewed, and results.

J. All inspection data shall be submitted on a portable hard drive. Each hard drive shall be filled with as much data as practical to minimize the number of hard drives submitted. Sections of a single segment of sewer main shall not be recorded to more than one hard drive. Video footage of recorded segments shall be grouped by area and shall be submitted in sequential order relating to the area mapping designation.

K. Upon approval by the City of all, or portions of, the data delivered via the portable hard drives, the approved CCTV data shall be delivered to the City on a portable hard drive labeled with project information. The hard drive shall clearly indicate the date of the inspection, the designated segment(s) of sewer mains(s) contained on the disk, the name of the project, the project number, and CONTRACTOR name. The hard drive shall contain separate digital files for each manhole-to-manhole section.

L. The database shall be comprehensive for the entire project, and additional data shall be added to the database each week.

6.10.09 Acceptance

A. Inspection deliverables will be validated to check conformance with the specified requirements for file names, formats, quantity, resolution, data table references, in addition to checks for null fields, asset numbers, duplicate records, connectivity, material, size, and depth. Any data not passing the data validation checks will be returned to the CONTRACTOR for resubmittal.

B. Inspection submittals will be reviewed for quality control. A minimum of 5% of the submitted inspections will be randomly reviewed. A quality control check will be performed for each CCTV operator and each operator must exceed 90% accuracy.

C. Throughout the duration of the project, should the City discover inaccuracies in data or quality issues with any of the videos, CONTRACTOR shall re-inspect those segments at no additional cost to the City. The City will provide comments regarding the acceptance of the data within 30 days of receiving the data from the CONTRACTOR. Neither the CCTV inspections nor the WORK inspected is accepted by the City until such time that an acceptance letter is issued by the City.

6.10.10 Measurement and Payments

A. Only those items as specified in the proposal rate schedule (exhibit B) shall be considered for payment, all other items, labor equipment, or materials necessary to complete the work shall be considered incidental to the work.

6.11 ROCK EXCAVATION

6.11.01 General Description

Rock excavation shall consist of excavating igneous, metamorphic and sedimentary rock and hardpan which cannot be excavated without continuous drilling and blasting or

continuous use of a ripper or other special equipment, and all boulders of 1/2 cubic yard or more in volume. Hardpan is defined as cemented soil layers. The term hardpan shall not be applied to hard clay layers that are not cemented.

Where rock excavation is encountered within the grading limits, the surface of the rock shall be sufficiently exposed to permit adequate measurements to be taken before the rock excavation is started.

Where rock is encountered in the excavation, it shall be removed between the subbase limits to the cross section and elevation below earth grade, shown on the plans or as authorized, with no rock projecting more than 6" above the lines of the required cross section. The operations shall be so conducted as to affect drainage off the pavement structure and not leave undrained pockets in the surface of the rock. The back slopes shall be excavated to the average of neat line slopes shown on the plans, with no rock projecting more than 12" from the true slope. All rock or boulders loosened in the excavation and overhanging ledges, either on or outside the required cross section, shall be removed. All rock which is to be used in the construction of embankments shall be reduced in size so that the pieces do not exceed 1/2 cubic yard in volume.

A backfill of granular Class II material shall be placed over the rock cut to the required cross section.

Over break, as referred to in rock cuts, is the material removed outside the plan or authorized cross section for rock excavation.

6.11.02 Measurement & Payments

Rock Excavation will be measured by the staked-section method with no allowance for over break and with no deduction for rock projecting inside the lines of the cross section within the limits specified herein. The removal of the overburden will be measured as Earth Excavation. Boulders over 1/2 cubic yard in volume will be measured individually and the volume computed for average dimensions taken in 3 directions. The backfill of granular Class II material shall be included with the "Rock Excavation" item of work and the removal of the overburden.

<u>Pay Item</u>	<u>Pay Unit</u>
Excavation, Rock	Cyd

6.12 TRENCH ROCK EXCAVATION

6.12.01 General Description

Trench rock excavation shall consist of excavating igneous, metamorphic and sedimentary rock and hardpan which cannot be excavated without continuous drilling and blasting or continuous use of a ripper or other special equipment and all boulders of 1/2 cubic yard or more in volume. Hardpan is defined as cemented soil layers. The term hardpan shall not be applied to hard clay layers that are not cemented.

Where rock excavation is encountered within the trench, the surface of the rock shall be sufficiently exposed to permit adequate measurements to be taken before the rock excavation is started.

Where rock is encountered in the trench, the rock shall be removed to a minimum depth of 6” below the bottom of the utility and 12” either side of the utility or a minimum 3 foot wide trench. All loose rock shall be removed and backfilled with granular class II material (MDOT).

6.12.02 Measurement & Payments

Trench rock excavation shall be paid on a cubic yard basis for all rock removed to the line and grade as described above, except the width of payment shall not be less than 3 feet regardless of utility diameter.

Payment shall be payment in full for all labor, equipment and materials (including backfill with granular Class II material) required to complete the work.

Under this contract the completed work for "Trench Rock Excavation" will be paid under the bid pay item "Rock Excavation".

<u>Pay Item</u>	<u>Pay Unit</u>
Excavation, Trench Rock	Cyd

6.13 TREE REMOVAL

6.13.01 General Description

The plan indicates trees to be removed as part of this contract. These trees are known to have a conflict with construction or are of poor condition. Because of the desire of the City of Marquette to protect its tree environment, these trees will only be removed after the arborist or his agent has reviewed the situation with the adjacent property owner. Other trees may have to be removed as the work progresses. No trees shall be removed until specific authorization is received from the Engineer.

The item of tree removal will be paid at the unit price bid. Trees not shown on the plans to be removed but authorized for removal as the work progresses shall also be paid at the unit price bid.

<u>Pay Item</u>	<u>Pay Unit</u>
Tree, Rem, 6 inch to 18 inch	Ea
Tree, Rem, 19 inch to 36 inch	Ea
Tree, Rem, 37 inch or Larger	Ea

6.14 UTILITY EXPLORATION

6.14.01 General Description

The Owner and Engineer reserve the right to suspend the Contractor's work for up to thirty (30) minutes per occurrence to verify the location and origin of existing utilities by

exploratory excavation without compensation (except when called out as a pay item on the plans). Existing utilities include public and municipal utilities, their mainlines, service laterals, valves, control points, manholes and other miscellaneous related items. During the exploratory excavation the Contractor shall maintain the equipment and personnel on site, ready for resumption of the work, unless otherwise authorized by the Engineer.

6.14.02 Construction Methods

Intended applications of this item:

1. To explore for utilities which have vague existing locations.
2. To search for utility items which were not found at the intended location.
3. To verify locations of utilities which have been located at other locations.
4. To search for utilities which have unknown locations.
5. To verify utility connections or locations which have been determined from research. This item shall only be utilized when authorized or directed by the Owner or Engineer.

6.14.03 Measurement & Payments

Payment shall be made at the contract unit price per each utility exploration occurrence which exceeds thirty (30) minutes in duration (except where so designated on the plans utility exploration shall be paid as 1 each regardless of duration). Said payment shall be made for each thirty (30) minute time interval after the initial thirty (30) minutes in accordance with the following schedule:

SUSPENSION OF WORK DURATION	COMPENSATION UTILITY EXPLORATION UNITS
0-30 minutes	0*
31-60 minutes	1 each
61-90 minutes	2 each
91-120 minutes	3 each

Payment, based upon the above schedule, shall be compensation in full for all plant, equipment, material, labor, and all other associated costs resulting from temporary suspension of work.

When utility explorations are required or authorized by the Owner or Engineer, the first 30 minutes of activities shall be considered included in all other items of utility construction and no separate compensation shall be made to the Contractor.

The initial 30 minute time period shall begin when actual excavation ends and all men, material and equipment are present as required by the Owner or Engineer. The Contractor shall proceed with the excavation and backfill in an expedient manner as approved by the Engineer. The Engineer shall strive to coordinate required exploratory excavations so as to minimize the contractor’s interruptions.

*0 except when called out on plans.

Pay Item	Pay Unit
Utility Exploration, Sanitary	Ea
Utility Exploration, Water	Ea

6.15 SUBBASE MODIFIED

6.15.01 General Description

Subbase Modified (CIP) shall consist of crushed rock, choked with Granular Material. The rock shall be crushed to a maximum size of 3". The contractor shall use screens, breakers, crushers, grizzlies or other means to achieve the reduction to the 3" or less size. Subbase modified (CIP) must be thoroughly compacted to achieve a dense stable base before placing aggregate base.

Subbase Modified (CIP) shall be measured and paid for by the Cubic Yard, compacted in place, to the thickness specified on the plans or directed by the Engineer.

SUBBASE MODIFIED CIP GRADUATION REQUIREMENT (PERCENT PASSING)				PHYSICAL PROPERTIES		
3" 75mm	1" 25mm	3/8" 9.5 mm	N0100 0.150mm	Loss by Washing	Crushed Material Percent	Loss % Max. Loss Angeles Abrasion
100%	35-62%	15-35%	0-10%	0-7%	75%	50%

Note: The placement of 2-3 inches of aggregate base on top of the subbase modified will be acceptable underneath the curbing for ease in placement and grading. A plate compactor will be used after the curbing machine has trimmed the area to allow for curb placement and adequate subbase density.

Pay Item	Pay Unit
Subbase, Modified, CIP	Cyd

6.16 RESIDENT NOTIFICATION, MAX \$ _____

6.16.01 General Description

The contractor will be required to notify all affected resident in writing of any disruption to their normal day to day activities. The written notification shall provide residents with:

1. The nature and duration of the disruption.
2. The name, address and telephone numbers of the Contractor and the City Engineer's office.
3. Notifications shall not be placed in mailboxes. These will be removed by the postal worker. Please place notifications inside the door where they can be easily seen or as a door hanger.

The form for the notification shall be submitted to the City Engineer for approval prior to distributing to the public.

A copy of every notification will be given to the City Engineer or his representative. Included with the copy of the notification will be a list of the resident names and addresses that received the notification.

For those cases where the property being affected has multiple housing units, such as apartment complexes or multi-family rentals, the owner of the property being affected will be notified per the same requirements as the residential notice.

6.16.02 Requirements

The contractor will be required to notify all affected residents to any disruption per the requirements outlined below.

A. Project Start

1. Letter describing project. What will be constructed and when it will be constructed. This includes all aspects of the project such as parking, driveway access, pedestrian access, utility disruptions, noise, vibrations, project phasing, times of operation, restoration to lawn areas, information on replacement of water and sewer laterals, garbage pickup, mail delivery, etc.
2. Advanced notice for this letter will be 7 days.

B. Active Construction Work

1. Includes all work during the construction of the project that will disrupt the day to day activities of the resident. This will include parking, driveway access, pedestrian access, utility disruptions, project phasing or changes in the phasing, changes in the hours of operation, lawn care, replacement of water and sewer laterals, garbage pickup, mail delivery, etc.
2. Advanced notice for this letter or door hanger will be 3 days.

C. Emergency Work

1. Includes all emergency related work. Includes water shut offs, gas leaks, sanitary sewer issues, power issues, etc.
2. Notice will be immediate. Door to door verbal notification.

Failure to notify the residents or businesses per the above requirements will result in a deduction from the pay item for this item of work. Deductions will be made on a flat rate monetary basis and increase per occurrence as outlined under the measurement and payment section below.

6.16.03 Measurement & Payments

Measurement shall be a maximum amount as called out by the pay item on a lump sum basis. Payment shall be compensation in full for all material, equipment and labor required for all notifications required during the course of construction of this project.

OCCURRENCE	MONETARY DEDUCTION FROM PAY ITEM
1	\$200
2	\$300
3	\$400
4+	\$500

<u>Pay Item</u>	<u>Pay Unit</u>
Resident Notification, Max \$_____	LS