

**I N D E X  
DIVISION F  
SANITARY & STORM SEWERS**

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Revision Date: 05/16/07

## DIVISION F

### SANITARY SEWER AND STORM SEWER CONSTRUCTION SPECIFICATIONS

1. GENERAL:

These specifications shall apply to the construction of sanitary sewers and storm sewers with all their appurtenances.

2. MATERIALS:

All materials necessary for the completion of the Contract shall be furnished by the Contractor unless otherwise specified.

2.01	Concrete	Division E	Para. 7
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2.03	Aggregates	Division E	Para. 3
2.04	Water	Division E	Para. 16
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2.12	PolyVinyl Chloride Pipe (PVC)	Division E	Para. 10.7
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2.14	Manhole Steps	Division E	Para. 12
2.15	Manhole, Catch Basin, Inlet Frames and Covers	Division E	Para. 13
2.16	Structural Steel	Division E	Para. 14
2.17	Landscaping	Division E	Para. 15
2.18	Block (Concrete)*	Division E	Para. 4
2.19	Brick*	Division E	Para. 5
2.20	Corrugated Metal Sewer Pipe (CMP)*	Division E	Para. 10.3

\*Material item acceptable for storm sewer construction only. The material shall not be used for sanitary sewer construction.

3. EXISTING UNDERGROUND STRUCTURES AND UTILITIES:

3.1 Prior to commencing excavation, the Contractor shall be required to adhere to the provisions of Act 53 of Public Acts of 1974. (MISS DIG)

3.2 Existing Sewers, Drains, Utilities: Unless otherwise directed, the Contractor shall protect and not damage any existing sewer or drain. If damage is done, the Contractor shall repair such damage and leave such sewer or drain in a good condition as when first encountered.

Sewer and drains, before backfilling shall be provided with structural steel or other Engineer approved supports across the trench and this expense shall be incidental to the item of "Excavation". Whenever existing water, gas, or other utility services, pipes or structures are encountered in the construction, they shall be protected by the Contractor. Any damage to them by the Contractor shall be reimbursed to the utility involved. If not paid before Contract completion, the City shall deduct such expenses from the final Contract payment.

Services, pipes or structures needing supports across or in the trench shall be properly supported with structural steel or other suitable material by the Contractor in coordination with the requirements of the utilities before any backfilling is attempted. Provision for the cutting of any utility services, which crosses the trench, shall be made by the Contractor with the utilities approval and such expense of cutting and reconnecting shall be borne by the Contractor. Any expense incurred by the Contractor because of interference of utility services, pipes or structures with the excavation shall be regarded as incidental to the item of "Excavation".

- 3.3 Crossing Under Existing Railroad Tracks: In laying the sewer under the railroad tracks, special care must be taken to properly shore up and protect the tracks and maintain traffic over them. This work shall be done in such a manner as will meet with the approval of the railroad companies involved; and the Contractor shall save the City harmless from any damage or injury resulting to such companies or individuals by reason of this work. The expense involved for the protection of tracks by the use of track supports or any other expenses involved in such crossing shall be borne by the Contractor.
- 3.4 Dust Control: All haul roads, detour roads, and other public and private roads, driveways, and parking lots used by the Contractor must be maintained in a dust-free condition during the life of this contract. The control materials and methods of application which are in accordance with the requirements of the agency having jurisdiction over the roadway or driveway. Such dust control materials shall be applied as often as is necessary to control the dust.

The use of road oils and waste oils to control dust is prohibited unless authorized by the Engineer.

Should the Contractor be negligent of his duties in providing dust control, the Owner may take the necessary steps to perform such work and will charge the Contractor for all costs.

The Contractor shall keep clean all streets used in his operations. Trucks hauling excavated materials, cement, sand, stone, or other loose materials from or to the site, shall be tight so that no spillage will occur. Before trucks start away from the site, their loads shall be carefully trimmed to prevent spillage.

4. EXCAVATION:

4.1 Earth: All excavation for sewer shall be done in open cut except when boring is required provided the method of backfilling is such, in the judgment of the Engineer, as to avoid any present or future injury to adjacent structures. Such open cut excavations shall meet the requirements and standards as set forth by MIOSHA. Where tunneling or boring is done, it shall be carried out in a manner acceptable to the Engineer.

4.2 The Contractor shall remove all paving and curb and clear the surface of the ground as required for the full width and length of the proposed trench and shall dispose of all trees, shrubs, refuse and excavated material, not required for backfill, in a satisfactory manner.

4.3 Width of Trench: The maximum width of trench at the top of pipe shall be as follows:

PIPE DIAMETER	TRENCH WIDTH
Through 12"	30"
15" through 30"	O.D. plus 18"
36" and larger	O.D. plus 24"

If the maximum trench width specified above is exceeded, unless otherwise authorized by the Engineer, the Contractor shall, at his own expense, construct a concrete cradle or other type of approved bedding to provide support for the additional load. When rock is encountered, that portion of the trench which is in rock shall have a width equal to the outside diameter of the pipe plus 6" on each side or as specified in Section 4.11. The outside diameter of the pipe shall be its diameter of the barrel and not of the bell.

4.3a. Trenching shall be completed in accordance with Section 4 of this Division. The recommended Standards for Wastewater Facilities, Section 33.82 may be used for reference.

4.4 For all pipe sewers, the bottom of the trench shall be excavated below the grade of the pipe a sufficient amount to permit the installation of a stone bedding the thickness shown on the plans and/or details.

4.5 The excavation shall be kept dry until structures are constructed and no water shall be allowed to come in contact with new concrete until it has taken its initial set.

4.6 Whenever the sewer trench crosses a paved surface such as streets, sidewalks, driveways, parking lots, etc., the trench width will be based upon excavating the entire depth of the trench as a sheathed trench. If the Contractor so selects to excavate the trench in these areas without sheathing

and therefore excavates a wider trench at the surface to meet the Michigan OSHA requirements, all costs of the excavation, pavement removal and replacement, stone or backfill beyond the sheathed trench shall be assumed by the Contractor.

- 4.7 Rock Excavation Defined: Rock excavation shall consist of excavating igneous, metamorphic and sedimentary rock which cannot be excavated without drilling and blasting, or the use of pneumatic hammers and all boulders of 1/3 cubic yard or more in volume. Rock that can be removed by means of a power driven mechanical shovel, unless boulders greater than 1/3 cubic yard in volume, shall be considered earth excavation.
- 4.8 When pre-blasting is used (fracturing of rock with explosives prior to actual trench excavation) the Contractor, if required by the Engineer, shall first verify that the rock cannot be removed by pick and shovel or by power driven mechanical shovel. Cost of such verification shall be at the Contractor's expense.
- 4.8 Open Cut, Tunnels and Boring and Jacking: In general, excavation shall be made in open cut from the surface and the Contractor will not be allowed to do any tunneling or boring without obtaining permission from the Engineer, and then only according to methods approved by him. This permission will only be given where a line is to be laid behind the curb, across a paved street, under street car or railroad tracks, or where, in the opinion of the Engineer, it is necessary to tunnel or bore short sections on account of proximity of adjacent walls, trees or structures. Such excavations then can be made in alternate sections of open cut and tunnel or boring, the length of the tunnel sections to be specified by the Engineer and the head room in them, unless otherwise specified, to be not more than three (3) feet measured from the top of the sewer or pipe.

Where required or ordered by the Engineer, the excavated tunnels shall be sheathed, shored or cased in a satisfactory manner unless otherwise specified.

The space between the outside of the sewer or pipe and the sides of the tunnel or casing shall be compactly filled with Class 4 concrete or as directed by the Engineer, after the sewer or pipe is completed.

- 4.9 Dewatering (Pumping and Bailing): The Contractor shall remove by pumping, bailing, or otherwise any water which may accumulate or be found in the trench and other excavations made under this Contract; and shall form all dams, flumes or other works necessary to keep them entirely free from water while the sewers, their appurtenances and their foundations, if any, are being constructed. Newly laid masonry shall be protected from injury, resulting from the unwatering work, by plank, by the use of canvas, tar paper, or by other suitable methods as may be approved. The Contractor shall at all times have upon the works sufficient pumping machinery ready for immediate use.

Water from the trenches and excavations shall be disposed of in such a manner as will not cause injury to the public health, nor to public or private property, nor to the work completed or in progress, nor to the surface of the street, nor cause a violation of the Soil Erosion Control Act as administered by the Monroe County Drain Commission.

4.10 Trench Excavation and Tunneling Near Trees: Trench excavation shall not approach nearer than 4 feet to any tree that is not designated, on the plans, to be removed. Trees 2-inches or less in diameter may be removed, "heeled in" and subsequently replanted in their original location, if proper precautions are taken to prevent permanent injury to the tree. Trenches approaching trees having a diameter greater than 8-inches shall begin and end at points located no nearer to such trees than the radius of the tree, expressed in inches, multiplied by 1 foot per inch. As an example, the trench shall not approach closer than 6 feet to a 12-inch diameter tree. Tunneling operations adjacent to or under trees shall begin and end at points which fall outside a radius (measured from the center of the tree) equal to:

- a. Four feet, around trees 8" or less in diameter.
- b. The radius of the tree in inches multiplied by 1 foot per inch.

4.11 Pipe Clearance in Rock: Ledge rock, boulders, and large stones shall be removed to provide a clearance of at least 6-inches below all parts of the pipe, fittings, or structures and to a clear width of 6-inches on each side of all pipe and appurtenances for pipes 24" or less in diameter, a clearance of 9" below and a clear width of 9" on each side of the pipe shall be provided for all pipes larger than 24" in diameter. The cost for additional stone bedding required for pipes and their appurtenances laid in rock shall be included in the unit bid price for rock excavation.

5. SHEATHING AND SHORING:

When necessary to avoid injury to workers or undermining or otherwise damaging any structures, trenches shall be properly and sufficiently shored and braced to prevent caving, slipping or cracking of the sides of the trench and shall be done to the satisfaction of the Engineer.

Trenches shall be properly and securely sheathed and shored, to the satisfaction of the Engineer. Where necessary, sheathing shall be driven ahead of the excavation as it advances. Unless otherwise specified, all timber and planking for foundation platforms and sheathing and shoring shall be of the grades necessary to insure safety of men and structures of work.

Sheathing which takes an arch thrust from the structure shall not be removed from below the springing line. Sheathing extending below the foundation of the structure or against which work is constructed shall not be removed. The cost of this sheathing shall be included in the prices bid for excavation, or in the case of Class C excavation under the lineal foot method of payment, it shall be included in the price bid for the structure requiring excavation.

All other sheathing and shoring shall be removed unless ordered by the Engineer to be left in place in which case it will be paid for at the prices bid for one thousand (1000) feet board measure for the grades of lumber left in place.

No sheathing and shoring will be paid for above a line eighteen (18") inches below the surface of the ground.

When stated in the proposal or ordered by the Engineer, payment for matched and grooved sheathing will be based in each case on the length of trench occupied by such sheathing, with no allowance for wastage due to tongues and splines respectively.

No machinery, equipment, materials or flumes shall be placed upon, supported, braced or slung from the members comprised in the sheathing and shoring of the excavation, but shall be carried on independent supports with a safe bearing beyond the line of sheathing.

6. BEDDING, CRADLE, BASE AND ENCASEMENT:

6.1 Pipe Bedding: Pipe bedding shall be defined as that material placed from a minimum of 4" below the pipe barrel through 12" diameter and 6" for 15" diameter pipe and larger to 12" above the top of the pipe. It shall consist of crushed stone equivalent to MDOT specification 25A. The bedding shall be removed under the bell so that the pipe will bear uniformly on the barrel. The bedding shall be rodded or otherwise compacted under the pipe haunches in order to insure proper support. The stone bedding shall have a level surface extending to the sides of the trench.

6.1a Bedding cradle, base, and encasement shall be completed in accordance with Section 6 of this Division. The Recommended Standards for Wastewater Facilities, Section 33.83 may be used for reference.

6.2 Concrete: A concrete cradle, when specified, shall have a depth similar to that indicated for stone in Section 6.1. It shall be composed of Class 4 concrete.

6.3 Concrete Encasement: When necessary, sewers that are in shallow depths shall have concrete encasement completely around the sewer pipe and to a height above the barrel as specified on the plans. Concrete shall be level across the trench and shall be Class 4, unless otherwise specified. In general, encasement will be indicated on the plans or may be ordered by the Engineer.

6.4 Where sewers are constructed below existing water mains and other sewers, the trench shall be backfilled with the specified bedding material to the centerline of the existing pipes. The bedding shall be tamped in place in six

(6") inch layers and extended three (3') feet minimum each way from the outside of the existing pipe.

7. LAYING THE SEWER PIPE:

7.1 The sewer pipe shall be laid upon the prepared bedding or cradle and shall be brought accurately to the proper alignment and grade. Straight alignment between manholes shall be checked by using a laser beam, lamping, or other acceptable practice. The Recommended Standards for Wastewater Facilities, Section 33.5 may be used as a reference. The bell of the pipe already laid shall be wiped clean and the spigot end of the pipe to be laid shall then be inserted and seated against the base of the socket. The actual procedure and use of lubricants shall be in accordance with the pipe manufacturer's recommendation and with the Engineer's approval to insure a tight system. The entire length of the pipe, except the bell, shall be supported by the stone cradle. The use of blocks under the pipe for support will not be permitted.

8. BACKFILLING:

8.1 Unless otherwise directed, all excavations shall be backfilled to a point one (1) foot above the pipe immediately after installation.

8.1a Backfilling shall be completed in accordance with Section 8 of this Division. The Recommended Standards for Wastewater Facilities, Section 33.83 and 33.84 may be used as a reference.

8.2 Material: All backfill material shall be free from cinders, ashes, refuse, vegetable matter, organic matter, frozen material, boulders, rock or other material which, in the opinion of the Engineer, is unsuitable.

8.3 Backfilling Around Structures: All backfill placed within three (3) feet of manholes, catch basins, inlets and other underground structures shall be approved material.

8.4 Drives, Parking Areas, Streets, Proposed Streets, Alleys and Sidewalks: The trench backfill under drives, parking areas, streets, proposed streets, alleys and sidewalks shall be of approved stone conforming to or similar to MDOT 21A placed in layers and thoroughly compacted to 95 percent of maximum density as determined by the AASHTO T180 Method. The maximum thickness of each layer shall generally be no greater than eight (8") inches and in all cases shall be of such thickness that the equipment used will provide the required density for the full depth of the backfill. This backfill shall include the area to the outside of shoulders in ditch sections and three (3') feet outside of metal in curb sections, and thence down on a ratio of 1 to 1 slope - unless otherwise required by the governmental body or agency having jurisdiction over the area affected. In all cases, this fill shall be constructed to an elevation determined by the proposed grade of the surfacing. Drives, parking areas, streets, alleys, and sidewalks which are



disturbed during the course of the construction shall be backfilled and restored to a useable condition as soon as each crossing is made.

9. DISPOSAL:

9.1 General: The excavated material shall be deposited in such a manner as to interfere as little as possible with the execution of the work of other contractors. So far as feasible, the excavated material may be placed in its final position, but it shall not be done in a manner to interfere with the satisfactory carrying out of the work. Such excavated material as cannot be placed directly in its final position shall be removed to a temporary spoils bank, from whence it shall be subsequently taken and placed in position.

Where directed by the Engineer, telford, gravel, surface load, sod, etc., shall be kept separate from the remainder of the excavated material and replaced in its original position after backfilling of the trench.

The Contractor will not be allowed, unless by written permission from the Engineer, to sell, remove or permit to be removed from the line of work, any sand, clay, gravel or earth excavated therefrom which may be suitable and required for refilling or embankment.

9.2 Places of Disposal: All excavated material not required or allowed for refilling or in embankments shall be removed and deposited at such locations as are specified, or, if no such locations are specified, the Contractor shall find suitable dumping places for all such material. No material shall be deposited on private property until written consent of the owner or owners thereof has been filed with the Engineer. All cost of disposal of surplus excavated material shall be included in the prices bid for excavation or items requiring excavation.

Excavated material shall be disposed of, all dumps shall be leveled by the Contractor in the following order of preference; or as directed by the Engineer:

- a. Along the site of the work to fill requirements of the work, materials for this purpose shall be of the same type or better than the existing material where fill is required or where necessary to replace as backfill.
- b. On private property facing the site of the project.
- c. On any City-owned property in or outside the city limits.
- d. Adjacent to the work upon the request of property owner upon property within a two-mile haul and as directed by the Engineer.
- e. Non-adjacent to the work within a two-mile haul as directed by the Engineer.

- f. Any balance remaining after the above requirements are filled shall be disposed of by the Contractor to his best advantage with no "Overhaul" compensation.
- g. The Contractor shall be entitled to the unit bid amount for "Overhaul" under the terms of this Contract for his compensation for hauling beyond the two-mile limit upon orders from the Engineer.

All "Overhaul" and free-haul shall be made by written orders of the Engineer on order blanks having a number sequence.

- 9.3 Salvage: In the case of structures the services of which is permanently abandoned, the Engineer will designate which of the materials are to be salvaged and which are to be abandoned. The Contractor shall remove and deliver to a designated point of storage, materials ordered to be salvaged, and unless otherwise specified no additional compensation will be allowed for this removal and hauling. He shall allow owners of privately-owned structures reasonable facilities for salvaging their property. Structures designed as abandoned and not mentioned in plans or specifications to be salvaged shall become the property of the Contractor, and shall be removed from the work without additional compensation. The Contractor shall not move nor disturb the structures in any way without the approval of the Engineer.

10. CONNECTIONS TO EXISTING SEWERS AND DRAINS:

Unless otherwise noted on the plans or in the proposal, no extra allowance will be made to the Contractor for breaking into existing manholes, walls, or drains. The Contractor shall point up all manholes or barrels or drains where such connections are made and shall leave same in neat condition. In case the connection is made to a drain, the first pipe entering the drain shall be cut down in length so that when inserted in the barrel of the drain, the spigot end of the pipe will be flush with the inside surface of the drain, and the bell of the entering pipe shall rest against the outside surface of the barrel around the entering sewers in sufficient quantity so that at least the first foot of sewer is entirely encased in concrete.

11. HOUSE CONNECTIONS, WYES, AND TEES:

11.1 Wyes, Tees, Stoppers, Markers, Drop Connections: The Contractor shall place 6-inch "Y" or "T" branches at such points along the line of the sewer as shown on the drawings or as may be designated by the Engineer. All branches shall be closed with watertight stoppers, secured in place as directed by the Engineer. Suitable markers shall be furnished and placed by the Contractor at the end of each branch. The Contractor shall build drop connections as shown on the plans and where directed by the Engineer.

11.2 House Connections: Where sewer services are already built, the Contractor shall connect them to the new sewer. In cases of excessive depths of trench or in rock it may be necessary to build risers for services and these shall, if

indicated in plans, proposal, or by the Engineer, be encased in MDOT 30S concrete, six (6) inch thickness or more from the outside barrel of the pipe.

- 11.3 Wyes and Tees: When wyes and/or tees are left without connections being made, they shall have a manufacturer's recommended watertight stopper. The wyes or tees may be specified to have risers encased in concrete.

12. MANHOLES, CATCH BASINS AND INLET STRUCTURES:

- 12.1 Manholes, catch basins, and inlets shall be built according to the details of the plans. They shall be built of precast reinforced concrete or approved cement blocks. When cement blocks are used, they shall be plastered inside and outside with 1/4" cement mortar.
- 12.2 The upper core section (3'-0" or 3'-6") of manholes shall be eccentric. The cast iron ring shall be set in accordance with the plans and carefully adjusted to the grade set by the Engineer. Cast iron ring and cover shall be as specified on the plans.
- 12.3 Structures shall be thoroughly bonded to the barrel of the sewer and all connections to pipes made without projections or voids. Structures supported partially or entirely by the arch of the sewer shall not be built until the sewer has been completed at least twenty-five (25') feet on each side of the structure or until the sewer has been in place three (3) days.
- 12.4 Casting Grade Adjustments: Adjustments to meet the final design grade shall be set with precast reinforced concrete adjusting rings as detailed in the plans. The total maximum height of the adjusting rings shall not exceed sixteen (16") inches.
- 12.5 Bedding and Backfills: All structure based whether of precast type or poured-in-place type shall be placed on a 6-inch compacted stone bedding. Backfill around structures which are or will be under a street, drive, alley, parking area or sidewalk shall be with crushed stone compacted to 95% maximum density. Other material such as K-Krete, when approved by the Engineer may be used. Cost for the bedding and backfill material shall be included in the unit bid price for the structures installed.
- 12.6 Rock Excavation: Where rock is encountered, the excavation shall be to a depth which will allow the placing of the 6-inch stone cushion mentioned in paragraph 12.5. Rock shall be removed to a clear distance of 8-inches around the perimeter of the structure. The aforementioned shall delineate pay limits for rock excavation around structures.
- 12.7 Steps: Manhole steps shall be of the materials, size, length and shape as shown on the plans. They shall be firmly built into the walls not more than sixteen (16") inches apart.

12.8 Frames and Covers: Manhole frames and covers shall be as specified on the plans.

13. CONCRETE STRUCTURES:

13.1 Concrete: Concrete shall consist of a mixture of Portland cement, aggregates and water, proportioned in accordance with the requirements of this specification. Admixtures shall be included in these primary ingredients when specified.

The concrete work shall conform to the plans and as indicated elsewhere in these specifications. In general, all concrete shall be of MDOT 35S unless otherwise specified.

13.2 Handling and Placing: No concrete shall be used which does not reach its final position in the forms within one (1) hour after water is first added to the mix, except when the concrete is continually agitated when the time may be extended to one and one-half (1-1/2) hours.

13.3 Depositing Concrete Under Water: Concrete until it has set shall not be exposed to the water by which it is surrounded, it shall not be deposited in water except with the approval of the Engineer and under his immediate supervision; and in this case the method of placing shall be as hereinafter designated.

Concrete deposited in water shall be MDOT 35T with ten (10) percent excess cement. To prevent segregation, it shall be carefully placed in a compact mass, in its final position, by means of a tremie, a bottom dump bucket or other approved method, and shall not be disturbed after being deposited. Still water shall be maintained at the point of deposit and the forms under water shall be watertight.

For parts of structures under water, when possible, concrete seals shall be placed continuously from start to finish, the surface of the concrete shall be kept as nearly horizontal as practicable at all times. To insure thorough binding, each succeeding layer of a seal shall be placed before the preceding layer has taken initial set. All laitance or other foreign matter shall be removed from the top surface before any concrete is placed upon it in the dry.

A tremie shall consist of a tube having a diameter of not less than ten (10") inches, constructed in sections having flanged couplings fitted with gaskets. The tremies shall be supported so as to permit free movement of the discharge end over the entire top surface of the work and so as to permit rapid lowering when necessary to retard or stop the flow of concrete. The discharge end shall be plugged at the start of work so as to prevent water entering the tube and shall be entirely sealed at all times; the tremie tube shall be kept full to the bottom of the hopper. When a batch is dumped into the hopper, the flow of concrete shall be induced by slightly raising the

discharge end, always keeping it in the deposited concrete. The flow shall be continuous until the work is complete.

13.4 Spudding and Vibration:

13.41 Spudding: Spudding shall be used in all work if deemed necessary by the Engineer. The spuds shall be of such lengths that they will reach the bottom of the concrete poured. Care should be taken to spud the concrete in and around the reinforcing and at the form faces so that the entrapped air will be brought to the surface.

13.42 Vibration: All concrete, except that in sewer cradles, immediately after having been placed in the forms, shall be subjected to high frequency vibration by means of a vibrating tool arranged to be inserted within the mass of the concrete from above. The tool shall be of such diameter that it will not disturb or wedge the reinforcement from its specified position. The tool shall impart sufficient energy to the concrete to make it plastic and flowing, so that when the forms are removed there will be no stony pockets or segregation. The tool shall operate at frequencies in excess of five thousand (5,000) impulses per minute and shall be allowed to remain in the concrete long enough to puddle the concrete thoroughly but no longer.

In the placement of concrete in roof slabs, the vibrating tool shall be provided with a short handle so constructed that vibration of the tool will not be transmitted to the operator and permitting the operator to control the position of the tool with ease. As the concrete is deposited in the forms, the vibrating tool shall be inserted at close intervals and to a depth which will permit the tool to vibrate the concrete through the lateral motion of the tool and at the same time permit the tool to transmit vibrations to the supporting forms. The tool shall be inserted under the flanges of girder beams, re-entrant angles in the forms and wherever it is necessary to force the concrete to flow into proper position. The tool shall be inserted at locations close enough together to insure that the whole mass of concrete being treated shall have been subjected to adequate vibration.

If it is evident after the tool has operated for a reasonable length of time that stony pockets still remain due to a deficiency of mortar, such stony pockets shall be removed, fresh concrete substituted and vibration repeated until the condition of segregation disappears.

The Contractor shall have a sufficient number of vibrating tools available to accomplish the results desired.

13.5 Construction Joints: Concrete shall be deposited continuously and as rapidly as possible until the unit of operation, as approved by the Engineer, is completed. Construction joints at points not provided for in the plans shall be subject to the approval of the Engineer. When rectangular sewers of sidewalls and roof shall be constructed to its full thickness without

interruption, so as to form a monolith, the length of each section to be such as to permit it to be completed within the working hours of a day.

Adjoining sections shall be bonded by a tongue and groove joint of sufficient section to resist shear, or by approved methods of embedded stones projecting beyond the surface.

13.6 Curing: All exposed surfaces of finished and unfinished work shall be kept constantly moist by sprinkling with water at short intervals, or by such means as the Engineer shall direct, and this moistening shall be continued until, in the opinion of the Engineer, the concrete has sufficiently hardened.

13.7 Protection: Sufficient tarpaulin or other covering shall be provided to protect freshly laid work from the action of the elements.

13.71 No wheeling, working or walking on finished surfaces will be allowed for twenty-four (24) hours after the concrete is deposited.

13.72 Temperatures: When the air temperature falls to 40° F. or less, no concrete shall be deposited unless the aggregate and water have first been heated so that the mixture shall have a temperature on leaving the mixer between 70° F. and 100° F. When the temperature falls to 20° F. or less, concrete pouring shall be stopped and shall not be resumed until the temperature has risen above 20° F. In places protected from the weather, mass concrete may be poured upon approval of the Engineer. All concrete during curing shall be protected during freezing weather by straw, hay, tarpaulins or salamanders or all for not less than 72 hours after pouring.

This section shall be subject to the special provisions if provided in any other section of this specification.

13.73 Frozen Base: No concrete shall be poured on a frozen, dry or uncompacted subgrade.

13.74 Hot Weather Curing: All exposed surfaces of concrete shall be protected from the sun and the wind and kept wet in dry weather for fourteen (14) days after placing.

13.8 General Concrete Finish: Unless otherwise specified, concrete surfaces shall be finished as follows:

Immediately after the face forms are removed, the surface shall be freed from inequalities and projections by scraping. All voids shall be filled by floating with cement mortar, and the entire surface shall be brushed or broomed with a thin wash, composed of equal parts of cement and fine, sharp sand, in as many successive coats as may be required to produce an even surface in finish and color.

- 13.9 Reinforcement: All reinforcement bars shall have the dimensions and shall be placed as shown on the plans and details. The bars shall be supported at intervals of not more than three (3) feet by bent steel or molded concrete chairs of approved pattern, to maintain them in position with respect to the forms, and they shall be wired together at all intersections with two turns of No. 12 wire.

All bars shall be protected from exposure to the weather until used and immediately before placing them in the concrete they shall be thoroughly cleaned of scale and any rust, grease or dirt that may have accumulated on them.

Exposed reinforcement intended for bonding with future extensions shall be protected from corrosion.

The reinforcement shall be bent to shapes shown on the plans. The radii of bends shall be equal to or greater than twice the diameter of the bar, measured from the inside of the curved bar, except for stirrups in which the bends shall be equal to or less than the diameter of the bar. When bars are heated for bending, they shall not be heated to a higher temperature than that producing a dark cherry red color. Only competent persons shall be employed for cutting and bending, and proper appliances shall be provided for the work.

All reinforcement shall be furnished in the full lengths indicated upon the plans. No splicing or bars, except where shown on the plans, will be permitted without the written approval of the Engineer. Splices which are permitted shall have a length of not less than forty (40) times the nominal diameter of the bars, and shall be well distributed or else located at points of low tensile stress. No splices will be permitted at points where the section is not sufficient to provide a minimum distance of two (2") inches between the splice and the nearest adjacent bar or the surface of the concrete. The bars shall be rigidly clamped or wired at all splices in a manner approved by the Engineer.

- 13.10 Forms: All centers or forms shall be collapsible, of ample strength, rigidly braced, with smooth surfaces against the concrete. Ribs and bracing may be constructed of either wood or steel, and must be of adequate strength to prevent deviation in the line. Ribs shall be cut or fabricated to exact dimensions, and all ribs shall be matched before the sheathing is fastened to them. Unless otherwise specified on the plans, sheathing over ribs shall be constructed of steel plates, rolled and fabricated to exact size and curvature before assembling. Steel plates used for this purpose shall be securely fastened to the ribs, and shall be of such thickness and weight that they will not buckle or crumple under load. They shall be of such size as to reduce the number of joints to a minimum. All joints shall be butt joints, and shall fit together in such a manner as to leave no large marks on the finished concrete surfaces. Sections of forms shall be constructed with all ends exact duplicates, so that when the form is moved ahead, after pouring, the rear

end of the section will fit exactly into the front end of the arch in place. Any section in which the space at any point between it and the arch, as outlined above, is more than one-eighth (1/8) of an inch, shall not be used on the work; this restriction to apply to each movement of the section. All forms shall be maintained in first class condition during the entire period of their use, and any repairs ordered repaired may again be used in the work. Steel filler plates of the correct size, shape and strength, shall be provided for forming bends or curves in the sewer.

In the determination of the time for removal of false work and forms, consideration shall be given to the location and character of the structure, the weather and other conditions influencing the setting of the concrete, and the materials used in the mix. Methods of form removal likely to cause over-stressing of the concrete shall not be used. In general, the forms shall be removed from the bottom upwards. Forms and their supports shall not be removed without the approval of the Engineer. Supports shall be removed in such a manner as to permit the concrete to uniformly and gradually take the stresses due to its own weight.

If form removal is not controlled by tests for compressive strength, the following periods, exclusive of days when the temperature is below forty (40°) degrees F., may be used as a guide for form removal.

- for arches. . . . .14 to 21 days
- for reinforced slabs. . . . .14 to 21 days
- for walls . . . . . 7 days

Should the Contractor desire to remove the forms in a shorter time than designated above, the removal must be controlled by tests for the strength of the concrete, and the forms shall not be slackened until the concrete has attained a compressive strength of at least fifteen hundred (1500) pounds per square inch. This compressive strength shall be determined by the testing laboratory designated by the municipality from specimens cast at the time of pouring of the concrete. The specimens shall be stored and cured under conditions similar to the concrete in the sewer structure. The cost of these tests shall be borne by the Contractor. The Contractor shall be responsible for all damage caused by the premature removal of forms.

13.11 Grouted Rip rap: The stones shall be laid as specified for Plain Rip rap, Section 13.13. The spaces between the stones shall be filled with Type III mortar. Mortar shall be placed from bottom to top and sufficient mortar shall be used and worked with suitable tools to completely fill all voids, except that the face surface of the stone shall be left exposed. Any excess mortar shall be removed with a stiff brush. The mortar shall be cured for a minimum period of four days by being kept continuously wet or by the application of transparent membrane curing compound for structures.

13.12 Headers: Toe and side headers, one foot wide and two feet deep, unless otherwise shown on the plans, shall be constructed according to the details shown on the plans.



13.13 Plain Rip rap: The bank on which the plain rip rap is to be placed shall be trimmed to a uniform slope as shown on the plans. The rip rap shall commence in a trench below the toe of the slope, as shown on the plans, and shall progress upward, each stone being laid by hand and firmly bedded into the slope and against the adjoining stones. The stones shall be laid perpendicular to the slope with the surfaces in contact and with well broken points. The rip rap shall be thoroughly compacted as the construction progresses, and the finished surface of the rip rap shall present an even, tight surface. The thickness of the rip rap other than precast concrete blocks, shall be not less than 4-inches, measured perpendicular to the slope. Individual stones shall be laid with their 4-inch minimum dimension perpendicular to the plane of the surface to be rip rapped. Machine placing will be allowed for rip rap placed below water and for precast concrete blocks.

13.14 Heavy Rip rap: The bank on which the heavy rip rap is to be placed shall be trimmed to a uniform slope as shown on the plans. Heavy rip rap shall be constructed in accordance with the requirements of plain rip rap except that the thickness of the rip rap, other than precast concrete blocks, shall be not less than 18 inches measured perpendicular to the slope. Individual stones shall be laid with their 18-inch minimum dimension perpendicular to the plane of the surface to be rip rapped. Machine placing will be allowed for heavy rip rap.

13.15 Pointing: Pointing shall not be done in freezing weather or when the stone contains frost.

Joints not pointed at the time the stone is laid shall be thoroughly wet with clean water and filled with mortar. The mortar shall be well driven into the joints and finished with an approved pointing tool. The wall shall be kept wet while pointing is being done, and in hot or dry weather the pointed masonry shall be protected from the sun and kept wet for a period of at least three (3) days from completion. After the pointing is completed and the mortar set, the work shall be thoroughly cleaned and left in a neat and workmanlike condition.

14A. TELEVISION SANITARY AND STORM SEWERS: As a requirement for final acceptance of sanitary and storm sewer installations and after required infiltration, exfiltration, air testing and deflection testing have been performed and approved, the contractor shall have an independent agency prepare and submit to the engineer a television video tape on VHS format and hand written log of every main line sewer installed under this contract document. Said television service shall be incidental to the contract.

14. TESTING SANITARY SEWERS: (All Pipe Materials Except PVC and ABS)

14.1 Testing for Infiltration: All sanitary sewers shall be installed with watertight joints and shall be tested to measure the infiltration of ground water. Where sewers are constructed below the ground water table, they shall be inspected for excessive leakage at all joints. In small diameter sewers this may be done by lamping between manholes, and wherever possible, a TV camera shall be used to locate the points of excessive leakage. Any joints or locations of excessive leakage shall be repaired prior to final testing. After the sewers have been visually inspected and all observed leakage stopped, the infiltration into the sanitary sewers shall be measured. The Contractor shall isolate sections of the sewer by the installation of bulkheads in the pipe as required and the measurement shall be made by means of a V-notch weir or other Engineer approved method. If the measured leakage with a four foot head exceeds 100 gallons per inch diameter per mile of pipe per day, the Contractor shall locate the points of excessive leakage and make the necessary repairs. If the natural ground water provides a 2 foot or more head over the top of the sewer pipe of the test section, an infiltration test shall be made with the allowable infiltration being calculated by the following formula:

$$\text{Allowable Infiltration} = (\text{Actual Average Ground Water Head Above the Test Section} / 4' \text{ Maximum})^{0.50} \times 100 \text{ gal/inch/mi/day}$$

Four inch perforated plastic pipe observation wells or other Engineer approved method shall be furnished at each manhole at the Contractor's expense for the determination of the ground water level (See Standard Detail Sheet). In the event the line does not meet the infiltration test as stated above, the test shall be repeated after repairs. Final tests shall be made by the City of Monroe at the Contractor's expense.

At the direction of the Engineer, exfiltration tests shall be required where ground water is not adequate.

NOTE: When Asbestos Cement Pipe is approved and used for sanitary sewers, the allowable leakage shall be 100 gallons per inch of diameter per mile per 24 hours.

14.2 Test for Exfiltration: Where the ground water provides less than a two foot head over the top of the sewer pipe, an exfiltration test shall be conducted by filling the inside of the sewer with water to the basic four foot head or four feet above the average ground water level over the test section, whichever is the greater elevation. The allowable water loss shall be 100/gal/in/mi/day as calculated in Section 14.1.

All lengths of sewers to be tested by either method shall be limited to 1,600 feet or less for main sewer sizes 8" diameter through 18" diameter, and 1,200 feet or less for main sewer sizes 21" diameter and larger.

When the sewer is filled with water, twenty-four hours time shall be allowed for water absorption in the pipe. Final tests and expenses paid shall be similar to that under "Test for Infiltration".

For the purpose of establishing the basic four foot head on 6", 8", 10", and 12" sewers, the head shall be measured from the invert of the sewer pipe at each manhole location and averaged across the test section. All larger sewers shall have the basic four foot head measured above the center of the sewer pipe at each manhole location and averaged over the test section. Excepting large diameter pipe, this procedure shall be used for infiltration and exfiltration tests. For large diameter pipe, 48" and greater, a minimum head of 2' above the top of the pipe shall be maintained to perform either test.

14.3 Manhole Leakage: All manholes shall be tested for leakage. The manholes may be tested by the use of plugs on outlet sewers, and filling the manholes with water to the top of the manhole. The water must stand for a twenty-four hour period to allow for absorption before testing for leaks and shall not exceed the 100/gal/in/mi/day leakage rate. The manhole may be tested by vacuum testing as follows:

- a. Plug the manhole inverts and exits (other than the manhole top access) using suitably-sized pneumatic or mechanical plugs.

CAUTION: FOLLOW ALL MANUFACTURER'S RECOMMENDATIONS AND WARNINGS REGARDING SAFE AND PROPER INSTALLATION OF SUCH PLUGS. MAKE SURE THE PLUGS ARE PROPERLY RATED FOR THE PRESSURES REQUIRED IN THE TEST. THE STANDARD TEST OF 5 INCHES MERCURY IS EQUIVALENT TO ABOUT 2.5 PSIG (0.15 BAR) BACK PRESSURE. IT IS RECOMMENDED THAT THE PLUGS USED HAVE AT LEAST TWICE THE SAFETY FACTOR (OR A RATING OF 5 PSIG/0.3 BAR BACK PRESSURE).

- b. Brace the pipeline inverts if the lines entering the manhole have not been back-filled. This will prevent the pipe from dislodging and being pulled into the manhole.
- c. Install and operating the manhole testing unit into the manhole according to the manufacturer specifications.
- d. The manhole tester unit shall evacuate the manhole to 5 inches Hg for one minute with no loss.
- e. If the vacuum does not drop any amount of mercury within the test time, the manhole is considered acceptable and passes the test. If the manhole fails and leaks, the needed repairs shall be made and the manhole must be tested again until satisfactory results are obtained at the Contractor's expense.

- 14.4 Retesting: All sewers shall be retested after leaks are repaired. The City of Monroe shall have the right to retest, after repairs, at the Contractor's expense.
- 14.5 Low Pressure Air Testing: Upon direction and approval of the Engineer, low pressure air tests may be used to test the sewer for infiltration.

All tests shall be conducted under the supervision of the Engineer with the Contractor furnishing all labor, material and equipment to perform the test.

The Contractor may desire to make an air test prior to backfill for his own purposes but the line acceptance test shall be conducted after backfilling has been completed in accordance with other portions of these specifications.

All wyes, tees, or ends of lateral stubs shall be suitably capped to withstand the internal test pressures. Such caps shall be easily removable for future lateral connections or extensions.

After a manhole-to-manhole section of line has been backfilled and cleaned, it shall be plugged at each manhole with pneumatic plugs inflated to the appropriate internal pressure. The design of the pneumatic plugs shall be such that they will hold against the line test pressure without requiring external blocking or bracing, although blocking and bracing is recommended for personal safety.

There shall be three hose connections to the pneumatic plug. One hose shall be used only for inflating of the pneumatic plug. The second hose shall be used for continuously reading the air pressure rise in the sealed line. The third hose shall be used only for introducing low pressure air into the sealed line.

There shall be a 0-30 psig gauge for reading the internal pressure of the line being tested. Calibrations from the 0-10 psig range shall be in tenths of pounds (not ounces) and this 0-10 portion shall cover 90 percent of the complete dial range.

Low pressure air shall be introduced into the sealed line until the internal air pressure reaches 4.0 psig greater than the average back pressure of any ground water pressure that may be over the pipe. At least two minutes shall be allowed for the air pressure to stabilize. After the stabilization period, the internal air pressure shall be repressurized to 4.0 psig and the third hose shall be disconnected.

The portion of line being tested shall be accepted if the portion under test does not lose air at a rate greater than 0.003 cfm per square foot of internal pipe surface when tested at an average pressure of 3.5 psig greater than any back pressure exerted by ground water that may be over the pipe at the time of the test.

The above requirement shall be accomplished by performing the test as follows: The time requirement for the pressure to decrease from 3.5 to 2.5 psig (greater than the average back pressure of any ground water that may be over the pipe) shall not be less than the time given in the air tests as shown below:

**CONCRETE PIPE ONLY (ASTM C 924)**

(1 psig Drop Allowable) Minimum Test Time for Various Pipe Sizes

Nominal Pipe Size, in.	T (time), min/100 ft	Nominal Pipe Size, in.	T (time) Min/100 ft
4	0.3	15	2.1
6	0.7	18	2.4
8	1.2	21	3.0
10	1.5	24	3.6
12	1.8		

**CLAY PIPE ONLY (ASTM C 828)**

(1 psig Drop Allowable) Minimum Test Time for Various Pipe Sizes

Nominal Pipe Size, in.	T (time), min/100 ft	Nominal Pipe Size, in.	T (time) Min/100 ft
3	0.2	21	3.0
4	0.3	24	3.6
6	0.7	27	4.2
8	1.2	30	4.8
10	1.5	33	5.4
12	1.8	36	6.0
15	2.1	39	6.6
18	2.4	42	7.3

**ALL OTHER PIPE**

(1 psig Drop Allowable)  
(Except Clay, Concrete, ABS & PVC Pipe)

<b>PIPE SIZE (INCH)</b>	<b>TIME</b>
4	2½ Minutes
6	4 Minutes
8	5 Minutes
10	6-1/2 Minutes
12	7-1/2 Minutes
15	9-1/2 Minutes

In areas where ground water is known to exist, the Contractor shall install a one-half inch diameter capped pipe nipple, approximately 10 inches long, through the manhole wall level with the top of the sewer lines entering the manhole. This shall be done at the time the sewer line is installed. Immediately prior to the performance of the line acceptance test, the ground water level shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to the pipe nipple. The hose shall be held vertically and a measurement of the height in feet of water shall be taken after the water stops rising in this plastic tube. The height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings. For example, if the height of water is 11.5 feet, then the added pressure will be 5 psig. This makes the 4.0 psig to be 9.0 and the 3.5 psig to be 8.5 psig. The one pound allowable drop and the timing remains the same. Note: Air testing of these pipe materials shall not be permitted if the air pressure required for the test is greater than 9 psig.

If any section of the sewer fails to meet this requirement, the Contractor shall perform a television inspection of the faulty section and repair or replace at his own expense all defective materials or workmanship. The test procedure shall be repeated until the results are acceptable.

15. TESTING: (PVC Pipe and ABS Pipe)

15.1 Testing for Tightness: After the pipe has been laid and backfilled, the line may be tested between manholes by a low pressure air test or water infiltration or exfiltration test. The specifying Engineer shall designate the type of test to be performed and the manner in which it shall be conducted.

15.2 Low Pressure Air Testing: When a low pressure air test is required, the Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air (ASTM F 1417, as amended) shall be used. The minimum requirements for air testing shall be 0.5 psig pressure drop, from 4.0 psig to 3.5 psig as shown in the following table:

ABS & PVC PIPE ASTM F 1417) (0.5 PSIG Drop Allowable)  
Minimum Specified Time Required for a 0.5 psig Pressure Drop for Size and Length of Pipe Indicated

Nominal Pipe Size, in.	Minimum Time, mins.	Length for Minimum Time, ft.	Time for Longer Length, s
4	1:53	597	0.190 L
6	2:50	398	0.427 L
8	3:47	298	0.760 L
10	4:43	239	1.187 L
12	5:40	199	1.709 L
15	7:05	159	2.671 L
18	8:30	133	3.846 L
21	9:55	114	5.235 L
24	11:20	99	6.837 L
27	12:45	88	8.653 L
30	14:10	80	10.683 L
33	15:35	72	12.926 L
36	17:00	66	15.384 L

Note: Air testing of these pipe materials shall not be permitted if the air pressure required for the test is greater than 9 psig.

- 15.3 Infiltration/Exfiltration Testing: When an infiltration or exfiltration test is required, the provisions of Section 13.0 shall apply unless otherwise specified by this section. The maximum allowable amount of infiltration/exfiltration measured by test shall be at a rate of not greater than 50 gallons per inch of pipe diameter per mile per 24 hours.

When using the exfiltration test method, the average internal pressure in the system under test shall not be greater than 5 pounds per square inch (11.5 ft. hd.), and the maximum internal pressure in any part of the system under test shall not be greater than 10.8 pounds per square inch (25 ft. hd.).

- 15.4 Test for Deflection: (PVC Pipe) After the pipe has been laid and backfilled, the specifying Engineer shall require appropriate deflection testing. This test is conducted by pulling a pointed mandrel through the pipe, as described on Standard Detail Sheet. The Engineer shall designate the method of testing to be used. Thirty (30) days after completion, the maximum allowable deflection shall not exceed 5% of the pipe's internal diameter. Testing shall be conducted on a manhole-to-manhole basis or in total, as specified. To assure accurate measurement, it is important the line to be tested is completely water flushed. Deflection shall be measured in accordance with ASTM D 2122.
- 15.5 Test Rejection: Should the result of any test fail to meet the criteria established in this specification, the Contractor shall, at his own expense,

locate and repair rejected section and retest until it is within specified allowance.

16. TELEVISION SANITARY AND STORM SEWERS:

As a requirement for final acceptance of sanitary and storm sewer installations and after required infiltration, exfiltration, air testing and deflection testing have been performed and approved, the contractor shall have an independent agency prepare and submit to the Engineer a television video on VHS format and hand written log of every main line sewer installed under this contract document. Said television service shall be incidental to the contract.

17. STRUCTURES:

17.1 New Structures shall be constructed as indicated on the plans and of the materials specified. In general, structures will be indicated in the Proposal as a unit and this work shall include necessary excavation of earth and rock, furnishing of materials, labor, clean up, etc., incidental for the completion of the whole unit of construction.

17.2 Existing Structures encountered in the work which necessitates some alteration or demolishing will be indicated on the plans and, if not, any work necessary to the progress of the project shall be ordered by the Engineer.

17.3 Alteration or Demolishing of any Structure, etc., will be indicated in the Proposal. In general, when this work is not included in the Proposal, it shall be regarded as incidental to item of excavation with no additional payment.

18. PAVEMENT, CURB AND WALK RESTORATION:

18.1 General: The Contractor shall replace all pavement, sidewalk and curb and gutter that is broken or removed during the sewer construction. All such replacement shall be done in accordance with the City's specifications for each type of work. All materials and workmanship shall be subject to inspection by the Engineer.

18.2 Work Included: Under the heading Pavement, Curb and Walk Restoration is included the work of tearing up such areas of pavement other than macadam or telford, as may be required for the construction of sewers, sewer appurtenances therein; of removing and disposing of all materials torn up; of placing temporary pavement to carry traffic until such time as the backfill has settled and the permanent pavement may be laid; of subgrading for the permanent pavement, including the accurate removal and the disposal of all materials for the width of the proposed pavement, below the existing surface to a depth not exceeding that of the pavement and foundation to be laid; of



compacting or rolling of subgrade as specified or directed by the Engineer; and of permanently repaving these areas.

- 18.3 Temporary Pavement: In placing the temporary pavement, the backfill shall be compacted or puddled as described under "Backfilling", up to the level of the pavement subgrade, after which the pavement as shown on the plans shall be placed and compacted as far as possible, without requiring the use of a roller. This temporary pavement may be crowned at the discretion of the Engineer, but in no case shall this crown be more than three-quarters (3/4) of an inch in height for each foot of width of repavement. The Contractor shall maintain this temporary pavement in condition adequate for its usual traffic, until such time as it is replaced by the permanent pavement, and shall be liable for any claims or damages arising from his neglect to maintain the temporary pavement.
- 18.4 Permanent Pavement: The permanent pavement shall be laid at such times as the Engineer may permit, but in no case in less than two (2) weeks after the trench was backfilled, except as specified below, nor more than one (1) year after the temporary pavement was laid. The Contractor shall replace the permanent pavement during the above stated period upon receipt of notice from the Engineer. Such replacement must be under local inspection and in accordance with the local standard specifications for the kind of pavement to be laid.

When specified on the plans or in the proposal, and permitted under local laws, regulations and ordinances, permanent paving over trenches may be laid immediately after the sewer structure is completed and the trench backfilled and properly compacted to subgrade elevation. In this case, the permanent surface course shall be supported on a concrete or reinforced-concrete base having the thickness and reinforcement shown or specified on the plans. This base shall have a satisfactory bearing at least one (1) foot each side on the trench, and shall be designed to support the maximum allowable surface loads over the trench.

The Contractor shall guarantee all permanent pavement for a period specified in the Contract. If, within the period of guarantee, any of the work shall prove to be defective either in materials or workmanship, or if damage occurs by settlement of the backfill, the Contractor shall immediately upon demand of the Engineer (whose decision as to such defectiveness shall be binding and conclusive upon the parties hereto) repair and replace the same, at the Contractor's own cost and expense. All repairs and replacement shall be done to the satisfaction of the Engineer and subject to his approval.

Concrete pavements shall be replaced with Class 1 concrete.

- 18.5 Walks and Curbs: Walks and curbs shall be of Class 1 concrete laid to proper lines and grades after proper settlement of the trench backfill. Under walks the trench backfill shall be thoroughly tamped or flushed or both as

necessary with the top one (1) foot to be of approved crushed stone well tamped.

19. RESTORATION OF CONDITIONS:

All rubbish or refuse and all unused materials and tools shall be removed promptly from the premises, and as the work progresses it shall be carefully cleaned and kept clean from such rubbish and refuse. Before the work will be considered as having been completed, the sites and places affected by the work shall be thoroughly cleared and left clean; free from debris, construction plant, buildings, and materials; fit for travel and other proper use; and in as good condition as existed before the work was begun. Grass plots disturbed shall be resodded or planted anew. The restoration work shall be governed by a record of existing conditions made and filed in the office of the Engineer previous to the commencement of work.

19.1 Work included shall be grading, the replacement of trees, shrubs and topsoil, and placement of topsoil, fertilizer, seed and mulch, or fertilizers, seed and mulch, and sod.

19.2 Materials:

Topsoil	Division E	Section 15.1
Sod	Division E	Section 15.2
Seed	Division E	Section 15.3
Fertilizer	Division E	Section 15.4
Trees	Division E	Section 15.5
Mulch	Division E	Section 15.6
Latex Base Adhesive	Division E	Section 15.7

19.3 Time of Placement:

Seed: April 15 to May 15; August 15 to October 1  
Sod: April 15 to June 15; August 15 to November 1  
Trees: (Bare-root) April 1 to May 15; September 15 to October 1  
Trees: (Balled) March 1 to June 1; September 1 to November 1

19.4 Placement:

19.41 Topsoil, Fertilizer, Seed and Mulch: Three inches (3") of topsoil shall be placed on the subbase and fertilizer applied at a rate not less than 20 lbs. per 1000 sq. ft. Class A seed shall be sown in an amount not less than 5 lbs. per 1000 sq. ft. After sowing, the surface shall be lightly raked, mulch applied, rolled with a light lawn roller and thoroughly wetted.

19.42 Fertilizer, Seed and Mulch:

- a. Fertilizer shall be applied on the slope surface or the R.O.W. surface, and worked into the soil to a depth of not less than one (1") inch. When a hydro-seeder is used, seed and fertilizer may be mixed in a water solution and applied in one operation.
  - b. Class B seed shall be incorporated into the soil to a depth not to exceed 1/4 inch. Seed shall be placed from the time ground is workable in the spring until June 1 and from August 15 to October 1.
  - c. Mulch shall be spread uniformly over the surface. Asphalt emulsion shall be sprayed on the mulch at time of placement.
- 19.43 Sod: Sod shall be placed on two (2) inches of topsoil previously placed on the trench. Sod shall be moist. Ditch bottoms and side slopes shall be sodded when the slopes are greater than 3% and 3 horizontal to vertical respectively.

20. LANDSCAPING RESTORATION:

- 20.1 Trees: Trees shall be planted at locations directed by the Inspector. Tree holes shall be 6" deeper and 12" wider than the root spread of the tree to be planted. The main root area shall be covered to a depth of at least three (3) inches after the soil is tamped around the tree roots. Trees shall be guyed.
- 20.2 Sod, Seed and Trees: Sod, seed and trees shall be watered by the Contractor one week after installation.
- 20.3 Guarantees: All seed, sod and trees shall be guaranteed for one (1) year from placement. Any sliding or washing out which may occur before final acceptance of the Contract shall be repaired in a satisfactory manner.
- 20.4 Approvals: Contractor shall submit for approval the names of suppliers of material to be used before work under this section commences.

21. FENCES, BARRICADES, ETC.:

The Contractor, at his own expense, shall erect and maintain all necessary fences, barricades, red lanterns, and danger signals. The lights shall be kept burning from sunset until sunrise, and necessary watchmen shall be provided for the safety of the public. The Contractor shall observe such rules relative to signals and safeguards as the police regulations, harbor regulations, laws and ordinances require.

22. PROTECTION OF TREES AND SHRUBS:

The Contractor shall exercise every precaution to protect from injury all trees and shrubs not directly on the line of the sewer, and upon completion of the work shall restore the ground to its original condition without additional compensation. Where directed by the Engineer, he shall tunnel beneath trees, being careful not to disturb

the roots any more than is necessary. No additional compensation will be allowed for this work above the prices bid for excavation and sewer structure.

23. MAINTENANCE OF TRAFFIC AND ACCESS TO PROPERTY:

Traffic of all kinds shall be maintained continuously and access to buildings shall be provided for at all times, unless otherwise specified in the Contract Documents, or where temporary interference is authorized by the Engineer, in which case it shall be interrupted only for such time as is necessary to provide temporary substitutes for surfaces disturbed by the construction and to restore street and sidewalk surfaces after the completion of the work. Provision shall be made for owners and occupants to reach their premises. Where partial occupation of the street is allowed, materials and equipment shall be so placed as to insure a minimum of interference with traffic. The work shall be so conducted that annoyance to residents and interference with the normal use of the properties will be reduced to a minimum. The flow in gutters and inlets shall be maintained. When access to any adjacent property is temporarily cut off, owing to occupation of the street by the Contractor, he shall render every assistance to the owner or occupant in handling materials of every description that must be delivered to or removed from such property, including ashes, rubbish and garbage, and such materials shall be taken to or from the nearest accessible point that, in the opinion of the Engineer, is convenient for handling. No additional compensation will be allowed for the various items of expense above noted. When the Engineer permits the closing of a street, the detouring of traffic or the temporary closing of a traffic lane; the Contractor shall provide all necessary signing, barricading, flashers and flagmen as required by the Michigan Manual of Uniform Traffic Control Devices.

24. BASIS OF PAYMENT:

Payment to the Contractor shall be done in accordance with the following unless otherwise noted on the plans, in the proposal or in the General Conditions and Specifications:

24.1 Protection of Existing Structures and Utilities: No extra compensation shall be considered for the required labor and materials to provide adequate protection to existing structures and utilities located within the project area.

24.2 If indicated in the proposal as a separate bid item, earth excavation shall be paid for at the unit price in the proposal per cubic yard of excavation from the top of ground to the top of rock or to the base of trench when applicable. Earth excavation made for the purpose of installing sewer pipe, manholes, and other appurtenances for the sewer installation shall be incidental to the unit price of the item. When applicable, measurement of earth excavation shall be determined by measuring the rectangular width and depth specified in Earth Excavation, and the length of the trench along the centerline of the trench. This item shall include all necessary labor, equipment, and materials, such as shoring unless otherwise specified for a complete unit of work. Pumping and bailing shall be incidental to this item.

- 24.3 Rock Excavation: Rock excavation shall be paid for at the unit price in the proposal per cubic yard of rock measured to the rectangular width and depth specified under Rock Excavation and measured along the centerline of the trench. Pay for this item shall include all necessary blasting, drilling, labor, equipment and material for the complete removal of the rock as required in these specifications.
- 24.4 New Structures in general will be paid for by the unit lump sum price for a completed structure which includes all the necessary excavation, furnishing of materials, labor, equipment, etc. A new structure may be broken down into its component parts of construction and if so, will be indicated in the Proposal.
- 24.5 Existing Structures to be altered or demolished shall be paid for at the unit lump sum price or component unit prices if stated in the Proposal. This work shall entail the making or demolishing of a completed structure.
- 24.6 Tunnels, Bore and Jacking shall be paid for at the unit price per lineal foot for the necessary earth and rock excavation, sheathing, shoring, casing, concrete backfill, except the sewer pipe laid in place, but including any other items necessary for a completed operation. Tunnels which are less than ten (10) feet in length and necessary to pass under trees, walks or other structures shall be incidental to the item excavation, and the Contractor is not to receive added compensation for such work.
- 24.7 Sheathing and Shoring:
- 24.71 General: Sheathing and shoring shall be incidental to the item of Earth Excavation unless specifically mentioned in the Proposal, in which case, it will be paid for at the unit price per M.B.F. of usage and shall include all labor, materials, and other equipment necessary for the safety of men, structures, etc.
- 24.72 Left in Place sheathing and shoring shall be paid for at the unit price per M.B.F. and shall be payment in full for the sheathing and shoring involved. The labor, materials, and equipment used in addition to the sheathing and shoring shall be incidental to the item of Earth Excavation.
- 24.8 Base and Cradle:
- 24.81 Stone shall be incidental to the item of Pipe Sewers.
- 24.82 Concrete shall also be included in the item of Pipe Sewers.
- 24.9 Concrete Encasement shall be paid for at the unit price per lineal foot of encasement measured along the centerline of the sewer from the top of the

cradle to the top of encasement and for the width of the trench and shall include the concrete and its proper placement.

- 24.10 Pumping and Bailing shall be incidental to the item of Earth Excavation.
- 24.11 Pipe Sewers shall be paid at the unit price per lineal foot in the proposal and shall include the pipe, joint materials, stone or concrete base and cradle, and any other material, labor or equipment necessary for a complete unit of construction and shall be measured along the centerline of the sewer from center-to-center of manholes.
- 24.12 Backfill Earth and Stone: Earth and stone backfill shall be incidental to the construction item requiring the excavation unless otherwise specified.
- 24.13 Disposal: Disposal of excavated material, per the specified paragraphs A, B, D, and F of Section 9.2, page F-8, shall be incidental to the item excavation.
- 24.14 Overhaul: Overhaul, as specified in paragraph G of Section 9.2, page F-8, shall be paid on the proposal rate per mile of travel per compacted cubic yard of excavated material.
- 24.15 Salvage: The Contractor shall not receive compensation for salvaging, transporting, and delivering specified materials from structures that are specified for removal or abandonment.
- 24.16 Connections to Existing Sewers and Drains shall be incidental to the total construction of this project.
- 24.17 House Connections, Wyes and Tees:
  - 24.171 House Connections shall be paid for at the unit price per each connection to include necessary pipes, joints, encasement or shoring, etc., to make a complete job.
  - 24.172 Wyes and Tees shall be paid for at the unit price each for the furnishing of such wyes or tees together with their plugs and necessary joints, labor, equipment, and any other essential materials.
- 24.18 Manholes and Drop Manholes shall be paid for at the unit price for a completed structure, including earth and rock excavation, base, walls, pipe, covers and frames, labor, materials, equipment, etc., necessary.
- 24.19 Manhole Frames, Covers, Castings and Steps: Frames, covers, castings and steps shall be incidental to the unit lump sum price of the construction items.
- 24.20 Concrete Structures shall be paid for at the unit lump sum price or by its unit component prices and such compensation shall be for any

necessary use of materials, labor, or equipment essential for a complete unit of construction.

24.21 Pavement, Curb and Gutter, and Sidewalk Restoration:

24.211 Pavements shall be paid for at the unit price per square yard, pavement removed and replaced, to include any excavation, forming, concrete, reinforcing or other materials, labor, equipment necessary.

24.212 Curb and Gutter shall be paid for at the unit price per lineal foot which shall include excavation, removal, replacement, forming, concrete, reinforcing or other materials, labor, equipment necessary.

24.213 Walks shall be paid for at the unit price per square foot of old walk removed and new walk laid including intersection ramps when specified and is to include concrete, forms, excavation, and any other labor, materials, or equipment necessary to complete unit of work.

24.22 Restoration: Unless otherwise noted in the plans or specifications, the Contractor shall receive no compensation for restoration as specified in Section 18.0.

24.23 Landscaping: Landscaping shall be paid for at the unit price stated in the proposal. If no unit price/lump sum is stated in the proposal, this item shall be considered incidental to the project cost.

24.24 Barricades and Traffic Control: The Contractor shall not receive compensation for providing barricades and traffic control.