Section XI

GRAVITY SANITARY SEWER SYSTEM

CONSTRUCTION PROCEDURES

This section covers construction procedures normally required for work within the District. It does not cover any special construction procedures which may be encountered for abnormal conditions.

Special construction procedures are to be presented to the District by the Developer's Design Engineer.

All design criteria, materials, and construction shall be in accordance with DHEC regulations, AWWA, and ASTM Standards.

A. HANDLING OF MATERIALS

1. Storage of PVC pipe:

    a. Store in unit packages as received from manufacturer until just prior to use.

    b. Stack units to prevent deformation to pipe barrel and bells.

    c. Protect from direct sunlight by covering with opaque material.

2. Avoid severe impact blows, gouging or cutting by metal surfaces or rocks.

3. Handle pipe so as to ensure delivery to the trench in sound, undamaged condition.

    a. Carry pipe into position - do not drag.

    b. Use pinch bars or tongs for aligning or turning the pipe only on the bare end of the pipe.

    c. Use care not to injure pipe linings.

4. Thoroughly clean interior of pipe and accessories before lowering pipe into trench. Keep clean during layout operations by plugging or other approved method.

5. Before installation, inspect each piece of pipe and each fitting for defects:
    a. Replace material found to be defective before or after laying with sound material meeting the specified requirements.

6. Rubber gaskets: Store in a cool dark place until just prior to time of installation.

B. PIPE CUTTING

1. Cut pipe neatly and without damage to the pipe.

2. Unless otherwise recommended by the pipe manufacturer, cut pipe with mechanical cutter only.

    a. Use wheel cutters when practical.

    b. Cut plastic pipe square and remove all burrs.

C. LOCATING

1. Sewer lines in relation to water lines must conform to “Ten State Standards.”

2. Where possible, locate sewer pipe at least ten (10) feet away, horizontally, from water lines.

3. Should ten (10) foot separation not be practical, then the sewer pipe may be located closer provided:

    a. It is laid in a separate trench.

    b. It is laid in the same trench with the water main located at one side on a bench of undisturbed earth.

    c. In either of the above cases, the sewer pipe must be a minimum of 18” below the water pipe measured outside to outside.

4. Where water lines cross over, maintain 18" minimum clearance between crown of sewer and invert of water lines.

5. Where sewer lines cross over water lines, provide ductile iron pipe.

a. Concrete encase the sewer pipe fully for a distance of ten (10) feet on each side of the crossing.

1) Not less than 4" thickness, including that on pipe joints.

b. Use pressure pipe with no joint closer, horizontally, than three (3) feet from the crossing.

1) Pressure test pipe prior to backfilling.

D. INSTALLATION

1. Trench, backfill and compact for the work of this Section in strict accordance with pertinent provisions of Section XXIII of these specifications, and the following requirement.

a. Maximum trench widths, depths and bedding methods.

1) Install all sewers complying with tables for depths of cut and class of bedding included hereinafter.

b. Ductile-iron pipe:

MAXIMUM DEPTHS IN FEET						
			CLASS OF BEDDING			
			D	C	B	A
PIPE SIZE	MAX. TRENCH WIDTH	CLASS OF PIPE	FLAT BOTTOM TRENCH	TYPE 1 OR TYPE 2	TYPE 1 OR TYPE 2	SPECIAL CONCRETE BEDDING
8"	2'2"	50	24	28	32	35
10"	2'4"	50	15	24	32	35
10"	2'4"	51	24	32	35	35
12"	2'6"	50	16	20	32	35
12"	2'6"	51	20	24	35	35
12"	2'6"	52	28	32	35	35
14"	2'9"	50	14	16	32	35
14"	2'9"	51	16	20	35	35
14"	2'9"	52	24	28	35	35
16"	3'0"	50	13	17	32	35
16"	3'0"	51	17	21	35	35
16"	3'0"	52	21	25	35	35
18"	3'2"	50	11	15	32	35
18"	3'2"	51	15	17	35	35
18"	3'2"	52	17	21	35	35
20"	3'6"	50	11	15	32	35
20"	3'6"	51	13	17	35	35
20"	3'6"	52	17	21	35	35
24"	3'10"	50	10	14	30	35
24"	3'10"	51	12	16	34	35
24"	3'10"	52	14	18	35	35

30"	4'7"	50	0	12	26	35
30"	4'7"	51	0	14	30	35
30"	4'7"	52	0	16	34	35
36"	5'5"	50	0	13	27	35
36"	5'5"	51	0	19	31	35
36"	5'5"	52	0	19	35	35
36"	5'5"	53	0	13	35	35
42"	6'1"	50	0	15.5	27.5	35
42"	6'1"	51	0	17.5	27.5	35
42"	6'1"	52	0	19.5	31.5	35

c. Polyvinyl chloride pipe (SDR35):

MAXIMUM DEPTHS IN FEET					
			CLASS OF BEDDING		
		D	**C**	**B**	**A**
PIPE SIZE	**MAX. TRENCH WIDTH**	**FLAT BOTTOM TRENCH**	**TYPE 1 OR TYPE 2**	**TYPE 2* ONLY**	**SPECIAL CONCRETE BEDDING**
4"	2'0"	**	**	30	30
8"	2'2"	**	**	30	30
10"	2'4"	**	**	30	30
12"	2'6"	**	**	30	30
15"	2'10"	**	**	30	30
18"	3'2"	**	**	30	30
21"	3'6"	**	**	30	30
* Class B Bedding (Type 2) shall extend to the top of the pipe.					
** Do not use this Class of bedding for this pipe size and trench width.					

d. Bedding and tamping:

1) Class A Bedding:

a) Excavate trench to one-fourth of nominal pipe diameter below pipe grade; lay pipe to grade on concrete blocking; place 2500 psi concrete around pipe for full width of trench up to one-fourth nominal pipe diameter above the invert.

2) Class B (Type 1) Bedding (Ductile iron pipe only):

a) Shape bottom of trench to a level 2" below bottom of pipe; bring bed to proper level by spreading and thoroughly tamping fine granulated moist earth and sand to conform accurately to one-fourth circumference

of pipe barrel; provide suitable material if not available from trench excavation; lay pipe, backfill and hand tamp in thin layers to height three-fourths of pipe diameter, using material same as bedding material; complete trench backfill complying with Section XXIII.

b) In lieu of Class B (Type 1) bedding for ductile iron pipe, Class B (Type 2) bedding may be used.

3) Class B (Type 2) Bedding:

a) Undercut 4" below pipe barrel, full width of trench; bring to grade with compacted crushed stone complying with SCHD Aggregate No. 5, except for PVC sewers, use SCHD Aggregate No. 57, then:

i) For pipe other than PVC, place stone in 6" layers to mid-point of pipe, compacting by slicing with shovel.

ii) For PVC pipe, place stone (Aggregate No. 57) in 6" layers to the top of the pipe, compacting by slicing with shovel.

b) In lieu of Class B (Type 2) bedding, fine granulated material may be used from the excavation provided that the trench is dewatered prior to excavation and a dry trench is maintained until the pipeline is completely backfilled.

c) Trench backfill complying with Section XXIII.

4) Class C (Type 1) bedding (Ductile iron pipe only):

a) Shape trench bottom by hand to conform accurately to bottom one-quarter of pipe barrel circumference.

i) Use Class C (Type 2) bedding if unable to properly shape trench bottom.

5) Class C (Type 2) Bedding (Ductile iron pipe only):
a) Undercut 4" below bottom of pipe barrel; full width of trench; bring to grade with compacted crushed stone

complying with SCHD Aggregate No. 5; lay pipe; place stone in 6" layers to quarter-point of pipe, compacting by slicing with shovel.

b) Trench backfill complying with Section XXIII.

6) Class D Bedding (Ductile iron pipe only):

a) Excavate bell holes in flat-bottomed trench; lay pipe.

b) Trench backfill, comply with Section XXIII.

2. Pipe laying:

a. General:

1) Protect pipe during handling against shocks and free fall. Remove extraneous material from the pipe interior.

2) Lay pipe by proceeding upgrade with the spigot ends of bell-and-spigot pipe pointing in direction of flow.

3) Lay each pipe accurately to the indicated line and grade, aligning so the sewer has a uniform invert.

4) Continually clean interior of the pipe free from foreign material.

5) Before making pipe joints, clean and dry all surfaces of the pipe to be joined.

6) Use gasket lubricants as recommended by the pipe manufacturer.

7) Place, fit, join and adjust the joints to obtain the degree of water tightness required.

b. Polyvinyl chloride pipe:

1) Select proper bedding class from preceding table as determined by pipe size and depth of cut.

a) Use Class B (Type 2) or Class A for all PVC sewers.

2) Comply with ASTM D2321, except as otherwise specified herein.

c. Ductile-iron pipe:

1) Select proper bedding class from proceeding table as determined by pipe size and depth of cut.

a) Class D bedding limited to maximum pipe size of 24", Class 52 at fourteen (14) foot depth.

2) Comply with ANSI/AWWA C600, except as otherwise specified herein.

E. MANHOLES

1. Set bases level so that walls will be plumb.

2. Clean bells and spigots.

3. Apply joint sealer, or ring gasket to wall section(s), set firmly in place to assure watertight joints.

4. Set risers and cones so steps align.

5. Connect pipe boot to piping with dual stainless-steel straps.

6. Grout lift holes from the outside using non-shrink grout.

7. Install exterior joint collar.

a. Follow manufacturer's recommendations.

b. Clean the surface.

c. Remove the protective paper and place the band around the manhole, mastic side to the manhole and spanning the joint.

8. Form the invert channels directly in the concrete of the manhole base, with mortar, or by laying a full section of sewer pipe through the manhole and breaking out the top half after surrounding concrete has hardened. Smooth the floor of the manhole outside the channels, and slope toward the channels at not less than 1" per foot nor more than 2" per foot.

a. Shape the invert channels to be smooth and semi-circular, conforming to the inside of the adjacent sewer section.

b. Make changes in direction of flow with a smooth curve of as large a radius as the size of the manhole will permit.

c. Make changes in size and grade of channels smoothly and evenly.

d. Slope invert uniformly from invert of inlet to invert of outlet.

9. Match manhole top to grade utilizing brick, maximum height 8".

F. MANHOLE COATINGS: SAUEREISEN SYSTEM

1. Provide in existing manholes where a new force main enters and in the next manhole down stream.

a. Coat with Sauereisen coating.

b. Temperature of working area.

1) Must be between 65F and 80F.

2) Store materials within the 65F to 80F range for 48 hours prior to use.

3) Do not apply in direct sunlight or where rising surface temperatures may result in blistering of the materials.

4) Shade new concrete surfaces that have been in direct sunlight for 24 hours prior to application and keep shaded until the initial set has taken place.

5) When the surface temperatures are rising, postpone the application or apply during cooler hours.

c. Surface preparation.

1) Old concrete:

a) Concrete must be dry, firm and structurally sound.

b) Utilize mechanical methods to remove laitence, old paints, protective coatings and attached or deteriorated concrete.

c) Concrete surfaces that have been cured with conventional curing compounds or are contaminated with form oils or grease must be chemically cleaned or scarified to remove the contaminants prior to abrasive blasting or hydroblasting.

d) Abrasive blast or high-pressure water blast concrete to remove laitance and obtain uniform sound substitute.

e) Suitably finished concrete must have a uniform surface texture, exposing fine aggregate and resembling coarse sandpaper.

i) If surface texture is not uniform in appearance, repeat abrasive blasting or hydroblasting until the desired surface is obtained.

f) After surface preparation, fill all voids with underlayment grout.

g) Follow all manufacturer's recommendations for surface preparation.

2) All surfaces must be free of dust, loose particles, oils, grease, chemical contaminants and previously applied paints or protective coatings.

3) All surfaces are to be dry after completion of surface preparation.

d. Application of underlayment grout

1) Mix grout in accordance with manufacturer's directions:

a) Voids greater than ½":

i) Trowel onto surface at a minimum thickness of 1".

b) Voids less than ½":

i) To maximize working time, spread grout onto a plasterer's hawk upon completion of the mixing.

ii) Apply grout to concrete with a smooth plasterer's rubber float.

iii) After application, remove excess material by using the edge of the float or squeegee.

e. Application of finish coat

1) Mix in accordance with manufacturer's directions.

2) Trowel finish at a minimum _" thickness.

3) Provide a pinhole and trowel mark free surface.

4) Test surface for pinholes after 24-hour cure using a Tinker Razor Holiday Detector, San Gabriel, CA, Model AP/W or an approved similar model.

G. MANHOLE LINER:

1. Provide in pump stations, wetwells, pressure sewer receiving manholes, the next manhole downstream of receiving manholes, air release valve manholes and drop manholes.

a. Install in accordance with Manufacturer's published directives and procedures.

b. Welding:

1) Perform by welders certified by the Manufacturer.

2) Provide a one-piece monolithic concrete protective liner system.

3) Acceptable welding techniques:

a) Extrusion welding.

b) Wedge welding.

c) Butt welding.

d) Hot air welding.

c. Testing and supervision of the installation and welding.

1) Perform by qualified staff only.

2) Visually check when completed.

3) Spark test all welded joints.

H. CONNECTIONS TO EXISTING SYSTEM

1. Construct new manhole breaking upper half of existing pipe after base of manhole is completed so as not to obstruct flow of the existing pipe.

2. At existing manhole tie-ins, temporarily block and/or divert sewage flows, perform other miscellaneous work.
   a) Use high-early strength cement for mortar, forming proper channels with minimum interruption to service of the existing sewer.

I. SERVICE LINES

1. Connect to street sewers using wye branches and bends not greater than 45.

2. Do not stack service lines vertically over the sewer main.

3. Comply with details in Section XII.

4. Locate service lateral within five (5) feet from property corner on opposite corner of water lateral.

J. CLEANOUTS

1. Secure the District's approval of cleanout locations prior to installation.

2. Pour a concrete protection pad around cleanouts.

3. Install cleanout and concrete protection pad level with finished grade.

K. INSPECTIONS AND TESTING

1. General:

    a. Perform all tests on all PVC pipe in the presence of the Developer's Design Engineer.

    b. Visually inspect, test, and gauge all sewers for infiltration and/or exfiltration.

    c. All visible leaks shall be repaired.

    d. Broken and cracked pipe, mislaid pipe and other defects shall be corrected.

2. Inspection:

    a. Each section between manholes shall show a full circle of light when viewed from either end.

3. Deflection tests:

    a. No pipe to exceed a deflection of 5%.

    b. Conduct deflection testing after the final backfill, and compaction thereof, has been in place at least thirty (30) days and prior to placing the sewer lines into operation.

    c. Conduct the deflection tests using a rigid ball or mandrel having a diameter equal to 95% of the inside diameter of the pipe.

    d. Do not use mechanical pulling devices for the deflection tests.

4. Infiltration tests:

    a. Conduct tests using V-notch weir, or by direct measurement prior to allowing sewage flows in the line.

    b. Close the end of the sewer at upstream structure sufficiently to prevent the entrance of water.

    c. Discontinue use of well points or other groundwater pumping operations at least three days prior to testing.

d. Infiltration into the entire system of new sewers or any one trunk, interceptor or outfall sewer, including connecting laterals, or any stretch of sewer shall not exceed:

1) All gravity sewers shall be designed and specified such that the leakage outward (exfiltration) or inward (infiltration) shall not exceed two hundred (200) gallons per inch of pipe diameter per mile per day. An air test may be utilized in lieu of an infiltration/exfiltration test, if approved by the Department.

5. Air testing:

a. All gravity sewer must be air tested per ASTM F1417 after dry utility installation is completed.

L. NOTICE OF CONSTRUCTION ACTIVITY

1. Immediately prior to the beginning of construction the "Notice of Construction Activity" form as included in the appendix is to be completed and mailed to the District Representative with a copy mailed to the District's Engineering Representative.

M. GRAVITY SEWER LINES/COLLECTION SYSTEMS

1. Excluding service connections less than fifty thousand (50,000) gpd, sewer connections to gravity sewer lines shall be constructed such that the internal angle of deflection is equal to or greater than ninety (90) degrees, including connections at manholes. Angles less than the required ninety (90) degrees may be considered on a case-by-case basis, when there is adequate justification (e.g., drop through the manhole) provided.

2. For all domestic wastewaters and for industrial wastewaters with solids which are similar in size and nature to solids in domestic wastewater, no gravity sewer line conveying raw sewage shall be less than eight (8) inches in diameter. In cases where the flow and number of taps are limited to less than ten (10) percent of the design capacity of the receiving sewer line, as determined by the Department, and the line cannot be reasonably extended, the Department may consider the use of six (6) inch diameter lines.

3. For all domestic wastewaters and for industrial wastewaters with solids which are similar in size and nature to solids in domestic wastewater, all gravity sewers shall be designed and constructed to give mean velocities, when

flowing full, of not less than two (2) feet per second, based on Manning's formula using an "n" value of thirteen thousandths (0.013). Slopes slightly less than those required for the two (2) feet per second velocity, when flowing full, may be permitted. Such decreased slopes shall only be considered where the depth of flow shall be three tenths (0.3) of the diameter or greater for average flows. Whenever such decreased slopes are selected, the design engineer shall furnish with the report design computations of the anticipated flow velocities of average and peak flows. The report shall indicate the actual velocity in the sewer lines at the proposed slope and the actual velocity at the required slope in order to achieve two (2) feet per second, when flowing full. The pipe diameter and slope shall be selected to obtain the greatest practical velocities to minimize settling problems. Oversized sewers shall not be approved to justify using flatter slopes. The operating authority of the sewer system shall give written assurance to the Department that any additional sewer maintenance required by reduced slopes shall be provided.

4. Sewers shall be designed with a uniform slope between manholes.

5. Sewers on twenty (20) percent slopes or greater shall be anchored securely with concrete anchors or equal, spaced as follows:

    a. Not over thirty six (36) feet center-to-center on grades twenty (20) percent and up to thirty five (35) percent;

    b. Not over twenty four (24) feet center-to-center on grades thirty five (35) percent and up to fifty (50) percent; and

    c. Not over sixteen (16) feet center-to-center on grades exceeding fifty (50) percent.

6. Sewers twenty four (24) inches or less in diameter shall be laid with straight alignment between manholes. Consideration for curvilinear sewers in excess of twenty four (24) inches in diameter shall be evaluated on a case-by-case basis.

7. Manhole top elevations shall be greater than or equal to the fifty (50) year flood elevation, unless watertight covers are provided.

8. Manholes shall be installed: at the end of each line; at all changes in grade, size, or alignment; at all intersections of piping; and at distances not greater than four hundred (400) feet for sewers fifteen (15) inches or less, and five hundred (500) feet for sewers eighteen (18) inches to thirty (30) inches. Distances up to six hundred (600) feet may be approved, for sewers equal to

or greater than eight (8) inches in diameter, in cases where adequate cleaning equipment for such spacing is provided. Greater spacing may be permitted in larger sewers. Cleanouts may be used only for special conditions and shall not be substituted for manholes except when installed at the end of laterals not greater than one hundred fifty (150) feet in length. A drop pipe shall be provided for a sewer entering a manhole at an elevation of twenty four (24) inches or more above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than twenty four (24) inches, the invert shall be filleted to prevent solids deposition. Manholes may not be required on sewer lines transporting special waste (e.g., volatile organic compounds) or effluent wastewater from a treatment facility.

9. The minimum inside diameter of manholes shall be forty eight (48) inches unless using an inside drop connection where a minimum inside diameter of sixty (60) inches shall be required for all new manholes. For modifications to existing manholes, a minimum diameter of forty eight (48) inches, for inside drop connections, may be provided if justified and approved by the Department. A minimum manhole access diameter of twenty two (22) inches shall be provided.

10. Each section of sewer pipe shall be specified to be laid to the appropriate line and grade, as designed, working in the upstream direction with the bell end laid upgrade.

11. All gravity sewers shall be designed and specified such that the leakage outward (exfiltration) or inward (infiltration) shall not exceed two hundred (200) gallons per inch of pipe diameter per mile per day. An air test may be utilized in lieu of an infiltration/exfiltration test, if approved by the Department. Refer to DHEC Reg. 61-67.3.B.

N. GREASE TRAPS

1. Any new food service facilities permitted under R.61-25, Retail Food Establishments, and served by an onsite wastewater system that is permitted after the effective date of this regulation shall be required to have a properly sized grease trap. This requirement may also apply to new facilities not requiring a food service permit under R.61-25. Exception may be granted in cases where a permitted retail food service establishment performs limited food preparation and/or cooking.

2. Any existing food service establishment that does not have a grease trap, but experiences an onsite wastewater malfunction as a result of grease

accumulation, shall be required to immediately comply with all portions of Section 201 as if it were a new food service facility.

3. Any food service facility requiring a grease trap shall provide two (2) separate plumbing stub-outs, one serving the food preparation area and the other serving the restrooms. The stub-out from the restrooms shall discharge directly into the main building septic tank. The stub-out from the food preparation area shall discharge directly into the grease trap with the effluent then directed to the main building septic tank. In order to enhance grease separation while the liquids are hot, the grease trap shall be placed as close as possible to the source of wastewater. Garbage grinders shall not be allowed to discharge to such systems.

4. All grease traps must be directly accessible from the surface, and must be equipped with an extended outlet sanitary tee terminating six (6) to twelve (12) inches above the tank bottom. The minimum access opening shall be eighteen (18) inches in diameter.

5. All grease traps serving facilities from which the peak sewage flow exceeds fifteen hundred (1500) gpd shall either be dual chambered or individual tanks in series. If dual chambered, both the dividing wall and the second chamber must be equipped with a sanitary tee terminating six (6) to twelve (12) inches above the tank bottom.

6. It shall be the responsibility of the owner/manager to ensure that the grease trap(s) is cleaned by a licensed septage pumper at frequent intervals to prevent the carryover of grease into other parts of the onsite wastewater system.

7. Determination of Minimum Net Liquid Capacity

    a. No grease trap used as part of an onsite wastewater system shall have a net liquid capacity of less than one thousand (1000) gallons. Commercial interior-type grease interceptors shall not be utilized in lieu of a properly sized exterior grease trap.

    b. Minimum net liquid capacities of grease traps shall be determined as follows:

NLC = GPD x LF x RF

Where,

NLC = Net Liquid Capacity of Grease Trap (gallons)
GPD = Total Maximum Estimated Sewage Flow (gpd)

LF = Loading Factor (the approximate portion of the total maximum daily flow generated in food preparation areas)

- 0.3 - Schools and Other Institutions
- 0.4 - Restaurants
- 0.5 - Retail Food Stores

RF = Minimum Retention and Storage Factor of 2.5 for Onsite Wastewater Systems