3. DESIGN REQUIREMENTS FOR SANITARY SEWERS

3.010 General

This section gives the minimum technical design requirements of the District for sanitary sewerage and sewage treatment facilities. Adherence to these will expedite review and approval of plans. In general, the formulae presented herein for hydraulic design represent acceptable procedures not necessarily to the exclusion of other sound and technically supportive formulae. Any departure from these design requirements should be brought to the attention of the District and discussed before submission of plans for approval, and should be justified. All construction details pertaining to sanitary sewer improvements shall be prepared in accordance with the District Standard Construction Specifications unless otherwise noted.

3.020 General Requirements of Sanitary Sewer Construction

All sanitary sewers shall meet the following general requirements:

3.020.01 Size and Shape

The minimum diameters of pipe for combined sewers shall be twelve (12) inches, and for sanitary sewers, eight (8) inches. Sewers shall not decrease in size in the direction of the flow. Circular pipe sewers shall be used for all sizes of sanitary sewers.

3.020.02 Materials

All materials shall conform to the District Standard Construction Specifications, including periodically updated “Approved Materials”. Trench backfill material for sewers beneath street pavement may be as required by the local jurisdiction for the street pavement and its maintenance. That shall not alter standard pipe bedding, cradling or immediate pipe covering procedures or materials, however, unless otherwise specifically approved by MSD.

3.020.03 Bedding

The project Plans and Project Specifications shall indicate the specific type or types of bedding, cradling, or encasement required in the various parts of the sanitary sewer construction if different than the current the District Standard Construction Specifications.

Special provisions shall be made for pipes laid under or over fills or embankments in shallow or partial trenches either by specifying extra strength pipe for the additional loads due to differential settlement, or by special construction methods, including ninety (90%) modified proctor compaction of fill, to prevent or to minimize such additional loads.

Compacted granular backfill shall be required in all trench excavation within public (or private) streets rights-of-way or areas where street rights-of-way are anticipated to be dedicated for public use. Under areas to be paved, the compacted granular backfill shall be placed to the subgrade of the pavement. Under unpaved areas, the compacted granular backfill shall be placed to within two (2) feet of the finished surface, and generally not more than two (2) feet beyond street pavement or curb lines. Local street jurisdiction shall govern, where more stringent.

Pipes having a cover of less than three (3) feet shall be encased in concrete, or a stronger pipe be used, unless otherwise directed by the District.

If the storm and sanitary sewers are parallel and in the same trench, the upper pipe shall be placed on a shelf and the lower pipe shall be bedded in compacted granular fill to the flow line of the upper pipe.
3.020.04 Pipe or Conduit Under Streets and Pavements

Any pipe or conduit material beneath a highway, road, street, or pavement, or with reasonable probability of being so located, shall have ample strength for all vertical loads, including the live load required by the highway authority having jurisdiction, but in no case shall provide for less than an AASHTO HS-20 loading. For other locations, the minimum live load shall be the HS-10 loading. Special considerations may be required for adverse conditions. Compacted granular backfill shall be utilized to the base of the pavement.

3.020.05 Joints

The joint type required for the type of pipe used and the application shall conform to the latest standards set forth in the Standard Construction Specifications of the District or as approved by the District.

3.020.06 Monolithic Structures

Monolithic reinforced concrete structures shall be designed structurally as continuous rigid units. Wall thickness shall be 8” minimum with one row of reinforcement, horizontal and vertical. Wall thickness 10” and greater shall require 2 rows of reinforcement, horizontal and vertical. (Where approved, District precast structures are allowed, less steel & thickness may be accepted).

3.020.07 Alignment

Sanitary sewer alignments are normally limited by the available easements, which in turn should reflect proper alignment requirements.

Sanitary sewers shall be aligned:

1. To be in a straight line between structures for all pipe sewers thirty inches (30) in diameter and smaller.

2. To be parallel with or perpendicular to the centerlines of straight streets unless otherwise unavoidable. Deviations may be made only with approval of the District.

3. To avoid meandering, off-setting and unnecessary angular changes.

4. To make angular changes in alignment for sewers thirty (30) inches in diameter or smaller in a manhole located at an angle point and for sewers thirty-three (33) inches in diameter or larger, by a uniform curve between two tangents. Curves shall have a minimum radius of ten times the pipe diameter.

5. To avoid angular changes in direction greater than necessary and any exceeding ninety (90) degrees.

3.020.08 Location

Sanitary sewer locations are determined primarily by the requirements of service and purpose. It is also necessary to consider accessibility for construction and maintenance, site availability and competing uses, and effects of easements on private property.

Sanitary Sewers shall be located:

1. To serve all property conveniently and to best advantage.
2. In public streets, roads, alleys, rights-of-way, or in sewer easements dedicated to the District.

3. In easements on private property only when unavoidable.

4. On private property along property lines or immediately adjacent to public streets, avoiding crossing through the property.

5. At a sufficient distance from existing and/or proposed buildings (including footings) and underground utilities or other sewers to avoid encroachment and reduce construction hazards.

6. To avoid interference between house connections to foul water or sanitary sewers and stormwater sewers.

7. In unpaved or unimproved areas whenever possible.

8. To avoid, whenever possible, any locations known to be or probably to be beneath curbs, paving or other improvements particularly when laid parallel to centerlines.

9. To avoid sinkholes and creeks.

10. No sanitary lateral clean outs or sampling tees shall be placed within the area of the stormwater overflow path.

3.020.09 Flowline

The flowline of sanitary sewers shall meet the following requirements:

1. The flowline shall be straight or without gradient change between the inner walls of connected structures.

2. Gradient changes in successive reaches normally shall be consistent and regular, with small or insignificant differences in successive reaches. Gradient designations less than the nearest 0.001 foot per foot, except under special circumstances and for larger sewers, shall be avoided.

3. For sanitary or combined sewers the hydraulic grade line shall not rise above the intrados of the pipe.

4. When the grade of a sewer is twenty percent (20%) or greater, a concrete cradle or collars is required. For grades exceeding fifty percent (50%) a special design and Project Specifications are required.

3.020.10 Manholes

Manholes provide access to sewers for purposes of inspection, maintenance and repair. They also serve as junction structures for connecting lines. Requirements of sewer maintenance determine the main characteristics of manholes.

1. Manholes shall be located at changes in direction, changes of pipe size, flowline gradient, and at junction points with connecting sewers.
For sewers thirty-three (33) inches in diameter and larger, manholes shall be located on special structures at junction points with other sewers and at changes of size or gradient.

2. Spacing of manholes shall not exceed four hundred (400) feet for pipe sewers thirty-six (36) inches in diameter and smaller, five hundred (500) feet for pipe sewers forty-two (42) inches in diameter and larger, except under special approved conditions. Spacing shall be approximately equal, whenever possible.

In addition, street access manholes should be located at a spacing of not more than 1200 feet apart to facilitate sewer maintenance requirements. “Street access manholes” are those manholes in or adjacent to a paved street accessible to MSD.

3. Manholes on sanitary and combined sewers ten (10) inches through thirty-six (36) inches shall be a minimum of forty-eight (48) inches in diameter and/or have a square bottom section with sides of forty-eight (48) inches, depending on the sewer diameter. Manholes on sewers eight (8) inches in diameter shall have a minimum bottom section of forty-two (42) inches. Manholes on sewers greater than thirty-six (36) inches in diameter shall be built in accordance with the Standard Specifications.

4. At stream and channel crossings, manholes shall be located on both sides of the crossing at changes in pipe material. The manholes shall be a minimum of ten (10) feet from the top of the bank on both sides of the crossing.

5. All manholes on sanitary sewers that are built within the 100-year flood limits, the stormwater overflow path, or in other areas determined to be subject to flooding shall be provided with lock type watertight manhole covers.

6. Manholes for sanitary or combined sewers shall be precast concrete or poured in place type and waterproofed on the exterior, as approved by the District.

3.020.11 Sewage Treatment Facilities

1. New treatment plants will not be allowed.

2. Treatment using a septic system for continued use of an existing individual residence may be considered only where the District determines that no public sanitary sewer is available. Replacement of a burned down or otherwise destroyed individual residence may also be so considered, but only if an affidavit is provided from an “A” rated insurance company to show non-arson and claims approval for residence replacement. Approval from the local Plumbing Authority will be required. Availability of sanitary sewers is assumed if any point on the property to be served is within a distance of two hundred (200) feet of a public sanitary sewer. In any case, the District will make the final determination based on specific site conditions.

3. Septic systems will not be allowed for a property or a lot size less than three (3) acres.

4. For new or replacement construction or development, including residential, refer to 1.020.03
3.030 Design Requirements

3.030.01 General

All sanitary sewers shall be designed and constructed as to conform to these design requirements. Hydraulic calculations must be submitted as part of the plan review for all public sewer construction. Calculations must be submitted for the existing and ultimate upstream development condition.

3.030.02 Gradients

The following minimum slopes of sanitary pipe sewers are those giving at least three (3) feet per second velocities flowing full, based on Manning's formula using an "n" value of 0.013 unless otherwise directed by the District. Slopes greater than these minimums shall be used wherever possible.

For sewers with a design grade less than one percent (1%), field verification of the pipe grade will be required for each installed reach of sewer, prior to any surface restoration or installation of any surface improvements.

The District may require the submittal of revised hydraulic calculations for any sewer reach having an as-built grade flatter than the design grade by more than 0.1%. Based on a review of this hydraulic information, the District may require the removal and replacement of any portion of the sewer required to ensure sufficient hydraulic capacity and cleansing velocity of the system.

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Minimum Slope in Ft. per 100 Ft. (% Grade)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 (house lateral)*</td>
<td>2.0</td>
</tr>
<tr>
<td>8</td>
<td>1.0</td>
</tr>
<tr>
<td>10</td>
<td>0.6</td>
</tr>
<tr>
<td>12</td>
<td>0.6</td>
</tr>
<tr>
<td>15</td>
<td>0.4</td>
</tr>
<tr>
<td>18</td>
<td>0.3</td>
</tr>
<tr>
<td>21</td>
<td>0.3</td>
</tr>
<tr>
<td>24</td>
<td>0.2</td>
</tr>
<tr>
<td>27</td>
<td>0.2</td>
</tr>
<tr>
<td>30</td>
<td>0.2</td>
</tr>
<tr>
<td>36</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Pipes larger than thirty (36) inches in diameter shall maintain a cleansing velocity of three (3) feet per second.

3.030.03 Depth and Minimum Cover

Sewer depths shall be determined primarily by the requirements of pipe or conduit size, utility obstructions, required connections, future extensions, and adequate cover. The minimum depth requirements shall be as follows:

1. For sewers which may be extended in the future, the minimum depth shall be nine (9) feet below the finish grade to flowline, except where upstream topography indicates that this depth is not necessary as determined by the District.
2. The minimum depth of sewers shall be not less than three (3) feet plus the sewer diameter. The flowline of the sewer must have a vertical distance from the low point of a basement or low floor of not less than 2.5 feet plus the sewer diameter. *The minimum depth shall be increased as required to insure a minimum of two percent (2%) slope and 2.5 feet of cover for a six (6) inch house lateral.

3. At stream and channel crossings, a minimum depth of two (2) feet shall be allowed where greater depths cannot be achieved. Where this minimum cover can not be achieved, Schedule 50 ductile iron pipe with Field Lok Mechanical restrained joints or approved equal must be used from manhole to manhole unless otherwise directed by the District. Stream and channel crossings must be protected with rock blanket or other approved stream stabilizational/channel protection methods. Concrete encasement is not an option. Aerial crossings are not allowed unless attached to a bridge.

4. Sewer depths at manholes shall be sufficient to ensure the use of standard manholes. Special manholes will only be allowed upon approval by the District.

3.030.04 Flow Design

All lateral and sub-main or collecting sewers shall be designed on the basis of an average per capita use of not less than one hundred (100) gallons per day, and on that basis shall be designed with capacities of four hundred (400) gallons per capita per day at peak flow unless otherwise directed by the District. Sanitary flow from day schools with gymnasiums, showers and cafeterias shall be computed on the basis of thirty (30) gallons per capita discharged in eight (8) hours. On this basis the daily peak flow rate shall be 90 x 4 gallons per capita per day for the lateral sewers. Sanitary flow from tourist camps and trailer courts shall be computed on the basis of 2.5 persons per each unit for each twenty four (24) hour period at fifty (50) gallons per capita per day times a peak factor of four (4). Sanitary flow from apartments, boarding schools and condominiums and other smaller facilities shall be computed at the same rate as residential property. Sanitary flow from all other types of institutions, commercial property, industrial plants, etc., shall be separate and individual studies based on a conservative ultimate anticipated flow multiplied by the peak factors applicable to each case. In the case of industrial flow, when the rate and volume can be predetermined with a reasonable degree of accuracy, no dilutions or diminishing factor shall be applied against this flow in the outfall, sub-trunk or trunk sewers.

3.030.05 Population Factors

Family population factors for the various areas in the District are to be determined from the latest United States Census Tracts. An acceptable figure is 3.7 persons per household unit.

3.030.06 Sanitary Flow Table

<table>
<thead>
<tr>
<th>Population Unit</th>
<th>Cu. Ft./Sec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>One Person @ 400 G/D</td>
<td>0.00062</td>
</tr>
<tr>
<td>One Household Unit @ 3.7 Persons @ 400 G/C/D</td>
<td>0.00229</td>
</tr>
</tbody>
</table>

Where G/C/D = Gallons per Capita per Day

Basic Formula:

Flow in Cu. Ft./Sec. = Population x Flow(in G/C/D) / 646,317
Hydraulic Grade Line

1. Hydraulic Grade Line Limits

The hydraulic grade line for sanitary and combined sewers shall not rise above the pipe intrados.

The beginning point for the hydraulic grade line computations shall be the higher (i.e. more conservative) elevation as determined below:

For connection to existing pipe systems

a. Top of pipe intrados at least two reaches downstream of the connection point to the existing system; or

b. The hydraulic grade line computed for the existing system, especially where the downstream system has suspected or known lack of capacity issues.

Field verified structure and flowline elevations, pipe sizes and characteristics shall be used.

2. Computation Methods

Sanitary or combined sewers shall be designed to flow not more than 80% full at ultimate peak design flow conditions. The hydraulic grade line shall be computed to show its elevation at manholes, transition structures, and junction points of flow in pipes, and shall provide for the losses and the differences in elevations as required below.

a. Friction Loss

The major energy loss in a sanitary or combined sewer will be the energy loss due to friction. It is determined by the equation:

\[ hf = \text{difference in water surface elevation, or in length } L \]
\[ L = \text{length in feet of pipe} \]
\[ S_h = \text{hydraulic slope required for a pipe of given diameter and for a given roughness "n", expressed as feet of slope per foot of length} \]

From Manning's formula:

\[ S_h = \left[ \frac{(V)(n)}{(1.486 R^{0.667})} \right]^2 \]

Where:

\[ R = \text{hydraulic radius of pipe or conduit in feet} \]
\[ V = \text{velocity of flow in feet per second} \]
n = Manning's value for coefficient of roughness; where
n = .013 for concrete, vitrified clay and plastic pipe;
n = .012 for concrete pipe greater than forty eight (48) inches in diameter

b. Curve Loss

Curve loss in pipe flow is the additional head required to maintain the required flow because of curved alignment, and is in addition to the friction loss of an equal length of straight alignment. If concrete pipe, it may be evaluated from Figure 4-2 which includes an example.

c. Turn Loss

Head losses in manholes due to change in direction of flow (turns) will be determined in accordance with the following:

<table>
<thead>
<tr>
<th>Change in Direction of Flow (A)</th>
<th>Multiplier of Velocity Head of Water Being Turned (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 Deg.</td>
<td>0.7</td>
</tr>
<tr>
<td>60 Deg.</td>
<td>0.55</td>
</tr>
<tr>
<td>45 Deg.</td>
<td>0.47</td>
</tr>
<tr>
<td>30 Deg.</td>
<td>0.35</td>
</tr>
<tr>
<td>15 Deg.</td>
<td>0.18</td>
</tr>
<tr>
<td>0 Deg.</td>
<td>0.0</td>
</tr>
<tr>
<td>Other Angles</td>
<td>By Interpolation</td>
</tr>
</tbody>
</table>

Formula: \( H_L = K(V_L)^2/2g \)

Where:

\( H_L \) = Feet of head lost in manhole due to change in direction of pipe flow
d. **Junction Chamber Loss**

A sewer junction occurs for large pipes or conduits too large to be brought together in a forty two (42) inch diameter manhole where one or more branch sewers enter a main sewer. Allowances should be made for head loss due to curvature of the paths and due to impact at the converging streams.

Losses in a junction chamber for combining large flows shall be minimized by setting flowline elevations so that pipe centerlines (spring lines) will be approximately in the same planes.

At junction points for combining large flows, a manhole with a slotted or lock-down cover shall be required depending on the type of sewer.

A computation method for determining junction chamber losses is presented below:

\[
H_j = \Delta y + V_{h1} - V_{h2}
\]

Where:

- \(H_j\) = junction chamber loss
- \(\Delta y\) = change in hydraulic grade line through the junction in feet
- \(V_{h1}\) = upstream velocity head
- \(V_{h2}\) = downstream velocity head

Where:

\[
y = \frac{\left[Q_2V_2 - (Q_1V_1) + (Q_3V_3\cos\Theta_3) + (Q_nV_n\cos\Theta_n)\right]}{0.5(A_1+A_2)g}
\]

Where:

- \(Q_2\) = Discharge in cfs at the exiting conduit
- \(V_2\) = Velocity in fps at the exiting conduit
- \(A_2\) = Cross section area of flow in sq. ft. for the exiting conduit.
- \(Q_1\) = Discharge in cfs for the incoming pipe (main flow)
- \(V_1\) = Velocity of fps for the incoming pipe (main flow)
- \(A_1\) = Cross sectional area of flow in sq. ft. for the incoming pipe (main flow)
- \(Q_3, Q_n\) = Discharge(s) in cfs for the branch pipe(s)
- \(V_3, V_n\) = Velocity(ies) in fps for the branch pipe(s)
- \(\Theta_3, \Theta_n\) = The angle between the axes of the exiting pipe and the branch pipe(s)
- \(g\) = Acceleration of gravity, 32.2 ft/sec/sec.
Where:

\( \Theta \) = The angle between the axes of the outfall and the incoming pipe(s)

e. **Losses at Junctions of Several Flows in Manholes**

The computation of losses in a manhole with several flows entering the structure should utilize the principle of the conservation of energy. This involves both the elevation of water surface and momentum (mass times the velocity head). Thus, at a manhole with two or more incoming pipes, the sum of the energy content for inflows is equal to the sum of the energy content of the outflows plus the additional energy required by the turbulence of the flows passing through the structure.

**DIAGRAM:**

The upstream hydraulic grade line may be calculated as follows:

\[
H_u = \left[ \frac{V_u^2}{2g} \right] - \left[ ((Q_u/Q_d)(1-K)(V_u^2/2g)) + ((Q_{L1}/Q_d)(1-K)(V_{L1}^2/2g)) + ((Q_{LN}/Q_d)(1-K)(V_{LN}^2/2g)) \right] + H_o
\]

Where:

- \( H_u \) = Upstream hydraulic grade line in feet
- \( Q_u \) = Upstream main line discharge in cubic feet per second
- \( Q_d \) = Downstream main line discharge in cubic feet per second
- \( Q_{L1} - Q_{LN} \) = Pipe discharges in cubic feet per second
- \( V_u \) = Upstream main line velocity in feet per second
- \( V_{L1} - V_{LN} \) = Pipe velocities in feet per second
- \( V_d \) = Downstream main line velocity in feet per second
- \( H_o \) = Downstream hydraulic grade line in feet
- \( K \) = Multiplier of Velocity of Water being turned
- \( g \) = Acceleration of gravity, 32.2 ft/sec/sec

The above equation does not apply when two (2) almost equal and opposing flows, each perpendicular to the downstream pipe, meet and no other flows exist in the structure. In this case the head loss is considered as the total velocity head of the downstream discharge.
f. Transition Loss

The relative importance of the transition loss is dependent on the velocity head of the flow. If the velocity and velocity head of the flow are quite low, the transition losses cannot be very great. However, even small losses may be significant in flat terrain. The sewer design shall provide for the consideration of the necessary transitions and resulting energy losses. The possibility of objectionable deposits is to be considered in the design of transitions.

For design purposes it shall be assumed that the energy loss and changes in depth, velocity and invert elevation, if any, occur at the center of the transition. These changes shall be distributed throughout the length of the transition in actual detailing. The designer shall carry the energy head, piezometric head, and invert as elevations, and work from the energy grade line.

(1) Closed Conduits

Transitions in small sewers may be confined within a manhole. Special structures may be required for larger sewers. The energy loss in a transition shall be expressed as a coefficient multiplied by the change in velocity head \((V^2/2g)\) in which \(V\) is the change in velocity before and after the transition. The coefficient may vary from zero to one, depending on the design of the transition.

If the areas before and after a transition are known, it is often convenient to express the transition loss in terms of the area ratios and either the velocity upstream or downstream.

For an expansion:

\[ H_L = K(V_1 - V_2)^2/2g \approx K(V_1)^2/2g[1-(A_1/A_2)]^2 \]

in which \(H_L\) is the energy loss; \(K\) is a coefficient equal to 1.0 for a sudden expansion and approximately 0.2 for a well-designed transition, and the subscripts 1 and 2 denote the upstream and downstream sections, respectively, i.e., \(A_1 = \text{Area Before Transition}\) and \(A_2 = \text{Area After Transition}\).

For a contraction:

\[ H_L = K(V_2)^2/2g[(1/C_c)-1]^2 = K(V_2)^2/2g[1-(A_2/A_1)]^2 \]

in which \(K\) is a coefficient equal to 0.5 for a well-designed transition, \(C_c\) is a coefficient of contraction, and the other terms and subscripts are similar to the previous equation. Losses in closed conduits of constant area are expressed in terms of \((V^2/2g)\).

The above equations may be applied to approximate the energy loss through a manhole for a circular pipe flowing full. If the invert is fully developed, that is, semi-circular on the bottom and vertical on the sides from one-half depth up to the top of the pipe, for the expansion \(A_1/A_2 = 0.88\), and for the contraction \(A_2/A_1 = 0.88\). The expansion is sudden; therefore, \(K = 1\). The contraction
may be rounded if the downstream pipe has a bell or socket. In this case, K may be assumed to be 0.2.

The expansion energy loss is $0.014 \left(\frac{V_1^2}{2g}\right)$ and the contraction energy loss is $0.010 \left(\frac{V_2^2}{2g}\right)$. Thus it may be seen that if the invert is fully developed, the manhole loss is small.

### 3.030.08 Infiltration [See Amendment 4]

An additional amount of flow due to infiltration shall be evaluated. All sanitary sewers shall be limited to a maximum of one two hundred (100) (200) gallons per inch of diameter per day per mile of line, as required by MDNR Specifications, when tested by appropriate water of low pressure air testing. In addition, there shall be no visible leaks.

### 3.030.09 Special Situations and Design Requirements [See Amendment 4]

1. **Connections to Manholes**
   a. Foulwater drops are required only for sewers containing sanitary flow and then only when it is necessary that sanitary flow enter a manhole at a height more than two (2) feet above its flowline. If an inside drop is to be used, a forty-eight (48) inch diameter manhole is required. However, new inside drops are generally, no longer allowed. Sewer lines shall not enter the manhole in the transition conical section, or through a joint. The slope on incoming pipes should be limited to a maximum one percent (1%) for inside drops; slopes greater than this require an outside drop structure. Incoming pipe, upstream of an outside drop, should be limited to a maximum slope of 5%. Manhole inverts should be shaped to assure proper flow through drop structures. The largest size to be used for an outside drop is twelve (12) inches.

   b. If it is necessary to enter a manhole with a force main this should be done within twelve (12) inches of the flowline of the manhole, and the manhole invert should be shaped to insure proper flow through the structure. Consideration shall be given to the detention time of the sewage in the force main, and the potential detrimental effects of the release of hydrogen sulfide from the force main on the concrete structure of the manhole. Where it is determined that the release of hydrogen sulfide may be a problem, the concrete manhole shall be protected by a liner or epoxy coating. All existing manholes will have steps removed prior to the installation of any form of protective sealant, such as epoxy coatings or plastic liners. All new manholes will not have steps installed if the structure is to be sealed from H$_2$S exposure. Connection of a public force main to a manhole will require that protections for at least one manhole and possibly as many as five (5) downstream. Connection of a private forced lateral may require some similar protection.

   c. The number of sewers coming into one manhole should be kept to a minimum. A special detail may be required to assure the proper constructability and maintenance of the structure, especially for larger pipes, angled approaches or multiple incoming pipes.

   d. Pipes entering and exiting manholes at the flowline should project toward the center of the structure and the manhole invert should be shaped to assure proper flow through the structure.

   e. Private house lateral connections should be made to the main sewer, at existing wyes of record. In the absence of a wye, connect to the public sewer pipe using
another approved method, and not to the manholes unless an 8 inch private lateral connecting to an 8 inch public sewer.

f. All connections to sanitary manholes are subject to the District review and approval and will be made at the District's discretion.

g. Connections to existing structures may require rehabilitation or reconstruction of the structure being utilized. This work will be considered part of the project being proposed.

2. Adjusting Manholes to Grade

When a project requires a manhole to be adjusted to grade, a maximum of twelve (12) inches of rise is allowed if not previously adjusted. When adjustments to raise or lower a manhole are required, the method of adjustment must be stated on the project plans and approved by the District.

3. Swimming Pools

Swimming pool backwash connections to the sanitary sewer must not exceed fifty gallons per minute (50 gpm). Commercial swimming pools will require a Missouri State Operating Permit.

4. Storm Sewers Crossing Over Sanitary Sewers

When a storm pipe crosses over a sanitary sewer and the vertical clearance is less than two (2) feet, the sanitary sewer must be encased in concrete through the crossing and for ten (10) lineal feet each side of the crossing unless otherwise directed by the District.

5. Location in Conjunction with Water Service

Sanitary sewers and manholes shall be at least ten (10) feet horizontally from any existing or proposed water main. On crossings, a minimum vertical clearance of eighteen (18) inches shall be provided between the outside of the water main and outside of the sanitary sewer. MoDNR provisions for waiver will be considered on a case by case basis.

6. Sanitary Sampling Appurtenance

A sanitary sampling appurtenance (“T” or manhole) is required for non-residential, commercial, and industrial projects. A sampling appurtenance shall be located on each private building lateral, in a location readily accessible to the District personnel, downstream from any traps, interceptors or other pretreatment facilities, and before connection to the public sewer. Each sampling appurtenance shall be fitted with a cover that can readily be removed for sampling access. If a locking cover is desired for security purposes, the District’s Office of Environmental Compliance shall be provided with any keys or special tools required to remove the cover. (See sections 1.020.04 and 1.020.06, also.)

a. For all industrial projects the sampling appurtenance shall be a standard manhole in accordance with Chapter 3, Sections 3.020.10 or a similar structure which affords an equivalent degree of access for the installation of flow monitoring and sampling equipment. An industrial project is any development, which will be occupied by an “industrial user” as defined by the District’s Sewer Use Ordinance.
b. For commercial projects, the sampling appurtenance shall be a minimum of a “T” of the same diameter as the private lateral except that no sampling “T” shall be less than six (6) inches in diameter. The District may, at its discretion, require a standard manhole or equivalent structure, as described above in lieu of a sampling “T” for a commercial project.

7. **Abandonment of Sanitary Sewer Services**

Sanitary sewer laterals, from buildings to be demolished, shall be plugged with concrete unless the lateral is to be used for the replacement building. The lateral shall be plugged with concrete at the foundation wall or at the last trap leaving the building. The District need not be notified unless the lateral is being cut off or plugged at the main sewer. A detail must be provided.

8. **Private Force Main Connections**

Private force lateral main connections to the public gravity sewers will only be considered where site topography does not allow for gravity lateral service to the sanitary sewer or the gravity extension of the sanitary sewer is not feasible. See Chapter 13.1 for requirements for connecting into a public force main or a private force main extending outside its property line. Make the force connection into a public gravity sewer by one of the following two methods:

- Directly into a manhole one foot above its flowline. See Section 3.030.09.1b.
- Connect the private small diameter force main into a private 6” clean-out assembly. From the clean-out, install a 6” gravity lateral with a two percent slope into the public sewer through a wye connection.

For all properties, the operation and maintenance of private grinder pumps and their pressure laterals shall be the responsibility of the property owner.

9. **Oil/Gas Separators, Sand Filters, and Grease Traps**

If required by the District, grease, oil and sand interceptors or traps shall be provided when such devices are necessary for the proper handling of liquid wastes containing grease or oil in excessive amounts or any flammable wastes, sand, or other harmful materials which can be trapped. Such interceptors or traps shall not be required for private dwelling units. Prior to the installation of any interceptor or trap, drawings and specifications shall be submitted to the District for approval. All interceptors and traps shall be located so as to be readily accessible for cleaning and visual inspection on influent and effluent sides. An exterior location shall be the norm.

Grease and oil interceptors or traps shall be constructed of impervious materials capable of withstanding sudden and extreme changes in temperature. All such devices shall be of substantial construction, water-tight, and equipped with easily removable covers which, when bolted in place, shall be gas tight and watertight, unless otherwise approved by the District.

All grease, oil and sand interceptors or traps shall be maintained in effective operation at all times by and at the expense of the user.

10. **Coldwater Creek Gravity Elevation**

In the Coldwater Creek watershed, the elevation of the lowest gravity outlet from any building shall not be lower than U.S.G.S. Elevation 470.5.
11. **Common Lateral**

A common lateral will only be allowed for a building of same use, vertically stacked condominiums, i.e. one owned unit above a unit owned by another, all residential or commercial. For side by side, non-vertically stacked condominium units, each unit shall have its own lateral and each lateral shall be connected directly to a public sewer. In all other cases, each building shall be provided with a separate lateral sewer for each use from the building to the public or private main within the boundaries of the property line extensions. Connection of a building’s lateral to a private sewer will only be allowed where the District determines future subdividing without the District approval is highly unlikely, or structurally impossible per a building code official. Free-standing commercial leaseholds which could become outlots and any leaseholds which could be come separately owned (unstacked) will each be connected directly and separately to a public sewer. The lateral shall be installed in accordance with the local building code, and in a manner consistent with these Rules and Regulations.

12. **Private Lateral**

Where a private sanitary sewer crosses a property line it must be immediately and directly connected to a public sewer in the District easement or public right-of-way. Where the receiving public sewer is immediately across the street or alley, the private lateral may extend directly across the street or alley to it. Existing private sewers traversing multiple properties or parts of properties shall be made public upon failure of the existing private sewer or any further development of such properties and in the manner described first above. New private sewers shall not serve multiple properties beyond the property in which the private sewer originates, except where otherwise allowed in these Rules as a common lateral. A new private sewer serving two or more properties is not allowed. Legally recorded consolidation of multiple properties into one property is another acceptable method of eliminating the situation. Conversely, subdividing or other creation of multiple properties will necessitate conforming public sewers, as part of Plat and Plan approvals, to assure the availability of proper sewer maintenance and service for future owners.

Private sewers are not to utilize public easements or public right-of-ways for long distances or to cross same as long diagonals. Crossings are to be kept to a minimum, be direct and should not course in front of an adjacent owners property. Reasonable, traditional, semi-radial patterns in cul-de-sac situations and the like may be allowed, unless prohibited by another jurisdiction.

13. **Separate Laterals and Sewers**

New sewers and laterals constructed as part of all development or redevelopment within areas served by existing combined sewers shall be separated storm and sanitary systems. Combined sewers currently serving redevelopment areas shall be removed or fully grout filled and abandoned, unless suitable for recycling as public separate sewer. Construction of new combined sewers is not allowed unless approved by the District for special cases only.

If existing public combined sewers can be recycled as separate storm sewers with needed capacity, then that is more desirable. However, lining or other refurbishing or stabilization/repair may be required, especially for the very old sewers.
14. **Protection from Surcharging**

Due to sewer overcharge and water backup potential, building structures shall be protected with appropriate backflow prevention measures (i.e. approved backwater valves or strapped plumbing) as outlined in local plumbing codes.

It is noted that the District may prohibit gravity sewer service to basements in some combined sewer areas and some known problem areas served by separate sanitary sewers. In these situations a backwater valve will not suffice for surcharge protection and instead strapped plumbing shall be required as directed by the District. See most recent Figures 3-1 and 3-2.

15. **Residential Basement Garage Flooding**

Basement garages will only be allowed as directed by the District. Driveways to basement garages shall be designed whenever possible to allow for positive drainage away from the garage and to an acceptable location such as the street gutter. When sump driveways are necessary and allowed by the District, gravity drains shall be provided to intercept stormwater and discharge to an acceptable surface location or storm or combined sewer. Pumped discharge will not be allowed. Finished floor elevations of sump (basement) garages shall be a minimum of 1 foot below the lowest basement finished floor elevation and sanitary sewer floor drain elevation. The District reserves the right to deny construction of sump (basement) garages.

16. **Lateral for Commercial Use**

For mixed use buildings (example: commercial on lower floors, with residential on upper floors) separate sanitary laterals shall be provided for each “use-section” of the building (example: commercial sanitary lateral and a residential lateral). These “use-section” sanitary laterals may be connected together on private property outside the building limits and downstream of any external grease traps or sampling appurtenance.

3.040 **Sanitary Detention Requirements**

3.040.01 **Surcharged Sanitary Sewers**

When it has been determined that the outfall sewer or the downstream system serving a proposed development is overcharged, the District may require the developer to provide special facilities that the District deems necessary, for example, a sanitary holding tank (detention) for eighteen (18) hours of storage, with discharge during the off-peak hours or upgrading the downstream system to provide additional capacity.
In the design of such facilities, consideration should be given for the protection of structures and equipment against corrosive and/or explosive gasses that may result from the detention of sewage.