

CHAPTER 6

Sanitary Sewer

A. Introduction

All proposed developments, subdivisions, and buildings must have a properly designed and constructed sanitary sewer collection system. The system shall provide an adequate means of delivering sewage collected from the development to an existing sanitary sewer system.

B. Design Requirements

1. General

- a. All engineering plans and specifications shall be designed, prepared, stamped, and signed by a qualified professional engineer registered in the State of Wisconsin.
- b. The design engineer shall prepare final engineering drawings based on the requirements outlined in this document, the Oak Creek Water and Sewer Commission standards, city ordinances, and Milwaukee Metropolitan Sewerage District (MMSD) standards.
- c. All work performed and materials supplied shall conform to the Standard Specifications for Sewer and Water Construction in Wisconsin, current editions, unless otherwise specified. Any additional requirements of the MMSD and state and local plumbing codes shall also apply.

2. Service Areas

The design engineer shall design a system that accommodates the flows of the development and all tributary areas outlined in the city's ultimate service area plan.

As part of the design, adequate details shall be shown on the ultimate service area map relative to future sewer sizes, elevations, and topography. All sewer mains shall be extended to the far property boundaries for future connection.

3. Location of System Connection

The design engineer shall select the location of proposed connections to the existing sanitary sewer system with regard to the adequacy of the downstream system for the additional hydraulic loadings.

4. Sewer Design Capacity

When designing a sewer system, the sewer capacity shall be designed for the estimated ultimate tributary population. In determining the required capacities of sanitary sewers, the following factors shall be considered:

- a. Maximum hourly domestic sewage flow.
- b. Additional maximum sewage or waste flow from industrial plants.
- c. Inflow and ground water infiltration.
- d. Topography of area.
- e. Location of interceptor sewer connection.
- f. Depth of excavation.
- g. Pumping requirements, if any.

The basis of design for all projects shall accompany the engineering plans submitted to the engineer.

5. Design Formula

Sanitary sewers shall be designed to provide adequate capacity without surcharging of the design flow using Manning's formula.

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

with $n = 0.013$ and with a velocity of no less than 2.0' per second. The design flow at any point in the system shall be the total of the allowable infiltration at that point, plus sanitary sewage flow from the fully developed service area, plus any other MMSD wastes from the overall service area.

6. Design Flows

The following flow coefficients shall be used in design of sanitary sewer lines:

<u>Type of Use</u>	<u>Average Flow GAL/ACRE/DAY</u>	<u>Design Flow* GAL/ACRE/DAY (cfs/acre)</u>
Residential	1,250	9,000 (0.014)
Public	1,250	9,000 (0.014)
Commercial	3,000	18,000 (0.028)
Industrial	3,750	22,500 (0.035)

*Includes a peaking factor of 6.

Multi-family average flows used shall be 450 Gal/Unit/Day and the design flows used shall be 2,700 Gal/Unit/Day.

C. Mainline

1. All sanitary sewer systems shall be designed to flow by gravity.
2. Minimum sewer diameter for the conveyance of raw sewage shall be 8" for main sewer and 4" for service laterals.
3. Depth

Sewers should be sufficiently deep to prevent freezing. Minimum depth allowed from finished grade is 10' in residential areas, 12' in commercial and industrial areas.

Where required depth cannot be maintained, a variation can be requested from the Oak Creek Water and Sewer Utility and the City Engineer. The variation request shall address design modifications to address pipe strength and freezing issues.

4. Service risers are required where the main line sewer is greater than 12' deep to the top of the pipe. Service risers must extend to within 12' of the ground surface and connect to the main line via tee.
5. Location

All sanitary sewers are to be located in public ROW or dedicated easements.

No storm water detention facilities may be located over any sanitary sewer existing or proposed without the prior approval of the Oak Creek Water and Sewer Utility and the City Engineer. All sanitary sewers located outside the ROW must be centered in a 25' wide permanent sanitary sewer easement. If the sanitary sewer is located the same easement as another utility then the easement shall be increased to 25 feet plus the distance between the utilities. All sewers located inside the ROW but less than 10' from the lot line must have a 10' easement along the lot line. To allow utility vehicles to reach sewers in these locations, a 10' wide access route capable of supporting up to 25 tons of vehicle weight shall be provided. No curvilinear sewers are allowed. The sanitary sewer shall extend across any lot to be served. All services shall be extended to the lot line perpendicular from the mainline sewer, except in cul-de-sacs.

Additional requirements regarding location of sanitary sewers:

- a. Minimum vertical separation shall be 18" and a minimum horizontal separation shall be 8' between sanitary sewer and storm sewer. The plans shall include a method of backfilling between the pipes that will provide adequate structural support for the sewer. If less, the

sanitary sewer shall be constructed of ductile iron pipe. Whenever a storm sewer 24" in diameter or greater will cross less than 3' over a sanitary sewer, whether existing or proposed, the storm sewer shall be properly supported and a detail included as part of the construction plans.

- b. The depth of a sewer adjacent to a creek or stream must meet all regulating requirements pertaining to such crossings.
- c. Sewers located along streams shall be located outside of the stream bed and sufficiently removed to provide for future possible stream widening, and to prevent pollution by siltation during construction. Sanitary sewers shall be set back a minimum of 10' from the top of the bank of the stream when parallel. All rims shall be at least 1' above the high water elevation of the creek channel for a 100-year storm event.
- d. The sewer manholes or other structures shall be located so that they do not interfere with the free discharge of flood flows from the stream.
- e. Sewers crossing streams should be designed to cross the stream as nearly perpendicular to the stream flow as possible and shall be free from change in grade. Sewer systems shall be designed to minimize the number of stream crossings.
- f. Sewers crossing streams shall be constructed of ductile iron pipe. Backfill material for the trench shall be compacted clay backfill over the stone bedding and cover material.

6. Slope

The following are minimum slopes that should be provided, however, slopes greater than these are desirable:

Sewer Size	Minimum Percent
8"	0.45
10"	0.33
12"	0.27
15"	0.20
18"	0.17
21"	0.15
24"	0.13
27"	0.12
30"	0.11
36"	0.10

Where velocities greater than 15' per second are obtained, special provisions shall be made to protect against displacement by erosion and shock.

7. Sewer Pipe

Public sanitary sewers shall have a minimum internal diameter of 8" and shall consist of the following types:

Extra strength clay pipe	ASTM C-700
Polyvinyl chloride pipe	*ASTM D-3034
Reinforced concrete pipe and material allowed for water main construction	ASTM C-76

Non-reinforced concrete pipe, Class III ASTM C-14, shall be allowed for sewers under 12". All pipe supplied shall be in accordance with Section 6.3.0 of the Standard Specifications. Pipe installed for industrial or commercial use shall meet the coal-tar epoxy inner surface coating of Chapter 6.7.0 of the Standard Specifications. HDPE main or laterals shall have non-diameter reducing joints approved by the Utility Engineer.

** If PVC is used for sanitary sewers greater than 20' in depth, it shall be C-900 water main pipe.*

8. Alignment

Sewers shall be laid straight in both horizontal and vertical planes between manholes.

9. Sewer Size Changes

Under normal conditions when sanitary sewers of different diameters join, the invert elevations shall be adjusted to maintain a uniform energy gradient.

10. Bedding shall be provided for all sanitary sewers constructed in trench. Bedding material shall be composed of crushed stone chips in accordance with Section 6.43.2 of the Standard Specifications.

11. Excavation backfill shall be mechanically compacted in 12" lifts within the street ROW. No flushing of trenches shall be allowed. The backfill material shall be graded crushed ¾" stone per Section 6.43.7(c) of the Standard Specifications. Slurry shall be used for all existing street crossing.

12. Lift Stations and Force Mains

Whenever possible, sanitary sewage facilities shall be designed to avoid the necessity of providing pumping stations and force main.

If a lift station is part of the engineering design, it shall be shown in plan elevation. Specifications for the lift station shall be submitted with engineering plans. Lift station shall be of the dry or wet well type and shall conform in all respects to the standards established by the State of Wisconsin Department of Natural Resources or the Milwaukee Metropolitan Sewerage District. However, every reasonable effort shall be made to avoid lift stations in engineering design.

A connection for a separate source of power shall be furnished to each sewerage lift station for both auxiliary pumping and auxiliary power. An emergency alarm shall be installed to the utility master panel, located at 9325 S. 5th Avenue.

13. Protection of the Water Mains from Sewers:

a. Horizontal Separation

Sewers shall be installed at least 8' horizontally from any existing or proposed water main. The distance shall be measured edge to edge.

b. Crossings Above or Below a Water Main

- 1) Sewers crossing water mains shall be installed to provide a minimum vertical distance of 18" between the outside of the water main and the outside of the sewer.
- 2) The crossing shall be arranged so that the sewer joints will be equal distance and as far as possible from the water main joints.
- 3) The plans shall include a method of backfilling between the pipes that will provide adequate structural support for the sanitary sewer.
- 4) Where a sewer crosses over a water main, adequate structural support shall be specified by the engineer provided for the sewer to prevent damage to the water main.

c. Special Conditions

When it is impossible to obtain proper horizontal and vertical separations as stipulated above, the sewer shall be designed and constructed equal to the water pipe and shall be pressure-tested to assure water tightness.

D. Manholes

1. Manholes shall be installed:

- a. At the end of each line.
- b. At all changes in grade, size, or alignment.
- c. At all intersections.
- d. At distances not greater than 400'.
- e. On a service line as an inspection manhole.

2. All manholes shall be constructed with an outside drop connection if the sewer entering a manhole is at an elevation of 24" or above the existing or proposed sanitary sewer spring line. Inside drop connections are not permitted. Where the difference in elevation between the incoming sewer and the sanitary sewer spring line is less than 24", the incoming line shall be filleted to prevent the deposit of solids.

3. Only one connection of a service lateral to a manhole shall be permitted and only when the manhole is at the end of the line.

4. When service connection to a manhole is permitted, the service shall connect to the manhole at the spring line, or in the case of an extremely deep manhole, may be connected with an outside drop pipe discharging at the flow line of the manhole.

5. The minimum diameter of manholes shall be 42" for pipe sizes up to and including 27", 48" for a pipe size of 30", and 60" for a pipe size of 36". A minimum access diameter of 22¾" shall be provided. The cone section of all sanitary sewer manholes constructed in the city shall be of an eccentric design with the manhole opening and stairs in accordance with the Standard Specifications.

6. Manholes shall be made of precast concrete or poured in place concrete, unless otherwise directed by the City Engineer. No brick or concrete block manholes shall be permitted.

7. Inlet and outlet pipes shall be joined to the manhole with a gasketed flexible water tight connection or another water tight connection arrangement that allows minimal differential settlement of the pipe and manhole wall to take place.
8. The standard manhole frame and lid required shall be a water-tight design such as the Neenah Foundry R-1661 with a self-seal cover or similar as approved by the Utility and City Engineer. Manholes outside of the pavement limits shall be bolt-down type in accordance with File No. 32 of the Standard Specifications of Sewer and Water Construction in Wisconsin.
9. The manhole shall be set to binder grade in bituminous streets and finished grade in concrete streets. The corbel section should begin 4' below established street grade.
10. The manhole frame and lid shall be adjusted to final grade by means of precast concrete adjusting rings, or the use of adjusting rings manufactured with recycled rubber is allowed to a maximum of a 6" adjustment. Beyond that adjustment, precast concrete adjustment rings shall be used in conjunction with or as an alternative to recycled rubber adjusting rings. The individual adjusting rings shall have a maximum height of 8" and a minimum of 2" and shall be sealed with bituminous or plastic mastic to assure water tightness. The maximum chimney height shall not exceed 24" from the top of the pre-cast section to the bottom of the casting.
11. Manholes shall be set ½" below the binder grade in new installations.
12. While frame to chimney seals are required, only external seals by Adapter, Inc. or approved equal for the manholes within the street pavement or any paved area shall be permitted.

E. Laterals

1. Sewer service laterals shall be a minimum of 4" in diameter at a minimum slope of 2% and are to be connected to the sewer main at the time of construction by using a wye. Laterals 6" in diameter may be installed at a minimum slope of 1% (1/8"/ft.).

Where a sanitary sewer service line is to connect to an existing sewer main or lateral, or where specific approval has been granted by the engineer for the construction of a service line after the completion of the sewer main or lateral, the connection shall be made by one of the methods detailed below:

- a. Installation of a manhole.

- b. Hub wye saddle or a hub tee saddle in accordance with manufacturer's recommendations.
 - c. Remove an entire section of pipe and replace with a wye branch section. Pipe section shall be removed by breaking only to top of one bell. After the wye branch is inserted, concrete shall be placed over the broken area to a minimum thickness of 4" and to a dimension of 8" in all directions.
 - d. Using pipe cutter, cut desired length of pipe for insertion of proper fittings. Use "Band Seal" couplings, or similar couplings, and shear rings and clamps to fasten the inserted fitting and hold it firmly in place.
2. Test tees shall be installed for all laterals.
 3. A clay dam shall be constructed with all laterals adjacent to pavement low points.
 4. Any existing sewer lateral to be removed shall be removed at the sewer mainline, under inspection of the Utility.

F. Testing and Inspection

1. Inspection

An inspector shall be on the job site during the unloading of all materials and during construction of the sanitary sewer and laterals. The contractor is responsible for notifying the utility 24 hours before the start of construction. Contractor shall supply material certification sheets prior to unloading of any material.

2. Tests

It shall be the intention of this section to secure a sewer system with a minimum amount of infiltration.

- a. All leakage tests of sanitary sewers shall be completed in accordance with Chapter 3.7.0 of the Standard Specifications.
- b. All sanitary sewer mains shall be televised and video taped after being cleaned and manhole benches poured, tape to go to the Utility.
- c. All public improvements required by this manual and those that are to be accepted by the city for maintenance and ownership shall be inspected during the course of construction and at completion. Such

inspection may include television inspection of all new sewer installations. Videotapes of all television inspections may be required prior to the final inspection. The videotapes and reports must include footage counters for reference purposes.

- d. The contractor, without delay, shall take care of all defects and corrective work required as the result of television inspection. Upon completion, the sewer shall be retested and further inspection may be required.
- e. Sewers designed to be straight between manholes will be tested for straightness by flashing a light from manhole to manhole, lamping, or by other suitable means.
- f. PVC sewers must be deflection tested in accordance with Section 3.2.6(i)4. of the Standard Specifications.
- g. All sanitary sewer manholes shall be vacuum tested as follows:
 - 1) Sanitary sewer manholes shall be tested for leakage immediately after installation. Lift holes shall be plugged with a non-shrink grout. Inlet and outlet pipes at manholes shall be plugged, taking care to securely brace plug to avoid its being drawn into the manhole.
 - 2) Vacuum test equipment shall be placed to include the chimney rings and inflated to 40psi to effect a seal between vacuum base and structure. A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off.
 - 3) With the valves closed, time shall be measured for a vacuum drop to 9 inches of mercury. Manhole integrity is acceptable if the time exceeds 60 seconds for a 48-inch diameter manhole, 75 seconds for a 60-inch manhole, and 90 seconds for a 72-inch or larger diameter manhole.
 - 4) If the manhole fails the initial test, necessary repairs shall be made with a non-shrink grout or other acceptable and approved materials. Retesting shall continue until a satisfactory test is obtained.
 - 5) The cost of the equipment purchase or lease, materials, and labor necessary to conduct vacuum testing of manholes, and repair if necessary, shall be included in the cost of bid items for sanitary manhole construction.

G. Construction Requirements

1. Special consideration must be given to the installation of the sewer system by the contractor during the course of construction to ensure protection of adjacent areas, sewer alignment, connections, wye locations, and backfilling. The completed project must satisfy the inspection and testing requirements of the utility.
2. The contractor shall furnish and place a temporary 2" x 6" wood post, marked with green paint at the terminus of each sewer service.
3. The City Engineer shall approve any deviation, in writing, before such changes are made.
4. Revised plans or specifications shall be submitted two weeks in advance of any construction work that will be affected by changes to permit sufficient time for review and approval.
5. The construction activities shall comply to the Standard Specifications and General Specifications.
6. All sanitary manholes within new roads shall initially be set 2" below final grade and brought up to final grade with a 2" steel adjusting ring at the time of final asphalt surfacing.