

## 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 and licensed professional engineer in the State of Wisconsin.
  - b. The design engineer shall prepare final engineering drawings based on the requirements outlined in this document plus other City ordinances and the Standard Specifications.
  - 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 state and local plumbing codes shall also apply.
2. Service Areas
  - a. 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.
  - b. 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
  - a. 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

- a. 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:
- 1) Maximum hourly domestic sewage flow.
  - 2) Additional maximum sewage or waste flow from industrial plants.
  - 3) Inflow and ground water infiltration.
  - 4) Topography of area.
  - 5) Location of interceptor sewer connection.
  - 6) Depth of excavation.
  - 7) Pumping requirements, if any.
- b. The basis of design for all projects shall accompany the engineering plans submitted to the engineer.

5. Design Formula

- a. 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 a velocity of no less than 2.0 feet 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.

6. Design Flows

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

n = Manning's Roughness Coefficient

CMP	→	n = 0.024
Cast Iron	→	n = 0.013
Concrete	→	n = 0.013
VCP	→	n = 0.013
PVC	→	n = 0.0011

7. Tracer Wire

Refer to the City of Manitowoc Standard Specifications for Public Works Construction Section 400

**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
  - a. Sewers should be sufficiently deep to prevent freezing and to facilitate connections to properties. Minimum depth allowed from finished grade is 10' in residential areas, 12' in commercial and industrial areas, and 6' for service laterals with prior permission from the Engineer.
  - b. For pipe depths less than 6' or greater than 20 feet, pipe shall be cast iron, ductile iron, thick-walled PVC (SDR-26).
  - c. Insulation shall be provided for sewers that do not meet the minimum depth requirements unless this requirement is waived by the Engineer due to exceptional flow.
4. Service risers are required where the main line sewer is greater than 14' deep to the top of the pipe. Service risers must extend to within 12' of the ground surface. Risers shall be placed at 45 degree angle.
5. Location
  - a. All public sanitary sewers are to be located in public ROW or dedicated easements. The City Engineer will not allow public sanitary sewers in private streets without specific written permission. This approval will only be granted in rare circumstances.
  - b. No storm water detention facilities may be located over any sanitary sewer existing or proposed. All sanitary sewers located outside the

ROW must be centered in a 20' wide permanent sanitary sewer easement. Sanitary sewers located deeper than 14 feet shall have a 30-foot easement. All sewers located inside the ROW but less than 10' from the lot line must have a 10' easement along the lot line. No curvilinear sewers are allowed. The sanitary sewer shall extend across any lot to be served.

- c. Additional requirements regarding location of sanitary sewers:
- 1) Minimum vertical separation shall be 18" and 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, otherwise, 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.
  - 2) The depth of a sewer adjacent to a creek or stream must meet all regulating requirements pertaining to such crossings.
  - 3) 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 set to match existing grade for high water elevation of the creek channel for a 100-year storm event. Castings shall be bolted down with stainless steel bolts, watertight, Neenah type R-1916-C or as approved by the Engineer.
  - 4) 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.
  - 5) 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.
  - 6) Sewers crossing streams shall be encased in a casing. Backfill material for the trench shall be stone, course aggregate, washed gravel, or other materials that do not cause siltation.

6. Slope

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

Sewer Size	Minimum Percent	With City Engineer's Prior Approval
8"	0.40	---
10"	0.33	0.28
12"	0.27	0.22
15"	0.20	0.15

Sewer Size	Minimum Percent	With City Engineer's Prior Approval
18"	0.17	0.12
21"	0.15	0.10
24"	0.13	0.08
27"	0.12	0.067
30"	0.11	0.058
36"	0.10	0.046

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

7. Sewer Pipe

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

Polyvinyl chloride pipe	ASTM D-3034
Reinforced concrete pipe and material allowed for water main construction	ASTM C-76

- b. Non-reinforced concrete pipe, Class III ASTM C-14, shall be allowed for sewers under 12". All pipe supplied shall be in accordance with the

Standard Specifications. Pipe installed for industrial or commercial use shall meet the coal-tar epoxy inner surface coating as detailed in the Standard Specifications.

8. Sewers shall be laid straight in both horizontal and vertical planes between manholes.
9. Under normal conditions, when sanitary sewers of different diameters join, the invert elevations shall be adjusted to maintain a uniform energy gradient. (Top of pipes to match.)
10. Bedding shall be provided for all sanitary sewers constructed in trench. Bedding material shall be stone chips in accordance with the Standard Specifications.
11. Excavation backfill shall be mechanically compacted in 12" lifts within the street ROW or flushing of trenches shall be permitted when approved by the City Engineer. Native backfill will be allowed if approved by the Engineer for appropriate soils.
12. Lift Stations and Force Mains
  - a. Whenever possible, sanitary sewage facilities shall be designed to avoid the necessity of providing pumping stations and force main. It may be necessary for an owner to wait a long period of time before a gravity interceptor is constructed to service otherwise developable lands. Interest in such interceptors should be expressed to the City Engineer far in advance of the year in which development is contemplated to begin. In any event, lift stations shall only be permitted by permission of the Engineer. No guarantee of approval is suggested by the following. The cost for the lift station and force main typically will be borne by the requesting party.
  - b. If a lift station is part of the engineering design, it shall be shown in plan elevation. Detailed design and specifications for said lift station shall be submitted with engineering plans. Lift station design 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. However, every effort shall be made to avoid lift stations in engineering design. The design shall incorporate basin wide considerations.
  - c. Two separate sources of power shall be furnished to each sewerage lift station. They shall be from both the MPU grid and another electrical source provided by a separately powered engine. Engine enclosure

and mounting shall be subject to approval by the Engineer. The City has its existing lift stations interconnected by a SCADA system. An additional requirement of this section shall be that any newly constructed lift station also be interconnected. The City Engineer will supply the specifications for such an interconnect and the cost shall be borne by the developer.

13. Protection of the Water Mains from Sewers:

a. Horizontal Separation

- 1) 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, which 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

- 1) 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 sewer main intersections.
  - d. At distances not greater than 400' (350' maximum preferred).
  - 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 more, 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. The connection of a service lateral to a manhole shall only be permitted under the following conditions:
    - a. When the manhole is at the end of the line.
    - b. With prior permission from the City Engineer (typically allowed for large laterals in industrial applications).
  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 a minimum of 48" for pipe sizes up to and including 30", and 60" for a pipe size of 36" and larger (very large sewer mains will require custom structures). A minimum access diameter of 21" 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 pre-cast concrete or poured in place concrete, unless otherwise directed by the City Engineer. No brick or concrete block manholes shall be permitted. All manholes shall be waterproofed on the exterior surface in a manner approved by the City Engineer. A mastic seal or equal shall be used between precast sections and between concrete rings.
  7. Inlet and outlet pipes shall be joined to the manhole with a gasket type flexible water-tight connection or another water tight connection arrangement that allows differential settlement of the pipe and manhole wall to take place without compromising the seal.

8. The standard manhole frame and lid required shall be a water-tight design such as the Neenah Foundry R-1550 with a self-seal cover or similar as approved by the City Engineer. Manholes outside of the pavement limits shall be bolt-down type in accordance with the Standard Specifications of Sewer and Water Construction in Wisconsin.
9. The manhole shall be set to binder grade in asphalt streets and finished gravel grade in concrete streets.
10. The manhole frame and lid shall be adjusted to final grade by means of pre-cast 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, pre-cast 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 4" 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 12" from the top of the pre-cast section to the bottom of the casting.
11. All manholes in field or easement areas shall be marked with a steel channel post extending 4' (feet) above grade. The steel post shall also have a reflective marker attached to the top of the post.

#### **E. Laterals**

1. The location of the sanitary lateral shall be in accordance with File #50 of the Standard Sewer Specifications and the lateral shall extend to two feet beyond the street Right-of-Way or to the property side of a utility easement.
2. Sewer service laterals shall be a minimum of 4" in diameter at a minimum slope of 2% (1/4" per foot) and are to be connected to the sewer main at the time of construction by using an in line wye.
  - a. Where a sanitary sewer service line is to be connected 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:
    - 1) Installation of a manhole.
    - 2) Hub wye saddle in accordance with manufacturer's recommendations.

- 3) Using pipe cutter, cut desired length of pipe for insertion of proper fittings. Use fernco couplings, or similar couplings, and shear rings and clamps to fasten the inserted fitting and hold it firmly in place.
- 4) Sanitary lateral shall not extend more than 1" into mainline pipe.

## **F. Testing and Inspection**

### 1. Inspection

- a. A full-time 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 City Engineer 48 hours before the start of construction (in the case where construction ceases, the Contractor shall notify the inspector with a minimum of 24 hours before restarting operations). Contractor shall supply material certification sheets prior to unloading of any material.

### 2. Tests

- a. It shall be the intention of the City to secure a sewer system with a minimum amount of infiltration. All leakage tests of sanitary sewers shall be completed in accordance with the Standard Specifications.
- b. Subsequent to the construction of the sanitary sewer, the City Engineer will require television inspection and videotaping of all sections of the sewer. The videotapes and reports must include footage counters for reference purposes. This shall be performed at no cost to the City. No acceptance will be granted until the videotaping is completed.
- 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.
- d. All defects and corrective work required as the result of television inspection shall be remediated by the contractor without delay. Upon completion, the sewer shall be retested and further inspection may be required.
- e. PVC sewers must be deflection tested by visual examination via videotape and by use of a mandrel.

## **G. Construction Specifications**

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.
2. The Contractor shall mark the end of each sanitary lateral pipe with a 3' (foot) long wood 2"x4" and a 24" long #4 Rebar. The rebar shall be attached to the 2"x4".

For vacant lots, the Contractor shall mark the end location of the sanitary lateral at grade with a wood 2"x4". The 2"x4" shall extend a minimum of 3' (feet) below grade and a minimum of 2' (feet) above the existing ground grade. The 2"x4" shall be painted green.

3. Any deviation from the approved plans, specifications or these guidelines shall be approved, in writing, by the City Engineer, 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 (exceptions will be made for emergencies, however, lack of planning does not constitute an emergency).