

Section 1 – General Information

1.1 Introduction

Sanitary Sewer Systems are essential to the public health and welfare in areas of concentrated population and development. The Sanitary Sewer system collects and conveys wastewater to points of approved discharge or disposal. Uniform and adequate sanitary sewer design criteria is essential for public safety and proper wastewater treatment, maintenance and control.

1.2 Conditions

1. Design

- A. The design for sanitary facilities shall conform to the following:
- B. Requirements of the Iowa Department of Natural Resources.
- C. "Recommended Standards for Sewage Works Great Lakes-Upper Mississippi River Board of State Sanitary Engineers". (Ten State Standards).
- D. Design Standards Manual.
- E. In case of a conflict between the above standards, the more restrictive requirement shall apply.

2. Construction Standards

Construction standards shall be the most recent revision of the Cedar Rapids Metropolitan Area Standard Specifications and Details and the Jurisdiction's plumbing code.

3. Project Submittals

Construction Permit

A construction permit issued by the DNR or local jurisdiction is required for the construction, extension or modification of any sanitary sewer system. A local jurisdiction with permitting authority may issue permits for systems that primarily serve residential customers and fewer than 250 dwelling units in the ultimate sewer service area.

Permit applications shall include a sanitary service area map. This map shall include existing contours and delineated area that can be drained by gravity to the proposed sanitary sewer. Possible force mains from areas not draining by gravity to the proposed sanitary sewer do not need to be

considered except where the need is previously determined by the project engineer or Jurisdiction.

A construction permit shall not be required for the following sewers:

- A. Storm sewers that transport only surface water runoff.
- B. Any new disposal system or extension or addition to any existing disposal system that receives only domestic wastewater from a building or housing occupied by fifteen persons or less.
- C. Replacement of previously approved construction where the replacement is done with substantially the same slope, capacity and elevations. However, if there is any change in any of the design elements noted herein, the proposed construction will require a construction permit.
- D. Sanitary sewer service connections less than eight inches in diameter, defined as any connection from a single property unit to an existing sanitary sewer.

The following engineering services are required to obtain a construction permit and complete the approved construction:

- A. Certified Engineering report or facilities plan (not required for minor sewer extensions).
- B. Certified improvement plans and specifications.
- C. Construction inspection, administration, compliance and acceptance.

Some or all of the services noted above may be provided by the local jurisdiction in some cases.

Unless permits are being issued by the local jurisdiction, engineering reports or facilities plans shall be submitted to the IDNR at least 90 days prior to the date upon which acceptance is desired, or in accordance with the Iowa Operation Permit or other schedules. The final plans and specifications should not be prepared until the engineering report has been approved. This enables the IDNR to review the concept and design, make comments, and indicate to the applicant the general acceptability of the proposal before additional expenses are incurred for developing final plans and specifications. After the engineering report has been approved, the final plans and specifications shall be submitted. Any changes from the approved report must receive prior approval from the IDNR before incorporation into the plans and specifications.

Section 2 – Flow Determination

2.1 Sanitary Sewers

1. Discharge (Q) Average Daily Flow (Minimum)

Equation 1: Area x Area Density x Rate = Average Daily Flow

Equation 2: Number of Units x Unit Density x Rate = Average Daily Flow.

2. Discharge (Q) Peak Sewer Flow (Minimum)

Average Daily Flow x Ratio of Peak to Average Daily Flow

$$\text{Ratio of Peak to Average Daily Flow} = \frac{18 + \sqrt{P}}{4 + \sqrt{P}}$$

where P = population in thousands
population values are to be based on the area which discharges into the sewer

3. Design Density and Rate - See Table 3.1
4. Estimated BOD₅ for construction permit application = 0.17 lb/person/day

2.2 Infiltration and Inflow

The design capacity of a proposed sewer system shall include a reasonable allowance for infiltration and inflow. The design infiltration shall be 200 gal/day/mile/inch of pipe diameter

2.3 Density Table

Land use designations shall be according to the current comprehensive land use plan. If existing land uses provide greater contributions to the design flow than the land use noted in the comprehensive land use plan, the existing land use shall be used.

Table 3.1 Minimum Values			
<u>LAND USE</u>	<u>AREA DENSITY</u>	<u>UNIT DENSITY</u>	<u>RATE</u>
Low Density (Single Family) Residential	10 people/Ac.	3.3 people/unit	100 gpcd*
Medium Density (Multi-Family)	12 to 15 people/Ac.	3.3 people/unit 6.0 people/duplex	100 gpcd*

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Residential			
High Density (Multi-Family) Residential	20 to 75 people/Ac.	2.5 people/unit	100 gpcd*

If the Design Engineer uses values different than the above table, approval by the Jurisdictional Engineer is required.

Office & Institutional	5,000 gpd/AC (IDNR)	Special Design Density	
Commercial	5,000 gpd/AC (IDNR)	Special Design Density	
Industrial	10,000 gpd/AC (IDNR)	Special Design Density	

* Department of Natural Resources (DNR) - Dry Weather Flow - One hundred gallons per capita per day (gpcd) shall be used in design calculations as the minimum average dry weather flow. This 100 gpcd value may, with adequate justification, include maximum allowable infiltration for proposed sewer lines.

2.4 Special Design Densities

Special design densities shall be subject to approval by the Jurisdictional Engineer based on methodology provided by the Design Engineer.

Section 3 – Facility Design

3.1 Capacity of Pipe

Pipe sizes 15" and smaller shall carry the peak flow at a depth no more than 0.67 of the pipe diameter. Pipe sizes greater than 15" shall carry the peak flow at a depth of no more than 0.75 of the pipe diameter. To calculate 0.67 full and 0.75 full, multiply the full flow values by 0.79 and 0.91 respectively.

3.2 Velocity Within Pipe

Minimum at peak flow = 2 fps

Maximum at peak flow = 14 fps

When this value is exceeded, special measures shall be taken to dissipate energy. These measures shall be reviewed and approved by the Jurisdictional Engineer.

3.3 Pipe Materials

For detailed specifications of pipe materials and installation requirements, the

Design Engineer should reference The Metro Area Construction Specifications.

3.4 Design Formula

In the design of pipe systems flowing part full or under a slight surcharge, Manning's equation shall be used to determine flow rate and velocity. The roughness coefficient for all types of pipe shall be 0.013.

3.5 Force Mains

Force main design shall be based on the Colebrook or Hazen-Williams equation and shall provide a minimum velocity of three feet per second.

3.6 Minimum Slope

Minimum pipe slope shall be the greater of the below table value or slope that provides a minimum 2 fps peak flow velocity for the upstream service area.

Sewer Size:	Minimum Slope (ft./100 ft.)
8"	0.400
10"	0.300
12"	0.220
15"	0.150
18"	0.120
21"	0.100
24"	0.090
27"	0.080
30"	0.080
36"	0.080

3.7 Pipe Size

Public gravity sanitary sewer mains shall not be less than 8" diameter. The pipe diameter and slope shall be selected to obtain the greatest practical velocities to minimize settling problems. Oversized sewers should not be used to justify flatter slopes. Minimum size of building sanitary sewer service line or stub shall be 4". The size of services will increase based on the proposed number of fixtures that the sewer stub serves.

3.8 Crossings and Clearances

1. Storm Sewers

Sanitary sewer crossings of storm sewers shall have no less than 6 inches of clearance. Special structural support will be required if there is less than

18 inches clearance. The minimum horizontal clearance shall be 5 feet. Clearance refers to the distance from the outside of the sewer pipe to the outside of the storm sewer pipe.

2. Water Supplies as stated in IDNR rules:

A. "Wells: Sewers constructed of standard sewer materials shall not be laid within 75 feet of a public well or 50 feet of a private well. Sewers constructed of water main materials may be laid within 75 feet of a public well and within 50 feet of a private well but not closer than 25 feet to either."

B. "Horizontal Separation of Gravity Sewers from Water Mains: Gravity sewer mains shall be separated from water mains by a horizontal distance of at least 10 feet unless:"

1) "the top of a sewer main is at least 18 inches below the bottom of the water main, and"

2) the sewer is placed in a separate trench or in the same trench on a bench of undisturbed earth at a minimum horizontal separation of 3 feet from the water main. When it is impossible to obtain the required horizontal clearance of three feet and a vertical clearance of 18 inches between sewers and water main the sewer shall be constructed of water main materials meeting both a minimum pressure rating of 150 psi and the requirements of Sections 8.2 and 8.4 of the 'Iowa Standards for Water Supply Distribution Systems'. However, a linear separation of at least 2 feet shall be provided."

C. "Separation of Sewer Force Mains from Water Mains"

Sewer force mains and water mains shall be separated by a horizontal distance of at least 10 feet unless:"

1) "the force main is constructed of water main materials meeting a minimum pressure rating of 150 psi and the requirements of Section 8.2 and 8.4 of the 'Iowa Standards for Water Supply Distribution Systems' and"

2) "the sewer force main is laid at least 4 linear feet from the water main."

D. "Separation of Sewer and Water Main Crossovers"

Vertical separation of sanitary sewers crossing under any water main

should be at least 18 inches when measured from the top of the sewer to the bottom of the water main. If physical conditions prohibit the separation, the sewer may be placed not closer than 6 inches below a water main or 18 inches above a water main. The separation distance shall be the maximum feasible in all cases.

When the sewer crosses over or is less than 18 inches below a water main one full length of sewer pipe of water main material shall be located so both joints are as far as possible from the water main. The sewer and water pipes must be adequately supported and have watertight joints. A low permeability soil shall be used for backfill material within 10 feet of the point of crossing."

E. "Exceptions"

Should physical conditions exist such that exceptions to Sections 3.8.2.B, 3.8.2.C, and 3.8.2.D, of this standard are necessary, the design engineer must detail how the sewer and water main are to be engineered to provide protection equal to that required by these sections."

3. Sewer Crossing Under Waterway as Stated in IDNR Rules:

"The top of all sewers entering or crossing streams shall be at a depth below the natural bottom of the stream bed sufficient to protect the line. One foot of cover over the top of the line is required where the sewer is located in rock or cased and three feet of cover is required in other material. In major streams, more than the three feet of cover may be required.

In paved channels, the top of the sewer line should be placed below the bottom of the channel pavement. Sewer outfalls, headwalls, manholes, gate boxes, or other structures shall be so located that they do not interfere with the free discharge of flood flows of the stream. Sewers located along streams shall be located outside of the stream bed.

Sewers entering or crossing streams shall be constructed of cast or ductile pipe with mechanical joints or shall be so otherwise constructed that they will remain water tight and free from changes in alignment or grade. Sewer systems shall be designed to minimize the number of stream crossings. The stream crossings shall be designed to cross the stream as nearly perpendicular to the stream flow as possible. Construction methods that will minimize siltation shall be employed. Material used to backfill the trench shall be stone, coarse aggregate, washed gravel, or other materials which will not cause siltation.

Upon completion of construction, the stream shall be returned as near as

possible to its original condition. The stream banks shall be seeded and planted, or other methods employed to prevent erosion. The design engineer shall include in the project specifications the method or methods to be employed in the construction of sewers in or near streams to provide adequate control of siltation."

4. Aerial Crossings as Stated in IDNR Rules:

"Support shall be provided at all joints in pipes utilized for aerial crossings. The supports shall be designed to prevent overturning and settlement.

Precautions against freezing, such as insulation and increased slope, shall be provided. Expansion jointing shall be provided between above-ground and below-ground sewers.

For aerial stream crossings the impact of flood waters and debris shall be considered. The bottom of the pipe should be placed no lower than the elevation of the 50 year flood".

3.9 Depth of Sewer

Sanitary sewer services shall be constructed at a sufficient depth to provide three feet between the basement finish floor and the top of the sewer service pipe. The design shall provide for a 2 percent slope for sewer services. In no case shall a sanitary sewer service be assumed to have a slope less than 1 percent. The sewer service shall be well below the frost line in all cases and lower than any water lines placed in the same street. Insulation shall be provided for all sewers that cannot be placed at a depth sufficient to prevent freezing. For sewers greater than 12 feet in depth as measured at the building lines, risers shall be installed on service stubouts. In no case shall the depth of a sewer exceed the maximum depth recommended by the pipe manufacturer.

3.10 Sewer Alignment

The horizontal and vertical alignment of sewers less than 24" in diameter shall be uniform between manholes.

3.11 Manholes

1. Access to Manholes – Manholes in street right of way must be located at street centerline. Manholes shall not be located in the wheel tracks of a driving lane. Manholes located outside street right of way shall be subject to the approval of the Jurisdictional Engineer.
2. Location – Manholes shall be installed at the end of each sewer line, at all changes in pipe size, grade or alignment and all public sewer system

connections. The manhole shall be placed over the centerline or the pipe or on an offset not to exceed 12 inches.

3. Standard Manhole Size – A minimum of 48" diameter manhole is required for sanitary sewers 30" in diameter and smaller.
4. Special Manholes – For square or rectangular manholes, the manhole openings should be over the centerline of the pipes or on an offset not to exceed 12 inches. The distance from the centerline of the manhole opening to the face of the inside manhole wall shall not exceed 30 inches to better facilitate T.V. inspection and maintenance equipment. This may require more than one manhole opening.
5. Maximum Manhole Spacing shall be 400'. On large diameter sewers, the manhole spacing may be modified by the Jurisdictional Engineer. Jurisdictions may require reduced spacing due to maintenance constraints.
6. Minimum Manhole Flowline Drop

Change in alignment - 0° to 45° - 0.10 ft

Change in alignment across manhole – greater than 45° - 0.10 ft. (min.), 0.25 ft. (preferred)

Change in pipe size – match eight-tenths full points.
7. Drop manholes should be avoided when possible. If it cannot be avoided, external drop manholes may be constructed with the approval of the Jurisdictional Engineer.
8. Manhole Frames and Covers

Bolt-down covers and frames are required on manholes subject to inundation such as flood plains, detention areas, manholes outside the street and storm water easement areas subject to "major storms".

3.12 Sewer Services

1. Connections to Manholes

Individual services will not be connected to a manhole unless at terminal manholes which cannot possibly be extended in the future. Service line connections to manholes require approval from the Jurisdiction. The services may not enter the manhole at greater than two feet above the invert of the outlet. Sewer flow channels in the manhole bottom must be provided for all services.

2. Regular Services

- A. Each structure should be served by a separate service line connected to a public or private sanitary lateral sewer. The service should be perpendicular to the lateral sewer line where possible, with wye connections to the public sewer.
- B. Sewer services across one lot to provide service to an adjacent lot in a proposed subdivision should be avoided. If condition exists that requires crossing of an adjacent lot, the following conditions must be met:
 - 1) Proposed subdivision does not exceed two lots.
 - 2) A private utility easement 10 feet in width is provided across the adjacent lot (to be occupied by sewer service only).
 - 3) The Jurisdictional Engineer determines that a sewer main extension will not be necessary to perpetuate the system and in all likelihood no future developing of abutting properties will benefit from a main extension.

3.13 Lift Stations

Lift station design shall include a duplex pump system with each pump having the capacity to pump the design peak flow. The alarm system shall include telemetry to the monitoring jurisdiction, site audible and possible alarms. A stand by power generating set shall be provided with an automatic transfer switch in the event of a power outage. The wet well shall be sized for the recommended minimum pump run time and in accordance with AWWA standards for wet well design.

3.14 Siphons

Sanitary sewer siphons shall be avoided and will only be accepted where no feasible alternative exists and where there will be sufficient flow in the sewer so that maintenance will be held to a minimum. All siphons shall have a minimum of two barrels with a minimum pipe size of 6" diameter. Design provisions shall be made for diversion of normal flow to either barrel for maintenance. Sufficient head shall be provided to insure velocities of at least three feet per second for average flow.

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