Design Standard

Wastewater

May 2022

City of Regina | REGINA Infinite Horizons

Contents

1. General

1.1. Introduction

1.1.1. The wastewater collection system's objective is to safeguard public health and minimize the impact on the environment by collecting wastewater generated within the City of Regina for treatment and disposal at the municipal wastewater treatment plant.

1.1.2. The system's environmental aspect is to prevent untreated wastewater from escape or discharge to the environment, such as watercourses or onto public or private lands, either directly or through overflows to the stormwater system.

1.1.3. The Wastewater Design Standard should be used in conjunction with the General Design standard and the guiding documents listed below.

1.1.4. This design standard shall be used in the design of city wastewater systems.

1.1.5. Acts, bylaws, regulations and standards are referred to, and they shall be current, amended and updated issues.

1.1.6. It shall be the designers' responsibility to be aware of the statutory requirements governing such works and comply with those requirements. The listing provided below is for guidance. Other statutory instruments not included here may be applicable.

1.2. Reference Documents

1.2.1. All related references are noted in Design Standard: General Information.

1.3. Definitions

1.3.1. All definitions are noted in Design Standard: General Information.

2. Preliminary Design

2.1. Introduction

2.1.1. New development shall not reduce the existing collection system's service level below the minimum city service level as defined in this document's Level of Service section.

2.1.2. Private sanitary storage systems, including but not limited to septic and holding tanks, are not standard within the City.

2.1.3. New sewers are to be designed for anticipated flows from land-use zoning shown in the Official Community Plan.

2.1.4. Wastewater flow rates shall be determined from consideration of the present and probable future quantities of wastewater and commercial and industrial wastes and appropriate allowances for wet weather infiltration.

2.1.5. The City promotes an orderly progression of development and extension of wastewater collection systems. The objective is to achieve permanent system extensions in the most cost-effective manner. Temporary servicing schemes are not permitted where a permanent solution is feasible. Staging of connecting sewers through undeveloped areas ("leapfrogging") shall be avoided whenever possible.

2.2. Design Requirements

2.2.1. The expected design life of new sewers in Regina is 100 years.

2.2.2. Drainage runoff from roofs, lots, streets and other outside areas, including yards and parking areas, are excluded from the wastewater collection system.

2.2.3. Types of Wastewater that the wastewater collection system shall be designed to accept and convey waste liquid flows from:

2.2.3.1. Domestic wastewater from residential developments;

2.2.3.2. Commercial and Institutional developments, when compatible with residential wastewater; and
2.2.3.3. Industrial developments, where wastewater strengths, rates and discharge times are approved.

2.2.4. Weeping tile drainage shall be excluded from the wastewater collection system.
2.2.5. Extension of wastewater servicing using gravity flow systems to the maximum extent possible is preferred.
2.2.6. Alternative servicing considerations:

2.2.6.1. Life-cycle costs evaluations for alternatives must include operation, maintenance as well as capital cost.
2.2.6.2. Minimization of the life-cycle costs is a prime consideration in the selection of servicing alternatives.
2.2.6.3. Economics will not necessarily be the deciding factor in the evaluation of the acceptability of alternatives.
2.2.6.4. Utilization of pumping systems may be permitted only when sufficient grade is not available to allow for a gravity flow system.

2.3. Level of Service

2.3.1. No additional or new properties will be added to the "at-risk" areas due to any new development. Properties are considered to be "at-risk" if the sanitary sewer's surcharging occurs to a level less than 1.83 metres below the maintenance hole rim for the design peak flow rate. This shall be demonstrated through the use of the City's Wastewater model (InfoWorks ICM).
2.3.2. The City will accept solutions that provide for maintaining this level of service when considering new development.

2.4. Hydraulic Network Analysis

2.4.1. Computerized modelling shall be used when there is a need to assess the system dynamically. Flowsheets can be utilized to size mains assuming free-flow conditions.
2.4.2. Computerized modelling shall supersede Flow Sheets.
2.4.3. Computerized modelling shall use InfoWorks ICM® by Innovyze Inc®.
2.4.4. The City of Regina will provide an InfoWorks ICM® base model for analysis and design considering system-wide implications.
2.4.5. Projected wastewater flows shall be distributed throughout the system per the proposed development adjacent to each node.

2.5. Estimated Wastewater Flows

2.5.1. The average daily wastewater flow used in residential areas is 225 litres per capita per day.
2.5.2. Where available, detailed area design population densities shall be used.
2.5.3. In the absence of detailed design population projections, densities are obtained as follows:

Table 1: Design Population Table

Design Population Table	
Zoning	**Population**
Single Family Residential	3.3 persons/unit
Multi-Family Residential	2.3 persons/unit

High Rise Residential	235 persons/hectare
Commercial, Mixed*	65 persons/hectare
Institutional*	50 persons/hectare
Industrial*	25 persons/hectare
***Consideration will be given to alternate populations, provided alternative populations can be demonstrated to the City's satisfaction.**	

2.5.4. The average daily wastewater flows used in the design in all other areas shall be 454 litres per capita per day.

2.5.5. The wastewater flow shall be derived using the Wastewater Flow Formula.

Figure 1: Wastewater Flow Formula

$$Q = \frac{FDMA}{K} + I$$

Where

Q = the wastewater flow in litres per second

F = the average daily per capita water consumption in litres per capita

D = the population density in persons per hectare

M = the Harmon Peaking Formula (unitless)

A = area in hectares

K = a constant (86,400)

I = infiltration in litres per second

2.5.6. Peak dry weather flow is established by multiplying the average daily flow with a peaking factor. The peaking factor used is determined from the Harmon Formula.

Figure 2: Harmon Formula

$$M = 1 + \frac{14}{4 + \sqrt{P}}$$

Where:

P = population in thousands

2.5.7. The wastewater collection system and associated wastewater facilities are designed to convey a design peak flow rate equal to the sum of the peak dry weather flow, inflow/infiltration, and other unavoidable contributions.

2.5.8. The pipe capacity used in the design of all sewers is determined from the Manning equation using an appropriate roughness coefficient where:

2.5.8.1. n = 0.013

Figure 3: Manning Formula

$$Q = VA = A\frac{1}{n}R^{\frac{2}{3}}S^{\frac{1}{2}}$$

Where:

Q = flow in cubic metres per second

n = Manning's Roughness Coefficient

R = Hydraulic Radius in metres (cross-section area divided by the wetted perimeter)

S = Slope in metres of rise over metres of run.

A = Cross Section Area in square metres

2.6. Extraneous Flow Allowance

2.6.1. The total peak flow rates of the wastewater collection system shall include allowances as specified below to account for inflow/infiltration flow from extraneous sources based on a 1 in 25-year wet weather event:

2.6.2. An allowance of 31,100 litres per hectare per day shall be applied:

2.6.2.1. Irrespective of land use classification,

2.6.2.2. To account for wet-weather infiltration to the wastewater collection system, and

2.6.2.3. Including inflow from weeping tiles in buildings that are draining to the wastewater system;

2.6.2.4. Including infill development where the absence of interconnections cannot be demonstrated or;

2.6.3. An allowance of 21,000 litres per hectare per day shall be applied:

2.6.3.1. Irrespective of land use classification,

2.6.3.2. To account for wet weather infiltration to the wastewater collection system, and

2.6.3.3. For all new development where weeping tile discharge is excluded from the wastewater system as outlined in *The Wastewater and Storm Water Bylaw 2016.*

2.7. Capacity Assessment and Downstream System

2.7.1. The Wastewater Master Plan, Secondary Plans and Concept Plans identify concerns related to the downstream receiving system's available capacity. Where a capacity deficiency has been identified, the Designers and the City will jointly resolve the issue.

2.7.2. Where downstream capacity deficiencies have been identified, and there is a known, financed, and planned solution, the Designers and the City will discuss risk and reasonable timing of the development.

2.7.3. Consideration will allow new development to proceed based on the storage of wastewater flows, which will then be released after surcharging in the downstream system has subsided. Designers shall model storage elements to support the design and determine the change in performance to the existing system to assess the level of service impact.

2.7.4. Storage elements shall be sized to prevent the addition of "at-risk" properties throughout the City due to any new development.

2.7.5. Storage elements shall be sized through modelling of the Citywide wastewater network. Storage elements shall be designed with odour control measures. Specific operation and maintenance considerations shall be determined based on consultation with the City.

2.8. Trunk Mains

2.8.1. Sanitary sewer mains contribute to flows.
2.8.2. Direct service connections are not permitted to trunk sewer mains.

2.9. Preliminary Trunk and Sewer Location and Sizing

2.9.1. Design allowances shall be made for future development areas in consultation with the City.
2.9.2. Secondary Plans and Concept Plans identify areas for future expansion and outline required trunk main design flows, pipe sizes and routing.
2.9.3. Flows from proposed developments shall be modelled to support the design and determine the change in performance to the existing system to assess the impact.

2.10. Requirements of Stubs for Future Extensions

2.10.1. The design for each wastewater collection system extension shall include provision for further extensions adjacent to and future development areas per the Official Community Plan and Area Plans (Secondary and Concept), as they apply to each development area.

3. Detailed Design

3.1. Introduction

3.1.1. All sewers, maintenance holes and appurtenances shall be designed for superimposed live, dead, and surcharge loads (where applicable). In areas of high groundwater, uplift shall also be considered.

3.2. Mains - Sizing

3.2.1. All new wastewater collection systems shall be designed to have hydraulic capacity such that the sewer is flowing at no more than 80% of the full depth when conveying the design peak flow rate.
3.2.2. Wastewater collection systems are designed to carry the design flow at a flow depth of 80% of the sewer diameter. This results in a flow rate of approximately 86% of the sewers' full flow capacity. Therefore, the required flow capacity for sizing the sewer may be computed using the following relationship:

$$\text{Required full flow sewer capacity} = \frac{\text{estimated total design peak flow rate}}{0.86}$$

3.2.3. The design peak flow rate shall be determined for the total planned contributing area and be based on the ultimate anticipated land use, zoning and density of development.
3.2.4. No sewer main shall be less than 200 millimetres inside diameter to allow for pipe cleaning and maintenance.

3.3. Mains - Location

3.3.1. Sanitary sewer pipe shall be located within 1.5 metres of the centre of the travelled width to provide:
3.3.2. The maximum space for construction
3.3.3. To make the best use of elevation and;

3.3.4. To locate maintenance holes at height to reduce inflow through maintenance hole tops during major runoff events.

3.3.5. The horizontal separation between the sanitary main and the water and stormwater mains shall be a minimum of 3 metres measured edge of the pipe to the edge of the pipe.

3.3.6. Routing through alleys and/or easements is discouraged due to access problems for maintenance. Routing through alleys will be considered for the provision of servicing Laneway Suites.

3.3.7. No permanent structure shall be erected over a City sewer main or an easement to accommodate such.

3.4. Mains - Slope Requirements

3.4.1. Sanitary sewers shall be designed to achieve a mean flow velocity when flowing at the depth corresponding to the full flowing velocity of not less than 0.6 metres per second to provide for self-cleansing. For the sanitary system's upstream reaches, where it is not feasible to obtain a 0.6 metres per second flow velocity without resulting in excessive slopes, the pipe slope shall be maximized within limits dictated by the system depth constraints. The designer optimizes using the available elevation differences to provide extra slope in the sewer system reaches where design flows are minimal.

3.4.2. The maximum flow velocity shall be limited to 3.0 metres per second. This is to prevent undue turbulence, minimize odours due to sulphide generation, and limit the flow's erosive and momentum effects.

3.4.3. It is recommended that all sanitary sewers be designed with a slope of 0.4 percent or greater.

3.4.4. No sanitary sewer shall have a slope of less than 0.1 percent.

3.4.5. The minimum slope for the most upstream reaches of any wastewater system shall be 0.4 percent, from the terminal maintenance hole downstream to a point where the design peak dry weather flow exceeds 10 litres per second.

3.4.6. The maximum slope will be based upon limiting to the maximum flow velocity of 3.0 metres per second when conveying the design peak flow rate.

3.4.7. The minimum slopes permitted for various sewer sizes are outlined in Table 2. Where the minimum values outlined in Table 2 conflict with the standards noted above, the steeper slope shall govern.

Table 2: Minimum Sewer Slopes by pipe size

Minimum Sewer Slopes by pipe size	
Pipe Size (diameter)	**Minimum Slope**
Sanitary Service Connection	1.00%
200 millimetres	0.40%
250 millimetres	0.28%
300 millimetres	0.22%
375 millimetres	0.15%
450 millimetres	0.12%
525 millimetres	0.10%
600 millimetres and larger	0.10%

Note 1: For sewers aligned in a curve, the minimum slope shall be increased to 1.5 times those shown above.

3.5. Mains - Depth

3.5.1. Lower than the water main on the street.
3.5.2. Sufficient depth to provide frost protection.
3.5.3. Adequate depth to permit installation of sanitary services with a minimum of 2.6 metres of cover and a minimum of 2.74 metres of depth to the invert elevation of the service pipe at the property line.
3.5.4. Adequate depth to permit gravity drainage from all building services to the sewer main.
3.5.5. Special consideration should be given when property elevations may be below concerning the surface elevation at the road right-of-way.
3.5.6. The sewer shall be at a minimum of 1.0 metres lower than proposed basement elevations.
3.5.7. Use of insulation above mains in place of reduced cover is not permitted.

3.6. Maintenance holes

3.6.1. Maintenance holes are to be located at junctions, where a change of pipe size, slope, alignment, and monitoring may be required to provide for the proper operation and maintenance of the wastewater collection system.
3.6.2. The wastewater collection system design should avoid installing maintenance holes in stormwater system depressed areas and major system overland flow routes.

3.6.2.1. If a maintenance hole in a stormwater system depressed area and/or major system overland flow route is unavoidable, then the maintenance hole lid shall be designed to be watertight.

3.6.3. All sanitary sewers and maintenance holes shall be designed with approved joint seals.
3.6.4. Maintenance hole spacing for pipes 600 millimetres in diameter and greater shall be maximized as much as possible but shall not exceed 150 metres.
3.6.5. Maintenance hole spacing for pipes smaller than 600 millimetres in diameter shall be maximized as much as possible but shall not exceed 100 metres.
3.6.6. Monitoring maintenance holes shall be provided where the City identifies a need to monitor wastewater flows and/or strengths. The City may consult the Developer in the process.
3.6.7. The location, size, and other particulars of monitoring maintenance holes are site-specific and determined by the City. The City may consult the Developer in the process.

3.7. Sewer Service Connections

3.7.1. A separate service connection to the wastewater collection system is required for each lot with distinct title certificates.
3.7.2. In the case of Bareland Condominium, separate service connections are made to a private wastewater collection system. The private wastewater collection system shall have a single connection to the public wastewater collection system.
3.7.3. Larger commercial, residential or industrial parcels that cannot be serviced from the public right of way require a shared services easement agreement to be registered on the affected properties' title. Each of these parcels would require isolated services from the shared private wastewater collection system.

3.7.4. Sanitary service connections are to be provided to all detached residential properties.
3.7.5. Connections shall be constructed to the property line when mains are constructed.
3.7.6. Such connections shall be secure and permanent and, unless otherwise approved, shall be made with an integral tee or wye at the main.
3.7.7. The use of cut-in/strap-on saddles for new services off existing sewers will be considered on a case-by-case basis.
3.7.8. The minimum pipe size for connections is 150 millimetres in diameter.
3.7.9. Service connections shall be installed at a minimum slope of 1 percent and a maximum slope of 3 percent. A minimum slope provides for better flushing velocities, which is required due to the more variable flows through these pipes and the non-routine maintenance they receive.
3.7.10. For cleaning and maintenance purposes, where services require slopes of greater than 3 percent, a drop structure shall be used to connect to the sewer main.
3.7.11. Services to detached residential properties shall not be permitted off sewer mains located in easements.
3.7.12. Service connections to industrial and commercial/institutional properties may be permitted from sewer mains located in easements, provided the proposed development will permit access to the easement and allow excavation as may be necessary for maintenance or repair or reconstruction of service connection.
3.7.13. All redundant or unused service connections shall be disconnected and capped at the property line.
3.7.14. No building shall be erected over a service connection, nor shall a service connection be installed under a building.
3.7.15. Sewer service pipes are not permitted to traverse any private property other than the buildings that the piping serves are located unless a legal easement and permission from the City of Regina have been obtained.
3.7.16. If a sanitary service connection is not located beside the water service in a common trench, a clean-out should be included at the property line, complete with a cast iron top with a cap marked 'Sewer.'
3.7.17. Use of insulation above service connections in place of reduced cover is not permitted.

3.8. Siphons (Inverted Siphon or Depressed Sewer)

3.8.1. Siphons are to be avoided in the design of the wastewater collection system.
3.8.2. Siphon design must accommodate maintenance issues such as removing grease at the upstream end and removing settled solids at a low point.
3.8.3. The siphon design must allow an adequate drop in elevation between the two ends to accommodate a wide range of flow.
3.8.4. All new siphons shall be designed to have a minimum of two pipes.
3.8.5. The minimum internal diameter of the siphon pipe shall be 200 millimetres. The inlet invert of the second pipe shall be designed to match the obvert of the first pipe.
3.8.6. The maximum length of the siphon shall be 120 metres to permit maintenance.
3.8.7. Siphons shall be designed to provide a minimum velocity of 0.9 metres per second during average daily dry weather flow and a minimum cleansing velocity of 1.2 metres per second during the design peak wet weather flow.

3.9. Pumping Station and Force Main Requirements

3.9.1. The need for pumping shall be demonstrated before preliminary design as per the Design Standard: Lift Stations and in consultation with the City.

3.10. Pump Station Design Requirements

3.10.1. Pump station design requirements are set out in the Design Standard: Lift Stations.

Tables

Table 1: Design Population Table

Table 2: Minimum Sewer Slopes by pipe size

Charts

None

Figures

Figure 1: Wastewater Flow Formula

Figure 2: Harmon Formula

Figure 3: Manning Equation

Appendices

None

Revisions		
Description	**Notes**	**Date**
Conversion from Development Standards Manual and Update	See List of Specific Changes for 2021	January 2021
Changed Definitions & References	Migrated the content to the General Section.	May 2022