

## SECTION 5: SANITARY SEWER

### 5.0 INTRODUCTION

This section will cover the design of Wastewater Collection System including, but not limited to, underground collection mains, manholes, service connections and pumping facilities.

### 5.1 GENERAL

The overall design principles described in the introduction to these standards is the basis on which all construction is undertaken in the City of Prince Albert. These guiding principles are expanded below to provide more specific guidance related to the City of Prince Albert Wastewater Collection System. Often a combination of principles will come into play when designing a particular component of the system.

The design of sanitary sewer extensions must take public health and safety into account. Facilities that may put public safety or health at risk due to flooding, environmental overflows, or create unsafe access points are not acceptable.

#### 5.1.1 Level of Service Objectives

Level of service requirements have been defined based on a 2015 Hydraulic System Analysis. The City of Prince Albert has adopted this set level of service requirements and, as such, they will form a basis for these principles of functionality. The following level of service objectives have been set:

- i. Provide sewage collection adequate to meet the dry weather demand of the proposed development with appropriate allowances made for wet weather inflows based on current sanitary sewer construction practices.
- ii. Provide sanitary sewer capacity so that surcharging does not occur for design dry weather peak flows and so 99.5% of homes are protected from sewer back-up during peak wet weather flow events.
- iii. No additional or new homes will be added to the “at risk” list as a result of any new development. “At risk” is defined as locations where surcharging of the sanitary sewer occurs to a level less than 2 m below the manhole rim for the design wet weather event.
- iv. Limit wet weather inflows to less than 5% of the total volume of rainfall in the system during wet weather periods.

#### 5.1.2 Applicable Regulations, Guidelines and Resources

The following documentations are the regulations which have provisions that pertain to sanitary sewer systems include:

- *Sanitary Sewer Bylaw, City of Prince Albert;*
- *Connections Bylaw, City of Prince Albert;*
- *Standard Construction Specifications and Drawings, Roadways, Water, and Sewer, City of Prince Albert;*
- *Sewage Works Design Standard, Water Security Agency;*

- *National Plumbing Code;*
- *PVC Pipe: Design and Installation (M23), American Water Works Association (AWWA); and*
- *PE Pipe: Design and Installation, (M55), AWWA.*

**5.1.3 Sanitary Sewer Planning Requirements**

See Section 2.4 Development Plan - Infrastructure Requirements.

**5.1.4 Environmental Considerations**

See Section 2.5 for Environmental Considerations.

**5.2 SEWAGE GENERATION RATES**

**5.2.1 Hydraulic Network Analysis**

In general, a network wide hydraulic analysis is required for any new development that has not been analyzed previously, or for any development that significantly alters the servicing scheme such that an existing hydraulic network analysis is no longer applicable. An analysis is required, in particular, where sewage generation rates have been altered in a way that will affect existing customers.

All force mains and gravity sewer mains 200 mm in diameter or larger shall be modeled. Transient analysis is required for all force mains. Runs shall include, at a minimum, a simulation of peak flows including allowances for Infiltration and Inflow (I&I) and Wet Weather Flow (WWF) (where applicable).

The developer will submit a report showing that the system will meet level of service requirements at the final development concept and also through interim stages of development. A digital plan of the system compatible to the City of Prince Albert Hydraulic Model will be required.

**5.2.2 Sewage Generation Rates**

The rates given below shall be used to calculate design flows:

**5.2.2.1 Sewage Dry Weather Flows**

Residential	360	L/capita/d
Commercial	20	m <sup>3</sup> /ha/d
Institutional	20	m <sup>3</sup> /ha/d
Recreational	10	m <sup>3</sup> /ha/d
Industrial (light and medium)	30	m <sup>3</sup> /ha/d
Industrial (heavy)	process specific	

**5.2.2.2 Residential Density**

Highest	Observed	40	persons	per	hectare
New	Developments				
(Average	Density)	30	persons	per	hectare
Recommended					

Area Structure Plan Forecast

**5.2.2.3 Peaking Factor**

Harmon's Peaking  
(field correlated)

$$\frac{14}{4 + \sqrt{p}} + 1$$

**5.2.2.4 Sewage Wet Weather Flows**

Residential (new developments)	(in addition to Dry Weather Flows)		
Residential (older developments)		400	L/capita/d
Commercial Institutional		1600	L/capita/d
Recreational			
Industrial		7.5	m <sup>3</sup> /ha/d
		7.5	m <sup>3</sup> /ha/d
		2.5	m <sup>3</sup> /ha/d
		7.5 m <sup>3</sup> /ha/d	

**5.2.2.5 Infiltration and Inflow Allowance**

In areas where the ground water table is at a depth of 3 m or less below the surface, a groundwater infiltration allowance shall be accounted for as follows:

Residential	135	L/capita/d
Industrial	2.25	m <sup>3</sup> /ha/d
Commercial	2.25	m <sup>3</sup> /ha/d
Institutional	2.25	m <sup>3</sup> /ha/d
Recreational	2.25 m <sup>3</sup> /ha/d	

**5.2.2.6 Weeping Tile Flow Allowance**

Connection of foundation drains of any buildings to the sanitary sewer collection system is no longer permitted; therefore, there is no weeping tile allowance for new developments.

**5.2.3 Industrial Sewage Generation**

In circumstances where industrial sewage generation rates are being made without process specific information, the Public Works Department should be consulted regarding the capacity to be provided.

**5.3 GRAVITY FLOW**

Gravity sewer mains shall be sized for full flow during the total design peak flow. The Manning Equation shall be used for the design and modelling of gravity sewers.

- Q = (A\*R<sup>2/3</sup>\*S<sup>1/2</sup>)/n Where: Q = Flow (m<sup>3</sup>/s)
- A = Cross-sectional area of pipe (m<sup>2</sup>)
- R = Hydraulic radius (area/wetted perimeter) (m)
- S = Slope of hydraulic grade line (m/m)

$n =$  Manning coefficient = 0.013 for all approved materials in straight alignment (s/m  $1/3$ )

### 5.3.1 Velocity

*Sewage Works Design Standard*, a mean velocity of 0.6 m/s shall be maintained during average flow conditions to provide self-cleansing flow. The maximum velocity shall be 3.0 m/s to reduce the risk of undue turbulence and scour.

### 5.3.2 Size

The minimum size of gravity sanitary sewer pipe shall be 200 mm diameter. Mains with diameters equal to or greater than 375 mm shall be deemed to be trunk sewers.

### 5.3.3 Slope

Sanitary mains shall be laid in a straight alignment between manholes at the following minimum grades:

Sewer Size (mm)	Minimum Slope (%)
200	0.40
250	0.28
300	0.22
375	0.15
450	0.12
525	0.10
600 and greater	0.08

## 5.4 SANITARY SYSTEM COMPONENTS

This section covers standards for the design of pipes, manholes, and sewage pump stations.

### 5.4.1 PIPES

The sewer collection system shall consist of the following three types of sewage mains:

#### 5.4.1.1 Sanitary Collection Main

All sanitary collection mains with a minimum size of 200 mm mainly used for the collection of sewage from the neighbourhood. Service connections are allowed.

#### 5.4.1.2 Trunk Sanitary Main

All trunk sanitary mains with a minimum size of 375 mm mainly used for the collection of sewage from the collection mains. Service connections are not allowed.

#### 5.4.1.3 Forcemains

Mainly used for transmitting sewage from lift stations to gravity pipes.

#### 5.4.2 Sizing

Pipes shall be sized to accommodate the peak design flows for the proposed contributing area and, if applicable, to reasonably accommodate extensions to adjacent future development areas as described in the sector plan for each development area.

#### 5.4.3 Depth

All sewers shall be designed so that the top of the main is at the minimum depth 2.75 m, unless otherwise approved by the Director of Public Works. Where existing conditions dictate that the depth of buries be less than 2.75 m, the main/service is to be insulated. The maximum depth of cover shall not exceed 5.5 m in cases where sanitary and/or storm service connections are to be installed. In situations where depth of cover exceeds 5.5 m, the consultant shall redesign the sanitary sewer system and/or the site grading to reduce the depth of cover to less than 5.5 m.

#### 5.4.4 Clearance

Sewer mains shall pass under adjacent water mains. The minimum vertical clearance from the bottom of one pipe to the top of the next lowest pipe shall be 150 mm. The minimum horizontal clearance between the outer walls of adjacent pipes shall be 300 mm.

#### 5.4.5 Manholes

Manholes shall be installed at the end of each line, at all changes in sewer size, grade, or alignment, at all junctions, and at intervals of no greater than 150 m along the length of the sewer. To maintain a continuous energy gradient through manholes, the obvert (crown) elevation of the lowest upstream pipe shall be equal to, or higher than, the obvert of the downstream pipe. Wherever possible, sanitary sewer manholes shall not be located within trapped lows. Where it is unavoidable, the manhole shall be fitted with a watertight seal.

Manhole bases may be cast-in-place or pre-cast complete with flow channel, benching, and pipe stubs. See City Standard Design Drawings 00-01-03, 00-01-04, and 00-01-05.

#### 5.4.6 Sewage Pump Stations

Extension of sanitary servicing by means other than gravity flow sewers shall be considered only in cases where insurmountable constraints cannot be resolved, dictating a requirement for a wastewater pumping station. The use of a sewage pump station shall require the submission of a *Sewage Pump Station Design Report* and the approval of the Public Works Department. This report should include pump curves and system curves.

##### 5.4.6.1 Architectural

- i. Exterior block shall be 390 x 190 x 90 concrete block, #248 Red as manufactured by Expocrete
- ii. Roofing shall be 24 gauge, standing seam, complete with eavestroughs, HSS downspouts, perforated metal soffits. All prefinished metal shall be Bone White in colour.

- iii. Building shall be constructed with minimum 3600 mm ceiling height.
- iv. Roof shall be hip roof design with engineered trusses.
- v. Substructure and foundations shall be cast in place reinforced concrete.
- vi. Structure shall include an integrated wet well suitable cut off from the building and mechanical components, and a drywell to house all necessary mechanical components.

**5.4.6.2 Structural**

- i. All access into the substructure shall use stairwell design, meeting Occupation Health and Safety standards and regulations.
- ii. Station shall be equipped with necessary provisions for lifting and pump removal using electric hoist(s).

**5.4.6.3 Mechanical**

- i. Station shall have duplex pump arrangement, each pump of adequate capacity to meet peak flow rates and full pump redundancy. Pumps shall be Flygt submersible sewage pumps.
- ii. All mechanical components shall consist of 316 stainless steel.
- iii. Station shall be equipped with all necessary valves to easily isolate and remove one pump from service while maintaining operation of the station.
- iv. Station shall be equipped with domestic water service.
- v. Adequate ventilation shall be provided to meet all regulations.

**5.4.6.4 Electrical and Controls**

- i. Electrical distribution shall be combined into a single motor control center.
- ii. Voltage and power supply to the facility shall be 600V, 3 phase.
- iii. Programmable logic controller shall be fully programmable, shall be equipped with a touchscreen HMI, and shall be equipped with a redundant level monitoring system also capable of operating the pumps.
- iv. All functions of the station shall be integrated into and monitored by the City's SCADA system.
- v. Level monitoring shall be a fully redundant system consisting of a pressure transducer and ultrasonic transducer, with a high level float.
- vi. Station shall be equipped with an emergency standby generator, natural gas fueled, domestic (city) water cooled, and shall be capable of powering the station under all operating conditions. Generator shall automatically startup in the event of a power outage, and return to standby conditions once utility has ben restored.

**5.5 SANITARY SEWER SERVICES**

Residential sanitary sewer services shall be no less than 100 mm in diameter and have a slope from the main to the property line of a minimum of 2%. Services of a size larger than those indicated will be required where, in the opinion of the Director of Public Works, the lengths of service pipe or other conditions warrant these.

In general, note:

- i. Each building shall have separate connection.
- ii. Duplex buildings shall have separate connection to the main.
- iii. Multi-family units shall have shared one service connection connected to the main.
- iv. Sanitary service connections shall comply with the National Plumbing Code.

All sanitary services, from property line to main, are to be shown on the service connection. Note: see Standard Detail Drawing 00-01-20.

<b>Table 5.5: Service Connection Manhole Requirement Chart – Sanitary Sewer</b>						
<b>Service Connection Size (mm)</b>						
	100	150	200	250	300	375
150	No	Yes	Yes	N/A	N/A	See below
200	No	Yes	Yes	Yes	N/A	See below
250	No	No	Yes	Yes	Yes	See below
300	No	No	No	Yes	Yes	See below
375	No	No	No	Yes	Yes	See below
400	See Below					

**Main Size (mm)**

Each service larger than 375 mm will require review and approval by the Director of Public Works.