4.0 SANITARY SEWERS

4.1 GENERAL

Sanitary sewer facilities complete with mains, manholes, service connections and appurtenant structures shall be provided to collect and dispose of sewage. On site sewage disposal systems will only be considered on a case-by-case basis in areas where conventional sewage collection systems are cost prohibitive or where alternate sewage systems review is required in accordance with the Regional Liquid Waste Management Plan.

The sewage catchment boundary and the locations of pump stations and force mains will be pre-determined by the General Manager.

The Master Sewer Plan, Official Community Plan, Regional Liquid Waste Management Plan, and any other related planning documents shall be consulted to ensure the long-term sewer plans and objectives are addressed by each design.

4.2 SEWAGE CHARACTERISTICS

The discharge of storm water into the sanitary system will not be allowed.

All discharge of industrial wastewater to the City sanitary sewer requires a permit issued by the City. The conditions of this permit include compliance with all regulations of the City, GVRD, Provincial and Federal Governments and all other relevant legislative bodies.

4.3 SEWAGE FLOWS

The total design sewage flow shall be based on the greater of a) ultimate population densities and land use designations as outlined in the Official Community Plan for the entire catchment area, or b) for the planned development for the entire catchment area. Sanitary sewers shall be designed to convey the calculated peak sewage flows, including an allowance for inflow and infiltration.

The following densities are to be used for residential area unless otherwise approved by the General Manager:

- 3.3 persons/unit (min): Single-family (detached)
- 2.9 persons/unit (min): Multi-family (other)
- 2.1 persons/unit (min): Multi-family (apartment)

All design population assumptions must be reviewed with and approved by the General Manager.

The following sewage flow rate guidelines shall be used as a minimum design basis.

Where development is expected to exceed these guidelines the actual development parameters shall govern. For development within existing areas the design basis shall be based on the greater of a) flows from the present development combined with anticipated flows for extension of the sewer to both developed and undeveloped lands and b) flows from future development of the catchment area to full OCP density and land-use.

Table 4.1 Sewage Flows

Land Use	Unit Average Dry Weather Flow	Inflow and Infiltration (litres/ha/day)
Residential	350 litres/capita/day	11,200
Commercial/ Industrial	31,500 litres/ha/day	11,200
Institutional		
Hospitals	900 litres/bed/day	11,200
Nursing Homes	680 litres/bed/day	11,200
General	According to Health Act Guidelines	11,200

If relevant data is not available during the planning stage, the equivalent population factors mentioned below maybe used to determine the non-residential flows. For determining flows for Institutional general, the residential flow rate is to be applied.

Table 4.2 Equivalent Population Factors

Land Use	Equivalent Population/Hectare (gross)
Commercial/Industrial	90 people/ha
Institutional	
Hospitals	50 people/ha
Nursing Homes	200 people/ha
General	50 people/ha

4.4 HYDRAULICS

4.4.1 Downstream System Capacity

The Consultant shall discuss downstream system capacity requirements with the General Manager. If required, the calculation for Existing + Instream Application + Proposed Development and OCP (Ultimate Development) flows and system capacities shall be completed by the Consultant.

4.4.2 Design Flow

The steady-state design flow rate shall be calculated as follows:

Q_{DESIGN} = Peak Sewage Flow from all Sources + Infiltration and Inflow

Peak Sewage Flow from all Sources = (Q_{ADWF}) x Peaking Factor + Q_{PUMPED}

Where: Q_{ADWF} = Average daily sewage flows, from all sources, for the collection system upstream that is being fed by gravity
Q_{PUMPED} = Peak wet weather pumping rate from all upstream pump stations

Peaking Factor

The peaking factor shall be calculated using the Harman equation. All non–residential demands are to be converted to equivalent populations for peaking purposes.

$$\text{Peaking Factor} = 1 + \frac{14}{4 + \sqrt{\frac{Population}{1000}}}$$

The Consultant will be required to tabulate the calculations on the "Sanitary Sewer Design Sheet" (Table 4.3 on page 4-9), located at the end of this section, for submission along with the appropriate plans and other relevant information.

4.4.3 Pipe Flow

The hydraulic analysis of gravity sewer pipes shall be conducted using the Manning equation.

$$Q = \frac{A\, R^{0.667}\, S^{0.5}}{n}$$

Where: Q = flow capacity in m^3/s
A = cross sectional area in m^2
R = Hydraulic radius (area/wetted perimeter) in m
S = slope of hydraulic grade line in m/m
n = Manning roughness coefficient
0.013 for all pipes

New sanitary sewers shall be designed with the design peak wet weather flow rate not to exceed 50% of the full pipe capacity.

Where direct forcemain connections are required and approved by General Manager, the Hazen – Williams's formula shall be employed.

$Q = (C\ D^{2.63}\ S^{0.54})/278{,}780$ Where: Q = rate of flow in l/s
D = internal pipe diameter in mm
S = slope of hydraulic grade line in m/m
C = friction coefficient
100 for all pipes

Where deviation from the foregoing methodology occurs, a description of the procedure used for sewer design shall be submitted to the General Manager for approval.

4.5 MINIMUM VELOCITY

Minimum design velocities:

- Gravity sewers 0.6 m/s
- Forcemains 0.9 m/s

4.6 MINIMUM PIPE SIZES

The minimum pipe size for gravity sewers is 200 mm diameter.

For new extensions, no reduction in pipe size shall be made for pipes downstream, irrespective of grade provided on the pipe, unless specifically approved in writing, by the General Manager.

4.7 MINIMUM GRADE

The beginning section of a sanitary sewer, servicing 6 or less residential service connections shall have a minimum grade of 1.0%.

4.8 LOCATION

The location of the sanitary sewer main shall be in accordance with the City's standard utility location as shown on the "Typical Cross Section" drawings in Section 7.0.

Where front of lot sewers are technically impractical, as determined by the General Manager, sewers in rear of lot rights of way may be approved. Rears of lot sewers, if approved, are to be constructed in a right of way. The right of way shall include a minimum 3.0 m wide dedication on both of the adjoining lots for a total 6.0 m width. The sewer pipe is to be centred within the half right of way on each property.

4.9 SEPARATION

The elevations of all existing underground utilities crossing the proposed sanitary sewer shall be confirmed in the field and shall be shown on the plan and profile.

The minimum requirements for separation of sanitary sewer from watermain are as follows, unless otherwise indicated by Provincial Health Regulations.

The following separations are from edge to edge unless otherwise specified.

4.9.1 Horizontal Separation

- Private Utilities: 1.0 m
- Roadway lighting base & conduit and traffic communications conduit: 0.3 m
- Storm: 1.2 m between sewer pipes & 0.3 m between manholes
- Watermain: refer to Section 5.9.1

4.9.2 Vertical Separation

- Private Utilities: 0.3 m
- Roadway lighting conduit and traffic communications conduit: 0.3 m
- Storm: 0.3 m
- Watermain: refer to Section 5.9.2

4.10 MINIMUM DEPTH OF COVER

Sanitary sewers shall be installed at a reasonable depth to:

- Permit gravity service connections to properties
- Clear other underground utilities
- Prevent freezing
- Prevent damage from surface loading - The Consultant shall verify that the pipe material and bedding are suitable for the live and dead loads imposed on the pipe
- Minimum cover shall be 1.0 m unless otherwise approved by the General Manager

The maximum cover is 4.5 m, except under special circumstances and with approval of the General Manager.

4.11 CURVILINEAR SEWERS

Curvilinear sewers are not permitted unless authorized in writing by the General Manager.

4.12 MANHOLES

4.12.1 Location

Manholes are required at the following locations:

- 100 m maximum spacing
- Every change in grade
- Every change of pipe size
- Every change in alignment
- Every pipe intersection except for service connections
- Every future pipe intersection
- End of every line

4.12.2 Hydraulic Details

The crown elevations of sewers entering a manhole shall not be lower than the crown elevation of the sewer leaving the manhole.

The following minimum drops in invert elevations across manholes shall be used:

- Straight run and deflections up to 45°: 30 mm
- Deflections 45-90°: 60 mm

4.12.3 Other Requirements

- Drop manholes may be used if required
- Temporary cleanouts are required where an extension of the sewer, in the future, will provide a manhole at an appropriate spacing.

4.13 SERVICE CONNECTION/INSPECTION CHAMBERS

Every lot (existing or newly created) capable of being serviced, whether it is vacant or not, must be serviced by one connection, including an appropriate type of Inspection Chamber.

The size of service connection shall be designed to accommodate the peak flow rate on the property being served.

4.13.1 Service Connections

Minimum Size & Grade

- 100 mm diameter for single family
- 150 mm diameter for all other uses, unless otherwise approved by the General Manager
- 2.0% from property line to main

Other Requirements

- Service connections are to be installed perpendicular to the main
- Service connections may be tied into manholes, if:
  - The connection is not oriented against the flow in the main
  - The manhole hydraulic requirements are achieved

4.13.2 Inspection Chambers (I.C.)

Type

- Type II Inspection Chamber:
  - For all existing and new single family residential properties

I.C.s as per S9 of the MMCD may be used for only single connections for new single-family residential properties.

An appropriate type of inspection chamber and/or manhole shall be provided for industrial, commercial and multi family residential properties.

Location & Depth

- Offset of I.C., may be required on drawing if different from the Standard Detail Drawings

Other Requirements

- Where Type II I.C.s are used with a concrete lid, the lid shall be set 150 mm above the finished grade
- The minimum lead size is 150mm in diameter. If the lead size is different from the Standard Detail Drawings, it shall be clearly marked on the drawing

4.14 PUMPING STATIONS

Guidelines and specific requirements for pumping stations shall be obtained from the General Manager prior to undertaking design.

The location of such stations shall be determined by the General Manager.

4.15 FORCE MAINS

The following criteria apply to force main design:

- Force mains shall be designed for a 0.9 m/s minimum velocity with a minimum pipe size of 100 mm.
- An automatic air relief and/or vacuum valve shall be placed at high points in the force main. Odour control devices shall be installed on air vents unless otherwise approved by the General Manager.
- The Consultant shall ensure the pump cycle is set sufficiently to re-suspend settled solids.
- Isolation valves shall be provided at least every 1,000 m. Valves shall be full port type to allow for pigging. A resilient seated gate valve is required on a force main prior to tie-in to the trunk force main.
- Provisions shall be made to allow for force main cleaning. This shall include pig launching and receiving points and selection of appropriate bends and pipe sizes to allow for pigging of the force main.

Thrust restraint must be provided for all valves, tees, bends, and caps. The Consultant must design thrust blocks or mechanical thrust restraint systems with due regard for pipeline pressure transients and expected test pressures.

Thrust block design calculations and soil bearing pressures must be shown on the design drawings. Where mechanical thrust restraint systems are used the required length of restrained pipe must be shown on the design drawings.

TABLE 4.3 SANITARY SEWER DESIGN

Project Location ____________________

Reference No. ____________________

Date: ____________________

Calculated by: ____________________

Sheet __________ **of** ____________________

LOCATION			CATCHMENT AREA		LAND USE & POPULATION				SEWAGE FLOWS				CUMULATIVE			PEAK FLOWS		DESIGN FLOWS		SEWER DESIGN									ELEVATION						HYDRAULIC GRADE LINE			NOTES
			Increment Area						ADWF		inflow & Infiltration										Capacity (m^3/s)					Velocity (m/s)			Invert		Crown		Rim					
Road	From MH	To MH	No.	A (ha)	Land Use	Density	No. of Units	Population	Rate	Flow (l/day)	Rate (l/ha/day)	Flow (l/day)	Σ Population	Σ ADWF	Σ I&I	Peaking Factor	Flow (l/day)	(l/day)	(m^3/s)	% Capacity	100%	50%	Diameter (mm)	Slope (%)	n	Full Capacity	Design	Pipe Length (m)	From	To	From	To	From	To	HGL Slope (%)	Upper Elevation (m)	Lower Elevation (m)	