2020 - SECTION 9

SANITARY SEWER SYSTEM

9.1 GENERAL

The sanitary sewer system shall be of sufficient capacity to carry peak flows plus inflow/infiltration.

The design of this municipal improvement shall be undertaken in such a manner as to conform with the approved Sanitary Sewer Design report for the development area, the Aquatera Design/Construction Manuals, Aquatera Master Plans and all legislated Acts and Regulations.

The Sanitary Sewer System shall be approved by Aquatera and Alberta Environmental Protection Services.

9.2 TRUNK SYSTEM

As required to comply with the appropriate Wastewater Collection System Master Plans as follows:

- The current Aquatera Wastewater Collection System Master Plan for the City of Grande Prairie.
- The current Aquatera Wastewater Collection System Master Plan – County of Grande Prairie - Clairmont Corridor Servicing Strategy
- The current Aquatera Water and Wastewater Master Plans Town of Sexsmith

9.3 COLLECTION SYSTEM

9.3.1 SANITARY CATCHMENT CALCULATIONS

See Table 9.1

9.3.2 VELOCITIES

See Table 9.1

9.3.3 "n" VALUE

See Table 9.1

9.3.4 MINIMUM PIPE SLOPES

Minimum pipe slopes shall be as recommended by Alberta Environmental Protection, except that the minimum grade of the first upstream length of pipe shall not be less than 1%.

200 mm dia.	0.40 %
250 mm dia.	0.28 %
300 mm dia.	0.22 %
375 mm dia.	0.15 %
450 mm dia.	0.12 %
525 mm dia.	0.10 %
600 mm dia.	0.10 %

Minimum pipe slope values for curved sanitary sewers are to be 50% greater than the above values.

9.3.5 OVERSIZING

Sanitary sewers may have to be oversized to conform to the Wastewater Collection System Master Plans as noted in Section 9.2 or as required to service adjacent land for future development.

9.3.6 MAIN DETAIL AND LOCATION

a) See Table 9.1

b) Pipe bedding shall be Class B1 for all sizes of mains with water tight joints. Pipe classes shall be determined to withstand subsequent superimposed loading.

c) Mains shall be designed to provide a minimum depth of 2.75 m from the top of pipe to the final finished grade at the surface, or shall be insulated to the satisfaction of Aquatera.

d) Mains shall be designed to provide an adequate sanitary sewer service connection grade and depth at the property line.

e) Mains shall be located within a road right-of-way or utility lot in accordance with the applicable municipal standard. (Contact the City of Grande Prairie, The County of Grande Prairie or Town of Sexsmith as applicable.)

f) For augered sanitary sewers (subject to Aquatera approval), the design grade shall be 50% greater than the minimum grade required between the manholes upstream and downstream of the augered section.

g) Mains shall be separated from the watermain(s) by a horizontal distance of not less than:

for pipes not exceeding 300 mm in diameter

2.50 metres from center of pipe to center of pipe

for pipes greater than 300 mm in diameter

2.20 metres between the outside walls of the pipes

h) At crossings, mains shall be separated from the water main(s) by a vertical distance of not less than 500 mm, and the vertical alignment must be with the water over the sanitary whenever possible.

i) At crossings, mains shall be separated from storm main(s) by a vertical distance of 500 mm between the outside walls of the pipes.

9.3.7 MANHOLE DETAIL AND LOCATION

a) All manholes shall be water-tight. Ground water conditions may require manholes to be wrapped completely, the consultant shall identify on the drawings which manholes shall be wrapped. Joint wrap will be required in either case.

b) Manholes shall be located at the upstream end of each line, and at all changes in pipe size, grade, material and alignment. Manholes shall be designed to provide a minimum depth of 2.75 metres to the obvert of the pipe. Under no circumstances will manholes be permitted in driveways or private property. When planning manhole locations, due consideration must be given to access by sewer cleaning equipment.

c) Shallow manholes are to be avoided, in situations where manholes are shallower than

2.75 meters, manholes will require frost covers and insulation surrounding the base up to the top of the cone. Frost covers shall be installed between cones and first grade ring.

d) Where the inlet and outlet pipes are of the same diameter, inverts in manholes at changes in direction shall have a 60 mm fall across manhole, and a 30 mm on non- directional changes. Where a smaller pipe joins a larger one, the invert of the larger pipe should be lowered sufficiently to maintain the energy gradient. An appropriate method for securing these results is to place the 0.8 depth point of both sewers at the same elevation. The drop across a manhole where sewer piping is installed through a manhole, the slope across the manhole, from inlet to the outlet, shall not be less than the greater of the slopes of the downstream or upstream sewers. Alignment changes in excess of 90 degrees and unused channels are not permitted.

e) Service obverts in cul-de-sac manholes shall match the main obvert.

f) A smooth, semi-circular transition is to be provided between the inverts of the inlet and outlet sewer except where drop manholes have been provided.

Extreme changes in elevation across non-drop manholes are to be avoided except in situations where a small diameter pipe meets a large diameter pipe at the 0.8 depth point of both sewers at the same elevation. Where drops in excess of this occur, drop manholes, adjusting the slope(s), or lowering the profile of the in-coming pipe are required.

In general, one internal drop per manhole will be allowed for pipes up to 300 mm in diameter and for drops of up to a maximum of 3.0m. External drops will need to be individually designed and thoroughly detailed in the typical details section of the Aquatera Construction Manuals Detailed Engineering Drawings. Internal drop structures may not be installed in manholes with an inside diameter of less than 1200 mm, unless otherwise approved by Aquatera.

Where the drop is less than that which would allow the construction of a drop manhole, excepting conditions in d), the grade of the incoming sewer shall be increased or the profile lowered in order to achieve the requirements of 9.3.7.c).

Where the drop is greater, then a drop manhole is to be provided.

Internal drops are preferred provided adjustment is made in the manhole diameter, but external drops will be considered.

Internal drop structures shall be outfitted with Reliner Inside Drop Components. The bowl size shall be determined by incoming pipe size and flow rates. The bowl shall be installed as per manufacturer's instructions using stainless steel fasteners. The appropriately sized drop pipe of SDR 35 PVC shall be securely attached to the manhole wall using stainless steel Reliner Adjustable Clamping Brackets and stainless steel fasteners. Bracket interval shall be 1.2m maximum (minimum of 2 brackets). The connection of Drop Bowl to drop pipe shall be by flexible external pipe coupler (Fernco or approved equivalent). The turn-out at the base end of the drop pipe shall be accomplished with an appropriately angled PVC pipe elbow (45 degree recommended).

g) The maximum straight run distance between manholes shall not exceed 120 m. For trunk sewers this distance may be increased to 150 m subject to written approval by Aquatera. Chamber manholes for low pressure sewer shall not exceed 300 m.

h) Manholes shall not be located in sags or in areas subject to flooding during a major storm event. If it is necessary to locate in such an area, gasket or sealing covers and other special requirements will be necessary to prevent inflow into the manhole.

i) Manhole bases shall be reinforced concrete poured-in place, precast slabs, vaults or precast tee risers.

j) Safety platforms are required for manholes greater than 9m in depth and shall be located at 2.5m to 2.75m from the rim. In all case, safety platforms shall be installed above any incoming pipe entering the manhole. All barrels and cones shall be provided with aluminum ladder rungs spaced at 400mm O.C. continued all the way to the benching.

k) Sanitary sewer stubs for future extensions shall be designed to terminate within 1.5 m from the outside wall of the manhole, unless otherwise directed by Aquatera. The stub shall be designed with positive grade toward the manhole, matching the grade of the future extension of the line. Stubs that grade toward the plug (future downstream manhole) will not be permitted. It is the responsibility of the Engineer to verify that stubs are properly graded before connections are made. Any re-grading of stubs necessary to meet this requirement shall be done at the Developer's expense.

l) All manholes/chambers with forcemain or low pressure sanitary sewer inlets shall be designed larger to accommodate an IPEX Vortex Flow or Force inserts, or Aquatera approved equivalent, as appropriate for the flow range. Manholes shall be designed to facilitate installation of the vortex insert through the manhole frame/hatch where possible and with minimal excavation where the size is too large. Manholes will also be designed with an Aquatera approved liner to protect the manhole/chamber walls, to be installed prior to the installation of the vortex insert.

9.3.8 CURVED SEWERS

Curved sewers will be permitted with the following restrictions:

a) Only to follow curved R.O.W.s

b) The sewer shall be laid as a simple curve with a radius equal to or greater than 90 m or the manufacturer's minimum recommended radius, whichever is larger.

c) Manholes shall be located at the beginning and end of the curve.

d) Manholes shall be located at intervals not greater than 90 m along the curve.

e) The main shall run parallel to property line.

f) The minimum grade for sewers on a curve shall be 50% greater than the minimum grade required for straight runs of sewers.

9.4 WEEPING TILE

9.4.1 WATER AND WASTEWATER UTILITY BY-LAW

In accordance with the City of Grande Prairie Utility By-Law C-1365, County of Grande Prairie – Aquatera Utility By-Law 3070 and the Town of Sexsmith Utility By-Law No. 938, weeping tiles, roof drains, area drains, window wells and the like shall not be permitted to discharge into sanitary sewers. Weeping tiles may be connected to sumps with pumped discharge directly to the ground surface (splash pads are required to insure positive drainage away from the house for a distance of 1.5 m). Sump pump discharge lines at the ground surface shall be limited to 1.5 m from the face of the building at the point of discharge.

9.4.2 FOOTING ELEVATIONS

Critical footing elevations for all lots that do not have sump pump connections are to be shown on the Hydrotechnical Plan. Critical footing elevations are the minimum necessary to maintain a 1.0 m separation with the high groundwater table.

9.4.3 OTHER CONSIDERATIONS

a) In any circumstances, **weeping tile connection to sanitary sewers will not be permitted.**

9.5 SEWAGE FORCEMAINS

9.5.1 FORCEMAIN SIZE CONSIDERATIONS

The design of a sewage forcemain shall include an analysis of the comparative costs of construction and long-term operation for alternative sizes. There are practical limitations to the size options which may be considered, as flow velocities are required to exceed certain minimum values so as to prevent slime growth within the main and to ensure that solids are not deposited within the main. It is also necessary to minimize the residence time of sewage within the pumping station wet wells and forcemains to avoid anaerobic fermentation and the resultant production of odorous, hazardous or corrosive gases such as hydrogen sulphide.

9.5.2 FLOW VELOCITY LIMITS

9.5.2.1 To prevent slime growth on the pipe walls of the forcemain and transport solids, the minimum velocity of flow in the pipe should exceed the velocity by:

☐ $V = -0.3 \log (0.1/D)$

- Where: V = velocity in m/s
- And: D = pipe internal diameter in mm

9.5.2.2 Optimum design velocities, in the range of 0.9 to 1.5 m/s, are recommended, considering both the operating costs and prevention of solids accumulation. When the forcemain profile includes steep slopes or vertical sections, the minimum design velocity shall be increased by 50%. Where design forcemain velocities exceed 3.0 m/s, any special provisions required to ensure stability of the forcemain shall be identified and incorporated into the design. The maximum flow velocity shall not exceed 3.5 m/s.

9.5.3 DESIGN PRESSURES

The pressure design for forcemains shall consider normal static and dynamic operating pressures, the potential conditions that may occur due to outlet surcharge or blockages and transient pressure or water hammer effects. A transient pressure analysis shall be done to determine if protection is required and appropriate provisions are to be incorporated into the pumping system design.

9.5.4 SLOPE

All forcemains shall be designed with sufficient slope to promote the discharge of air during filling and to permit the forcemain to be drained. Forcemains shall not be installed at zero slope.

9.5.5 ALIGNMENT

The use of 90 degree bends and long sweep elbows shall be avoided. A series of 45 degree or smaller deflection bends shall be used where extreme changes in direction are required.

9.5.6 AIR RELEASE

Automatic air release valves shall be installed at all relative high points along the forcemain. The need for air release valves shall be minimized by establishing a grade profile to eliminate excessive summits. Air release valves shall be installed in waterproof concrete access chambers complete with insulation to prevent freezing and have provisions for drainage or shall be an alternative approved in writing by Aquatera. For further details refer to Section

61.2.6 of Aquatera's Construction Standards. Each air release valve shall be installed in a water tight chamber or manhole and be provided with an isolation valve between the air release valve and the main.

9.5.7 BLOWOFF VALVES

A valve for blowoff and drainage of the forcemain shall be provided at each low point.

9.5.8 VACUUM RELIEF

Provisions for vacuum release shall be made as necessary where forcemains are proposed to drain by gravity between pumping cycles.

9.5.9 FORCEMAIN OUTLET

9.5.9.1 The forcemain shall enter the receiving manhole horizontally at an invert elevation of no more than 300 mm above the flow line of the receiving sewer. A smooth flow transition to the gravity sewer shall be designed to minimize turbulence at the point of discharge.

9.5.9.2 Inert materials or protective coatings shall be used in all areas subject to attack by sulphides.

9.5.9.3 IPEX Vortex Flow or Force Insert - All forcemain and low pressure sewer outlets into gravity sanitary sewer manholes/chambers shall be designed with a IPEX Vortex Flow or Force insert, or Aquatera approved equivalent, to minimize odor and control corrosion. Manholes shall have an Aquatera corrosion resistant liner to prevent deterioration (see 9.3.7).

9.5.10 DESIGN DOCUMNETATION ON ENGINEERING DRAWINGS

The engineering drawings shall include "system curves" for each forcemain, considering the wet well water level at its lowest and highest points and for each different combination of pump operations possible. The plans shall include a notation of the design basis, which shall specify design friction coefficients, equivalent hydraulic length and design operating conditions.

9.5.11 REQUIREMENTS FOR LOCATING FORCEMAINS

To facilitate location of force mains a tracer wire or approved equivalent shall be placed along all forcemains at the time of construction and shall surface at all appurtenances that are at or above grade.

9.6 TESTING

The design must be conducive to achieving appropriate test results as detailed in Section 61, and other sections in the Aquatera Construction Manual.

9.7 REPORTS

All reports must be stamped and signed by a Professional Engineer recognized by APEGA.

Table 9.1 Sanitary Catchment Calculations

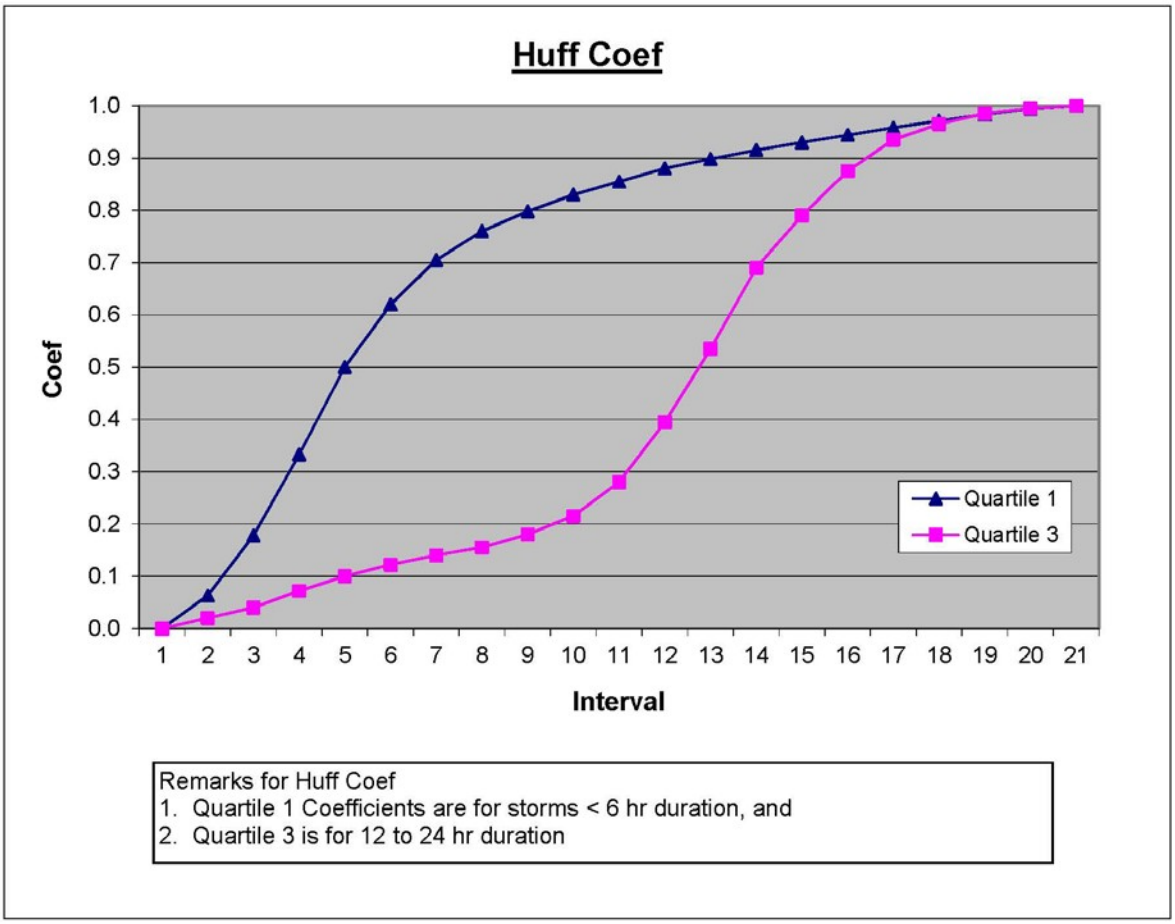
Section	Parameters	City of Grande Prairie	County of Grande Prairie Urban/Rural	County of Grande Prairie Low Pressure System	Town of Sexsmith
9.3.1.a	**Residential Flows**				
	Average Flow Per Capita (L/d)	275	275	County Rural Residential is based on Pump Capacity & Probability of Pumps Operating Simultaneously	275
	Peaking Factor	1.5 □□2.6 (p)$^{-0.1}$	$3<1+[14/(4+p^{0.5})]$		$3<1+[14/(4+p^{0.5})]$
9.3.1.a	**Population Density (Persons/Gross ha)**				
	RR = 3.2 * 11	35	RR1 = 36	RR1 = 36	25
	RL = 3.2 * 11	35	RR2 = 45	RR2 = 45	
	RG = 3.2 * 12.5	40	RR3 = 45	RR3 = 45	
	RT = 1.6 * 52	83.2	RR4 = 51	RR4 = 51	
	RM = 1.6 * 74	118.4	RE = 27	RE = 27	
	RH = 1.6 * 124	198.4	MHC = 51	MHC = 51	
9.3.1.b	**Non-Residential Flows**				
	Commercial (L/ha/d)				
	General Commercial	20,000	10,000		10,000
	Highway commercial	26,000	26,000		
	Industrial (L/ha/d)				
	Light Industrial	10,000	10,000		10,000
	Heavy Industrial	20,000	20,000 *		
	Institutional (L/ha/d)				
	School	20,000	15,000		15,000
	Hospital	30,000			
	Peaking Factor	**2 < 6.659 (Qavg.)$^{-0.168}$ <5**	**2 < 6.659 (Qavg.)$^{-0.168}$ <5**		**2 < 6.659 (Qavg.)$^{-0.168}$ <5**
9.3.1	**Infiltration/Inflow**				
	Gross Area (L/s/ha.)	0.28	0.28		0.28
	Sag Manhole (L/s)	0.40	0.40		0.40
	Roof Leader & Weeping Tile (L/s/ha)	Not Permitted	Not Permitted	Not Permitted	Not Permitted
9.3.2	**Velocities (m/s)**				
	Minimum Velocity	0.6	0.6	0.6	0.6
	Maximum Velocity	3.0	3.0	3.0	3.0
9.3.3	**Pipe Flow**				
	Manning "n" Factor	0.013	0.013	0.013	0.013
	Required Design Flow	Peak Flow / 0.864	Peak Flow / 0.864	Peak Flow / 0.864	Peak Flow / 0.864
	Forcemain				
	Hazen Williams Friction Coefficient "C"	110	110	140	110
9.3.6.a	**Minimum pipe size (mm)**			50	
	Residential	200	200		200
	Commercial	250	250		250
	Industrial	250	250		250
LEGEND	" * " denotes site specific when flow exceed 20,000 L/ha/d	L/d = Litre per Day p = population in 1000	Qavg in L/s L/s = Litre per second	L/s/ha = Litre per sec per hectare = Manufactured Home Community	MHC

Table 9.2 Simulated Wet Weather Storms For the Region of Grande Prairie

Huff Storms									
4-Hour - 2 Year		4 Hour - 5 Year		4 Hour - 10 Year		4 hour-25 Year		24 hour-25 Year	
Time	Intensity	Time	Intensity	Time	Intensity	Time	Intensity	Time	Intensity
0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
0.2	6.30	0.2	8.82	0.2	10.40	0.2	12.60	1.2	1.33
0.4	11.50	0.4	16.10	0.4	18.98	0.4	23.00	2.4	1.33
0.6	15.50	0.6	21.70	0.6	25.58	0.6	31.00	3.6	2.13
0.8	16.70	0.8	23.38	0.8	27.56	0.8	33.40	4.8	1.87
1.0	12.00	1.0	16.80	1.0	19.80	1.0	24.00	6.0	1.47
1.2	8.50	1.2	11.90	1.2	14.03	1.2	17.00	7.2	1.20
1.4	5.50	1.4	7.70	1.4	9.08	1.4	11.00	8.4	1.00
1.6	3.80	1.6	5.32	1.6	6.27	1.6	7.60	9.6	1.67
1.8	3.20	1.8	4.48	1.8	5.28	1.8	6.40	10.8	2.33
2.0	2.50	2.0	3.50	2.0	4.13	2.0	5.00	12.0	4.33
2.2	2.50	2.2	3.50	2.2	4.13	2.2	5.00	13.2	7.67
2.4	1.80	2.4	2.52	2.4	2.97	2.4	3.60	14.4	9.33
2.6	1.70	2.6	2.38	2.6	2.81	2.6	3.40	15.6	10.33
2.8	1.50	2.8	2.10	2.8	2.48	2.8	3.00	16.8	6.67
3.0	1.40	3.0	1.96	3.0	2.31	3.0	2.80	18.0	5.67
3.2	1.40	3.2	1.96	3.2	2.31	3.2	2.80	19.2	4.00
3.4	1.30	3.4	1.82	3.4	2.15	3.4	2.60	20.4	2.00
3.6	1.20	3.6	1.68	3.6	1.98	3.6	2.40	21.6	1.33
3.8	1.10	3.8	1.54	3.8	1.82	3.8	2.20	22.8	0.67
4.0	0.60	4.0	0.84	4.0	0.99	4.0	1.20	24.0	0.33
Total	**20**	**Total**	**28**	**Total**	**33**	**Total**	**40**	**Total**	**80**

DM Sec 09 Table 9.2 GP Rainfall Events-Huff-TL Huff

10/02/2011



DM Sec 09 Table 9.2 GP Rainfall Events-Huff-TL Huff Coef Chart 06/12/12