3. WASTEWATER COLLECTION SYSTEM

3.1 Sanitary Sewer System Overview

3.1.1 Existing Sanitary system

Currently sanitary sewer system consists of gravity sewer mains that feed two minor pumping stations and one main lift station. The main lift station pumps sewage to the existing lagoon.

Clear Water Pumping Station 2 Pumps (one Duty, one Standby)

Type	FLYGT Submersible
Pump Model	3101, 1,800 RPM
Motor	5 HP, 230 V, 3-Phase
Impeller	433

Shannon Pumping Station 2 Pumps (one Duty, one Standby)

Type	FLYGT Submersible
Pump Model	C3082, 1,800 RPM
Motor	2.5 HP, 230 V, 3-Phase
Impeller	436

Heritage Park Main Lift Station 3 Pumps (Duty, Assist, Standby)

Type	FLYGT Submersible
Pump Model	C3152, 1,750 RPM
Motor	20 HP, 600 V, 3-Phase
Impeller	454

3.1.2 Historic Data

Data available on the sanitary system is limited. The following information was gathered from the pump start/stop information of the main lift station for the month of September 2007

Average [DWF] Flow from Main Lift Station (Heritage)	5.16	l/sec
Wastewater Per capita	205	l/c/day
Difference between treated water and sewage flow	41	m3/d
	Or 8% of total daily flow	

3.1.3 Comparison of Design Criteria

Data collected from Aquatera was analyzed to understand and derive key factors such as per capita consumptions, wastewater flow, etc required for planning Wastewater services. The result of data analysis is summarized in the following table.

Table 3.1 Wastewater Design Criteria

Parameter	County of GP (Urban/rural) standards	Data from Sexsmith[10]	Value used in Master Plan
Wastewater Flow Residential (l/person/day)	275	205	275
Commercial (l/ha/day)	10,000	1,613	10,000
Peaking factor (Residential)	$3<1+[14/(4+p^{0.5})]$		$3<1+[14/(4+p^{0.5})]$
Peaking factor (Non-Residential)	$2 < 6.659\ (Q_{avg.})$-0.168 <5		$2 < 6.659\ (Q_{avg.})$-0.168 <5
Infiltration (l/s/ha)	0.1		0.1

[10] Sep 2007 Data

3.1.4 Infiltration & Inflow

Analysis of the wastewater flow from the main lift station indicates negligible or no significant level of infiltration in the existing system. However this is based on one month (September 07 data) and this does not truly reflect the inflow scenarios during storm events. The Town experienced severe storm during July/August 2007. During this time, it is understood that wastewater from the lift stations were temporarily trucked away due to the heavy inflow and surcharging in to the sanitary sewer system. Sufficient data is currently not available to establish the exact inflow and infiltration levels of the town. Morrison Hershfield reviewed records from two flow recording devices installed at two manholes, but the data from these recording devices are spurious and do not provide a sensible account of the flow situation. These flow-recording devices need to be recalibrated. It is also recommended that the town install a flow monitoring system at the inlets of the three existing lift stations in order to monitor flows more accurately and better establish the infiltration and inflows into the system. (see Section 3.6). This flow information will also be useful to calibrate the sewer model.

For the purpose of developing a Wastewater Model, several scenarios such as: 0.1 l/s/ha, 2 year 4 hour storm, 5 year 4 hour storm, 10 year 4 hour storm, 25 year 4 hour storm, 25 year 24 hour huff curve and storm data of July/03/2004 were included in the model to consider the infiltration / inflow contribution. Sewers were sized based on the 25 year 4 hours huff curve, which appeared to cause the highest peak infiltration & inflow contribution. Only 2 % for residential and 1 % for non-residential gross catchment areas were considered for estimation of infiltration & inflow from storm runoff analysis.

The existing wastewater collection system's inflow and infiltration values should be calculated based on a flow-monitoring program. It is understood that the majority of the manholes in the sag locations have been sealed off. However all manholes in sag locations need to be identified and should be sealed off to prevent inflow of surface water during storms. All future sanitary sewer construction should be carried out using modern materials such as PVC Pipes with rubber ring joints. Manholes should be avoided on sag locations as far as possible and higher standards should be enforced on design and construction of sanitary sewer systems to limit inflow and infiltration such as eliminating flow from weeping tiles and roof leaders from entering the sanitary sewers. Through these actions, it is possible to limit the inflow and infiltration from future development areas.

For the purpose of projecting Wastewater flow to evaluate Wastewater Treatment Options the infiltration value of 0.1 l/s/ha is applied only over the net developed area. For future growth areas approximately 23% of gross area is assumed to be undeveloped due to land constraints and a further allowance of 40% is provided for municipal infrastructure like roads, utilities, etc. We have also assumed that the system will experience wet weather flow for 60 days of the year and dry weather flows for the balance.

3.1.5 Wastewater Flow Projections

Wastewater Flow projection calculated using the design criteria are provided in Appendix D. A summary of Wet Weather Flow is provided in the following table 3.2.

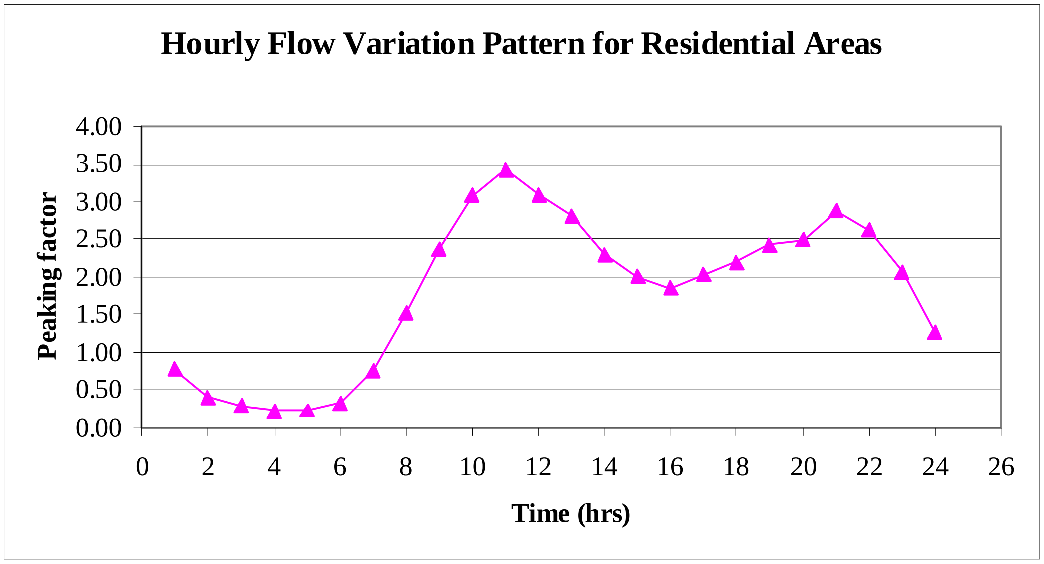
Table 3.2 Wastewater Flow Projections

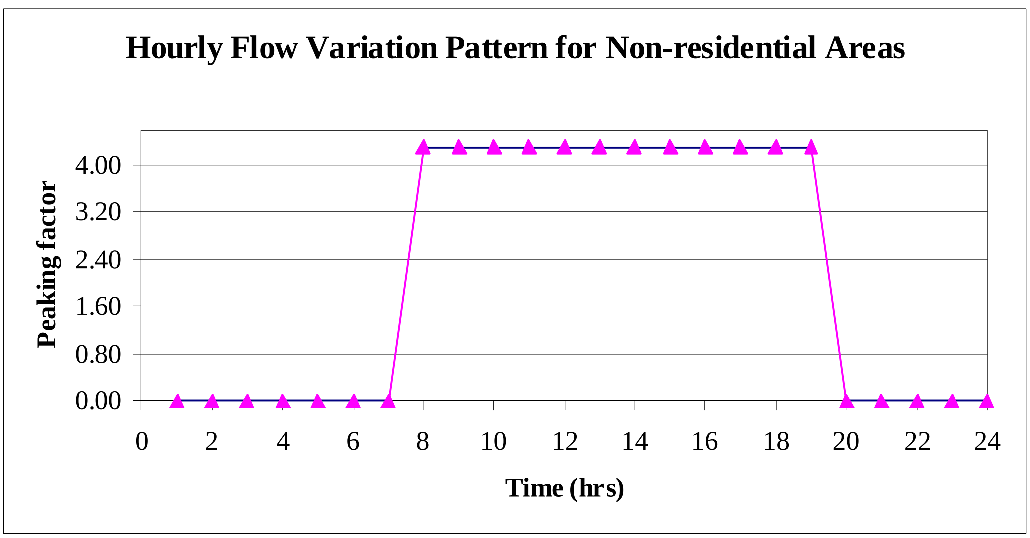
		Dry Weather Flow	Inflow & Infiltration	Wet Weather Flow
Year	Population	m3/day	m3/day	m3/day
2007	2,178	542 (Actual[11])	674	1,215
2012	2,650	1108	830	1,938
2017	3,072	1,384	962	2,346
2027	4,128	2,084	1,293	3,378
Ultimate	43,575	20,312	10,167	30,479

3.2 Design Criteria and Assumptions

Sanitary sewer modeling was based on the design criteria outlined in Table 3.1. The typical hourly flow variation patterns for residential and non-residential sewage used in the model are shown in the following graphs.

[11] Value from actual Water consumption data (2006 and 2007) obtained from SCADA


Hourly Flow Variation Pattern for Residential Areas
Peaking factor
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Time (hrs)


Hourly Flow Variation Pattern for Non-residential Areas
Peaking factor
4.00
3.20
2.40
1.60
0.80
0.00
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (hrs)

3.3 Objectives

- To evaluate the performance and adequacy of the existing system to collect and convey the sewage flow to the treatment system (lagoon).
- To identify sewer pipes that require upgrading to avoid flooding of manholes and to minimize surcharging of gravity sewers.
- To propose and design conceptual sewer network and appropriate pump capacity of lift stations for future expansion.

XPSWMM version 10.6.2 was used to carry out the hydraulic analysis of the existing and future sewer network.

3.4 Review of the Existing Model

Morrison Hershfield reviewed the existing model and identified the following issues:

- Some very minor surcharging of gravity sewers (i.e., flow hydraulic grade line is higher than sewer crown) was noted in the lane between 96 Street and 97 Street from 100 Avenue to 99 Avenue. Some limited surcharging can be accepted as long as it occurs rarely in exceptional I&I events and does not rise to a level where it causes any back-up into basements which is the case here.
- The existing model result indicated lower mean sewage flow.
- Two gravity sewers with a diameter of less than 200 mm were replaced by 200 mm diameter pipe.

3.5 Future Expansion – Methodology and Overview

Development phases 5 year (2012), 10 years (2017), 20 years (2027) and Ultimate Phase were considered for the future expansion of sanitary sewers.

In comparison to a water network, the sewer network is dependent on the ground profile (contour) to a greater degree. The desired strategy with sewer network design is to maximize gravity flow and minimize pumping. The proposed layouts of sanitary trunk mains for all future development plans were aligned to maximize the possibility of gravity flow.

Three basic scenarios were developed:

1. Conventional servicing based on ultimate full development of the total study area and then phasing the system expansion as the Town grows.
2. Conventional servicing of the ultimate full development of the area within the current Town boundary and servicing of the Fringe Area by low-pressure sewer.

3. Focus on conventional servicing of the area within the proposed 20-year development envelope with no allowance to service the lands outside this envelope.

With option 1, the proposed trunk mains were sized for future flows beyond 2027 to service ultimate development stages as far as possible. The purpose of this design approach is to provide the town with infrastructure that is capable of catering to the demand for future growth. This would avoid duplicating gravity sewer mains in future. The additional cost associated with providing excess capacity is minimal compared to the cost of duplicating or upgrading sewer mains in future.

With option 2, the size of the mains within the Town boundary can be reduced since with the low-pressure sewer system there is no infiltration.

With option 3, the number of mains is reduced and size of the mains is further reduced due to the reduced service area.

The conceptual development plan for the town in 5 year, 10 year, 20 year and Ultimate Development phases was marked on the map of the town. The proposed future sanitary sewer lines are indicated on the conceptual plan for all expansion phases.

3.6 2007 – Existing Collection System

Analysis of the wastewater model indicated that a small one block area in the lane between 96 Street and 97 Street from 100 Avenue to 99 Avenue may experience minor surcharging. It is recommended these pipes be monitored to establish if there is a need for replacement.

A flow-monitoring program to establish the inflow and infiltration level is recommended. A permanent installation of flow meters is recommended at the inlet pipes at all three existing lift stations. The program should start at the Heritage Park LS which receives the entire waste water flow from town. By comparing the flow against water consumption and rainfall data, we can establish both baseline dry weather flow and infiltration/inflow during storm events. The flows generated within the sub catchments served by the other two lift stations can then be tabulated and the I & I figures from each catchment compared. It may then be possible to narrow down a particular area of the Town that is causing the greatest amount of inflow and infiltration. Temporary flow monitors could then be placed in some specific pipes within the targeted area in order to identity which areas, if repaired, would provide the most benefit. This data is also required to calibrate the wastewater model.

3.7 Future Expansion 5 Year Development Phase

3.7.1 Option 1 - Conventional

We first looked at Option 1, the conventional system serving the full study area and then looked at what parts of the system fell within the 5-year development boundary. The 5-year development plan is based on servicing a population of 2,650, which is expected in year 2012 based on the population growth projections. The sewer layout is developed (See Figure 3.1) to accommodate sewage flows from areas within the 5-year growth envelope, which includes south, north, and east of Highway 2 in addition to the current developed areas.

Two major trunks traversing from northwest to southeast were proposed. The sewers were sized so that they can provide adequate service up to the ultimate development stage. The existing Heritage Park Lift Station (LS-HP) receives additional flows from new areas to the east of Highway 2 and to the south of 95 Avenue. The model indicates the capacity of existing pumps will be sufficient to meet the additional flow at this phase. However, the existing pumping station wet well capacity needs to be upgraded to provide additional 15m3 of volume.

Four new lift stations (LS-EHW2, LS-N04, LS-N20 and LS-N11) are proposed to transport sewage from the other new areas and also to service during the next 10 years and 20 years of consecutive development stages.

3.7.2 Option 2 – Low Pressure Sewers in Fringe Area

Option 2 is similar to option 1 with the exception that with the planned low-pressure sewer collection system in the fringe area, the flows are reduced resulting in smaller pipes and lower capacity lift stations. Refer Figure 3.2

3.7.3 Option 3 – 20 Year Growth Envelope Only

With the assumption that no additional capacity is provided for lands beyond the 20-year development envelope, we can eliminate two of the proposed lift stations, reposition the other two and reduce the size of many of the trunk mains. Refer Figure 3.3. This results in a substantial cost saving.

3.8 Future Expansion 10 Year Development Phase

3.8.1 Option 1 - Conventional

The 10-year development plan is based on servicing a total population of 3,072, which is expected in year 2017. The 10-year sanitary sewer layout (see Figure 3.4) was developed to accommodate sewage flows from areas within the 10 year growth envelope which includes areas further south, north and north east in addition to the sewer line added for

2012 expansion phase. New sewer lines were added in the north, northeast and further south for the 10-year development stage. The sewers were sized so that they can provide adequate services beyond the proposed 2017 development stage within the catchments shown in Figure 3.4. The new lift stations proposed in the five-year plan have the capacity to service this development stage.

3.8.2 Option 2 – Low Pressure Sewers in Fringe Area

As with the 5-year development phase above, the overall servicing concept is the same as option 1. Line sizes and lift station capacities have been adjusted to account for the reduced flows generated in the fringe area by going to a low-pressure sewer collection system for these outlying areas. Refer to Figure 3.5.

3.8.3 Option 3 – 20 Year Growth Envelope Only

As services are expanded to service the lands within the 10-year envelope, additional pipes are added but no new lift stations. Refer to Figure 3.6.

3.9 Future Expansion 20 year Plan

3.9.1 Option 1 - Conventional

The 20-year development plan is based on servicing a total population of 4,128, which is expected in year 2027. The 20-year sanitary sewer layout (see Figure 3.7) was developed to accommodate sewage flows from areas within the 20-year growth envelope. The additional sewers lines are sized to provide adequate service beyond 2027 development stage.

In addition to the sewer lines proposed in the previous development stages, two major parallel major sewer lines traversing west to east were proposed south of the Town. The first sewer line would gravitate to the lift station (LS-EHW2) proposed in the earlier development phase and the second would gravitate directly to the lagoon. The new lift station (LS-EHW2) proposed for 2017 development stage has a capacity to maintain service for 2027.

The topography of the area doesn't allow handling an emergency overflow during power interruption and it is recommended that a standby generator be provided at all the new lift stations.

3.9.2 Option 2 – Low Pressure Sewers in Fringe Area

As with Option 1 above, additional mains are added to service the lands within the 20-year development envelope. Line sizes and lift station capacities have been adjusted to account for the reduced flows generated in the fringe area by going to a low-pressure sewer collection system for these outlying areas. Refer to Figure 3.8.

3.9.3 Option 3 – 20 Year Growth Envelope Only

The 20-year development envelope represents full build-out for this option. Refer to Figure 3.9. Additional mains are added in the south to handle the additional lands added. This area will flow by gravity direct to the lagoon.

3.10 Future Expansion Ultimate Phase

For Option 1 and 2 we have allowed for servicing of the full study area.

3.10.1 Option 1 - Conventional

At full build-out this area can support a population of approximately 43,575. This is likely to happen around Year 2108. The Ultimate phase sanitary sewer layout (see Figure 3.10) was developed to accommodate sewage flows from all areas within the study boundary. At this phase the sewer network is extended to the entire study area. All the four lift stations proposed during the earlier phases require upgrade to service the increased sewage inflow from the additional areas.

3.10.2 Option 2 – Low Pressure Sewers in Fringe Area

As with Option 1 above, additional mains are added to service all the lands within the study boundary. Line sizes and lift station capacities have been adjusted to account for the reduced flows generated in the fringe area by going to a low-pressure sewer collection system for these outlying areas. Refer to Figure 3.11.

3.11 Conclusion

The existing sanitary sewer system was reviewed to evaluate its adequacy to collect and convey sewage to the treatment system (lagoon). Sewer network expansion is proposed during 5 year, 10 year, 20 years and Ultimate expansion phases. New lift stations are proposed during the 5-year phase and an upgrade of the lift stations is required during the Ultimate Development phase. It is recommended that standby generators be provided at lift stations to handle emergency overflow during main power supply interruption.

The approximate quantities of pipe in each development phase are summarized in Table 3.1 and a summary of proposed work for different development phases is provided in Table 3.2.

Table 3.3
Approximate sewer size and lengths required at each development phase
Option 1

Pipe Diameter (mm)	Pipe Length (m)			
	2012	**2017**	**2027**	**Ultimate**
200	315			
250	550			295
300		975	1,570	2,390
450	2,705	1,220		5,415
525	1,300		1,585	495
600	1,120	1,135	1,095	
900	2,735			

Table 3.4
Approximate sewer size and lengths required at each development phase
Option 2

Pipe Diameter (mm)	Pipe Length (m)			
	2012	**2017**	**2027**	**Ultimate**
200	315	1,400	1,570	785
250	550			295
300	3,340	1,370	2,680	2,905
375				3,795
450	1,805	795		
525				
600	2,735			

Table 3.5
Approximate sewer size and lengths required at each development phase
Option 3

Pipe Diameter (mm)	Pipe Length (m)		
	2012	**2017**	**2027**
200	2,015	3,240	3,945
250	550		670
300	3,105		

Table 3.6 Proposed Sewer Upgrades – Option 1

Year	Proposed Expansion/Upgrading	Remark
2007	Monitor the flow condition in the critical sewer pipes and monitor flow at all lift stations. Calibrate the Wastewater model. Carry out I & I mitigation program	
2012	Approximately 9.945 km long sewer pipe of different diameters is required for the new development area. Expand Heritage Park Lift station sump based on flow monitoring Four new additional pump stations (LS-EHW2, LS-N04, LS-N11 and LS-N20) are required. Provide standby emergency generators at new lift station (recommended).	
2017	Approximately 3.33 km long sewer pipe of different diameters is required for the new development area.	
2027	Approximately 4.25 km long sewer pipe of different size is required for the new development area.	
2108 (Ultimate)	Approximately 8.6 km long additional sewer pipe of different size (see Tables 3.3 & 3.4) is required for the ultimate development area.	

Table 3.7 Proposed Lift Stations

Option 1

Lift Station Name	Model ID	B.E.P.	
		Discharge (l/s)	H (m)
LS-EHW2	FLYGT NP3153.181 LT	85.1	6.89
LS-N04	Mody MS 252	22.9	5.9
LS-N11	FLYGT NP3171.180 MT	84.4	16.8
LS-N20	Mody MS 252	22.9	5.9

Option 2

Lift Station Name	Model ID	B.E.P.	
		Discharge (l/s)	H (m)
LS-EHW2	FLYGT NP3171.180 MT	84.4	17
LS-N04	Mody MS 252	22.9	5.9
LS-N11	FLYGT NP3202.180 HT	99.1	31
LS-20	Mody MS 252	22.9	5.9

Option 3

Lift Station Name	Model ID	B.E.P.	
		Discharge (l/s)	H (m)
LS-HP	NP3171.181 HT	60	30
LS N04	Mody MS 252	22.9	5.9
LS-20	Mody MS 252	22.9	5.9