

Acheson & Big Lake Area Wastewater System Study – 2022 Update

Final Report

Parkland County

60662782

November 2022



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November 15, 2022

Project #
60662782

Subject: – Acheson & Big Lake Area Wastewater System Study – 2022 Update

Dear Brandi:

AECOM is pleased to submit our final report for the Acheson and Big Lake Area Wastewater System Study.

Sincerely,
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Parkland County

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1. Introduction

1.1 Background

Parkland County has maintained a Wastewater Master Plan for the Acheson and Big Lake Area (ABLA) since 2006. The most recent version of the plan was updated in 2016. The goal of this assessment is to update the Master Plan with development that has occurred within ABLA in the last 6 years, perform a detailed model calibration, validate system recommendations, review system operations and provide recommendations, and a road map for future development.

The wastewater system in the ABLA generally consists of gravity services, trunks and mains as well as lift stations and forcemains which convey the wastewater to the Alberta Capital Region Wastewater Commission System. The assessment will determine the capability of the wastewater systems in providing servicing throughout the ABLA and will identify and provide a solution for any identified deficiencies. The study will also utilize population and area development projections to provide a roadmap for infrastructure projects required for system expansion. The assessment will be focused on providing adequate servicing for future development while maintaining or improving the existing system level of service. In addition, through the detailed model calibration, areas with high infiltration and inflow (I/I) will be identified along with system improvements for reduction.

Parkland County has seen ongoing requests for development. The County has undertaken several projects with the goal of improving and expanding the capacity of their water and wastewater systems to support the ongoing development. Parkland County is also maturing its Wet Weather Management Plan that is part of its Discharge Permit with Alberta Capital Region Wastewater Commission (ACRWC) that requires regular assessment of I/I entering the system and a plan to reduce I/I in the near future. I/I is assessed in increased detail to compare with ACRWC requirements.

1.2 Scope of Work

In general the scope of work will include the following:

- ◆ Data collection and review.
- ◆ Review of flow monitoring at various locations within the system to adequately calibrate and validate the model. Flow monitoring was conducted during the 2021 season and additional data from ACRWC was utilized.
- ◆ Calibration of dry and wet weather flows using flow and rainfall data, water consumption and pump data.
- ◆ System evaluation of the collection system to identify any performance deficiencies. Implementation plan development to prioritize the upgrades.
- ◆ Provide a roadmap for servicing concepts for future development including concept alignments, locations, triggers, and timing of infrastructure upgrades.
- ◆ Evaluate the system I/I and opportunities for improvement in line with ACRWC requirements.
- ◆ A report detailing the findings with figures of the assessment results, and cost estimates for recommended work.

2. Study Data

2.1 Study Area

The study area includes the Acheson Industrial Area and Big Lake Areas referred to as Acheson and Big Lake Area. ABLA is located immediately west of Edmonton and is bordered by the City of Edmonton to the east, City of Spruce Grove to the west, Big Lake and Atim Creek to the north, and Highway 628 to the south. Highway 16 separates Big Lake and Acheson areas; with the Big Lake area to the north, and the Acheson Industrial area to the south. Highway 60 runs in the north-south direction through the study area. The entire study area covers approximately 7,700 hectares. The study area is shown in Figure 2.1; the figure also includes the eight economic zones within the Acheson area and various areas of environmental importance. The existing topography of the study area is shown in Figure 2.2.

For the portion of the study area north of Highway 16, the Big Lake Area Structure Plan (ASP) July 2013 Consolidation generally identifies these lands as being county residential with pockets of neighbourhood commercial areas. For the area south of Highway 16, the 2020 Acheson Industrial Area Structure Plan, future land use concept identifies the lands as being primarily industrial and commercial/light industrial. The 2020 Acheson Industrial ASP also identifies; two special study areas, two recreational areas, the existing Osborne Acres residential subdivision and its surrounding 200 m development restriction area, as well as the Wagner Natural Area. The ASPs, available on www.parklandcounty.com, contain detailed maps of the land uses described above. For the purposes of this study, it is assumed the entire area south of Highway 16, with the exception of the Wagner Natural Area and Osborne Acres, will eventually be developed with full water servicing.

The Atim Creek / Big Lake Floodplain Overlay, identified in Section 10.2 of Parkland County's Land Use Bylaw No. 2017-18, was used to create the boundary between the proposed unserviced lands (Open Space, Golf Courses and Lois Hole Provincial Park) to the north and the serviced country residential area to the south. This overlay is defined as the 1:100 year Flood Plain for Big Lake plus 0.5 m consistent with the Big Lake Basin Task Force: Floodplain Delineation for Atim Creek from Campsite Road to Big Lake Study (Sameng, 2007), and is shown on Figure 2.3. The overlay restricts land use in the area north of the 1:100 year + 0.5 m boundary, regardless of the underlying land use district. Therefore, for the purposes of this Study, the lands north of the defined boundary were not considered to be developable lands.

Since the area to the south of the Wagner Natural Area is located in the Natural Area's groundwater recharge zone, as indicated on Figure 2.3, care must be taken when developing in this area to ensure that groundwater recharge is not interrupted nor affected. Developers will need to undertake necessary subsurface investigation, under the supervision of a Professional member experienced in hydrogeology, to ensure proposed underground infrastructure has no significant long-term impact on the groundwater flow system of the Wagner Natural Area.

Also, developers need to be aware of the potential for both active and unforeseen groundwater flow conditions in and around the Wagner Natural Area. Active groundwater conditions include, but are not limited to: high water tables, flowing artesian conditions, and strong upward water flow. Furthermore, the area in and around the Wagner Natural Area is known to have buried sand channels with no surface expression. These buried channels are focal points for groundwater flow and could pose potential problems associated with pipeline construction. For the purpose of this Study, it was assumed that the development within this area would be developed with full water servicing similar to the other industrial areas.

2.2 Development Staging Scenarios

For this Study, Parkland County's Planning and Engineering Departments recommended the following four development staging scenarios, shown on Figure 2.3, be considered and modelled as having wastewater servicing:

- ◆ Existing development (serviced in 2022)
- ◆ Near Future development (next 5-10 years)
- ◆ Long Term development (10 to 25 years)
- ◆ Ultimate development (26 years +)

In the Existing development stage, the total serviced area includes serviced lots within the Acheson and Big Lake area that have active water billing accounts in 2022. The County does not have metered wastewater accounts, therefore, for this study, it was assumed that lots with active water billing accounts also have active wastewater services. Developed lots without an active service were not considered as Existing development. The Near Future and Long Term development areas are expected to be the next greenfield areas to be developed (as estimated by Parkland County's Planning and Engineering Departments) and are either easily serviceable areas, or infill development areas. Easily serviceable areas are defined as lots within developed subdivisions that are not serviced to date in 2022; but may have wastewater mains adjacent with service connection stubs available. For residential areas, these are typically empty lots or partly constructed. For industrial areas, this could be lay down or storage yards, or empty lots not yet constructed on. The Ultimate development stage considers full build-out of the entire study area and assumes full development of the existing developed area.

It was assumed that 2% of the gross industrial area will be dedicated to roadways, 3% will be dedicated to public utility lots such as stormwater management facilities and 10% will be allocated to reserves (environmental and municipal). The not to be serviced areas also include golf courses, lands within the Atim Creek / Big Lake Overlay Area, and future planned highway expansion areas. Special servicing requirements are indicated on Figure 2.3 with a star to show a service connection of a small portion of a large lot such as a golf course where only the clubhouse would be serviced.

2.3 Population Data

Current population and forecasting data was provided by Parkland County. For residential land uses, a population density of 2.8 persons per dwelling was utilized, consistent with previous studies. Based on the water billing records provided by Parkland County, as of July 2022 there are 606 serviced lots within the Big Lake area (corresponding to 1,051 ha). Using a population density of 2.8 persons per dwelling, the total serviced population within the Big Lake area is 1,696 people. In the 2016 Study, the serviced population was approximately 1,352 people. This equates to a 2.9% growth rate over the last 7 years.

For future residential development in the Big Lake area, a population density of 2 dwellings/gross hectare and 3 persons per dwelling were used to determine the serviced population. The Near Future development scenario includes an additional population of 1,332 people, for a total serviced population of 3,028 people. The Long Term development scenario considers full development of the Big Lake residential area. The additional population for the Long Term scenario is 948 people, for a total serviced population of 3,976. The Osborne Acres area provides an additional population 972 persons. Due to the high cost of servicing these lots, it is anticipated that the servicing will not be in place until the Ultimate development scenario. Therefore, the serviced population for the Ultimate development scenario is 4,948. Table 2.1 outlines the residential population projections for Big Lake and Osborne Acres.

Table 2.1: Population Projections Summary – Big Lake Residential & Osborne Acres

Development Stage	Residential Served Area Increase (ha)	Total Residential Served Area (ha)	Served Population Increase	Total Served Population
Existing Development	-	179	-	1,696
Near Future Development	222	401	1,332	3,028
Long Term Development	158	559	948	3,976
Ultimate Development	162	721	972	4,948

2.4 Data Collection

Relevant data was collected from the County and included the following:

Existing Reports

- ◆ Wet Weather Discharge Permit, Alberta Capital Region Wastewater Commission.
- ◆ Parkland County Design Standards dated June 2014 Amended March 2015 (to be updated in 2022).
- ◆ Available relevant reports including the previous Water and Wastewater System Studies.
- ◆ I/I Assessment and Wet Weather Flow Management Plan submitted to ACRWC.
- ◆ Development servicing reports.

Growth Data

- ◆ Population and land use data.
- ◆ ABLA ASP information.
- ◆ Development forecasts.

Infrastructure Plan and Drawings

- ◆ As built drawings of water and wastewater infrastructure constructed and proposed since 2016.
- ◆ Concept design reports for Zones 4, 5, 6, 7, 8 including road alignments and grade constraints.
- ◆ GIS information.
- ◆ LiDAR data.

System Models

- ◆ The 2016 XPSWMM model of the Parkland County Acheson and Big Lake Area Wastewater System.

Flow and Rainfall Monitoring Data

- ◆ Available flow monitoring data from both ACRWC and Parkland County.
- ◆ Wastewater SCADA data including lift station pump run times and flows.
- ◆ Available rainfall monitoring data.

Water Consumption Data

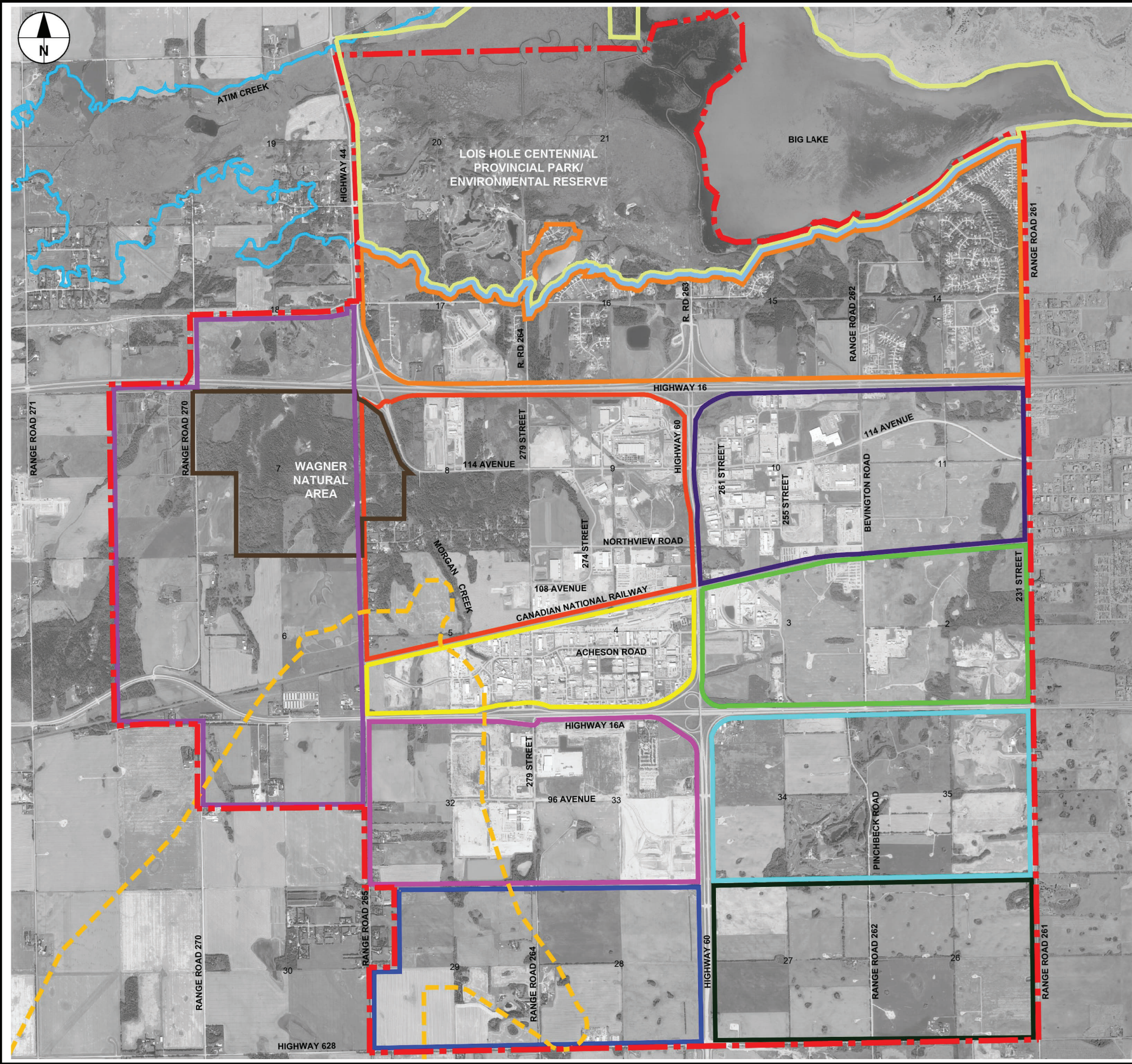
- ◆ Available water consumption data for residential and non-residential users, high and low demand users.
- ◆ Lot level consumption data.

Condition Assessment Data

- ◆ CCTV reports.
- ◆ Available geotechnical and groundwater data to define areas with high groundwater.

Other Data

- ◆ Operation and maintenance staff will also be interviewed to assist in the identification of areas with high Inflow/Infiltration and high groundwater.
- ◆ Off Site Levy Bylaw and Utility Rate Model.

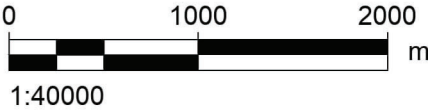


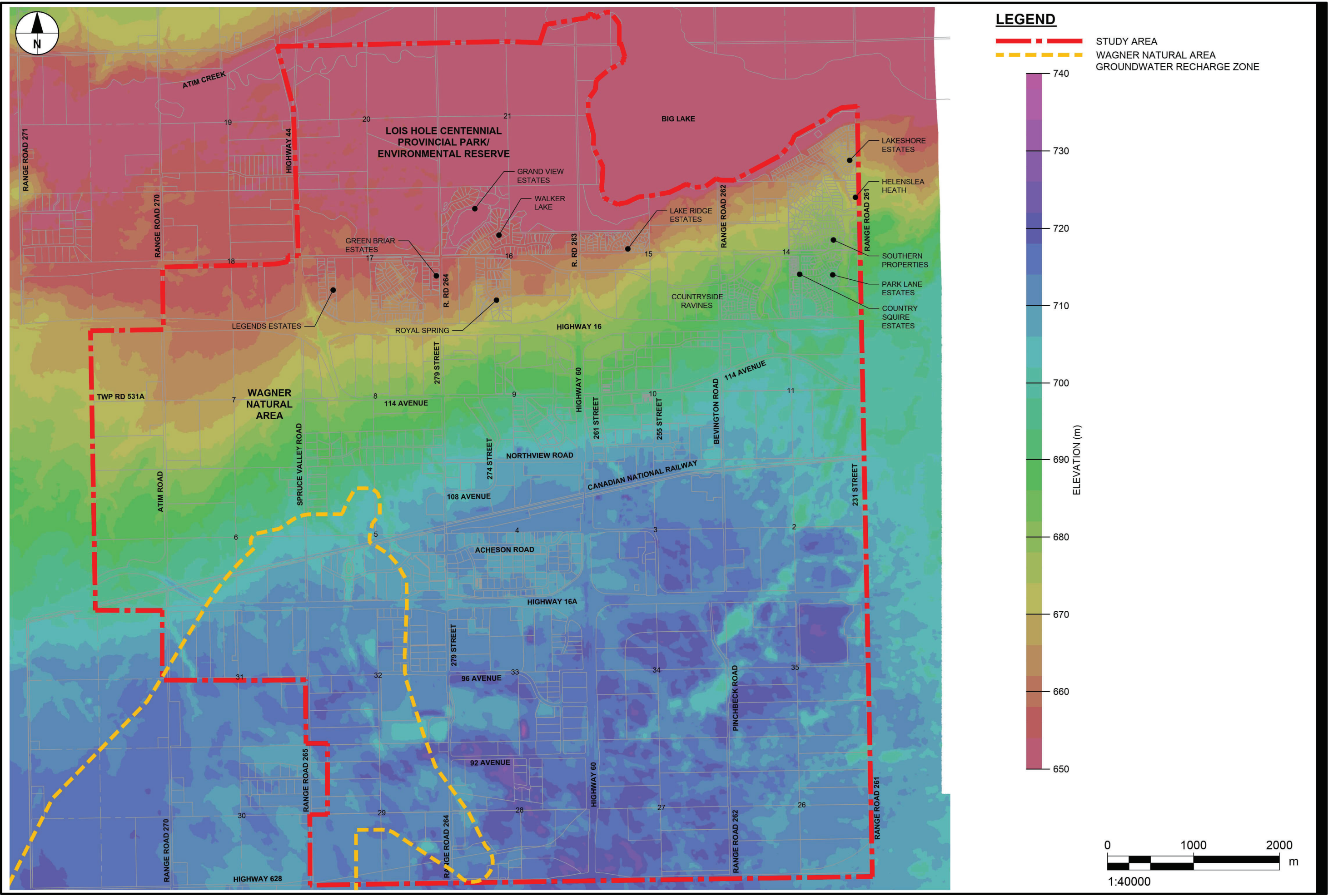
LEGEND

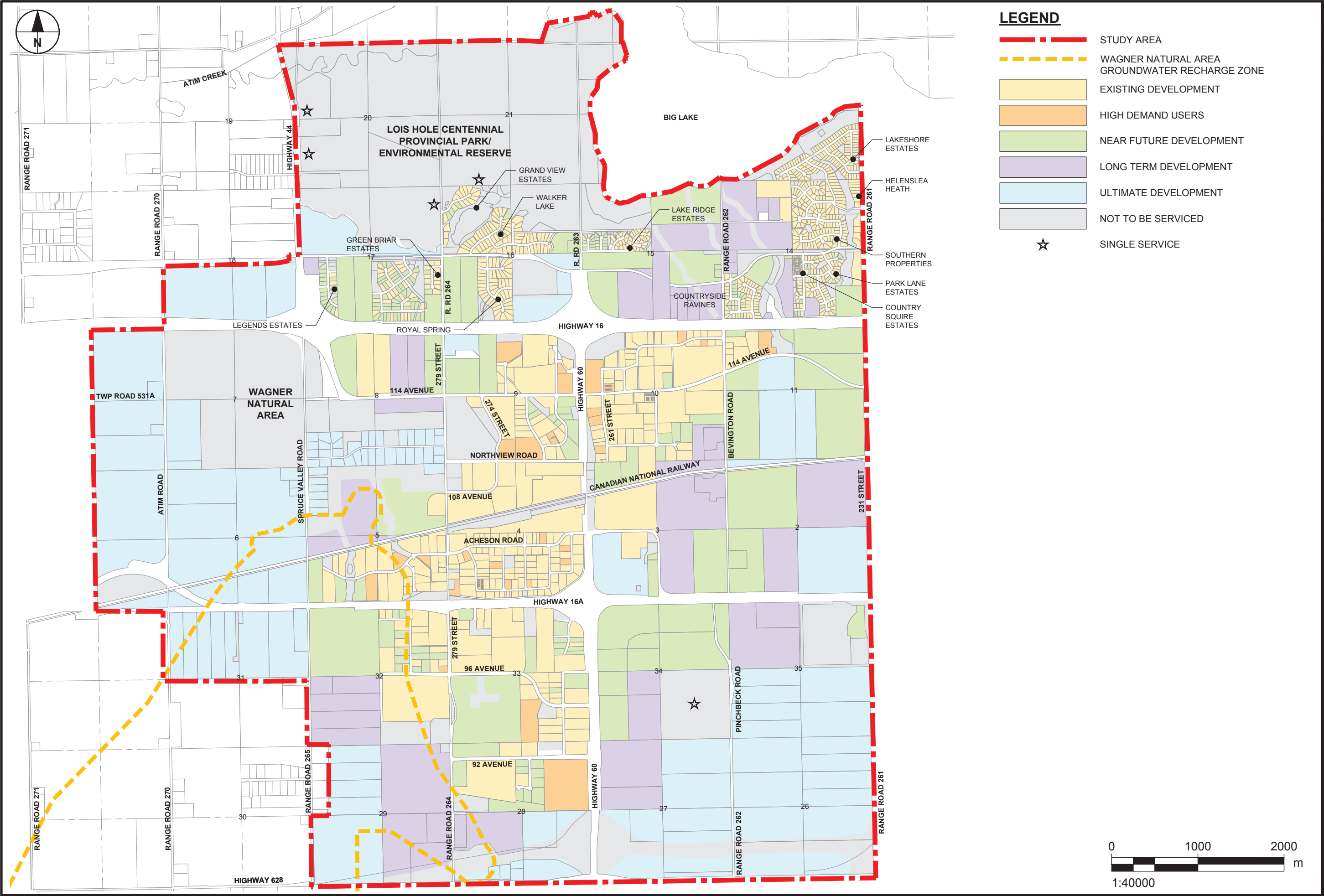
- STUDY AREA
- BIG LAKE FLOOD DELINEATION (1:100 YEAR FLOOD)
- WAGNER NATURAL AREA
- LOIS HOLE CENTENNIAL PROVINCIAL PARK / ENVIRONMENTAL RESERVE
- WAGNER NATURAL AREA GROUNDWATER RECHARGE ZONE

LEGEND:

- ZONE 1
- ZONE 2
- ZONE 3
- ZONE 4
- ZONE 5
- ZONE 6
- ZONE 7
- ZONE 8
- ACHESON WEST AREA
- BIG LAKE AREA STRUCTURE PLAN (MODIFIED TO FOLLOW THE BIG LAKE 1:100 YEAR FLOOD DELINEATION)







3. Existing System Assessment

3.1 System Description

The existing sanitary sewer system within Acheson, shown in Figure 3.1, generally flows from south of Acheson to the north via two main trunks known as the Acheson Trunk and the Bevington trunk. The Acheson trunk runs along 279 Street/Range Road 264 by gravity from Acheson Road to the ACRWC system and services the area west of Highway 60 including Zones 1, 3, 5, and 7 and the east most areas of Zones 2 and 4. This trunk ranges from 525 to 675 mm in diameter. The Bevington Trunk runs along the Bevington Road allowance (also called Range Road 262) from Highway 16A to north of Highway 16 where it ties into a 525 mm diameter line in Lake Ridge Estates. This trunk ranges from 450 mm to 750 mm in diameter with the majority of the line being 600 mm in diameter. The Bevington Trunk services area to the east of Highway 60 and will ultimately service the remaining undeveloped areas in Zones 2, 4, 6 and 8.

Both the Acheson Trunk and Bevington Trunk convey wastewater to the Parkland Sewage Transmission System (PSTS) which is part of the ACRWC system. The PSTS consists of a gravity line which starts at Stony Plain, runs through Spruce Grove, and then to the Parkland Pump Station located on the south side of Big Lake, where it is pumped and eventually flows to the ACRWC Wastewater Treatment Plant. The PSTS is 1350 mm in diameter at the Acheson connection point. Parkland County has four other connections to this line from residential subdivisions in Big Lake. The pipes within the residential subdivisions range from 200 mm to 525 mm in diameter.

There are currently three lift stations in operation in the ABLA. Areas south of Highway 16A (Zone 5 and Zone 7) are generally serviced by gravity to the Zone 5 Lift Station with the exception of several lots near the intersection of Highways 60 and 16A which drain to the north by gravity. The lift station has lead and stand-by pumps each with a capacity of 160 L/s (at 16 m of head) and a 450 mm forcemain discharging to the Acheson trunk.

A second pump station with a current capacity of 23.8 L/s is located in Zone 7 south of Highway 16A. This station was recently commissioned and was not in service when the model was calibrated.

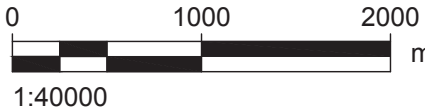
A third pump station is located west of the Acheson Trunk in Zone 3. This lift station services has lead and stand-by pumps each with a capacity of 53 L/s (at 19.6 m of head) and a 146 mm forcemain discharging to the 375 mm gravity main on Acheson Road.

Most of the residential system is gravity with the exception of Grandin Estates, Green Briar Estates, and part of Walker Lake which are located along the north end of Range Road 264 as well as some lots within Helenslea. These subdivisions are serviced by low pressure wastewater mains. There are also a number of residences that have septic tank pump systems which tie into gravity manholes.

3.2 Model Development

XP-SWMM, an industry accepted modelling software program, was used to develop the detailed model of the existing sanitary sewer system. The model features the XP-SWMM runoff layer, which generates wet weather flows to represent inflow and infiltration (I/I). It also features the XP-SWMM hydraulics layer, which simultaneously simulates the dry and wet weather. These two layers allow for the collection of simulated data for both dry and wet weather flows.

The model was built on previous work completed as part of the 2011 and 2016 studies. Physical data including manhole rim elevation, invert elevation, pipe diameter, and slope was obtained from as built drawings and GIS data provided by the County.



3.3 Model Calibration

The model calibration consists of two parts:

1. Dry weather flow, and
2. Wet weather flow.

Details on the model calibration are discussed in the following sections.

3.3.1 Flow Monitoring Data

Past model calibrations were based on limited flow monitoring data at the downstream end of the system which did not allow for differentiation between parts of Acheson and Big Lake. For this study, flow monitoring data was collected at 6 sites throughout ABLA for the months of June through October 2021. Flow monitoring services were provided by BOTCorp who provided installation, monthly downloads and data hosting services. In addition, data from ACRWC's two monitors located on the Acheson and Bevington trunk were also used, as well as flow data from the Zone 5 pump station.

Flow monitoring locations are illustrated on Figure 3.2.

3.3.2 Dry Weather Flow

With the majority of the development being industrial, the flow and consumption pattern differ from that of a typical municipality. While some businesses consist of a large land area, they may only have a few employees and therefore use very little water and generate very little wastewater. Conversely, there are large industrial operations that have significant water needs and can generate large amounts of wastewater. Water billing records were used as a starting point for dry weather flows to account for this variation.

The dry weather flow calibration was undertaken on a site-by-site basis. Average daily water consumption was inputted by parcel based on billing data.

Several periods of dry weather flow were selected from the monitoring data. The datasets were reviewed, and the average sewage generation rates were calculated based on the population/area and monitored volume, and then compared to the water consumption data. Diurnal patterns were calibrated so that the modelled data displayed peaks of similar magnitude and at similar times as the monitoring data. Groundwater base flows were also estimated based on the flow monitoring data. The dry weather calibration data is summarized in Table 3.1.

Base flows were estimated based on the minimum flows experienced and may be an indication of groundwater infiltration into the system. This was determined by using the average minimum flows at each site monitor location and dividing it by the catchment area to determine the groundwater base flow in L/ha/day. Zones 3 and 4 appear to experience the highest base flows. However, this base flow may not consist entirely of infiltration only as some businesses may operate for 24 hours and may produce wastewater consistently over a 24 hour period.

Table 3.1: Dry Weather Flow Data Inputs

Meter Site	Location Description	Catchment Area (ha)	Average Water Consumption (L/ha/d)	Weekday Peaking Factor	Diurnal Peaking Factor	Approximate Time of Peak	Groundwater Base Flow (L/ha/d)	Average Dry Weather Flow (L/s)
Site 1	Zones 1&2	142.8	852	1.4	2.8	1-2 PM	669	2.3
Site 2	Zones 1&2	129.3	531	1.0	2.4	3-4 PM	320	0.8
Site 3	Zone 1	70.3	641	1.1	2.0	8-9 AM	286	1.7
Site 4	Zones 3&4	127.5	998	1.3	2.5	11 AM -12 PM	1683	5.4
Site 5	Zone 5	190.7	3455	1.8	2.4	5-6 PM	471	11.2
Site 6	Zone 5	125.2	277	1.2	2.4	1-2 PM	451	1.7

The average wastewater generation rate was estimated in each site catchment based on the average water consumption billing data provided by the County's water billing records. At the majority of the sites, weekday wastewater generation was higher than average by a factor of 1.1 to 1.8 with Site 5 having the greatest difference between weekend and weekday flows. Site 5 includes the Champion Pet Foods facility which has the highest water use in Acheson. For this site, generation patterns were based on flow data which have a later time of peak than most of the areas in Acheson. This is due to the Champion Pet Foods undertaking plant cleaning in the overnight period.

Modelled flows and volumes were then compared to monitored flows and volumes. Graphs illustrating monitored vs. modelled dry weather flow for each site are shown on Figure 3.3. A summary of the dry weather flow calibration is provided in Table 3.2.

Table 3.2: Dry Weather Flow Results

Meter Site	Monitored Peak Flow (L/s)	Model Peak Flow (L/s)	Model / Monitored Flow Ratio (%)	Monitored Volume (m³)	Model Volume (m³)	Model/Monitor Volume Ratio (%)	Comparison Flow/Volume
Site 1	3.70	3.63	98.2 (-1.8)	196.29	197.35	100.5 (+0.5)	Good/Good
Site 2	1.39	1.32	95.3 (-4.7)	73.64	79.29	107.7 (+7.7)	Good/Good
Site 3	3.27	3.11	95.1 (-4.9)	147.70	157.97	107.0 (+7.0)	Good/Good
Site 4	10.39	10.15	97.7 (-2.3)	468.27	511.99	109.3 (+9.3)	Good/Good
Site 5	13.99	13.81	98.7 (-1.3)	970.14	1,006.89	103.8 (+3.8)	Good/Good
Site 6	2.53	2.48	98.3 (-1.7)	144.30	133.99	92.9 (-7.1)	Good/Good

The model results are compared to the monitored values as a percentage. Results within 10% are considered good, from 10 to 20% are considered fair, and results differing by greater than 20% were considered high or low. In general, the dry weather flow modelled volumes and peak flow rates were very consistent with the monitored data.

3.3.3 Wet Weather Flow

Wet weather flow was calibrated using rainfall events from summer 2021. A summary of the events utilized for the calibration is provided in Table 3.3. The rain events selected were the largest that occurred during the 2021 monitoring period. The event in September was not captured by the BOTCorp rain gauge.

Table 3.3: Rain Gauges

Date	BOTCorp Rain Gauge Rainfall Depth (mm)	County Rain Gauge Rainfall Depth (mm)
July 21, 2021	11.4	11.2
August 23, 2021	25.2	29.5
September 1, 2021	-	15.8

The region experienced lower than average total rainfall in the summer of 2021; however, there were still some heavy rainfall events. All the rain events had a return period less than a 1 and 2 year. The largest event occurred on August 23, 2021 with between 25 and 30 mm of rain. The following rain data was used to calibrate the model.

Table 3.4: Calibration Events

Date	Rainfall Depth (mm)	Duration (hours)	Average Intensity (mm/h)	Peak Intensity (mm/h)	Estimated Return Period
July 21, 2021	11.2	1	11.2	64	<1:2 year
August 23, 2021	29.5	23	1.28	6.1	<1:2 year
September 1, 2021	15.8	16.5	0.96	6.0	<1:2 year

Although the July event only had 11 mm of rain it was over a very short time period and had a very high intensity. The August event had the highest amount of rain and the longest duration while the September event was in between the two.

The RTK method was used to calibrate the wet weather flow in the model. The RTK calibration method allows the shape of the wet weather flow curve to be matched in both peak and tail and will be an improvement over the effective area method used in the previous models. This method involves an R value, which is the total fraction of rainfall that becomes I/I entering the sanitary sewer, a T value, which is the time it takes for the flow to peak, and a K value, which is the ratio of the falling limb duration to the rising limb duration indicating the time for the peak to subside. The parameters can also be an indication of the type of I/I experienced. A high R value or rapid response can indicate areas of inflow while a long tail or receding limb can indicate groundwater infiltration. Parameters were adjusted for each monitor's catchment as shown in Table 3.5. For example, as shown in Table 3.5, the area for Site 1 was assigned an R value of 0.025, T value of 0.1 and K value of 6, which means that 2.5% of the rainfall becomes I/I, the time to peak is 6 minutes and the time to recede is 36 minutes.

Table 3.5: RTK Calibration Parameters

Site	R	T (hours)	K (ratio of falling limb to T)
1	0.025	0.1	6
2	0.004	0.1	6
3	0.020	0.2	6
4	0.040	0.2	8
5	0.004	0.2	6
6	0.004	0.2	6

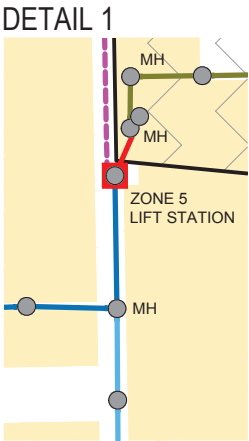
The model was calibrated during wet weather by simulating each rainfall event within the ABLA wastewater model and comparing the results of the flow monitoring to the modelled flows. Results of the wet weather flow calibration are summarized in Table 3.6. Similar to the dry weather flow, peak flow and volume ratios were compared to qualify the calibration.

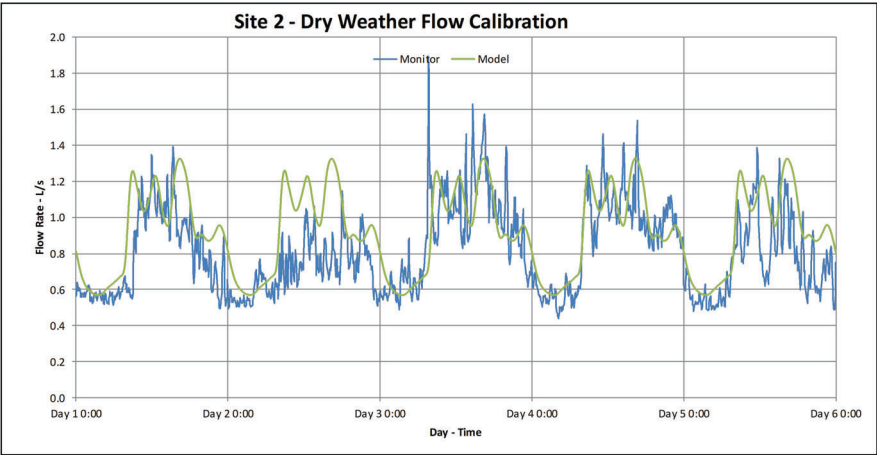
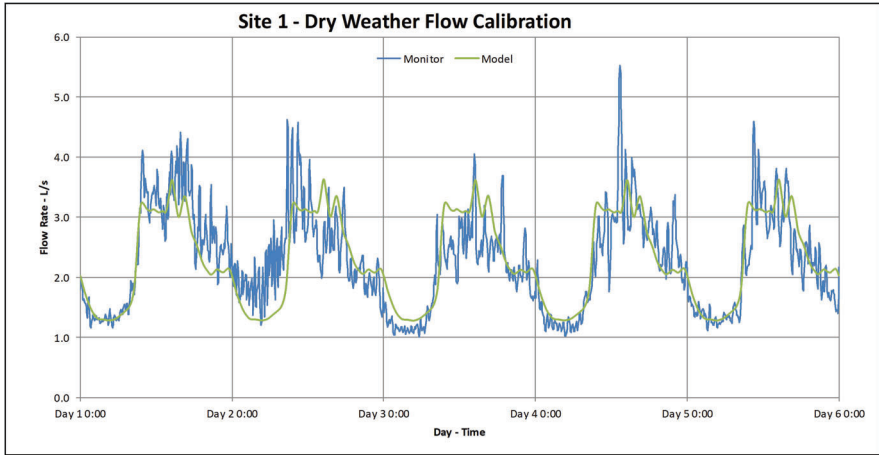
Table 3.6: Wet Weather Flow Calibration Results:

	Date	Monitored Peak (L/s)	Model Peak Flow (L/s)	Flow Ratio (%)	Monitored Volume (m ³)	Model Volume (m ³)	Volume Ratio (%)	Comparison Flow/Volume
Site 1	21-Jul-21	24.08	19.81	82 (-18)	643,434	704,445	109 (+9)	Fair/Good
	23-Aug-21	11.21	9.87	88 (-12)	405,524	377,712	93 (-7)	Fair/Good
	01-Sep-21	9.91	8.71	88 (-12)	397,342	378,469	95 (-5)	Fair/Good
	Average			86 (-14)			99 (-1)	
Site 2	21-Jul-21	10.90	11.37	104 (+4)	372,415	319,786	86 (-14)	Good/Fair
	23-Aug-21	3.63	4.25	117 (+17)	81,530	161,009	197 (+97)	Fair/High
	01-Sep-21	3.98	3.52	88 (-12)	137,006	157,109	115 (+15)	Fair/Fair
	Average			103 (+3)			133 (+33)	
Site 3	21-Jul-21	17.45	13.22	76 (-24)	542,049	459,483	95 (+5)	Low/Good
	23-Aug-21	13.44	14.83	110 (+10)	531,758	485,817	91 (-9)	Good/Good
	01-Sep-21	11.77	12.79	109 (+9)	498,440	461,636	93 (-7)	Good/Good
	Average			98 (-12)			93 (-7)	
Site 4	21-Jul-21	89.04	84.24	95 (-5)	2,928,973	3,189,694	109 (+9)	Good/Good
	23-Aug-21	51.77	43.15	83(-17)	1,517,204	1,460,017	96 (-4)	Fair/Good
	01-Sep-21	39.82	35.73	90 (-10)	1,339,874	1,368,086	102 (+2)	Good/Fair
	Average			89 (-11)			102 (+2)	
Site 5	21-Jul-21	22.50	24.86	111 (+11)	1,400,856	1,515,985	108 (+8)	Fair/Good
	23-Aug-21	19.89	19.79	100 (0)	816,071	1,254,914	154 (+54)	Good/High
	01-Sep-21	17.31	18.22	105 (+5)	1,119,938	1,195,245	107 (+7)	Good/Good
	Average			105 (+5)			123 (+23)	
Site 6	21-Jul-21	9.61	13.90	145 (+45)	279,203	546,473	196(+96)	High/High
	23-Aug-21	8.05	6.84	85 (-15)	267,074	277,912	104(+4)	Fair/Good
	01-Sep-21	7.83	6.71	86 (-14)	315,951	261,356	83(-17)	Fair/Fair
	Average			105 (+5)			128 (+28)	

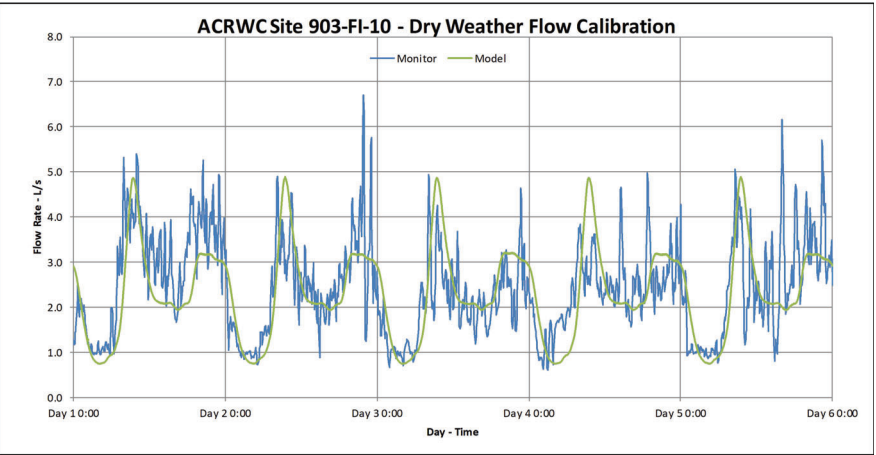
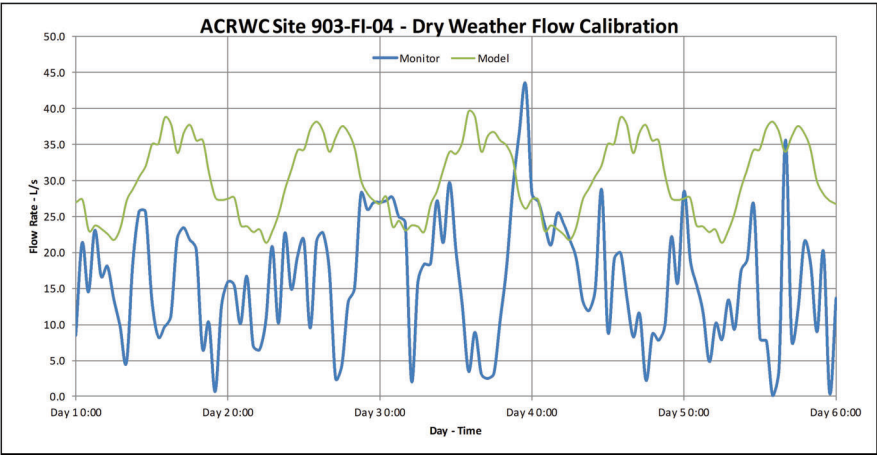
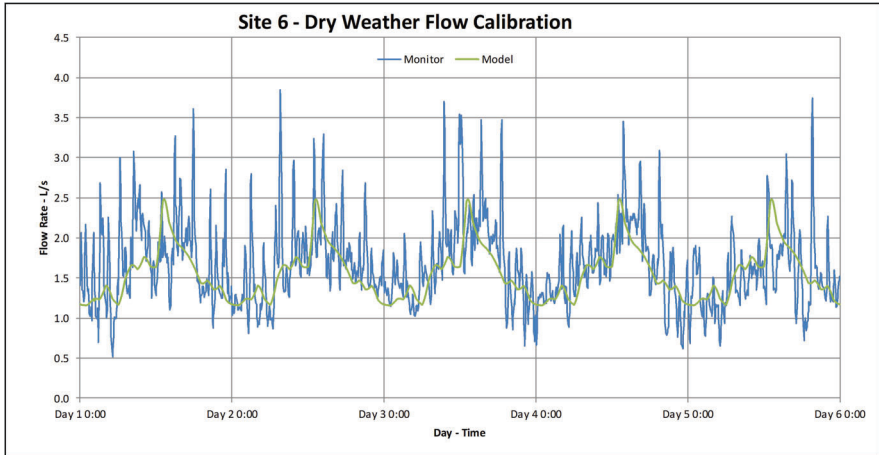
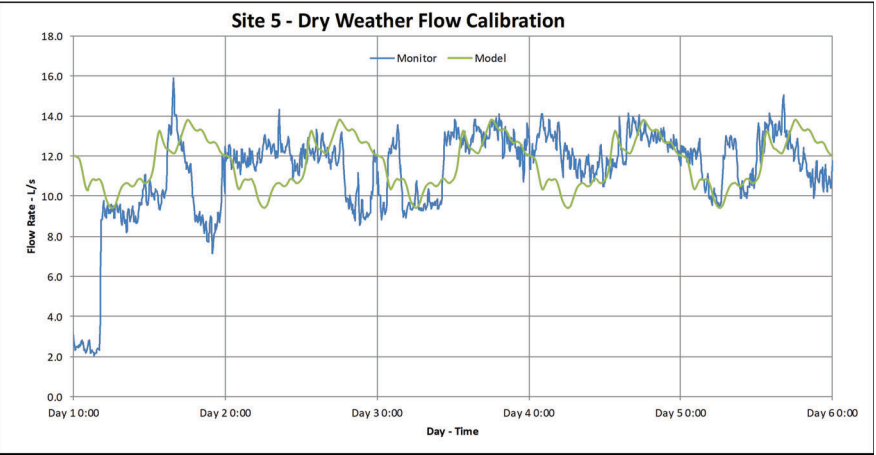
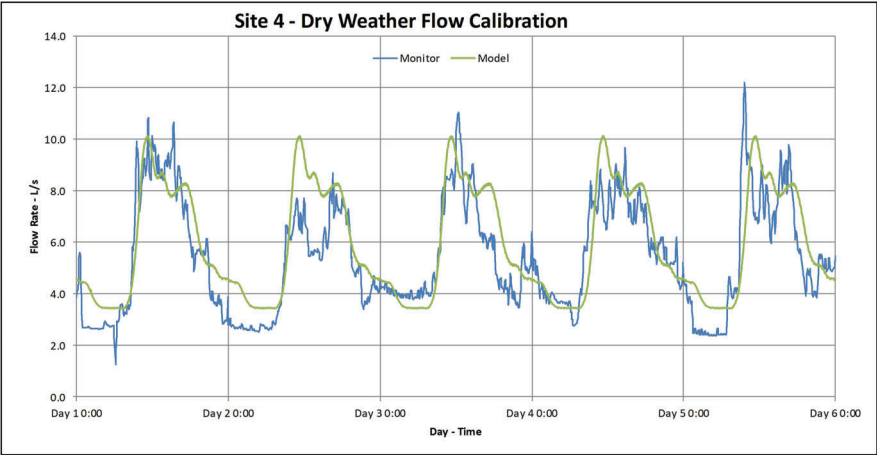
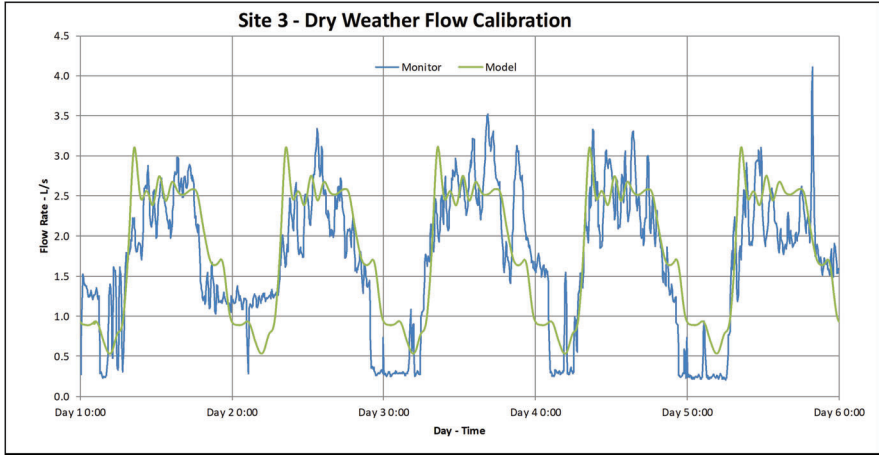
Similar to the dry weather calibration, wet weather results within 10% were considered good, from 10 to 20% were considered fair, and results differing by greater than 20% were considered high or low. The peak flows are relatively consistent with the monitored data in each site for the three rain events. The modelled volumes also compared well to the monitored volumes, apart from the August 23rd event at sites 2 & 5 which have high volumes. The July 21st modelled event at site 6 also results in a high volume and flow ratio. Graphs illustrating the wet weather flow calibration results are shown Figure 3.4 to 3.5. As seen in the figures, the modelled flows match up relatively well with the monitor data. The July 21st monitored and modelled data has one large peak flow in all the sites, and the August 23rd monitored and modelled data consistently has 2 peak flows during the rain event. On September 1st, both the modelled and monitored flows have two peaks, with the first monitor flow peak is higher than the second peak. On average, the data compares well with the average of the peak flow 3% lower and the average volume 11% higher than the monitored data.

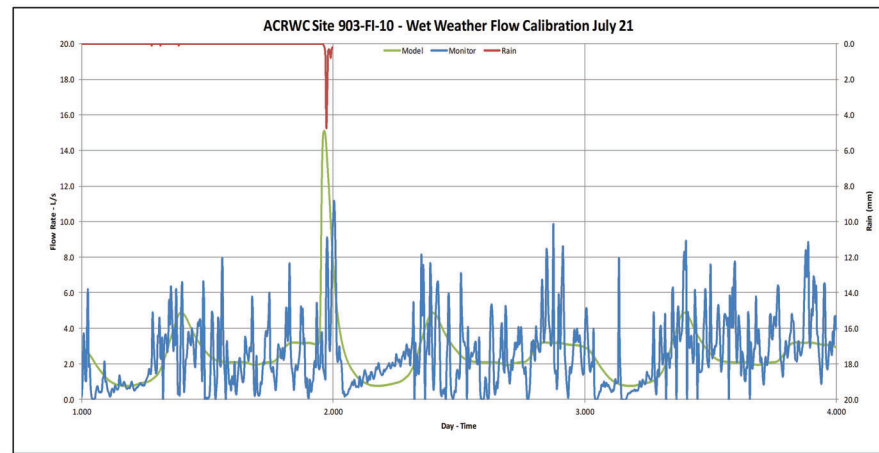
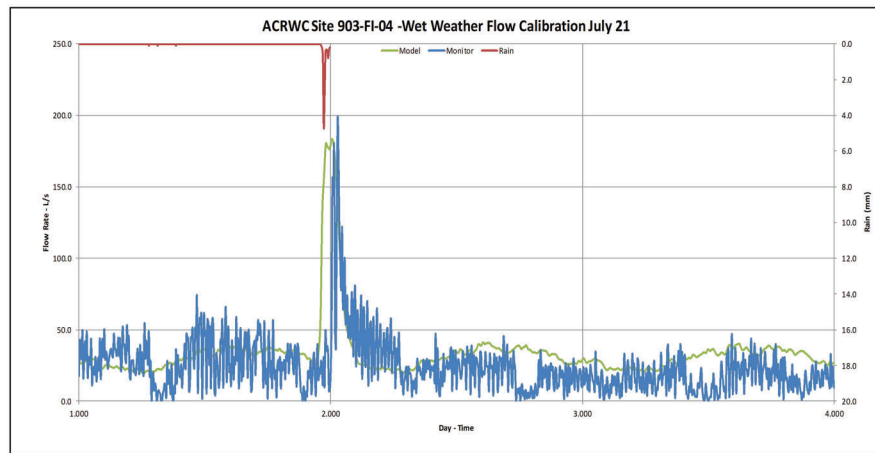
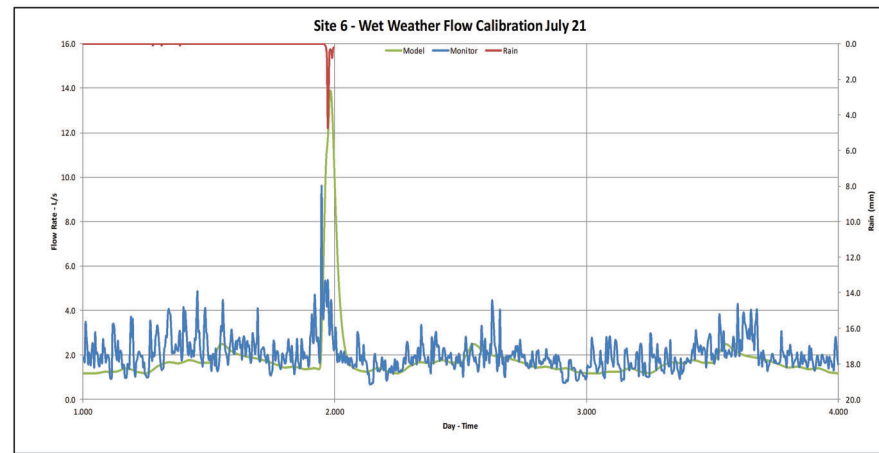
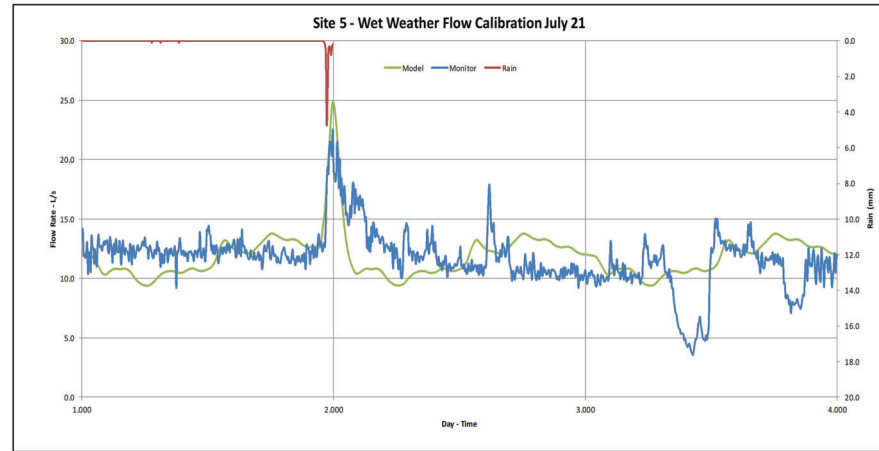
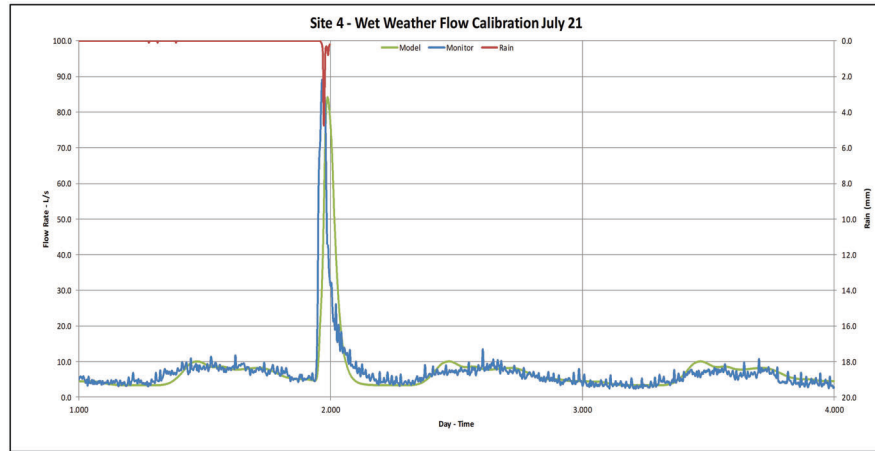
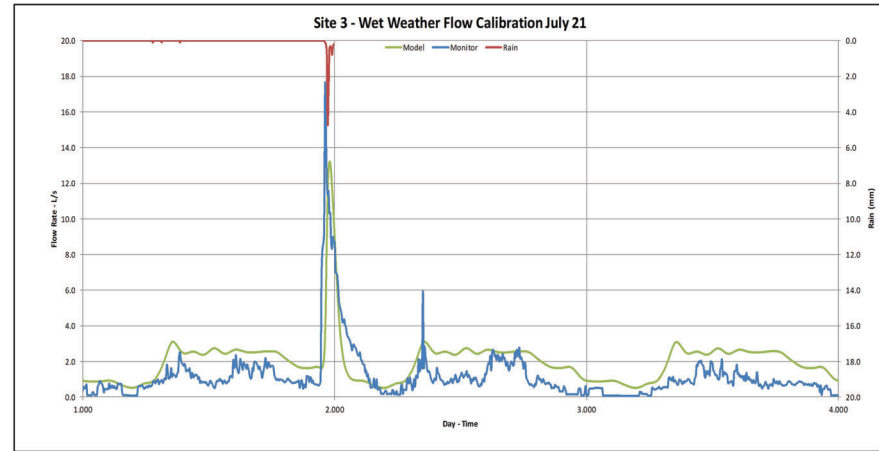
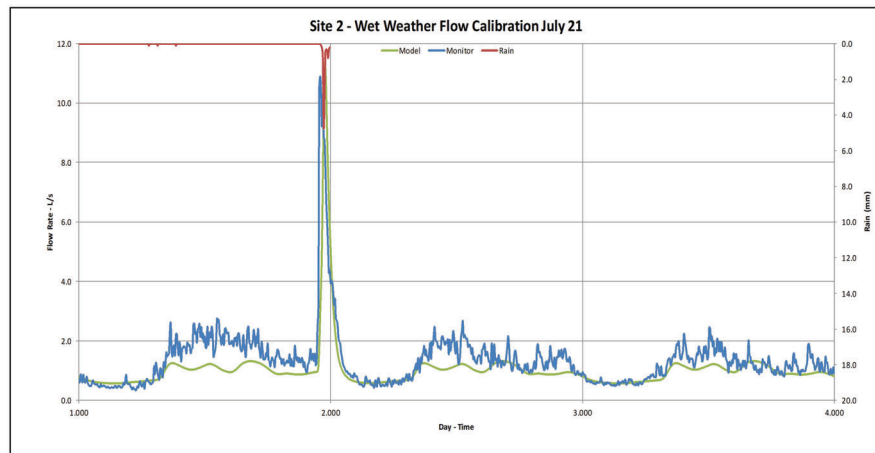
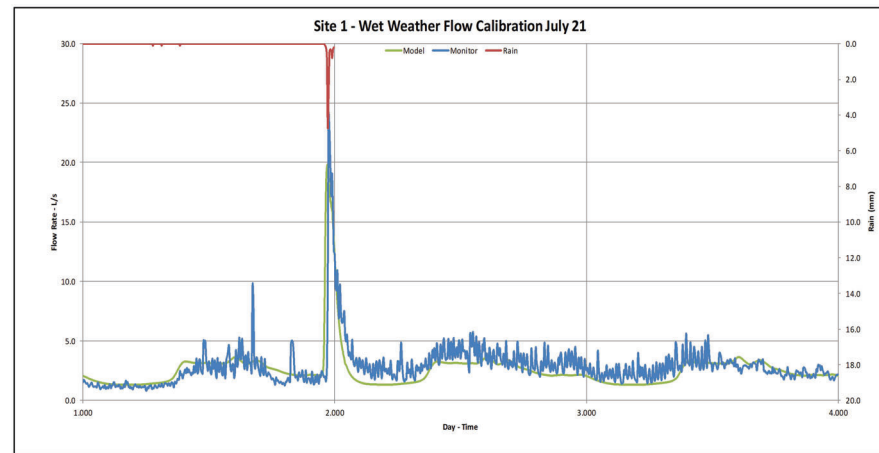
Calibration results are illustrated on Figures 3.3 to 3.6.





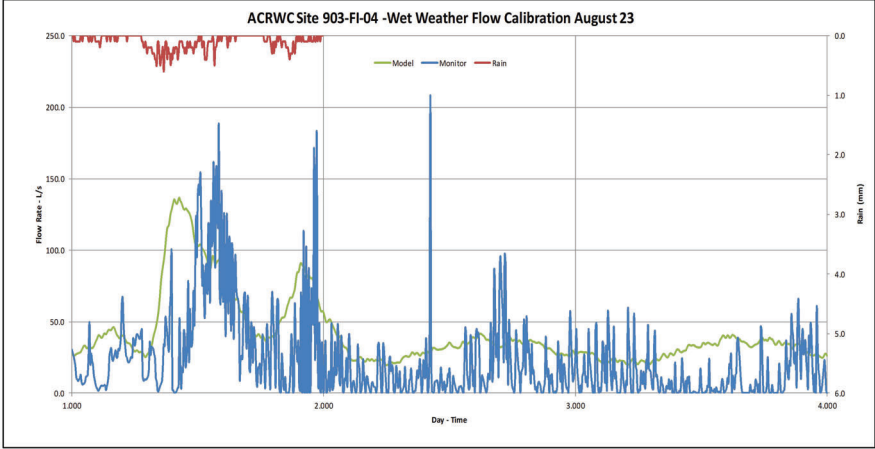
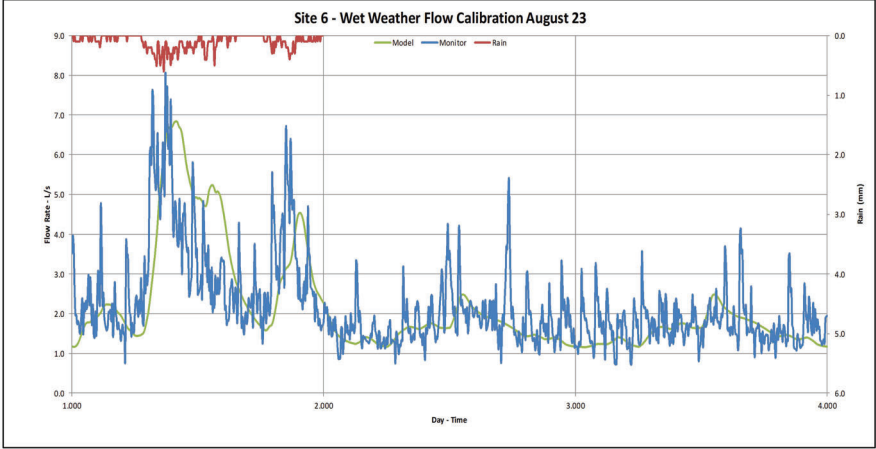
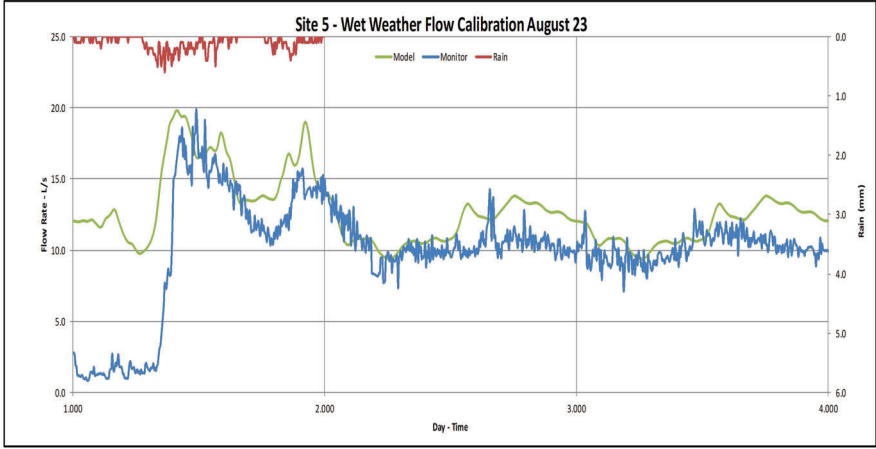
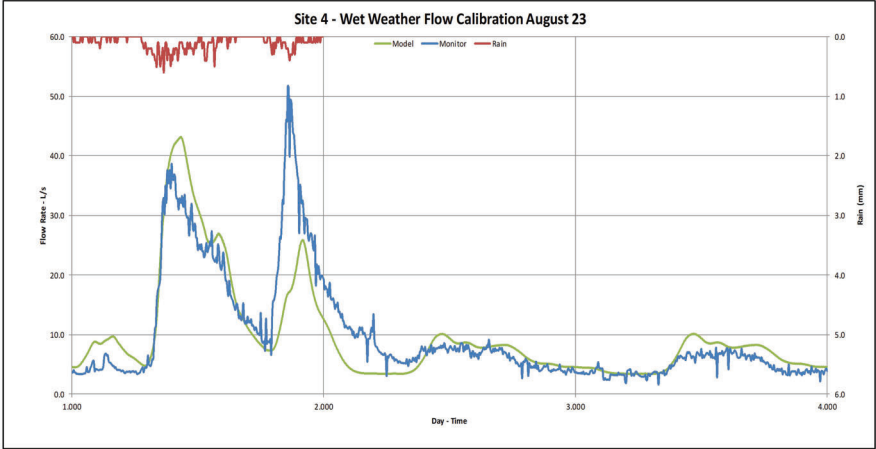
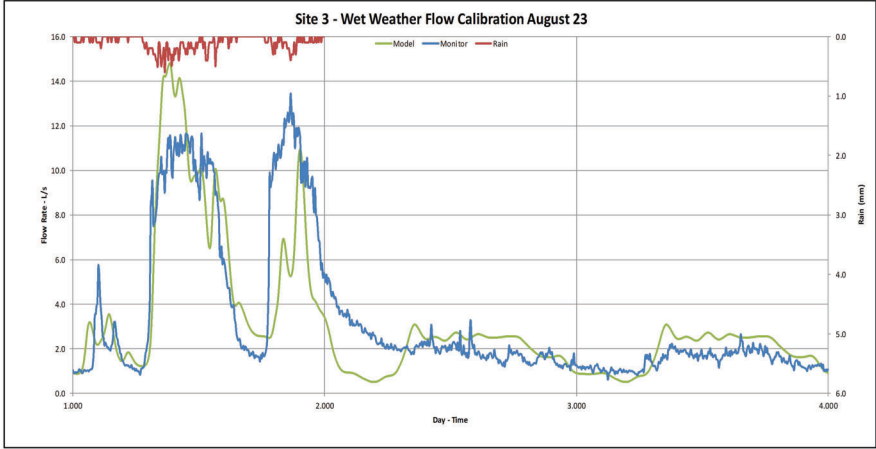
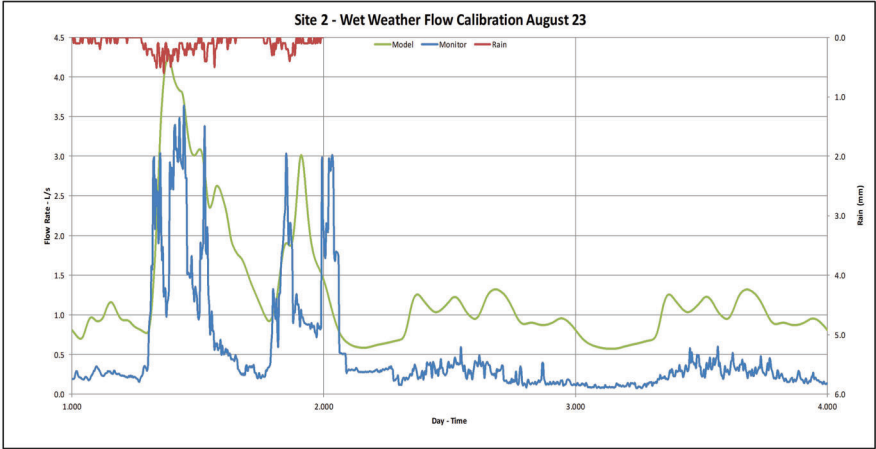
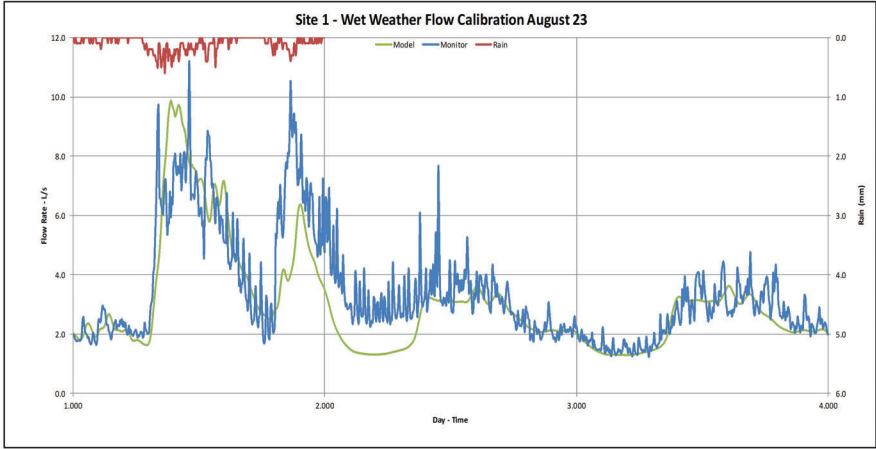
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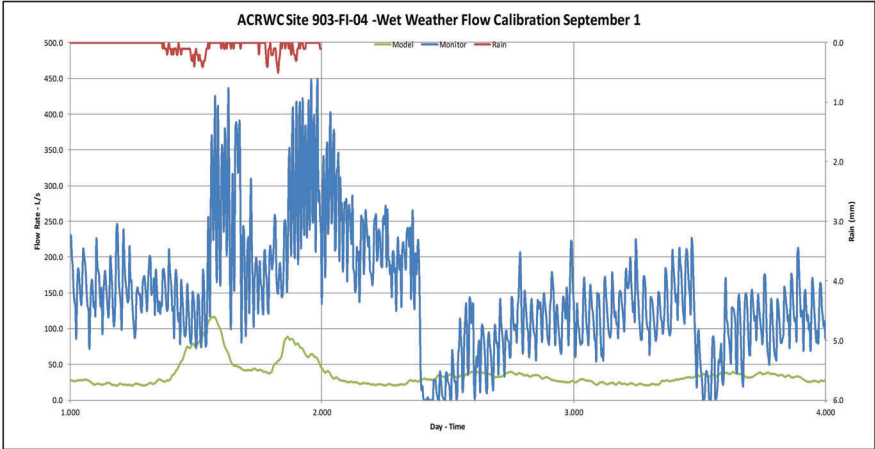
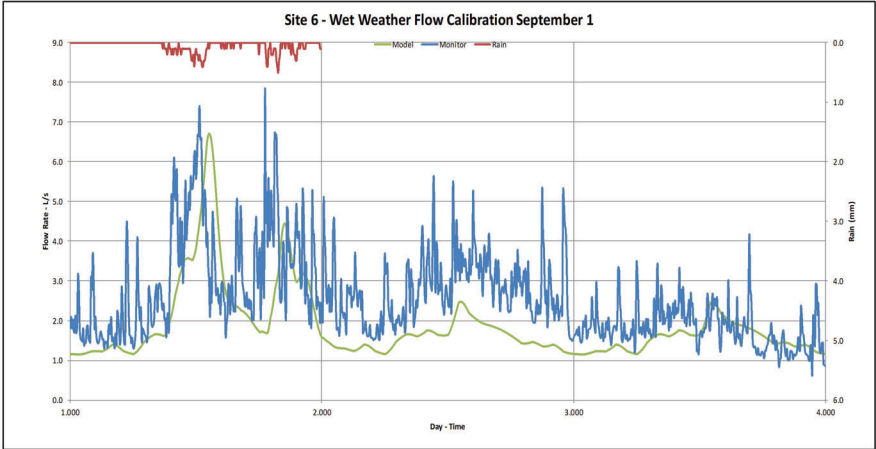
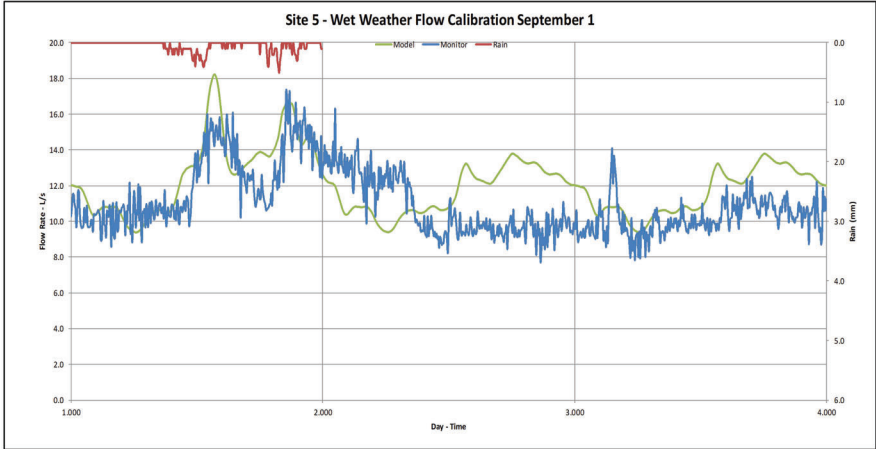
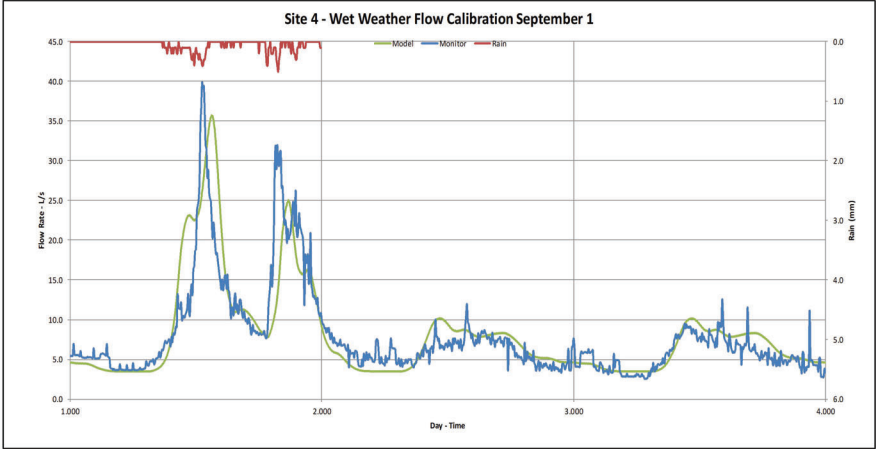
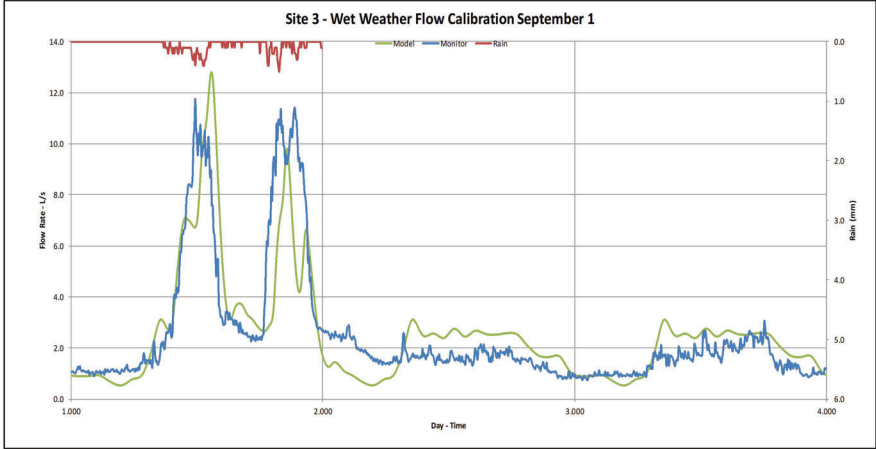
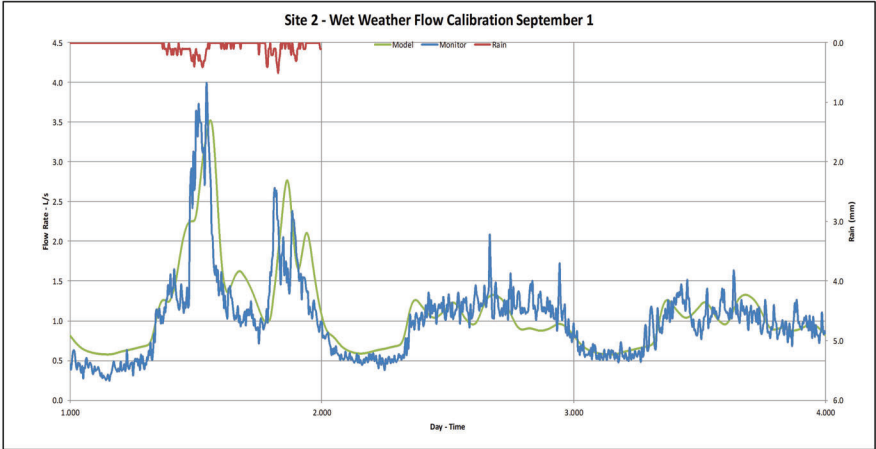
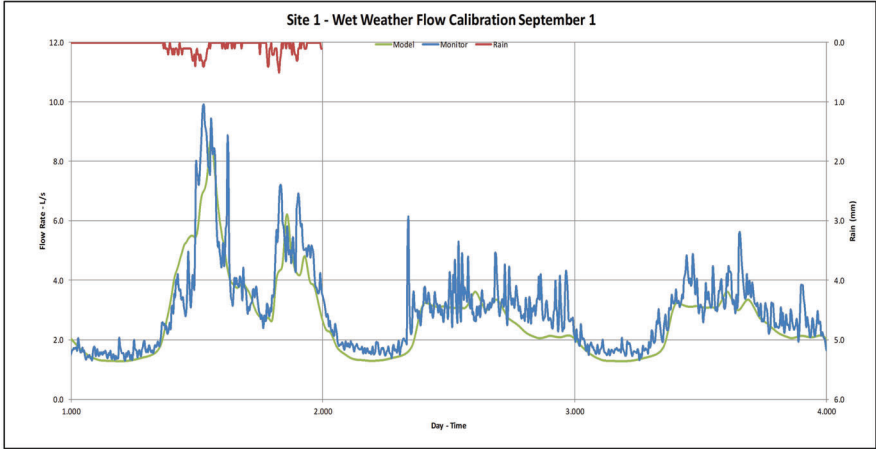
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- RAIN



LEGEND

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- RAIN

3.4 Existing System Evaluation

The existing system was assessed to examine the system performance for various rainfall events and to identify any deficiencies in the system. The existing system was evaluated for the following scenarios:

- ◆ Dry weather flow
- ◆ 5 year 4 hour event
- ◆ 25 year 24 hour event
- ◆ 25 year 4 hour event

A “Chicago” distribution was adopted for the 4 hour rainfall events. This distribution results in a high intensity rainfall, which is representative of short duration rainfall events. A “Huff” distribution was adopted for the 24 hour rainfall event which has a less intense peak and representative of longer duration rainfall events. These distributions are typically used in computer modelling of urban drainage systems. ACRWC requires that regional members assess their I/I under both the 5 year 4 hour and 25 year 24 hour rainfall events. In the 2016 study, only the 4 hour events were assessed. For this study, the 25 year 24 hour event has been included to be consistent with ACRWC regional member requirements for I/I analysis. The rainfall depths for the design events are summarized in Table 3.7.

Table 3.7: Design Rainfall Events

Return Period (years)	Duration (hours)	Total Rainfall (mm)	Peak Intensity (mm/hr)
5	4	33.3	73.0
25	24	84.7	11.8
25	4	46.4	110.8

The existing system was evaluated to assess the system performance with the calibrated sewage generation and rainfall response rates by examining the following parameters:

- ◆ The hydraulic grade line within the system to identify potential surcharge locations.
- ◆ The capacity utilization within the system to identify potential locations where pipe flow exceeds pipe capacity.

The magnitude of surcharging at manholes was calculated by subtracting the maximum hydraulic grade line (HGL) from the ground elevation and was divided into three levels, outlined in Table 3.8.

Table 3.8: Sanitary Sewer Manhole Surcharging Levels

Rating	Depth of HGL Below Ground
Red	Ground Surface to 0.5 m
Orange	0.5 m to 1 m
Blue	1 m to 2 m
Green	More than 2 m

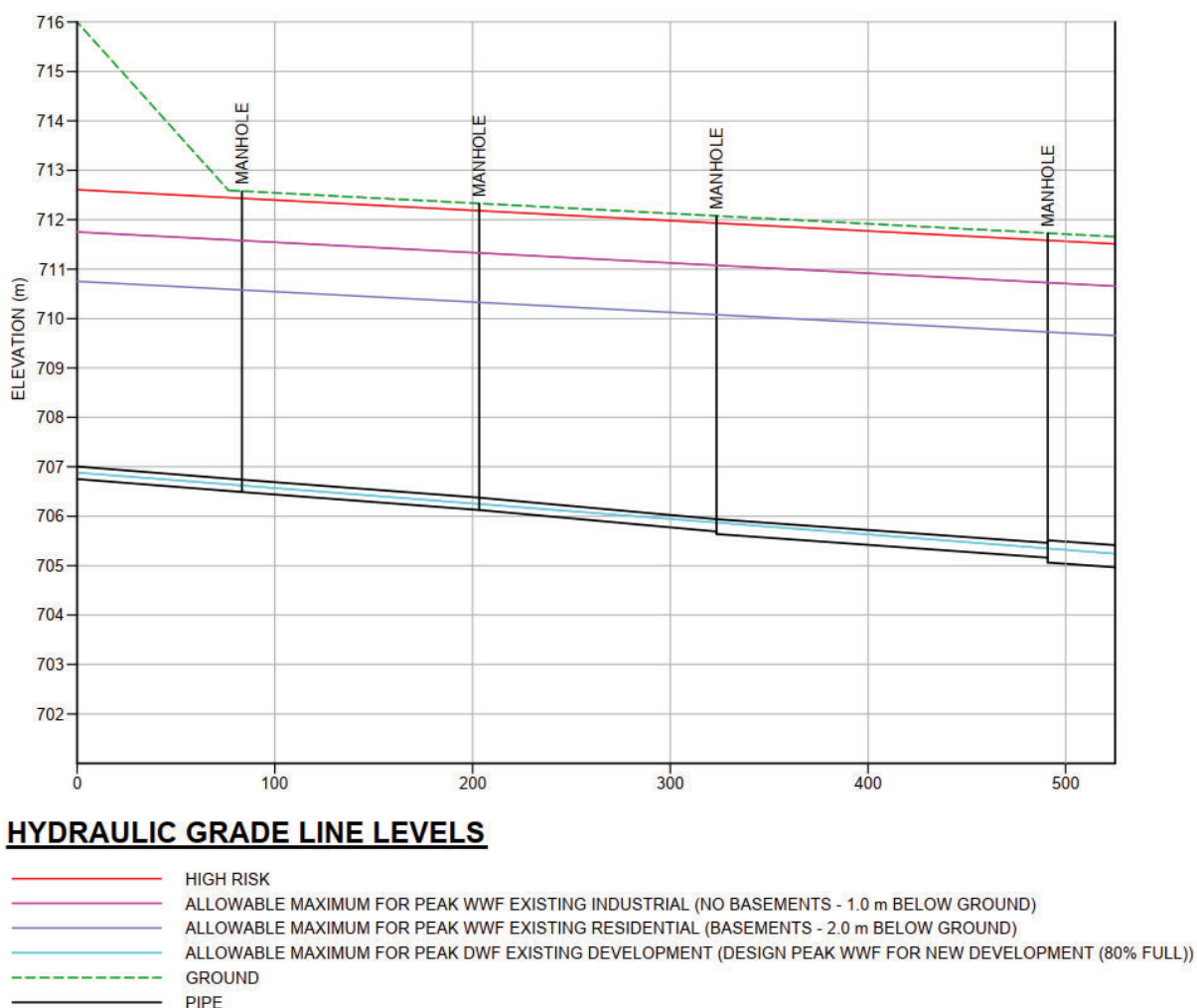
The capacity utilization in the pipe was calculated by taking the ratio of the peak flow in the pipe to the full pipe capacity and was divided into 3 levels as outlined in Table 3.9. Red indicates that the pipes are over utilized, blue denotes the cautionary range, and green indicates that capacity is sufficient or available.

Table 3.9: Sanitary Sewer Capacity Utilization Levels

Rating	Ratio of Peak Flow to Full Pipe Capacity
Red	Above 2.0
Blue	2.0 to 1.2
Green	1.2 to 0.0

Figures 3.7 to 3.10 illustrate the surcharge and capacity utilization levels in the existing system for dry weather flow as well as at various rainfall events. The colour of the nodes or manholes indicates the level of surcharging and the colours of the pipes indicate the capacity utilization.

A sample pipe profile is provided in the below graphic to illustrate the hydraulic grade lines at capacity and levels of surcharge that may be experienced. For the industrial areas in Acheson the hydraulic grade line can reach within 1 m of the ground during the 25 year 4 hour rainfall event without a high risk of impacting the buildings that are serviced. For residential areas approximately 2 m depth is recommended such that basements are not impacted. For dry weather flow it is generally recommended that the HGL remains within the diameter of the pipe while new pipes are designed such that they are flowing 80% full.

**Graphic A: Hydraulic Grade Line Profiles Example**

There are manholes throughout the system that are less than 2 m deep and therefore can appear to be surcharged when the HGL is still within the pipe. Manholes less than 2 m deep are illustrated on Figure 3.1.

3.4.1 Dry Weather Flow

The existing system has sufficient capacity to handle dry weather flows. As illustrated in Figure 3.7, most manholes and pipes are green. There are several areas where the system is shallow and the pipes are within 2 m of the ground. In these cases, the hydraulic grade line remains in the diameter of the pipe.

3.4.2 Wet Weather Flow 5 Year 4 Hour Event

The existing system has sufficient capacity to handle the 5 year 4 hour event. As illustrated in Figure 3.8, similar to the dry weather flow, most manholes and pipes remain green for this event.

3.4.3 Wet Weather Flow 25 Year 24 Hour Event

The existing system has sufficient capacity to handle the 25 year 24 hour event. As illustrated in Figure 3.9, the system performance remains similar to the dry weather flow and 5 Year 4 Hour event.

3.4.4 Wet Weather Flow 25 Year 4 Hour Event

The existing system has sufficient capacity to handle 25 year 4 hour event with the exception of two locations as illustrated in Figure 3.10.

The 250 mm diameter line on the upstream leg of the Acheson Road sewer line is surcharging. This line services the Standard General site along with several other businesses. It is located in a ditch with high potential for I/I. Although the line is not flooding, it is surcharging to within 1 m of the ground. There is also one manhole surcharging to within 1 m of the ground along the west section of Acheson Road to the intersection of 279 Street.

3.4.5 I/I Review

The wastewater system experiences dry weather flow peaks in the middle of the day when most businesses are up and running. Some areas of Acheson and Big Lake are located in areas with high groundwater elevation leading to high levels of infiltration, while other areas within Acheson have the manholes located in ditches. When the ditches fill with water this can be a source of inflow. The County is undertaking projects to reduce their I/I in line with ACRWC requirements.

Consistent with ACRWC's approach, Parkland County has shifted focus from adding conveyance capacity to reducing wet weather flow through inflow and infiltration reduction. The 2021 model calibration was used to determine the effectiveness of the reduction measures taken to date to aid in decision making on how I/I reduction can be implemented in other areas. System capacity for future development can then be better assessed.

Infiltration and inflow rates were calculated based on 5 year 4 hour and 25 year 24 hour consistent with ACRWC's requirements as shown in Table 3.10.

Table 3.10: Estimated I/I Rates

Site	Contributing Area (ha)	5Y 4H Peak I/I Rate (L/s/ha)	5Y 4H Average I/I Rate (L/s/ha)	25Y 24H Peak I/I Rate (L/s/ha)	25Y 24H Average I/I Rate (L/s/ha)
1	142.8	0.26	0.09	0.14	0.04
2	129.3	0.17	0.04	0.07	0.02
3	70.3	0.98	0.33	0.53	0.16
4	127.5	1.16	0.43	0.84	0.25
5	190.7	0.30	0.10	0.17	0.05
6	125.2	0.22	0.08	0.13	0.04

When compared to the Parkland County design standard of 0.28 L/s/ha, Sites 1, 2, 5 and 6 are approximately at or below the standard while sites 3 and 4 are above. This is consistent with the County's experience within monitoring Sites 3 and 4 (Zones 3 and 4) as manholes are located in ditches and experience high levels of inflow when it rains. Within Zone 5 (monitoring Sites 5 and 6) the manholes are located in the roadways and experience less inflow. Zone 5 is also has a newer development area and improved construction practices may have also contributed to the lower I/I.

Between 2019 and 2020, the County completed upgrades on the Zone 1 & 2 wastewater trunk. 53 manholes and 515 m of pipe was lined with Cured in Place Pipe (CIPP), 3 laterals were repaired, and 2 point repairs were completed. In addition, 12 manholes were raised above the ditch bottoms and sealed. The repairs were based on a condition assessment and review of in-pipe camera inspection information in 2019; locations with high potential for inflow and infiltration were identified. Infiltration and inflow rates were calculated during a flow monitoring program conducted in 2019 prior to the implementation of the rehabilitation work. Monitoring sites 1 and 2 remained at consistent locations during the 2021 monitoring program and I/I values were compared and summarized in Table 3.11. Details on the Zone 1 and 2 upgrades can be found in Appendix C

Table 3.11: Peak I/I Comparison in Zone 1 and Zone 2 Pre and Post Construction

Site	2019 5Y 4H I/I Rate (L/s/ha)	2021 5Y 4H I/I Rate (L/s/ha)	2019 25Y 24H I/I Rate (L/s/ha)	2021 25Y 24H I/I Rate (L/s/ha)	2019 Base Flow (L/s)	2021 Base Flow (L/s)
1	0.69	0.26	0.54	0.14	2.0	1.1
2	0.76	0.17	0.55	0.07	1.6	0.5

Based on the results of the model calibration, at Site 1 the base flow was reduced by 45% and the I/I rate by between 60 and 75%. High base flow values can be an indication of groundwater inflow. Although the base flows were reduced, 2021 was a particularly hot and dry year which may have also contributed to the reduction in groundwater flows. However, the trend is promising and indicates that the upgrades were effective in reducing I/I. Model calibration is never exact and wet weather flow trends should continue to be monitored to confirm the results.

The Zone 1 and 2 wastewater trunk was identified for improvements in the 2016 Study. With the results of the 2021 calibration following the implementation of the I/I reduction program, these upgrades are no longer required and the system has capacity for the 25 year 4 hour event. Based on these results the County may consider I/I reduction efforts in other parts of Acheson experiencing high flows during wet weather.

For comparison, the estimated cost of twinning the Zone 1 and 2 trunk was \$4.1M while the cost of the rehabilitation work was approximately \$1M. Improvements are discussed in more detail in Section 4.2.

3.4.6 Operational Issues Review

Operationally, the main concerns with the Acheson wastewater system are with the addition of the flow from the Champion Pet Foods Facility. Since the facility was commissioned, operators have experienced an increase in oil and grease build up in the lines downstream of the facility, an increase in odor complaints from businesses located on the same wastewater line, and an increase in odor and oil and grease at the Zone 5 pump station. Although the facility has on site wastewater treatment, the effluent is still overstrength and ACRWC surcharges are being applied. The customers pay for the surcharge fees; however, there are increased operation and maintenance that must be addressed by the County. Operators have noted that the high flows from the facility cause high velocities in the pipes and may create suction on the adjoining services, contributing to the odor concerns. Several buildings are now experiencing odor in their buildings from their floor drains and some businesses have reported sewer gases exiting their roof leaders. This would indicate that the roof leaders are tied into the wastewater system and should be disconnected and redirected to the ground. Theoretically, floor drains with functioning P-traps should not experience sewer gas odor and on-site plumbing may need to be investigated. The County flushes the line monthly, which helps with the odor temporarily, but the odor returns within 7 days.

Odor complaints on individual properties should be reviewed on a case-by-case basis but typically if there is a functioning P-trap, odor should not be making its way into buildings. This could be a plumbing issue rather than an issue with the County system.

Although the flows in the gravity system are higher than prior to Champion coming on, they are within the pipe capacity. Champion flows are higher than typical Acheson businesses; however, given the area of the site, the flows are quite close to the Parkland County standard of 6170 L/ha/d with a peaking factor of 3 and I/I allowance of 0.28 L/s/ha. It is the nature of the wastewater that contributing to the operational challenges as it is known to exceed ACRWC standards. The standards are based on levels that are likely to cause operational concerns. A routine flushing program is prudent but without further pre-treatment at the source, these issues are likely to continue.

Oil and grease should continue to be flushed regularly to prevent blockages and odors. Oil and grease and sediment in the system can lead to blockages and depending on the severity reduce the pipe capacity and increase the risk of surcharging with the capacity reduction proportional to the size of the blockage.

Oil and grease in the lift station generally has limited impact of the life cycle of a pump. The grease and oil can be removed from the station and pump operation should improve. The life cycle of the lift station structure is 45-60 years if it is maintained properly including maintaining the ventilation levels and minimizing the retention time in the collection system thus reducing the H₂S generation which can corrode the concrete structure. Mechanical equipment including the pumps and ventilation system has a life expectancy of 15-20 years if maintained properly. The electrical system has a life expectancy similar to the station structure. PLCs require yearly upgrades for firmware. PLC failure is rare but cards may require replacement periodically. A planned PLC replacement every 10-15 years will keep the system up to date with current hardware. Regular oil and grease removal from the wet well and pump should continue as part of routine scheduled maintenance.

As noted, H₂S can impact the service life of the lift station structure and is generally caused by the wastewater sitting stagnant for an extended time either upstream in the collection system or in the station itself. If there are no blockages in the collection system there should be limited opportunity for H₂S formation. A condition assessment could be used to identify sags which may require more frequent flushing. It is also possible that the wastewater from Champion is stagnating in their pre-treatment system and this could be investigated as a potential H₂S and odor source.

The Big Lake residential area has not experienced basement flooding due to wet weather flows. In general, any wastewater backups experienced in the system have been due to temporary blockages. This is consistent with the results of the modelling which assume that pipes are free flowing without any build up or blockages.

3.4.7 Existing System Improvements and Level of Service

The existing wastewater system has capacity for current development dry weather flow and wet weather flows up to and including the 5 year 4 hour and 25 year 24 hour events. For the more conservative 25 year 4 hour event, there are some capacity constraints at the east end of the wastewater line on Acheson Road. This line is surcharged to within 1 m of the ground level. As most of the development in the area would not likely have basements, the risk of property damage is low; however, the service connections at this location should be investigated in more detail to better understand the risk and confirm if backflow preventers are in use which can further reduce the risk. Although the modelling does not indicate flooding to ground, there is a risk that with blockages or heavy rain there could be wastewater overflowing to the ditches which would prompt an environmental report, fines, and clean up costs. The County may consider developing a plan for the areas at higher risk of surcharge including a response plan in the event of surcharge as well as a maintenance plan. In addition, future connections to this line increasing the service area and flows are not recommended.

Based on the existing system assessment results and the potential positive impact of the I/I projects in Zone 1 and Zone 2, if there is a desire to reduce the environmental risk and increase capacity for future development, an I/I reduction project would be recommended. This would consist of a CCTV investigation followed by a condition assessment and risk assessment. The findings of the condition assessment would prioritize areas with the highest potential for I/I and would likely consist of manhole lining, pipe or lateral lining as well as raising and sealing manholes located in ditches similar to the work completed in Zones 1 and 2 in 2019 and 2020.

3.4.7.1 Level of Service and Criteria for Improvements

As discussed in Section 3.4, past studies on the Acheson system have utilized the 25 Year 4 Hour event as the design criteria for improvements. This was based on the experience in Acheson that the shorter duration events produce the most issues historically.

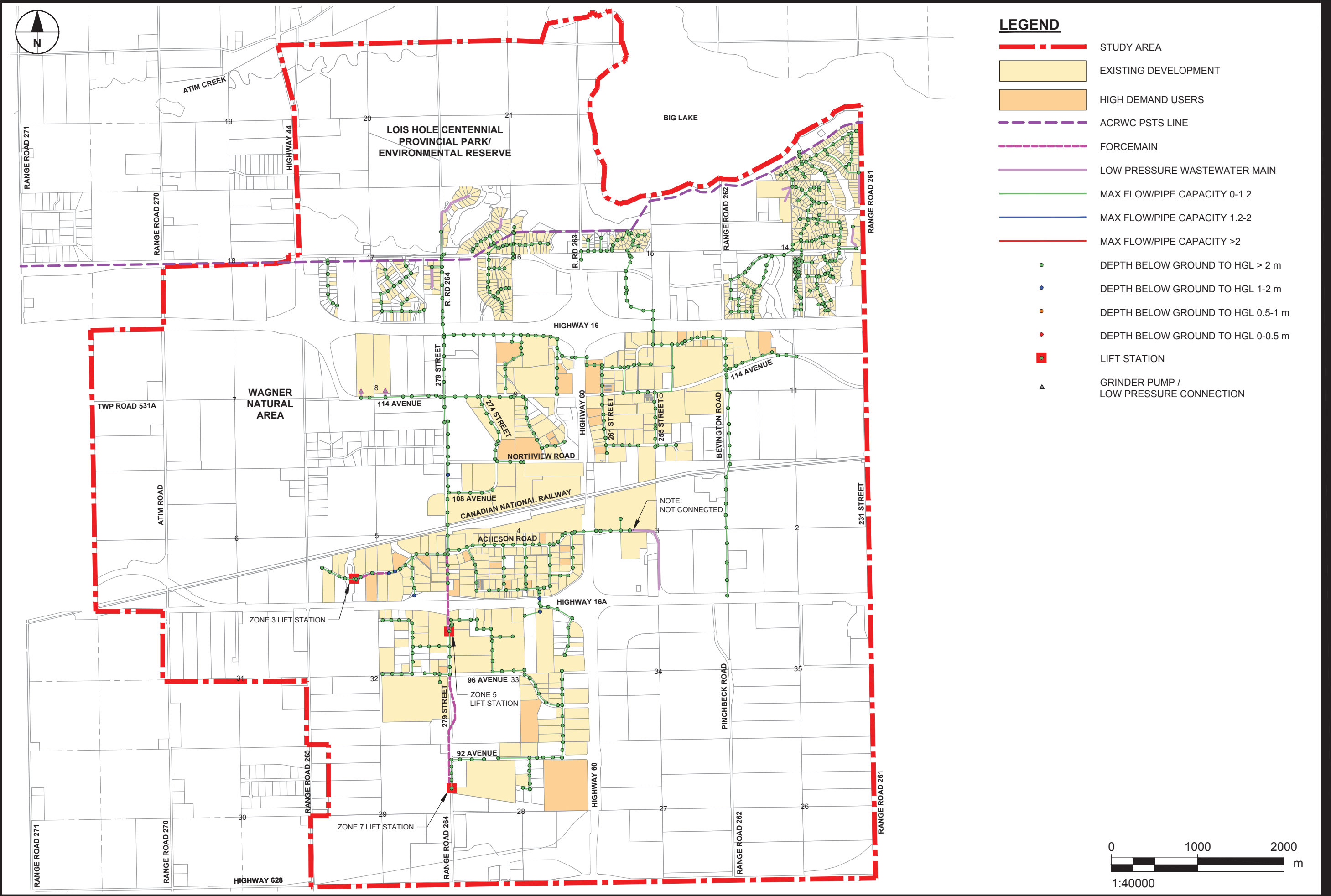
Since that time ACRWC has required their members to assess their system I/I based on the 5 Year 4 Hour and 25 Year 24 Hour rainfall events and compare I/I rates with their standard of 0.28 L/s/ha. These two events produce lower flows than the 25 year 4 hour event and the model indicates that the existing system does not require capacity upgrades to accommodate these events, however the I/I rate of 0.28 L/s/ha is still exceeded in some locations.

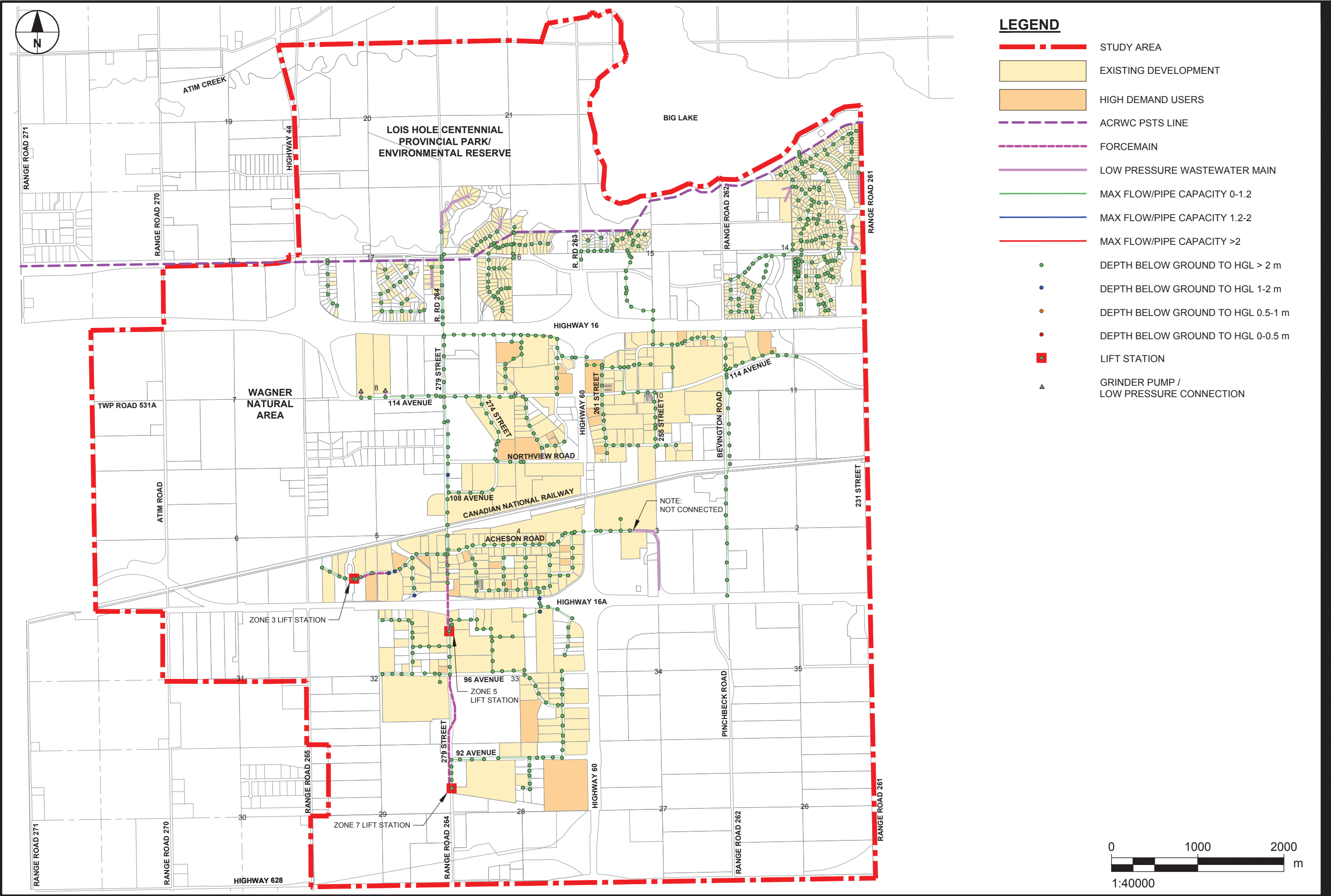
There are then two ways in which level of service can be measured:

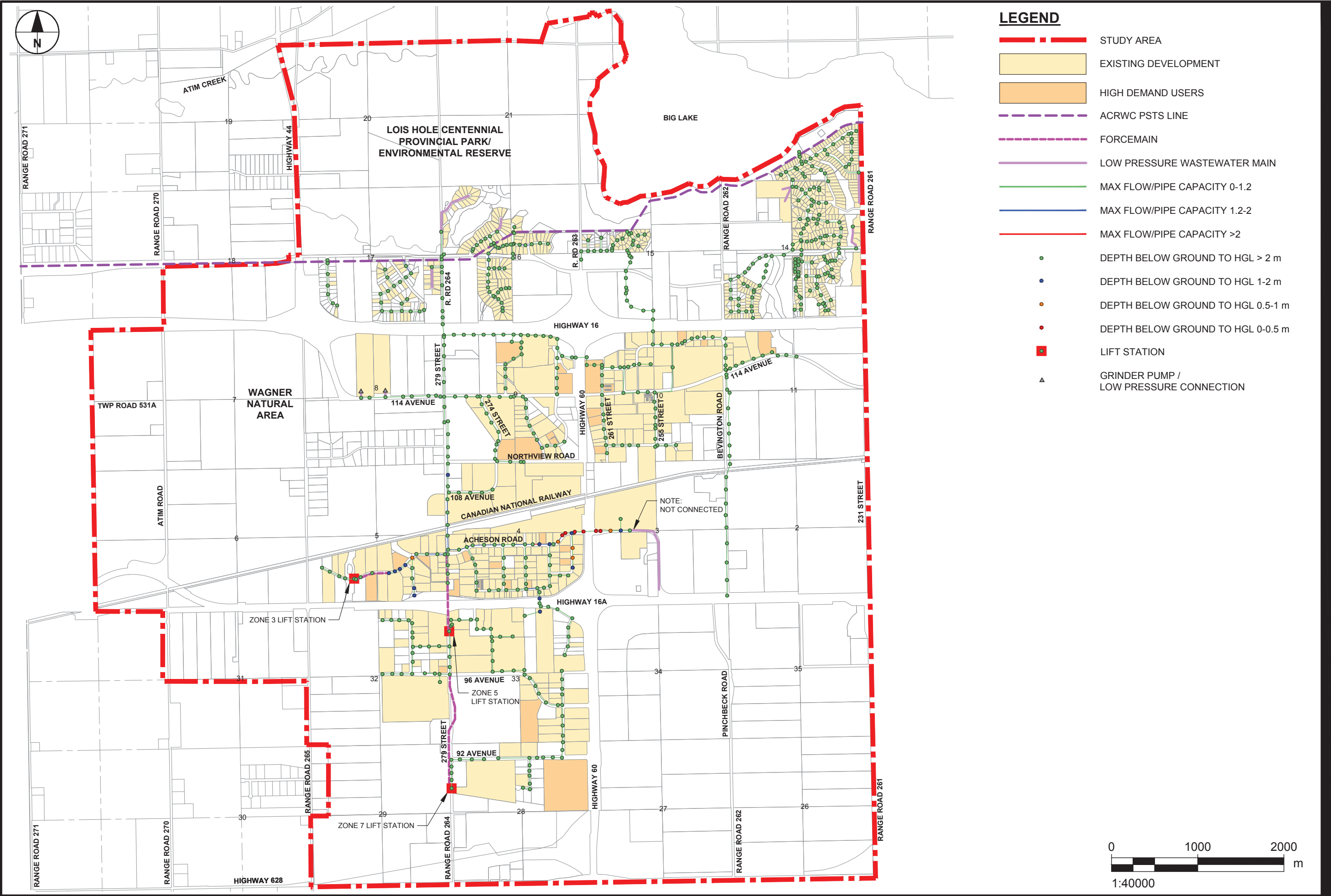
1. Hydraulic grade line in relation to the ground and risk of surcharge.
2. I/I in relation to the ACRWC standard of 0.28 L/s/ha.

The decision to design to the higher or lower rainfall events comes down to risk vs cost. The risk of the event occurring, of causing property damage, environmental damage, and the cost to the County, as well as the cost of upgrades to mitigate the risk must be considered while exceeding the standard I/I may also be a case for upgrades, particularly I/I reduction improvements.

For the purpose of this study, improvements are based on capacity such that the hydraulic grade line is not within 1 m of the ground level in industrial areas and 2 m in residential areas.







4. Future Development Servicing

There is high potential for development of areas surrounding the Acheson Industrial Area and the Big Lake Residential Area. The County continues to receive ongoing development requests. While some require simple connections to nearby systems, others consist of developing large areas that require significant planning in order to allow connection and servicing. Often times the system has adequate capacity to take on additional flows during dry weather but capacity is limited or not available during wet weather. Taking into account options for both increasing system capacity and reducing utilization during wet weather must be balanced including the cost and timing of both options.

In this section, future servicing concepts is broken down to three development stages: Near Future, Long Term, and Ultimate development as discussed in Section 2. Each development stages are simulated with the 25 year 4 hour rainfall event, as it is the governing rainfall event for the wastewater collection system. Each development stage is discussed in detail below.

4.1 Servicing Concept

A wastewater servicing plan was developed for Acheson and Big Lake area for Near Future, Long Term, and Ultimate development scenarios. These scenarios assume the full build-out of the areas identified in Figure 2.3. Areas were connected to the existing system where they could best be serviced by gravity or forcemains as well as where capacity is available if possible. The approximate locations of future gravity mains, lift stations and forcemains have been identified. The existing system was then analyzed to identify deficiencies as well as any required improvements.

The future servicing concept plan for each development stage assumes that all the recommended upgrades outlined in previous stages have been completed. For example, the Near Future stage upgrades are based on the assumption that the recommended Existing system upgrades have been implemented.

The locations of mains and lift station were based on existing topography and proposed development and road concept plans where available. Where not available the locations are schematic only and subject to change based as development, grading and road layouts are planned in more detail.

4.1.1 Design Criteria

For future developments, the design criteria used for this study are as follows:

- ◆ A residential sewage generation rate of 350 L/c/d, for all future developments.
- ◆ A non-residential sewage generation rate of 6170 L/ha/d with a peaking factor of 3.0, at Near Future, Long Term and Ultimate development stages.
- ◆ A residential and non-residential inflow/infiltration allowance of 0.28 L/s/ha.
- ◆ Actual high water user generation rates will be used, at Near Future, Long Term and Ultimate development stages. These values are based on actual water usage records as described in Section 3.3.

4.1.2 Near Future Development

For Near Future development, the new areas to be developed are connected to the existing wastewater system. Preliminary pipe alignment and 25 Year 4 Hour flow results are provided in Figure 4.3. However, these pipe designs must be confirmed at the subdivision/development agreement as development proceeds and road alignments and more detailed elevations become available.

Near Future developments in Acheson industrial Zones 1, 3, 5, 7, and western portions of Zones 2 and 4 will be connected to the Acheson Trunk Line and discharged into ACRWC PSTS line. Near Future developments in the remainder of Zones 2, 4, and Zone 6 will be serviced by the Bevington Road Trunk line, discharging to PSTS line.

In the Big Lake residential area, all Near Future developments are connected to existing wastewater lines discharging into the PSTS line. No new connections to PSTS are planned and it is assumed that the existing wastewater system will be utilized for future development.

It is anticipated, based on preliminary information, three additional wastewater lift stations will be required in the Near Future stage, as shown in Figure 4.3.

- ◆ Future Lift Station #1 is required to service Near Future lots on the west side of Zone 5 and should have a capacity of approximately 18 L/s. The accompanying forcemain is required to be 300 mm in the Ultimate development stage. Potential lift station capacity upgrades to 78 L/s are required in the Ultimate development stage.
- ◆ Future Lift Station #2 services the south end of the SW33 and has a capacity of approximately 23 L/s and the accompanying forcemain is required to be 150 mm in diameter.
- ◆ Future Lift Station #3 is required to service Near Future properties adjacent to Highway 16A and Highway 60, in Zone 6. This lift station should have a capacity of approximately 71 L/s during the Near Future development stage and the accompanying forcemain is required to be 250 mm in diameter in the Near Future stage and upgraded to 600 mm in the Ultimate stage. Potential lift station capacity upgrades to 145 L/s and 360 L/s are required in later Long Term and Ultimate development stages, respectively.
- ◆ As shown in Figure 4.3 a low-pressure connection is also recommended to service the Near Future properties to the far east of the study area, south of Highway 16A in NE35.

Figure 4.3 shows the surcharge and capacity utilization levels in the Near Future system for the 25 year 4 hour event.

The results for the Near Future system are based on the assumption that upgrades recommended for the existing stage in Section 4.2.1 are complete.

There are two red manholes in the Near Future scenario: In Zone 3 west of the intersection between Acheson Road and 279 Street, as well as in the South end of Zone 3 north of Highway 16A.

Several manholes are orange and blue, indicating that the hydraulic grade line is between 1 and 2 meters below ground level. However these sewer mains are shallow so this does not indicate surcharging in the system, as the maximum hydraulic grade line is still within the diameter of the pipe. There is a red pipe west of Highway 60 in Zone 1; however, the manholes are green. this is just indicative of a shallow slope and is not recommended for upgrades at this time.

Two areas of possible concern are also highlighted in the Big Lake residential area. While there is no flooding that occurs in the 25 year 4 hour rain event, there are several blue nodes, denoting that the line is surcharged within 2.5 m of ground. Because this is a residential neighbourhood, there is a chance of possible basement flooding and is worth monitoring.

4.1.3 Long Term Development

In the Long Term development scenario, areas in the outskirts of Zones 1, 2, 4, 5, 6, 7, and 8. The areas developed in Zones 1, 5 and 7 are anticipated to connect to the existing wastewater collection system to the east and discharges into the PSTS line through lift stations and gravity mains. Long term development area in Zones 2, 4, 6, and 8 are anticipated to connect to existing Bevington Trunk, via gravity mains and lift stations as required.

Three additional lift stations are anticipated to be installed in the Long Term development stage. The requirement for wastewater lift stations depends on the grading elevations during the development stage and should be reviewed as more detail becomes available. The locations shown in Figure 4.5 are approximate.

- ◆ Future Lift Station #4 is required to service lots developed in the Long Term scenario in west end of Zone 8 and should have a capacity of approximately 43 L/s. The accompanying forcemain is required to be 200 mm in diameter.
- ◆ Future Lift Stations #5 and #6 service the Long Term developed lots in Zone 4. Future Lift Station #5 has a capacity of 45 L/s with potential lift station capacity upgrades to 75 L/s are required in the Ultimate development stage.

Most of the Long Term residential development is located in east side of the Big Lake residential area, north of Highway 16. It is anticipated wastewater services will be connected to existing wastewater mains by gravity. Ultimately, the wastewater is discharged into the PSTS line north of the residential areas.

In the simulation results shown in Figure 4.5, there are several red and blue manholes and pipes in the west half of Zone 5 and in Zone 7 upstream of the Zone 7 lift station. The existing wastewater mains in the Zone 5 area are over utilized under the Long Term scenario and flooding is simulated in this area. The red manholes in Zone 7 are due to the Zone 7 Lift Station being under capacity. Currently, the pumps at the Zone 7 lift station have a capacity of 23.8 L/s, with a full-build out capacity of 160 L/s to accommodate the upstream flows. Red or blue pipes where the manholes remain green or blue are generally an indication of a shallow slope and are not recommended for upgrades.

Two areas of possible concern are also highlighted in the Big Lake residential area. While there is no flooding that occurs in the 25 year 4 hour rain event, there are several blue nodes, denoting that the line is surcharged within 2.5 m of ground. Because this is a residential neighbourhood, there is a chance of possible basement flooding and is worth monitoring.

4.1.4 Ultimate Development

In Acheson Industrial Park, Ultimate development area consists of the remainder of the unserved areas, excluding area not to be serviced, illustrated in Figure 4.7. Some of the areas not to be serviced include Lois Hole Centennial Provincial Park, Wagner Natural Area, and the future Highway 628 portions of Acheson Industrial Zones 7 and 8.

Ultimate development areas in the Acheson West Area are anticipated to be serviced by a new line, referred to as the Atim Road trunk, which will connect directly to the ACRWC PSTS Line. Based on preliminary contour data, there is sufficient drop in elevation to install a gravity wastewater line in this area.

Ultimate areas to the south of Highway 16A and west of Highway 60 are connected to the system at the Zone 5 Lift Station, at 279 Street. This will be referred to as the Acheson Trunk extension. The areas to the south of Highway 16A and east of Highway 60 will be serviced by the Bevington Road Trunk extension. Based on preliminary contour data, forcemains may be necessary as there are insufficient elevation changes for the installation of gravity mains. The residential area of Osborne Acres can be serviced by the Acheson trunk line through a low-pressure wastewater main.

A total of nine additional lift station locations were identified to be installed in the Ultimate development stage:

- ◆ Future Lift Station #7 is required to service the Ultimate developed lots the west end of Zone 5 and has a capacity of 45 L/s.
- ◆ Future Lift Station #8 is located in the west end of Zone 3 and has a capacity of 22 L/s.
- ◆ Future Lift Stations #9-15 service Ultimate developed lots in Zones 6 and 8. The capacities of these lift stations vary from 14 – 43 L/s.

The requirement for wastewater lift stations depends on the ground elevation during the development stage and should be reviewed as more detail becomes available. The locations shown in Figure 4.7 are approximate. Lift station approximate service areas are provided in Appendix A.

4.2 System Improvements

As development expands within the Acheson and Big Lake area, and flows increase, deficiencies within the system will become more apparent. Consequently, it is recommended that the existing system pipe upgrades be sized to accommodate the Ultimate development flows where necessary to avoid re-upgrading in the future. The upgrades are recommended to take place in stages. Some upgrades should take place right away in areas that are already showing issues. Some should be implemented during Near Future development, and some during Ultimate development. The upgrades are broken down into the different development plans with staged existing system upgrades. The criteria for upgrades was based on the HGL. Upgrades were proposed in industrial areas when the HGL is within 1 m of the ground. Upgrades were proposed in residential areas when the HGL is within 2 m of the ground.

4.2.1 Existing Development Stage Upgrades

As discussed in Section 3.4.4, there are areas of surcharging in the existing development condition during the 25 year 4 hour rainfall event. This rain event presents the most critical results for the existing development. Upgrade recommendation locations based on the existing system assessment HGL are shown in Figure 4.1.

- ◆ The wastewater mains along east Acheson Road, from Fulton Drive to Meyer Road in Zone 3 may require upgrading contingent on the amount of contributing wet weather flows coming from area east of Highway 60, namely flow from Standard General and Alberta Infrastructure properties in Zone 4. As described in Section 3.4.7, there are some capacity constraints at the east end of the wastewater line on Acheson Road. This line is surcharged above the diameter of the pipe and within 1 m of the ground level. Although the modelling does not indicate flooding to ground, there is a risk that with blockages or heavy rain there could be wastewater overflowing to the ditches which would prompt an environmental report, fines, and clean up costs. The proposed upgrades will eliminate potential manhole surcharging issues in the area.
- ◆ Upgrades in Zone 3 along the west section of Acheson Road to the intersection of 279 Street. This upgrade will improve manhole surcharging and over utilized mains in the area west of the intersection.
- ◆ The surcharging in residential areas is minimal under existing conditions and does not pose a significant risk for basement flooding. No residential upgrades are required for existing development.

It is important to note that most wastewater sewer problems experienced are due to wet weather flows. Ongoing maintenance and improvements to decrease wet weather flow entering the wastewater sewer system can be implemented as the opportunity arises when other repairs or upgrades are being carried out I/I reduction measures throughout Zone 3 may defer the need for pipe capacity upgrades on Acheson Road. The identified areas of concern are on upstream legs of the collection system; however, I/I reduction throughout Zone 3 will still benefit these areas as it frees up capacity downstream.

As noted in Section 3.4.5, the Zone 1 and 2 wastewater trunk was previously identified for improvements in the 2016 Study. Following the results of the 2021 model calibration and the implementation of the lining program, these upgrades are no longer required and the system has capacity for the 25 year 4 hour event. Based on these results the County may consider similar I/I reduction efforts to the Zone 3 area identified above rather than upgrades.

The 2016 report identified surcharging within 1 m of the ground in the line on 114 Avenue near the fire station. Based on the most recent calibration, these upgrades are not necessarily required due to capacity constraints, however, flow monitoring should continue, and the model calibration should be verified as larger rainfall events occur to confirm. I/I reduction measures are still worthwhile at this location and throughout the system as they reduce flows downstream and contribute to continual improvement in I/I levels, freeing up downstream capacity and helping the County meet its requirements as an ACRWC regional member.

The recommended upgrades for the existing system are summarized in Table 4.1. The existing system with improvements is shown in Figure 4.2.

Table 4.1: Existing Development Pipe Upgrades

Upgrades	Link Name	Length (m)	Upstream Manhole	Downstream Manhole	Existing Diameter (m)	Replacement Diameter (m)
Acheson Road East (Figure 4.1, Detail 1)	LM105	18	MH105	MH4	0.250	0.375
	LM110	21	MH110	MH105	0.250	0.375
	LM115	97	MH115	MH110	0.250	0.375
	LM120	151	MH120	MH115	0.250	0.375
	LM125	40	MH125	MH120	0.250	0.375
	LM130	120	MH130	MH125	0.250	0.375
	LM135	120	MH135	MH130	0.250	0.375
	L4	71	MH4	MH5	0.250	0.450
	L5	40	MH5	MH6	0.250	0.450
	L6	95	MH6	MH7	0.250	0.450
	L7	54	MH7	MH7A	0.250	0.450
	L7A	54	MH7A	MH8	0.250	0.450
	L8	118	MH8	MH9	0.300	0.450
	L9	81	MH9	MH10	0.300	0.450
	L10	83	MH10	MH11	0.300	0.450
Acheson Road West (Figure 4.1, Detail 2)	L19B	96	MH19B	MH19B1	0.375	0.525
	L19B1	41	MH19B1	MH18A	0.375	0.525
	L19C	120	MH19C	MH19B	0.375	0.525
	L19D	123	MH19D	MH19C	0.375	0.525
	L19E	65	MH19E	MH19D	0.375	0.525
Zone 3 I/I Reduction	Throughout Zone 3					

4.2.2 Near Future Development Stage Upgrades

Two main upgrades are proposed at the Near Future development stage, as shown in Figure 4.3. System upgrades under the Near Future development stage incorporates upgrades recommended in previous stages. The recommendations for the Near Future development stage are as follows:

- ◆ The Acheson Trunk requires upgrades downstream of the connection of the Acheson Road Trunk and Zone 5 forcemain connections in the Near Future development stage. The improvement is triggered prior to upgrades to the Zone 5 lift station due to the high wet weather flows in Zone 3. Improving this trunk also relieves surcharging throughout Zone 3. There is potential to delay this improvement if infiltration and inflow in Zone 3 is decreased; however, this trunk will require upgrades as flow rates in the trunk increase to 400 L/s. The existing peak wet weather flow in this gravity line is approximately 350 L/s, therefore there is 50 L/s of additional flow before improvements are required. Based on County standards, this is equivalent to 100 ha of additional allowable development area prior to improvements. I/I reduction measures throughout all of Zone 3 should be investigated. A detailed condition assessment is necessary to determine the extent of rehabilitation that may be appropriate and effective in reducing I/I.
- ◆ As shown in Figure 4.3, the gravity section of pipe between the Zone 7 forcemain and the Zone 5 Lift Station is also recommended to be upgraded. Additional peak wet weather flow that can be accommodated prior to improvements is estimated at 5.4 L/s which, based on County standards, is equivalent to 10.9 ha of developed area. This is in addition to what is added to the system at the Zone 7 lift station (21.2 ha) beyond the Amazon lot. The Zone 7 station pumps at 23.8 L/s. All flows are based on peak wet weather calculated using County Standards. Zone 5 lots that connect to this pipe section also count towards the 10.9 ha development area.
- ◆ In the west Big Lake residential area there is a blue node near Township Road 532A (Detail 3). While there is no flooding the water reaches between 1-2m within ground, posing risk for basement flooding. A possible upgrade to the pipe downstream of the surcharging node is shown North of Township Road 532A in Figure 4.3. Upgrades are recommended to alleviate this location; however, service connection and elevations should be reviewed to confirm the risk.

The recommended upgrades for the wastewater system in the Near Future development scenario are summarized in Table 4.2. The Near Future system with improvements is shown in Figure 4.4.

Table 4.2: Near Future Development Pipe Upgrades

Upgrades	Link Name	Length (m)	Upstream Manhole	Downstream Manhole	Existing Diameter (m)	Replacement Diameter (m)
Acheson Trunk (Figure 4.3 Detail 1)	L18A	80	MH18A	MH20	0.600	0.900
	L20	108	MH20	MH21	0.600	0.900
	L21	137	MH21	MH22	0.600	0.900
	L22	145	MH22	MH23	0.525	0.750
	L23	152	MH23	MH24	0.525	0.750
	L24	148	MH24	MH25	0.525	0.750
	L25	132	MH25	MH26	0.525	0.750
	L26	131	MH26	MH27	0.600	0.750
U/S of Zone 5 Lift Station (Figure 4.3 Detail 2)	L276	83	N267	N267.2	0.250	0.525
	L276.2	120	N267.2	N267.2.1	0.250	0.525
	L276.2.1	120	N267.2.1	N267.1	0.250	0.600

Upgrades	Link Name	Length (m)	Upstream Manhole	Downstream Manhole	Existing Diameter (m)	Replacement Diameter (m)
	L276.1	168	N267.1	N246	0.300	0.525
	Link737	10	N246	Z5LS	0.450	0.675
Big Lake West; North of Township Rd 532A (Figure 4.3 Detail 3)	L496	182	N399	N475	0.200	0.300

4.2.3 Long Term Development Stage Upgrades

There are 3 main pipe upgrades proposed for the Long Term development stage, as shown in Figure 4.5. System upgrades under the Long Term development stage incorporates upgrades recommended in previous stages. The recommendations for the Long Term development stage are as follows:

- ◆ As shown in Figure 4.5 (Detail 1), there are several nodes with an HGL within 0.5 m of ground in the area west of the Zone 5 Lift Station (283 Street and 96 Avenue). It is recommended to upgrade this line when the area in section 32 is developed in the Long Term. With respect to the existing flows, the additional peak wet weather flow that can be accommodated prior to improvements is estimated at 31.2 L/s which, based on County standards, is equivalent to 63.1 ha of developed area in the southwest area of Zone 5. In the Near Future, 37.7 ha will be serviced by this gravity line, therefore 25.4 ha of land can be developed in the Long Term scenario prior to improvements.
- ◆ There are also two blue nodes at the north end of the Bevington Trunk at Lake Ridge Drive in the residential area (Detail 3 in Figure 4.5). While there is no flooding the water reaches between 1-2 m within ground, posing risk for basement flooding for a small number of homes. The surcharging in this section of gravity line worsens as development in the Ultimate stage occurs. This area should be monitored as more land is developed and serviced upstream of the Bevington Trunk in Zones 6 & 8 in the Ultimate development scenario.

Additionally, it is expected that the Zone 7 lift station will be upgraded in the Long Term scenario. Upgrades to the Zone 5 lift station can possibly be avoided if when the Zone 7 lift station is upgraded to 160 L/s, the Zone 7 forcemain is extended north of Acheson Road to the Acheson Trunk bypassing the Zone 5 lift station.

The Zone 7 lift station is expected to be upgraded with a full-build out capacity of 160 L/s to accommodate the upstream flows. This will alleviate the surcharging that occurs to several nodes as shown in Detail 2 of Figure 4.5.

The 2016 report also identified surcharging at the residential creek crossing along Meridian Avenue at the east side of the Big Lake residential area. Based on discussions on the County, it was determined that this area is a local low point with no service connections in the future. Therefore, there is little risk of residential basement flooding and no upgrade was recommended for this area in this study.

The recommended upgrades for the wastewater system in the Long Term development scenario are summarized in Table 4.3. The Long Term system with improvements is shown in Figure 4.6.

Table 4.3: Long Term Development Pipe Upgrades

Upgrades	Link Name	Length (m)	Upstream Manhole	Downstream Manhole	Existing Diameter (m)	Replacement Diameter (m)
Zone 5 West (Figure 4.5 Detail 1)	Link725	120	Node696	Node697	0.250	0.300
	Link726	120	Node697	Node698	0.250	0.300
	Link727	120	Node698	Node699	0.250	0.300
	Link728	120	Node699	Node700	0.250	0.300
	Link729	102	Node700	Node701	0.250	0.300
	Link730	80	Node701	Node691	0.250	0.300
	Link720	82	Node691	Node692	0.300	0.450
	Link721	120	Node692	Node693	0.300	0.450
	Link722	120	Node693	Node694	0.300	0.450
	Link724	89	Node694	N267.1	0.300	0.450
Bevington Trunk North (Figure 4.5 Detail 3)	L379	45	N361	N362	0.525	0.600
	L388	86	N362	N371	0.525	0.600
	L389	39	N371	N370	0.525	0.600
	L390	24	N370	N372	0.525	0.600
Zone 7 Lift Station Upgrade to 160 L/s						

4.2.4 Ultimate Development Stage Upgrades

There are 3 main pipe upgrades proposed for the Ultimate development stage, as shown in Figure 4.7. System upgrades under the Ultimate development stage incorporates upgrades recommended in previous stages. The recommendations for the Ultimate development stage are as follows:

- ◆ Due to the increase in flows from Zone 5 and Zone 7, the Acheson Trunk requires two additional upgrades in the Ultimate development stage, as shown in Details 1 and 2 of Figure 4.7.
- ◆ During the Ultimate development stage, large areas in Zones 6 and 8 will be serviced by the Bevington Trunk. As shown in Detail 3 of Figure 4.7, there is surcharging within 0.5 m of ground at the forcemain connection of Lift Station 3 North of Highway 16A. It is recommended to upgrade the gravity pipe downstream of the forcemain connection. With respect to the existing flows, the additional peak wet weather flow that can be accommodated prior to improvements is estimated at 304 L/s which, based on County standards, is equivalent to 615 ha of developed area in Zones 6 and 8. It is estimated that 290 ha of land will be serviced by this gravity line prior to the Ultimate development, therefore an additional 325 ha of land can be developed in the Ultimate scenario prior to improvements.
- ◆ As shown in Figure 4.7 (Detail 4), there are several nodes within 0.5 m of ground in the area west of the Zone 5 Lift Station (99 Avenue). It is recommended to upgrade the north line when the area in the far west of Zone 5 in section 31 is developed in the Ultimate scenario. With respect to the existing flows, the additional peak wet weather flow that can be accommodated prior to improvements is estimated at 31 L/s which, based on County standards, is equivalent to 63 ha of developed area in the northwest area of Zone 5.

In the Ultimate scenario, the Zone 5 lift station should be upgraded from 160 L/s capacity to 440 L/s. The estimated flow trigger for upgrade at the Zone 5 lift station is 240 L/s or an additional 140 L/s beyond existing wet weather flows. Based on County standards, this is equivalent to 285 ha of development area. As noted in Section 4.2.3, upgrades to the Zone 5 lift station can likely be avoided if when the Zone 7 lift station is upgraded to 160 L/s, the Zone 7 forcemain is extended north of Acheson Road to the Acheson Trunk bypassing the Zone 5 lift station.

The discharge location of both the Zone 7 and Zone 5 forcemains could potentially be adjusted to optimize the improvements to the Acheson trunk. Upgrading the trunk at the current Zone 5 connection does provide some flow attenuation limiting the upgrades downstream. It is recommended that the upgrades to the Acheson trunk be reviewed in more detail in conjunction with condition assessment data. Bypassing sections of the Acheson trunk by extending the forcemains may be cost effective if the trunk is in good condition.

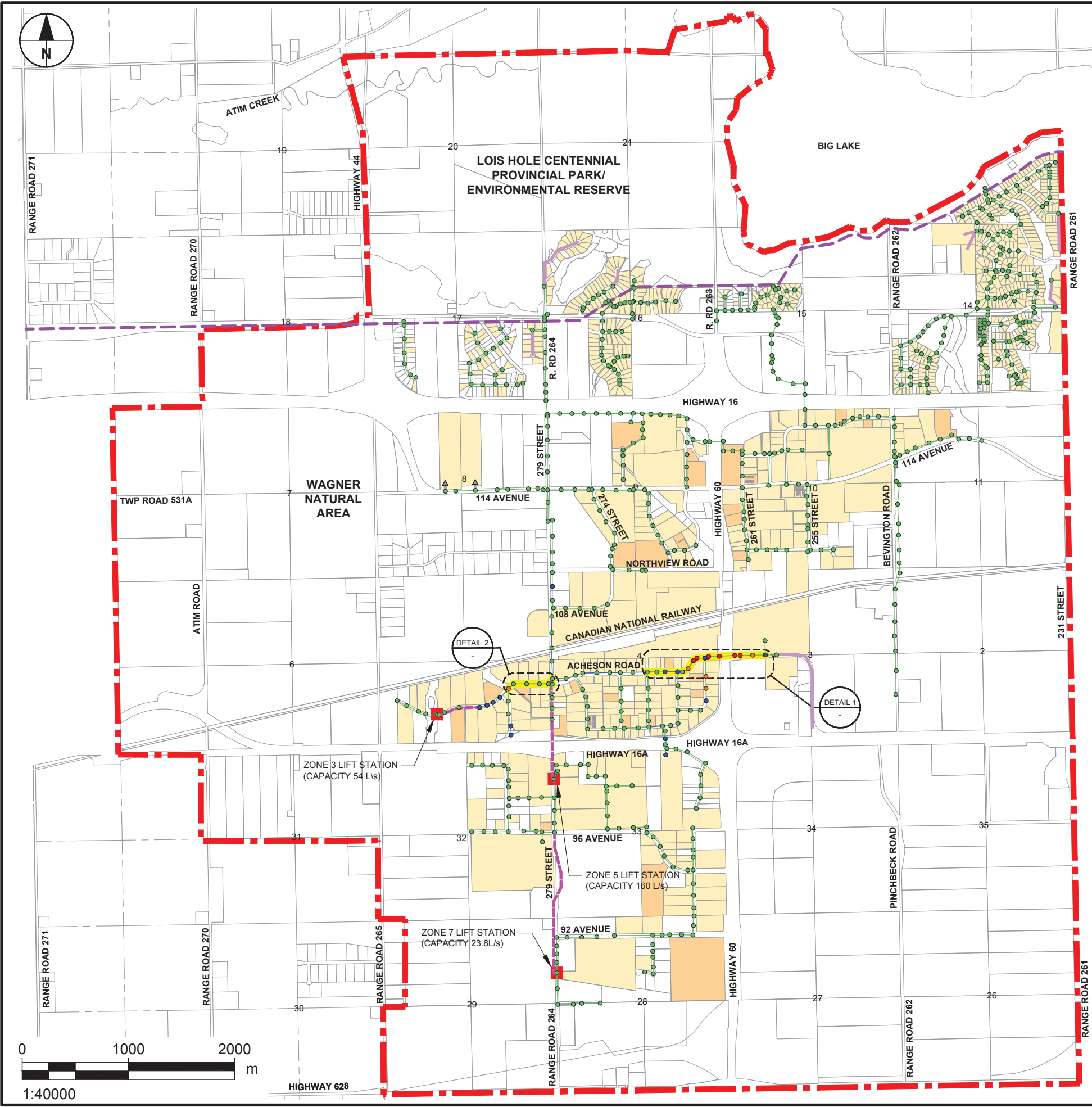
There is a potential to delay upgrades along the Acheson and Bevington Trunks if infiltration and inflow in the serviced zones are decreased. Implementation of a lining program or other I/I reduction efforts should also be explored.

The recommended upgrades for the wastewater system in the Ultimate development scenario are summarized in Table 4.4. The Ultimate system with improvements is shown in Figure 4.8.

Table 4.4: Ultimate Development Pipe Upgrades

Upgrades	Link Name	Length (m)	Upstream Manhole	Downstream Manhole	Existing Diameter (m)	Replacement Diameter (m)
Acheson Trunk	L118	15	MH44	PSTS	0.600	0.900
	L504	70	N407	MH44	0.675	0.900
	L27	90	MH27	MH28	0.600	0.750
	L28	102	MH28	MH29	0.600	0.750
	L29	150	MH29	MH30	0.600	0.750
	L30	135	MH30	MH31	0.600	0.750
	L31	135	MH31	MH31A	0.600	0.750
	L31A	101	MH31A	MH32	0.600	0.750
	L32	136	MH32	MH33	0.600	0.750
	L33	161	MH33	MH34	0.600	0.750
	L34	151	MH34	MH35	0.600	0.750
	L38B	128	MH97-1	MH39	0.600	0.750
	L39	90	MH39	MH39A	0.600	0.675
	L39.1	100	MH39A	MH40	0.600	0.675
	L40	106	MH40	MH41	0.600	0.675
	L41	148	MH41	MH42	0.600	0.675
	L42	154	MH42	MH43	0.675	0.675
Bevington Trunk (Figure 4.7 Detail 3)	L618	150	S-51	S-50	0.600	0.900
	L664	220	N300	S-51	0.600	0.900
	L619	150	S-50	S-49	0.525	0.675
	L620	150	S-49	S-48	0.525	0.675

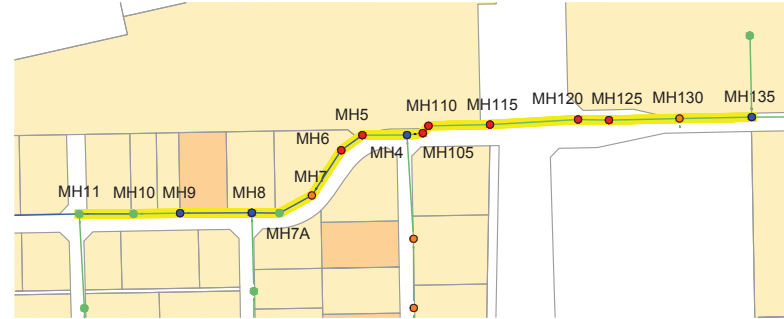
Upgrades	Link Name	Length (m)	Upstream Manhole	Downstream Manhole	Existing Diameter (m)	Replacement Diameter (m)
	L621	150	S-48	S-47	0.525	0.675
	L622	144	S-47	S-46	0.525	0.675
	L623	143	S-46	S-45	0.525	0.675
Zone 5 West; North Line (Figure 4.7 Detail 4)	Link710	120	Node681	Node682	0.250	0.375
	Link711	91	Node682	Node683	0.250	0.375
	Link712	120	Node683	Node684	0.250	0.375
	Link713	25	Node684	Node685	0.250	0.375
	Link714	120	Node685	Node686	0.250	0.375
	Link718	65	Node686	Node690	0.250	0.375
	Link719	120	Node690	Node691	0.250	0.375



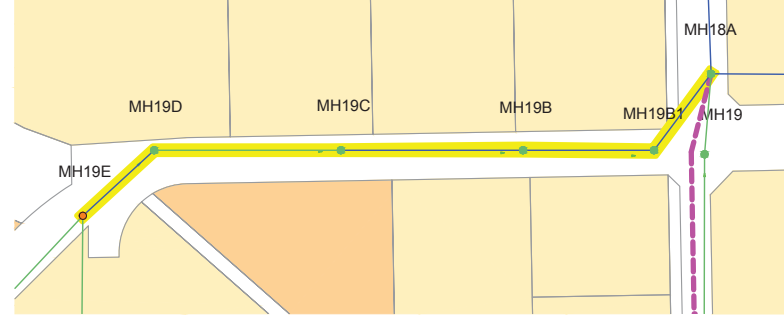
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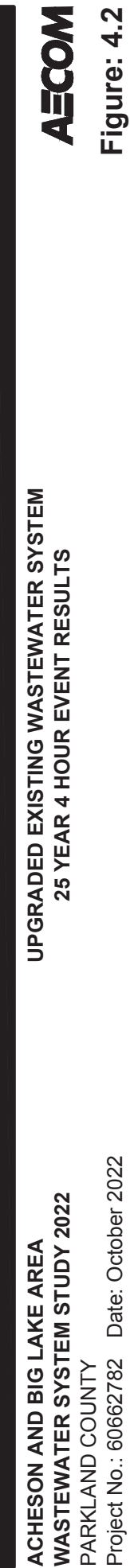
- STUDY AREA
- EXISTING DEVELOPMENT
- HIGH DEMAND USERS
- ACRWC PSTS LINE
- FORCEMAIN
- LOW PRESSURE WASTEWATER MAIN
- MAX FLOW/PIPE CAPACITY 0-1.2
- MAX FLOW/PIPE CAPACITY 1.2-2
- MAX FLOW/PIPE CAPACITY >2
- DEPTH BELOW GROUND TO HGL > 2 m
- DEPTH BELOW GROUND TO HGL 1-2 m
- DEPTH BELOW GROUND TO HGL 0.5-1 m
- DEPTH BELOW GROUND TO HGL 0-0.5 m
- LIFT STATION
- GRINDER PUMP / LOW PRESSURE CONNECTION

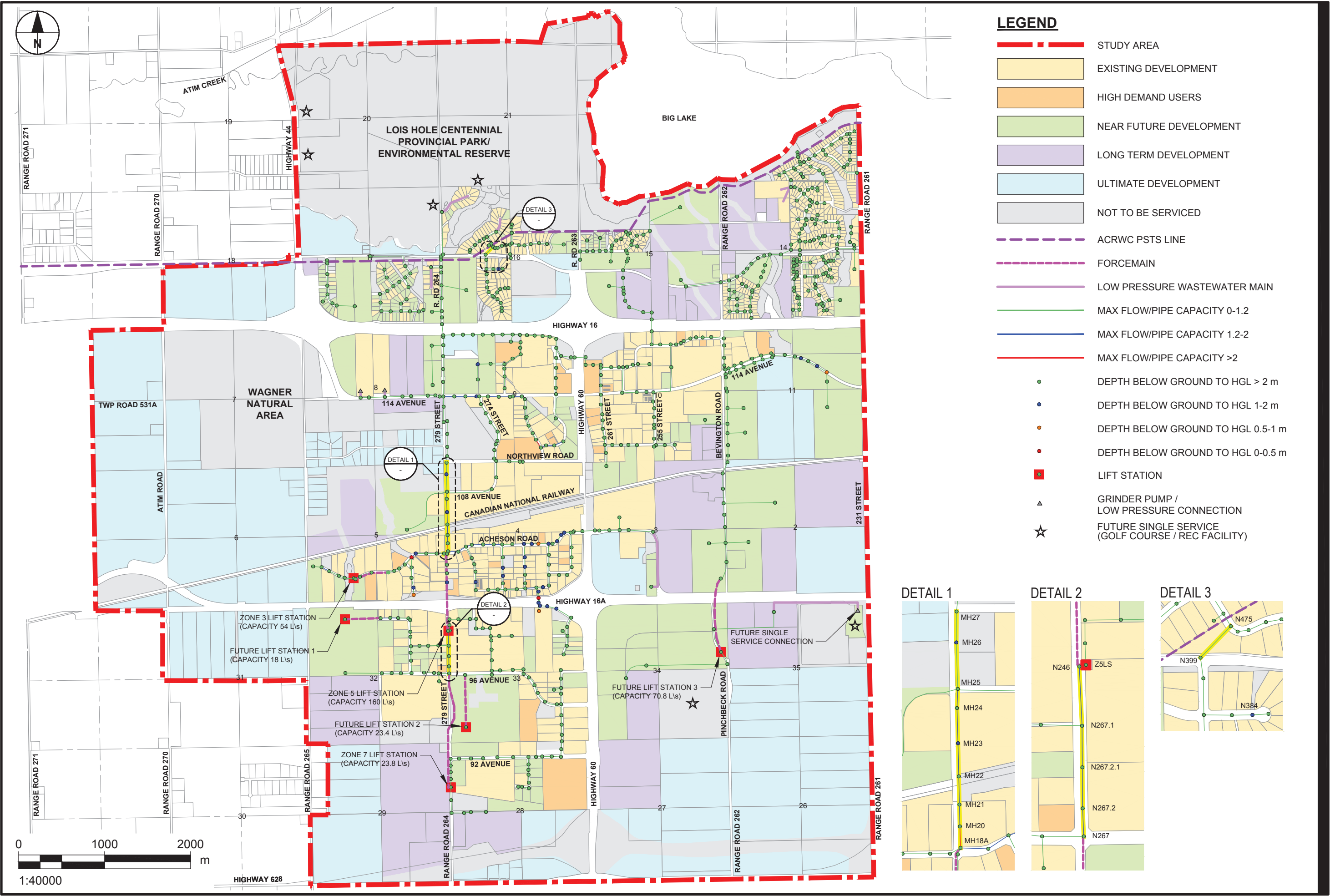
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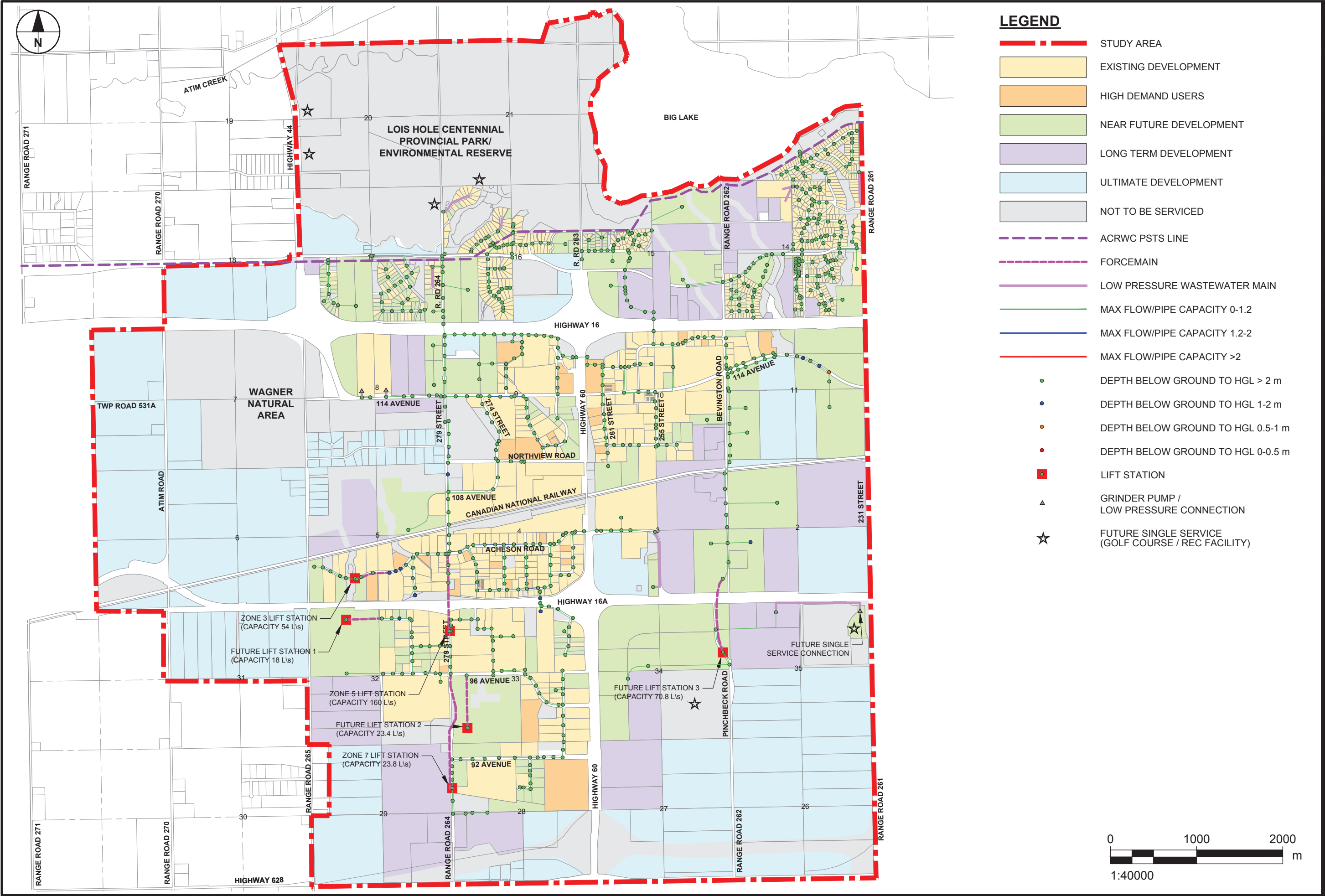


DETAIL 2

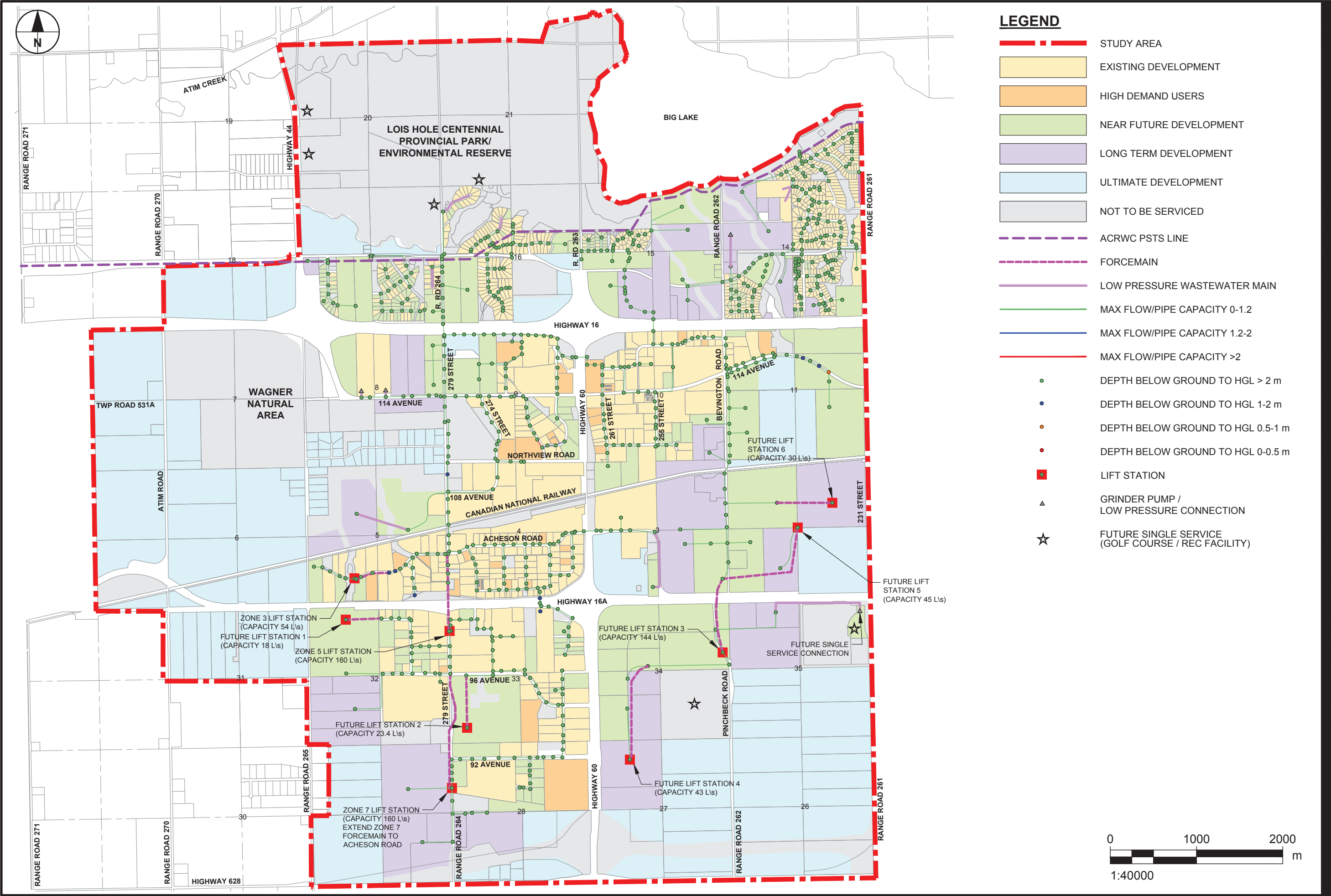


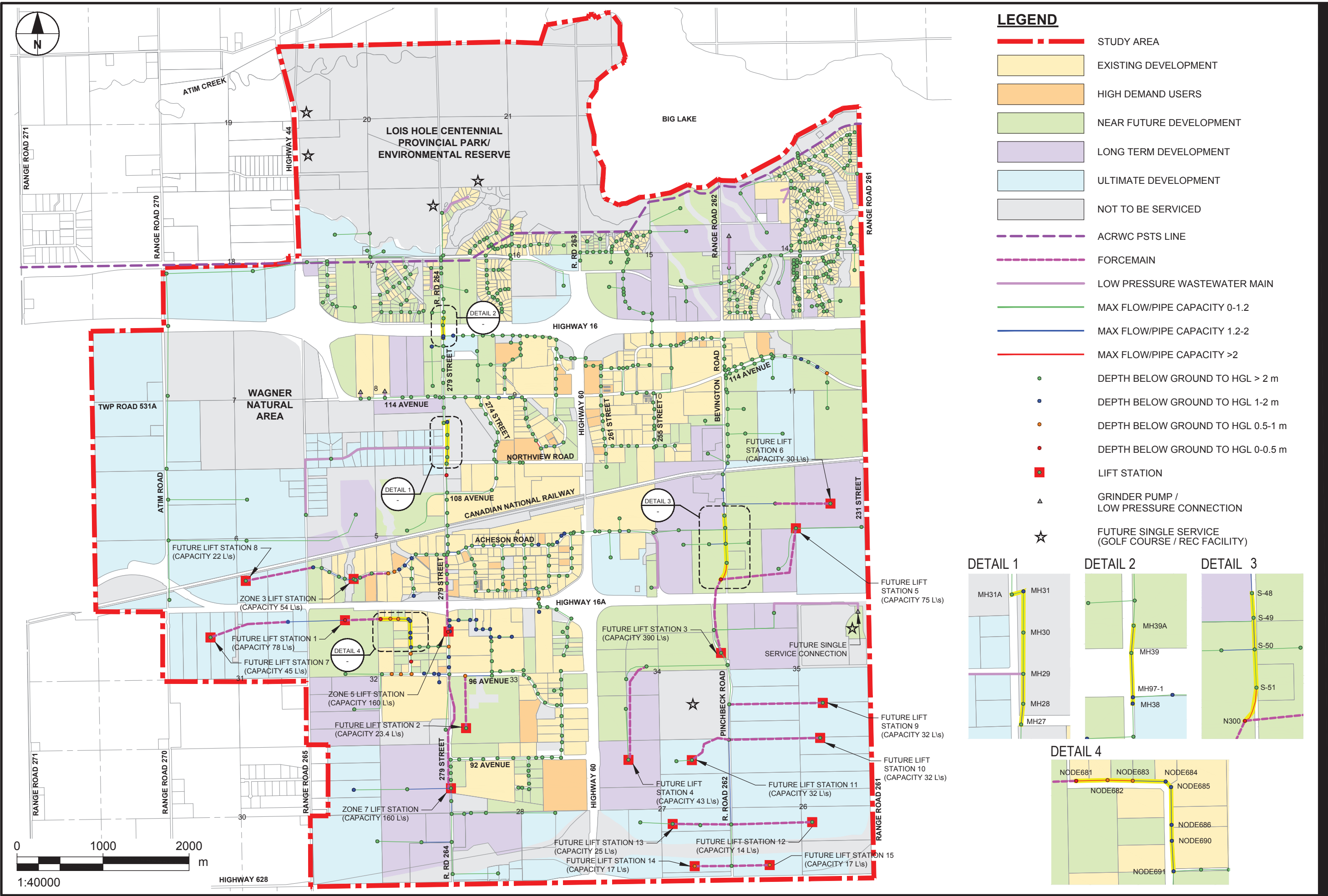








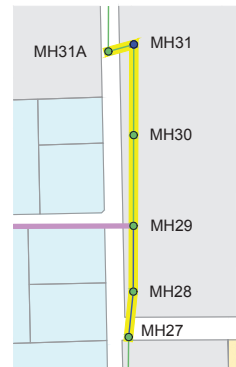




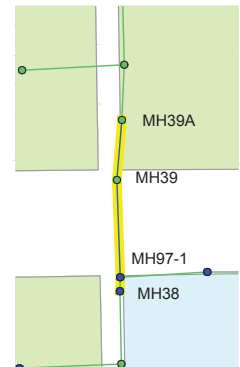
LEGEND

- STUDY AREA
- EXISTING DEVELOPMENT
- HIGH DEMAND USERS
- NEAR FUTURE DEVELOPMENT
- LONG TERM DEVELOPMENT
- ULTIMATE DEVELOPMENT
- NOT TO BE SERVICED
- ACRWC PSTS LINE
- FORCEMAIN
- LOW PRESSURE WASTEWATER MAIN
- MAX FLOW/PIPE CAPACITY 0-1.2
- MAX FLOW/PIPE CAPACITY 1.2-2
- MAX FLOW/PIPE CAPACITY >2
- DEPTH BELOW GROUND TO HGL > 2 m
- DEPTH BELOW GROUND TO HGL 1-2 m
- DEPTH BELOW GROUND TO HGL 0.5-1 m
- DEPTH BELOW GROUND TO HGL 0-0.5 m
- LIFT STATION
- GRINDER PUMP / LOW PRESSURE CONNECTION
- FUTURE SINGLE SERVICE (GOLF COURSE / REC FACILITY)

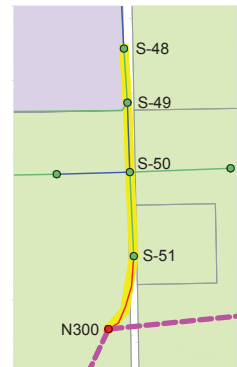
DETAIL 1



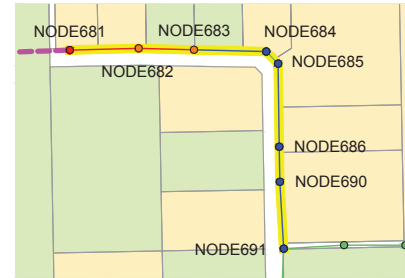
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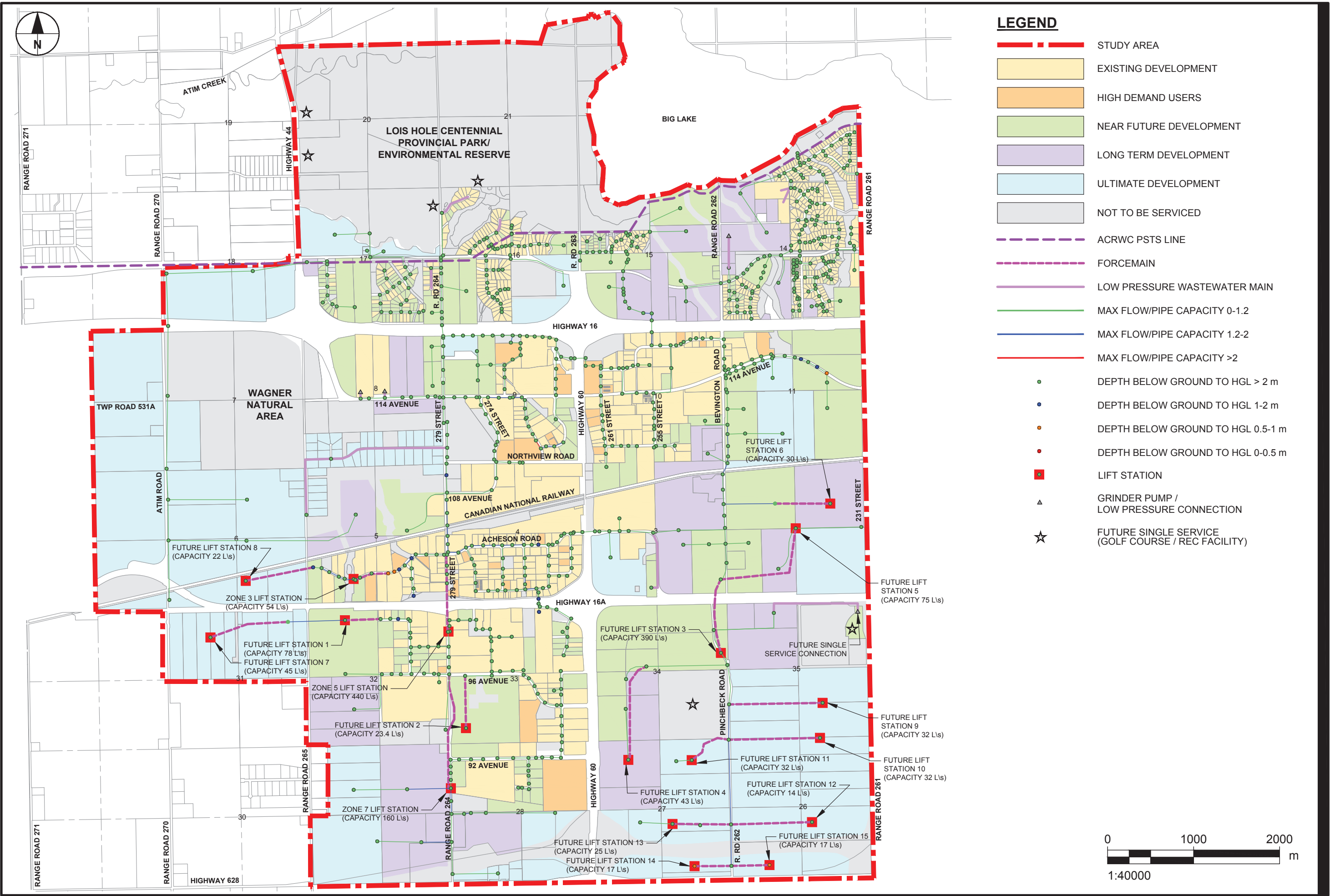


DETAIL 3



DETAIL 4





5. Cost Estimates

5.1.1 Cost Estimates and Prioritization Plan

The recommended upgrades account for Ultimate development flows and should be implemented in stages to best account for existing and future flows. The staged upgrades are summarized in Table 5.1. Some upgrades are necessary to be completed at the existing development stage, as the existing system cannot handle the existing flows as well as inflow and infiltration from the design rainfall events. An implementation order has been created based on the consequence of the risk. Installation of lift station and forcemains should be implemented based on the development rate.

It should be noted that all the proposed upgrades assume that the I/I from the existing areas is not controlled or improved. I/I reduction measures can be implemented to attempt to reduce wet weather flows.

The effectiveness of these measures can then be confirmed with flow monitoring. There is potential then to reduce or delay the required upgrades. Similarly, if the I/I rate is controlled to below the standard of 0.28 L/s/ha assumed for new development areas, there is potential to reduce the pipe size and lift station capacity required. Flow monitoring should continue and the calibration can be adjusted as more data is available.

Table 5.1 summarizes the costs and implementation plan for each upgrade. The replacement cost for each individual upgrade includes 50% engineering and contingency costs.

Table 5.1: Upgrade Implementation Stages and Cost Summary

Stage	Implementation Order	Upgrades to be Implemented	Reason for Upgrades	Approximate WWF Trigger (L/s)	Allowable Development Area (ha)	Replacement Cost (\$)
Existing	1**	Acheson Road East	Several surcharging manholes	50	-	\$3,039,200
	2**	Acheson Road West	Several surcharging manholes	98	-	\$1,542,900
		Subtotal				\$4,582,100
Near Future	1	Acheson Trunk	Several surcharging manholes U/S of line in Zone 3	400	101.2	\$4,602,300
	2	Gravity Line between Zone 7 forcemain and Zone 5 Lift Station	Reaches Capacity	44	10.9*	\$1,131,100
	3	Big Lake West; North of Township Rd 532A	Risk of basement flooding	37.5	-	\$210,000
		Subtotal				\$5,943,400
Long Term	1	Zone 7 Lift Station Upgrade	The Zone 7 Lift Station reaches capacity; surcharging U/S of Z7 LS	23.8	48.1	\$1,560,000
	2	Zone 7 Forcemain Extension	In place of Zone 5 Upgrade	23.8	48.1	\$3,437,450
	3	Zone 5 West Pipe Upgrades	Several surcharging manholes	32	63.1	\$2,825,200
	4	Bevington Trunk North	Risk of basement flooding	640	730	\$369,000
		Subtotal				\$8,191,650

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Stage	Implementation Order	Upgrades to be Implemented	Reason for Upgrades	Approximate WWF Trigger (L/s)	Allowable Development Area (ha)	Replacement Cost (\$)
Ultimate	1***	Zone 5 Lift Station Upgrade	The Zone 5 Lift Station reaches Capacity; severe surcharging U/S of Z5 LS	240	285.9	\$5,810,000
	2	Zone 5 West; North Line	Several surcharging manholes	32	62.9	\$741,100
	3	Acheson Trunk	Several surcharging manholes	700	374	\$3,050,000
	4	Bevington Trunk	Several surcharging manholes	304	615	\$1,514,400
Subtotal						\$11,115,500
TOTAL						\$26,395,200

*10.9 ha is in addition to the planned development draining to the Zone 7 station (21.2 ha)

**As discussed in Section 4, I/I reduction is recommended prior to implementing upgrades on Acheson Road.

***Not required if Zone 7 forcemain is extended.

For comparison purposes, the cost of I/I reduction in Zone 3 is estimated at approximately \$3.1M (including engineering and contingency). This is assuming manhole rehabilitation on 75% of the manholes and lining of 25% of the pipes similar to the ratios completed for the Zone 1 and 2 I/I reduction. I/I reduction in Zone 3 has the potential to reduce the identified pipe upgrades on Acheson Road as well as upgrades to the Acheson Trunk in future scenarios. Further study is recommended to determine the extent of the I/I reduction measures.

In order to expand the collection system to service the Ultimate development areas, several new wastewater mains must be added as described in Section 4.1.4 and Figure 4.8. The costs for new Atim Road Trunk, the Acheson Trunk Extension, the Bevington Road Trunk Extension, as well as any extensions in the Big Lake area have been summarized in Table 5.2. Detailed tables of the new pipe installations for the Near Future, Long Term and Ultimate development scenarios can be found in Appendix B.

Table 5.2: New Extensions for Ultimate Development Scenario

Installations	Total Gravity Pipe Length (m)	Total Pumping Facilities	Gravity Pipe Cost	Pumping Cost	Total Cost
Acheson Trunk Extension	3,580	Two Lift Stations c/w 1,500 m of forcemain	\$2,908,700	\$2,627,500	\$5,536,200
Big Lake Extensions	1,154	N/A	\$1,108,000	\$0	\$1,108,000
Bevington Trunk Extension	5,462	Seven Lift Stations c/w 4,550 m of forcemain	\$5,717,300	\$7,993,900	\$13,711,200
Atim Trunk	6,475	N/A	\$6,187,500	\$0	\$6,187,500
Subtotal	16,671	Nine Lift Stations c/w 6,050 m of forcemain	\$15,921,500	\$10,621,400	\$26,542,900
Engineering and Contingency (50%)			\$7,960,750	\$5,310,700	\$13,271,450
TOTAL			\$23,882,250	\$15,932,100	\$39,814,350

The estimated costs for future lift station construction and upgrade are summarized below in Table 5.3. The 50% engineering and contingency costs are included in each upgrade.

Table 5.3: Future Lift Stations and Forcemain Costs

Stage	Future Lift Station	Reason for Upgrades	Cost
Near Future	Future Lift Station #1 and Forcemain	Service Future Development Area	\$1,890,000
	Future Lift Station #2 and Forcemain	Service Future Development Area	\$1,590,000
	Future Lift Station #3 and Forcemain	Service Future Development Area	\$5,810,000
	Subtotal		\$9,290,000
Long Term	Future Lift Station #4 and Forcemain	Service Future Development Area	\$2,350,000
	Future Lift Station #5 and Forcemain	Service Future Development Area	\$1,870,000
	Future Lift Station #6 and Forcemain	Service Future Development Area	\$1,600,000
	Subtotal		\$5,820,000
Ultimate	Future Lift Station #7 and Forcemain	Service Future Development Area	\$2,350,000
	Future Lift Station #8 and Forcemain	Service Future Development Area	\$1,590,000
	Future Lift Station #9 and Forcemain	Service Future Development Area	\$2,310,000
	Future Lift Station #10 and Forcemain	Service Future Development Area	\$2,420,000
	Future Lift Station #11 and Forcemain	Service Future Development Area	\$2,420,000
	Future Lift Station #12 and Forcemain	Service Future Development Area	\$1,590,000
	Future Lift Station #13 and Forcemain	Service Future Development Area	\$1,580,000
	Future Lift Station #14 and Forcemain	Service Future Development Area	\$1,590,000
	Future Lift Station #15 and Forcemain	Service Future Development Area	\$1,560,000
	Subtotal		\$17,410,000
TOTAL			\$32,520,000

6. Conclusions and Recommendations

The existing wastewater system has capacity for current development dry weather flow and wet weather flows up to and including the 5 year 4 hour and 25 year 24 hour events. For the more conservative 25 year 4 hour event, there are some capacity constraints at the east end of the wastewater line on Acheson Road. This line is surcharged to within 1 m of the ground level. As most of the development in the area would not likely have basements, the risk of property damage is low. Although the modelling does not indicate flooding to ground, there is a risk that with blockages or heavy rain there could be wastewater overflowing to the ditches which would prompt an environmental report, fines, and clean up costs.

Two main pipe upgrades were proposed in the Existing Development stage:

- ◆ The wastewater mains along east Acheson Road, from Fulton Drive to Meyer Road in Zone 3 may require upgrading contingent on the amount of contributing wet weather flows coming from area east of Highway 60, namely flow from Standard General and Alberta Infrastructure properties in Zone 4. As described in Section 3.4.7, there are some capacity constraints at the east end of the wastewater line on Acheson Road. The proposed upgrades will eliminate potential manhole surcharging issues in the area.
- ◆ Upgrades in Zone 3 along the west section of Acheson Road to the intersection of 279 Street. This upgrade will improve manhole surcharging and over utilized mains in the area west of the intersection.
- ◆ As noted in Section 3.4.5, the Zone 1 and 2 wastewater trunk was previously identified for improvements in the 2016 Study. Following the results of the 2021 model calibration and the implementation of the lining program, these upgrades are no longer required and the system has capacity for the 25 year 4 hour event. Based on these results the County may consider similar I/I reduction efforts to the Zone 3 area identified above rather than conveyance upgrades.

For future developments, the design criteria used for this study are as follows:

- ◆ A residential sewage generation rate of 350 L/c/d, for all future developments.
- ◆ A non-residential sewage generation rate of 6170 L/ha/d with a peaking factor of 3.0, at Near Future, Long Term and Ultimate development stages.
- ◆ A residential and non-residential inflow/infiltration allowance of 0.28 L/s/ha.
- ◆ Actual high water user generation rates will be used, at Near Future, Long Term and Ultimate development stages. These values are based on actual water usage records as described in Section 3.3.

Near Future Development Stage

Two main pipe upgrades are proposed at the Near Future development stage as follows:

- ◆ The Acheson Trunk requires upgrades downstream of the connection of the Acheson Road Trunk and Zone 5 forcemain connections in the Near Future development stage. The improvement is triggered prior to upgrades to the Zone 5 lift station due to the high wet weather flows in Zone 3. Improving this trunk also relieves surcharging throughout Zone 3. There is potential to delay this improvement if infiltration and inflow in Zone 3 is decreased; however, this trunk will require upgrades as flow rates in the trunk increase to 400 L/s. The existing peak wet weather flow in this gravity line is approximately 350 L/s, therefore there is 50 L/s of additional flow before improvements are required. Based on County standards, this is equivalent to 100 ha of additional allowable development area prior to improvements.

- ◆ As shown in Figure 4.3, the gravity section of pipe between the Zone 7 forcemain and the Zone 5 Lift Station is also recommended to be upgraded. Additional peak wet weather flow that can be accommodated prior to improvements is estimated at 5.4 L/s which, based on County standards, is equivalent to 10.9 ha of developed area. This is in addition to what is added to the system at the Zone 7 lift station (21.2 ha) beyond the developed lot. The Zone 7 station pumps at 23.8 L/s. All flows are based on peak wet weather calculated using County Standards.
- ◆ In the west Big Lake residential area there is a blue node near Township Road 532A (Detail 3). While there is no flooding, the HGL reaches between 1-2m within ground, posing risk for basement flooding. A possible upgrade to the pipe downstream of the surcharging node is shown North of Township Road 532A in Figure 4.3. Service connection elevations should be reviewed to confirm the risk.
- ◆ Three future lift stations are proposed to convey flow from Near Future developments in Zones 5 and 6.

Long Term Development Stage

Three main pipe upgrades are proposed at the Long Term development stage as follows:

- ◆ As shown in Figure 4.5 (Detail 1), there are several nodes within 0.5 m of ground in the area west of the Zone 5 Lift Station (96 Avenue). It is recommended to upgrade this line when the area in section 32 is developed in the Long Term. With respect to the existing flows, the additional peak wet weather flow that can be accommodated prior to improvements is estimated at 31.2 L/s which, based on County standards, is equivalent to 63.1 ha of developed area in the southwest area of Zone 5. In the Near Future, 37.7 ha will be serviced by this gravity line, therefore 25.4 ha of land can be developed in the Long Term scenario prior to improvements.
- ◆ There are two blue nodes at the north end of the Bevington Trunk at Lake Ridge Drive in the residential area (Detail 3 in Figure 4.5). While there is no flooding the water reaches between 1-2 m within ground, posing risk for basement flooding for a small number of homes. The surcharging in this section of gravity line worsens as development in the Ultimate stage occurs. This area should be monitored as more land is developed and serviced upstream of the Bevington Trunk in Zones 6 & 8 in the Ultimate development scenario. Service connection elevations should be reviewed to confirm the risk.
- ◆ Additionally, it is expected that the Zone 7 lift station will be upgraded in the Long Term scenario. Upgrades to the Zone 5 lift station can likely be avoided if when the Zone 7 lift station is upgraded to 160 L/s, the Zone 7 forcemain is extended north of Acheson Road to the Acheson Trunk bypassing the Zone 5 lift station.
- ◆ Three future lift stations are proposed to convey flow from Long Term developments in Zones 4 and 8.

Ultimate Development Stage

Three main pipe upgrades are proposed at the Ultimate development stage as follows:

- ◆ Due to the upgrade of the Zone 5 lift station in the Long Term development stage, the Acheson Trunk requires two additional upgrades in the Ultimate development stage, as shown in Details 1 and 2 of Figure 4.7.
- ◆ During the Ultimate development stage, large areas in Zones 6 and 8 will be serviced by the Bevington Trunk. As shown in Detail 3 of Figure 4.7, there is surcharging within 0.5 m of ground at the forcemain connection of Lift Station 3 North of Highway 16A. It is recommended to upgrade the gravity pipe downstream of the forcemain connection. With respect to the existing flows, the additional peak wet weather flow that can be accommodated prior to improvements is estimated at 304 L/s which, based on County standards, is equivalent to 615 ha of developed area in Zones 6 and 8. It is estimated that 290 ha of land will be serviced by this gravity

line prior to the Ultimate development, therefore an additional 325 ha of land can be developed in the Ultimate scenario prior to improvements.

- ◆ As shown in Figure 4.7 (Detail 4), there are several nodes within 0.5 m of ground in the area west of the Zone 5 Lift Station (99 Avenue). It is recommended to upgrade the north line when the area in the far west of Zone 5 in section 31 is developed in the Ultimate scenario. With respect to the existing flows, the additional peak wet weather flow that can be accommodated prior to improvements is estimated at 31 L/s which, based on County standards, is equivalent to 63 ha of developed area in the northwest area of Zone 5.
- ◆ In the Ultimate scenario, the Zone 5 lift station should be upgraded from 160 L/s capacity to 440 L/s. The estimated flow trigger for upgrade at the Zone 5 lift station is 240 L/s or an additional 140 L/s beyond existing wet weather flows. Based on County standards, this is equivalent to 285 ha of development area. As noted in Section 4.2.3, upgrades to the Zone 5 lift station can likely be avoided if when the Zone 7 lift station is upgraded to 160 L/s, the Zone 7 forcemain is extended north of Acheson Road to the Acheson Trunk bypassing the Zone 5 lift station.
- ◆ Nine future lift stations are proposed to convey flow from Ultimate stage developments in Zones 3, 5, 6 and 8.

The cost and staged implementation of the upgrades are summarized in Table 6.1. Detailed cost estimates can be found in Appendix B.

Table 6.1: Upgrade Implementation Stages and Cost Summary

Stage	Implementation Order	Upgrades to be Implemented	Reason for Upgrades	Approximate WWF Trigger (L/s)	Allowable Development Area (ha)	Replacement Cost (\$)
Existing	1**	Acheson Road East	Several surcharging manholes	50	-	\$3,039,200
	2**	Acheson Road West	Several surcharging manholes	98	-	\$1,542,900
		Subtotal				\$4,582,100
Near Future	1	Acheson Trunk	Several surcharging manholes U/S of line in Zone 3	400	101.2	\$4,602,300
	2	Gravity Line between Zone 7 forcemain and Zone 5 Lift Station	Reaches Capacity	44	10.9*	\$1,131,100
	3	Big Lake West; North of Township Rd 532A	Risk of basement flooding	37.5	-	\$210,000
		Subtotal				\$5,943,400
Long Term	1	Zone 7 Lift Station Upgrade	The Zone 7 Lift Station reaches capacity; surcharging U/S of Z7 LS	23.8	48.1	\$1,560,000
	2	Zone 7 Forcemain Extension	In place of Zone 5 Upgrade	23.8	48.1	\$3,437,450
	3	Zone 5 West Pipe Upgrades	Several surcharging manholes	32	63.1	\$2,825,200
	4	Bevington Trunk North	Risk of basement flooding	640	730	\$369,000
		Subtotal				\$8,191,650

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Stage	Implementation Order	Upgrades to be Implemented	Reason for Upgrades	Approximate WWF Trigger (L/s)	Allowable Development Area (ha)	Replacement Cost (\$)
Ultimate	1***	Zone 5 Lift Station Upgrade	The Zone 5 Lift Station reaches Capacity; severe surcharging U/S of Z5 LS	240	285.9	\$5,810,000
	2	Zone 5 West; North Line	Several surcharging manholes	32	62.9	\$741,100
	3	Acheson Trunk	Several surcharging manholes	700	374	\$3,050,000
	4	Bevington Trunk	Several surcharging manholes	304	615	\$1,514,400
					Subtotal	\$11,115,500
					TOTAL	\$26,395,200

*10.9 ha is in addition to the planned development draining to the Zone 7 station (21.2 ha)

**As discussed in Section 4, I/I reduction is recommended prior to implementing upgrades on Acheson Road.

***Not required if Zone 7 forcemain is extended.

The total costs for future lift stations are summarized in Table 6.2.

Table 6.2: Future Lift Stations and Forcemain Costs

Stage	Future Lift Station	Reason for Upgrades	Cost
Near Future	Future Lift Station #1 and Forcemain	Service Future Development Area	\$1,890,000
	Future Lift Station #2 and Forcemain	Service Future Development Area	\$1,590,000
	Future Lift Station #3 and Forcemain	Service Future Development Area	\$5,810,000
	Subtotal		\$9,290,000
Long Term	Future Lift Station #4 and Forcemain	Service Future Development Area	\$2,350,000
	Future Lift Station #5 and Forcemain	Service Future Development Area	\$1,870,000
	Future Lift Station #6 and Forcemain	Service Future Development Area	\$1,600,000
	Subtotal		\$5,820,000
Ultimate	Future Lift Station #7 and Forcemain	Service Future Development Area	\$2,350,000
	Future Lift Station #8 and Forcemain	Service Future Development Area	\$1,590,000
	Future Lift Station #9 and Forcemain	Service Future Development Area	\$2,310,000
	Future Lift Station #10 and Forcemain	Service Future Development Area	\$2,420,000
	Future Lift Station #11 and Forcemain	Service Future Development Area	\$2,420,000
	Future Lift Station #12 and Forcemain	Service Future Development Area	\$1,590,000
	Future Lift Station #13 and Forcemain	Service Future Development Area	\$1,580,000
	Future Lift Station #14 and Forcemain	Service Future Development Area	\$1,590,000
	Future Lift Station #15 and Forcemain	Service Future Development Area	\$1,560,000
	Subtotal		\$17,410,000
	TOTAL		\$32,520,000

Operational Action Items

There are several recommendations related to the ongoing operation and maintenance of the wastewater system. A summary of action items is provided.

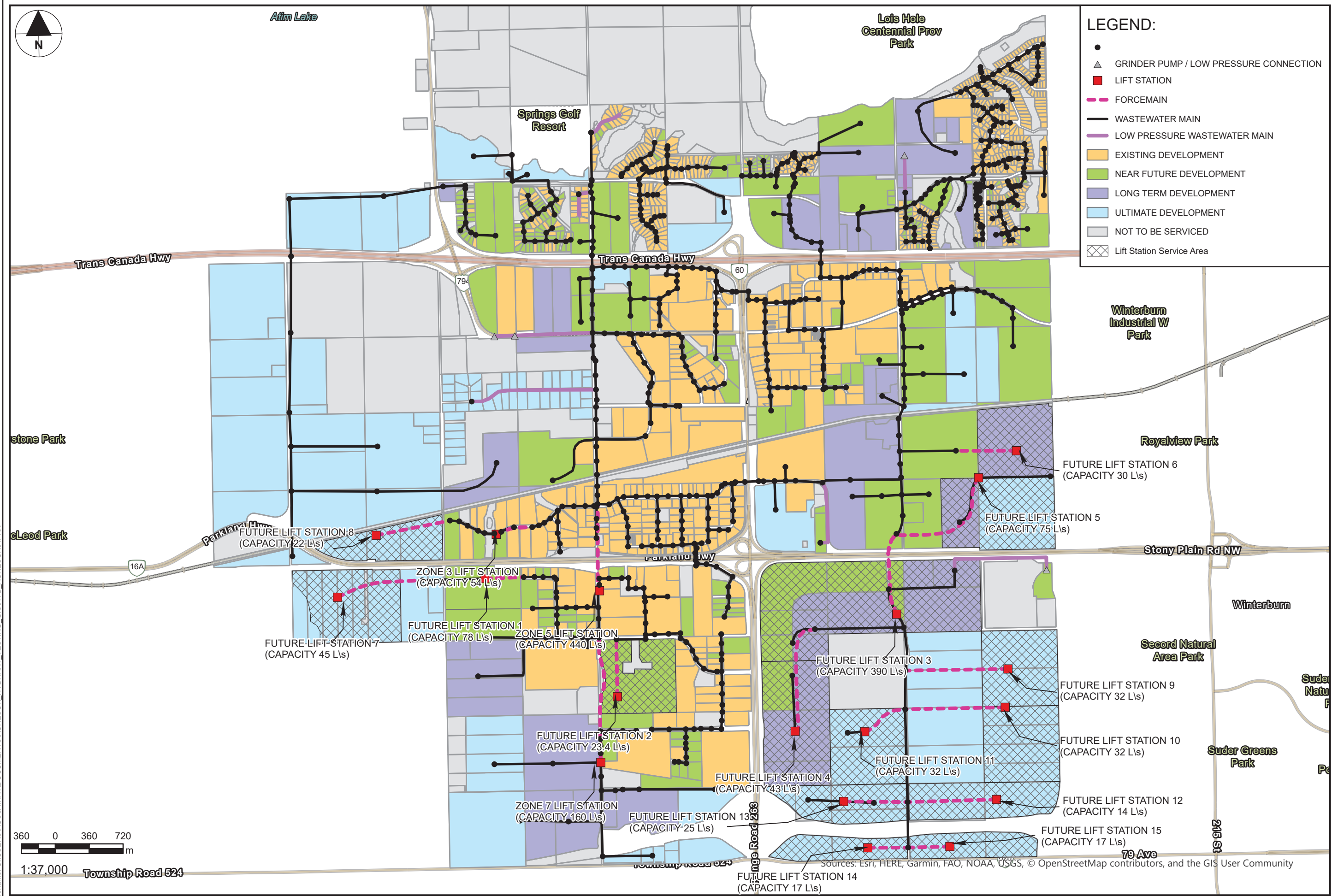
- ◆ A flow monitoring program was implemented as part of this study at 6 locations along with a rain gauge. It is recommended that monitoring at these locations continue to observe any trends over time as areas develop and as more severe rainfall events are experienced. The model calibration can then be reviewed periodically and the impact of any I/I reduction improvements can be measured.
- ◆ Pump station SCADA at the Zone 5 Station as Zone 3 and 7 can continue to be reviewed to identify if run times are in line with flow monitoring data.
- ◆ As the sewer line on Acheson Road was identified as a surcharge location during the 25 year 4 hour rainfall event, the serviced areas can be reviewed for service connection elevations and the presence of basements and backflow preventors to further assess the risk of surcharge. With the higher risk of surcharge, any blockage will have a greater impact and a flushing program and/or emergency response plan should be considered.
- ◆ Flushing of the sewers in Zone 5 downstream of the Champion Pet Foods facility should continue to prevent blockages and build up of oil and grease. Frequency of oil and grease removal should be monitored such that the operation of the Zone 5 pump station is not negatively impacted.
- ◆ Sources of H₂S may include any areas where wastewater is stagnating including blockages, sags and pre-treatment units as well as the lift station wet well. Actions should be taken to limit H₂S formation.

Appendix A

Future Lift Station Service Areas

ANSI B 279.4mm x 431.8mm

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Project Management Initials: Designer: Checked: Approved:



ULTIMATE WASTEWATER SYSTEM
FUTURE LIFT STATION SERVICE AREAS

ACHESON AND BIG LAKE AREA
WASTEWATER SYSTEM STUDY 2022
PARKLAND COUNTY

Project No.: 60662782

Appendix B

Detailed Cost Estimates

Table B.1 Existing Upgrades

Upgrades	Link Name	Crossing Type	Length (m)	Average Depth (m)	Upstream Manhole	Upstream Invert Elevation (m)	Upstream Manhole Ground Elevation (m)	Upstream Depth (m)	Downstream Manhole	Downstream Invert Elevation (m)	Downstream Manhole Ground Elevation (m)	Downstream Depth (m)	Existing Diameter (m)	Replacement Diameter (m)	Average Depth	Unit Cost (\$)	Pipe Cost	MH VM	Unit Cost	MH Cost	Cost (\$)	Contingency (50%)	Total Cost (\$)
Acheson Road East	LM105		18	4.14	MH105	705.859	709.95	4.1	MH4	705.81	710	4.2	0.250	0.375	4.0	\$700	\$12,600	8.3	\$1,200	\$9,937	\$22,537	\$11,269	\$33,806
	LM110		21	3.78	MH110	705.978	709.5	3.5	MH105	705.919	709.95	4.0	0.250	0.375	4.0	\$700	\$14,700	4.0	\$1,200	\$4,837	\$19,537	\$9,769	\$29,306
	LM115		97	3.33	MH115	706.311	709.5	3.2	MH110	706.038	709.5	3.5	0.250	0.375	3.0	\$700	\$67,900	3.5	\$1,200	\$4,154	\$72,054	\$36,027	\$108,082
	LM120	HWY 60 Crossing	151	2.98	MH120	706.956	709.75	2.8	MH115	706.341	709.5	3.2	0.250	0.375	3.0	\$8,227	\$1,242,209	3.2	\$1,200	\$3,791	\$1,246,000	\$623,000	\$1,869,000
	LM125		40	2.69	MH125	707.094	709.7	2.6	MH120	706.981	709.75	2.8	0.250	0.375	3.0	\$700	\$28,000	2.8	\$1,200	\$3,323	\$31,323	\$15,661	\$46,984
	LM130		120	2.66	MH130	707.455	710.2	2.7	MH125	707.119	709.7	2.6	0.250	0.375	3.0	\$700	\$84,000	2.6	\$1,200	\$3,097	\$87,097	\$43,549	\$130,646
	LM135		120	3.05	MH135	707.816	711.2	3.4	MH130	707.48	710.2	2.7	0.250	0.375	3.0	\$700	\$84,000	2.7	\$1,200	\$3,264	\$87,264	\$43,632	\$130,896
	L4		71	3.67	MH4	705.784	710	4.2	MH5	705.389	708.504	3.1	0.250	0.450	4.0	\$700	\$49,700	3.1	\$1,200	\$3,738	\$53,438	\$26,719	\$80,157
	L5		40	3.14	MH5	705.364	708.504	3.1	MH6	705.258	708.403	3.1	0.250	0.450	3.0	\$700	\$28,000	3.1	\$1,200	\$3,774	\$31,774	\$15,887	\$47,661
	L6		95	3.27	MH6	705.233	708.403	3.2	MH7	704.988	708.353	3.4	0.250	0.450	3.0	\$700	\$66,500	3.4	\$1,200	\$4,038	\$70,538	\$35,269	\$105,807
	L7		54	3.98	MH7	704.963	708.353	3.4	MH7A	704.837	709.4	4.6	0.250	0.450	4.0	\$700	\$37,800	4.6	\$2,000	\$9,126	\$46,926	\$23,463	\$70,389
	L7A		54	4.18	MH7A	704.807	709.4	4.6	MH8	704.665	708.426	3.8	0.250	0.450	4.0	\$700	\$37,800	3.8	\$1,200	\$4,513	\$42,313	\$21,157	\$63,470
	L8		118	3.64	MH8	704.586	708.426	3.8	MH9	704.27	707.715	3.4	0.300	0.450	4.0	\$700	\$82,600	3.4	\$1,200	\$4,134	\$86,734	\$43,367	\$130,101
	L9		81	3.68	MH9	704.245	707.715	3.5	MH10	704.155	708.045	3.9	0.300	0.450	4.0	\$700	\$56,700	3.9	\$1,200	\$4,668	\$61,368	\$30,684	\$92,052
	L10		83	4.24	MH10	704.125	708.045	3.9	MH11	703.901	708.464	4.6	0.300	0.450	4.0	\$700	\$58,100	4.6	\$2,000	\$9,126	\$67,226	\$33,613	\$100,839
	Acheson Road East																				Cost (\$)	Contingency (50%)	Total Cost (\$)
	Subtotal																				\$2,026,130	\$1,013,065	\$3,039,195
Acheson Road West	L19B		96	7.73	MH19B	702.627	710.047	7.4	MH19B1	702.478	710.523	8.0	0.375	0.525	8.0	\$2,150	\$206,400	15.5	\$2,000	\$30,930	\$237,330	\$118,665	\$355,995
	L19B1	Road Crossing	41	7.87	MH19B1	702.453	710.523	8.1	MH18A	702.328	710	7.7	0.375	0.525	8.0	\$8,227	\$337,289	7.7	\$2,000	\$15,344	\$352,633	\$176,316	\$528,949
	L19C		120	7.01	MH19C	702.952	709.582	6.6	MH19B	702.652	710.047	7.4	0.375	0.525	7.0	\$1,900	\$228,000	7.4	\$2,000	\$14,790	\$242,790	\$121,395	\$364,185
	L19D		123	5.29	MH19D	703.42	707.39	4.0	MH19C	702.977	709.582	6.6	0.375	0.525	5.0	\$1,050	\$129,150	6.6	\$2,000	\$13,210	\$142,360	\$71,180	\$213,540
	L19E		65	3.22	MH19E	703.566	706.066	2.5	MH19D	703.445	707.39	3.9	0.375	0.525	3.0	\$750	\$48,750	3.9	\$1,200	\$4,734	\$53,484	\$26,742	\$80,226
	Acheson Road West																				Cost (\$)	Contingency (50%)	Total Cost (\$)
	Subtotal																				\$1,028,597	\$514,298	\$1,542,895

Subtotal	\$3,054,726
Engineering and Contingency	\$1,527,363
Total	\$4,582,089

Table B.2 Near Future Upgrades

Upgrades	Link Name	Crossing Type	Length (m)	Average Depth (m)	Upstream Manhole	Upstream Invert Elevation (m)	Upstream Manhole Ground Elevation (m)	Upstream Depth (m)	Downstream Manhole	Downstream Invert Elevation (m)	Downstream Manhole Ground Elevation (m)	Downstream Depth (m)	Average Depth	Existing Diameter (m)	Replacement Diameter (m)	Average Depth	Unit Cost (\$)	Pipe Cost	MH VM	Unit Cost	MH Cost	Cost (\$)	Contingency (50%)	Total Cost (\$)
Acheson Trunk	L18A		80	8.42	MH18A	702.103	710	7.9	MH20	702.043	710.976	8.9	8.4	0.600	0.900	8.0	\$2,500	\$200,000	16.8	\$2,200	\$37,026	\$237,026	\$118,513	\$355,539
	L20		108	9.02	MH20	702.036	710.976	8.9	MH21	701.907	710.999	9.1	9.0	0.600	0.900	9.0	\$2,750	\$297,000	9.1	\$2,200	\$20,002	\$317,002	\$158,501	\$475,504
	L21	Rail Crossing	137	8.48	MH21	701.879	710.999	9.1	MH22	701.698	709.538	7.8	8.5	0.600	0.900	8.0	\$5,785	\$792,485	7.8	\$2,200	\$17,248	\$809,733	\$404,867	\$1,214,600
	L22		145	5.80	MH22	701.598	709.538	7.9	MH23	701.245	704.9	3.7	5.8	0.525	0.750	6.0	\$2,000	\$290,000	3.7	\$2,200	\$8,041	\$298,041	\$149,021	\$447,062
	L23		152	4.29	MH23	701.22	704.9	3.7	MH24	700.813	705.708	4.9	4.3	0.525	0.750	4.0	\$1,350	\$205,200	4.9	\$2,200	\$10,769	\$215,969	\$107,985	\$323,954
	L24	hg (MH 25 in m)	148	4.28	MH24	700.788	705.708	4.9	MH25	699.886	703.531	3.6	4.3	0.525	0.750	4.0	\$5,785	\$856,115	3.6	\$2,200	\$8,019	\$864,134	\$432,067	\$1,296,201
	L25		132	2.62	MH25	699.881	703.531	3.6	MH26	696.663	698.258	1.6	2.6	0.525	0.750	3.0	\$1,000	\$132,000	1.6	\$2,200	\$3,509	\$135,509	\$67,755	\$203,264
	L26		131	3.97	MH26	696.648	698.258	1.6	MH27	695.896	702.221	6.3	4.0	0.600	0.750	4.0	\$1,350	\$176,850	6.3	\$2,200	\$13,915	\$190,765	\$95,383	\$286,148
Acheson Trunk																					Subtotal	\$3,068,180	\$1,534,090	\$4,602,270
U/S of Z5 LS	L276		83	7.99	N267	706.754	717	10.2	N267.2	706.52	712.26	5.7	8.0	0.250	0.525	8.0	\$2,150	\$178,450	16.0	\$2,000	\$31,972	\$210,422	\$105,211	\$315,633
	L276.2		120	5.64	N267.2	706.49	712.26	5.8	N267.2.1	706.154	711.66	5.5	5.6	0.250	0.525	6.0	\$1,500	\$180,000	5.5	\$2,000	\$11,012	\$191,012	\$95,506	\$286,518
	L276.2.1		120	5.40	N267.2.1	706.124	711.66	5.5	N267.1	705.788	711.06	5.3	5.4	0.250	0.600	5.0	\$1,100	\$132,000	5.3	\$2,000	\$10,544	\$142,544	\$71,272	\$213,816
	L276.1		168	5.20	N267.1	705.688	711.06	5.4	N246	705.184	710.221	5.0	5.2	0.300	0.525	5.0	\$1,050	\$176,400	5.0	\$2,000	\$10,074	\$186,474	\$93,237	\$279,711
	Link737		10	5.61	N246	705.184	710.221	5.0	Z5LS	705.172	711.35	6.2	5.6	0.450	0.675	6.0	\$1,000	\$10,000	6.2	\$2,200	\$13,592	\$23,592	\$11,796	\$35,387
	U/S of Z5 LS																				Subtotal	\$754,044	\$377,022	\$1,131,065
Big Lake W North of Township Rd 532A	L496		182	5.26	N399	653.39	658.43	5.04	N475	652.22	657.69	5.47	5.3	0.200	0.300	5.0	\$700	\$127,400	10.5	\$1,200	\$12,612	\$140,012	\$70,006	\$210,018
	Big Lake W North of Township Rd 532A																				Subtotal	\$140,012	\$70,006	\$210,018

Subtotal	\$3,962,235
Engineering and Contingency	\$1,981,118
Total	\$5,943,353

Table B.3 Near Future Extensions

Location	Link Name	Crossing Type	Length (m)	Average Depth (m)	Upstream Manhole	Upstream Invert Elevation (m)	Upstream Manhole Ground Elevation (m)	Upstream Depth (m)	Downstream Manhole	Downstream Invert Elevation (m)	Downstream Manhole Ground Elevation (m)	Downstream Depth (m)	Diameter (m)	Average Depth	Unit Cost (\$)	Pipe Cost	MH VM	Unit Cost	MH Cost	Cost (\$)	Contingency (50%)	Total Cost (\$)	
Acheson Trunk	Link967		400	6.36	NF501S	710.584	715	4.4	Node696	709.704	718	8.3	0.300	6.0	\$800	\$320,000	12.7	\$1,200	\$15,254	\$321,200	\$160,600	\$481,800	
	Link871		199	6.72	NF014	709.554	712	2.4	NF904	708.997	720	11.0	0.250	7.0	\$500	\$99,500	13.4	\$1,200	\$16,139	\$115,639	\$57,819	\$173,458	
	Link954		50	8.32	NF904	708.04	720	12.0	Node789	707.82	712.501	4.7	0.300	8.0	\$1,300	\$65,000	4.7	\$1,200	\$5,617	\$70,617	\$35,309	\$105,926	
	Link913		350	2.94	NF278	700.681	702.95	2.3	MH25	699.911	703.531	3.6	0.300	3.0	\$600	\$210,000	5.9	\$1,200	\$7,067	\$217,067	\$108,533	\$325,600	
	Acheson Trunk Subtotal																				Cost (\$)	Contingency (50%)	Total Cost (\$)
																				\$724,523	\$362,261	\$1,086,784	
Big Lake	L473		84	3.97	N455	681.752	686.534	4.8	N456	681.134	684.293	3.2	0.200	4.0	\$900	\$75,600	7.9	\$1,200	\$9,529	\$85,129	\$42,565	\$127,694	
	L474		89	3.38	N456	681.088	684.293	3.2	NF457	680.276	683.84	3.6	0.200	3.0	\$400	\$35,600	3.6	\$1,200	\$4,277	\$39,877	\$19,938	\$59,815	
	L475		85	3.85	NF457	680.224	683.84	3.6	N458	679.869	683.947	4.1	0.200	4.0	\$900	\$76,500	4.1	\$1,200	\$4,894	\$81,394	\$40,697	\$122,090	
	L476		134	3.53	N458	679.838	683.947	4.1	N459	675.049	678.003	3.0	0.200	4.0	\$900	\$120,600	3.0	\$1,200	\$3,545	\$124,145	\$62,072	\$186,217	
	L704		100	4.46	Node891	681.95	686.81	4.9	N553	681.73	685.79	4.1	0.300	4.0	\$600	\$60,000	4.1	\$1,200	\$4,872	\$64,872	\$32,436	\$97,308	
	Link945		400	3.98	Node893	682.86	686	3.1	Node891	681.98	686.81	4.8	0.300	4.0	\$600	\$240,000	8.0	\$1,200	\$9,564	\$249,564	\$124,782	\$374,346	
	Link948		533	2.62	NF895	657.49	659	1.5	NF895.1	656.318	660.039	3.7	0.300	3.0	\$600	\$319,800	5.2	\$1,200	\$6,277	\$326,077	\$163,039	\$489,116	
Big Lake Subtotal																				Cost (\$)	Contingency (50%)	Total Cost (\$)	
																				\$971,058	\$485,529	\$1,456,586	
Bevington	L316		200	7.40	N251	707.2	715	7.8	NF602	706.2	713.2	7.0	0.525	7.0	\$1,550	\$310,000	14.8	\$2,000	\$29,600	\$339,600	\$169,800	\$509,400	
	Link910		1000	11.49	NF601	705.938	720	14.1	U606.1	704.738	713.663	8.9	0.450	11.0	\$2,000	\$2,000,000	8.9	\$1,200	\$10,710	\$2,010,710	\$1,005,355	\$3,016,065	
	L270		400	3.45	NF206S	702.76	705	2.2	S-39	701.56	706.229	4.7	0.375	3.0	\$600	\$240,000	4.7	\$1,200	\$5,603	\$245,603	\$122,801	\$368,404	
	L272		400	6.58	NF403	706.76	712	5.2	S-47	705.88	713.8	7.9	0.300	7.0	\$1,150	\$460,000	7.9	\$1,200	\$9,504	\$469,504	\$234,752	\$704,256	
	L664		220	4.41	N300	710.136	713	2.9	S-51	709.96	715.914	6.0	0.600	4.0	\$750	\$165,000	6.0	\$2,000	\$11,908	\$176,908	\$88,454	\$265,362	
	L618		150	5.78	S-51	709.934	715.914	6.0	S-50	709.007	714.589	5.6	0.600	6.0	\$1,400	\$210,000	5.6	\$2,000	\$11,164	\$221,164	\$110,582	\$331,746	
	Link756		128	4.16	Node727	695.02	699	4.0	Node728	694.662	699	4.3	0.375	4.0	\$600	\$76,800	4.3	\$1,200	\$5,206	\$82,006	\$41,003	\$123,008	
	Link757		109	4.49	Node728	694.662	699	4.3	Node729	694.357	699	4.6	0.375	4.0	\$600	\$65,400	4.6	\$1,200	\$5,572	\$70,972	\$35,486	\$106,457	
	Link840		20	3.97	Node729	694.62	699	4.4	NF811	694.58	698.15	3.6	0.375	4.0	\$600	\$12,000	3.6	\$1,200	\$4,284	\$16,284	\$8,142	\$24,426	
	Link841		93	4.49	NF811	694.52	698.15	3.6	NF812	694.33	699.68	5.3	0.375	4.0	\$600	\$55,800	5.3	\$1,200	\$6,420	\$62,220	\$31,110	\$93,330	
	Link842		90	5.46	NF812	694.3	699.68	5.4	NF203	694.12	699.66	5.5	0.375	5.0	\$650	\$58,500	5.5	\$1,200	\$6,648	\$65,148	\$32,574	\$97,722	
	Link843		99	5.65	NF203	694.09	699.66	5.6	NF814	693.89	699.62	5.7	0.375	6.0	\$900	\$89,100	5.7	\$1,200	\$6,876	\$95,976	\$47,988	\$143,964	
	Link844		100	5.84	NF814	693.86	699.62	5.8	NF815	693.66	699.57	5.9	0.375	6.0	\$900	\$90,000	5.9	\$1,200	\$7,092	\$97,092	\$48,546	\$145,638	
	Link845		100	5.95	NF815	693.63	699.57	5.9	NF816	693.43	699.38	6.0	0.375	6.0	\$900	\$90,000	6.0	\$1,200	\$7,140	\$97,140	\$48,570	\$145,710	
	Link853		99	5.64	NF816	693.4	699.38	6.0	Node823	693.18	698.48	5.3	0.375	6.0	\$900	\$89,100	5.3	\$1,200	\$6,360	\$95,460	\$47,730	\$143,190	
	Link847		107	2.63	NF205	696.811	699.86	3.0	NF204S	696.512	698.72	2.2	0.300	3.0	\$600	\$64,200	5.3	\$1,200	\$6,308	\$70,508	\$35,254	\$105,763	
	Link848		108	1.51	NF204S	696.512	698.72	2.2	NF204N	696.188	697	0.8	0.300	2.0	\$600	\$64,800	0.8	\$1,200	\$974	\$65,774	\$32,887	\$98,662	
	Link849		123	1.03	NF204N	696.188	697	0.8	NF820	695.843	697.09	1.2	0.375	1.0	\$600	\$73,800	1.2	\$1,200	\$1,496	\$75,296	\$37,648	\$112,945	
	Link850		98	1.76	NF820	695.843	697.09	1.2	NF821	695.569	697.84	2.3	0.375	2.0	\$600	\$58,800	2.3	\$1,200	\$2,725	\$61,525	\$30,763	\$92,288	
	Link851		98	2.07	NF821	695.569	697.84	2.3	NF822	695.294	697.16	1.9	0.375	2.0	\$600	\$58,800	1.9	\$1,200	\$2,239	\$61,039	\$30,520	\$91,559	
	Link852		98	2.92	NF822	695.294	697.16	1.9	Node727	695.02	699	4.0	0.375	3.0	\$600	\$58,800	4.0	\$1,200	\$4,776	\$63,576	\$31,788	\$95,364	
	L274		250	3.98	NF406	710.51	712.51	2.0	S-51	709.96	715.914	6.0	0.300	4.0	\$600	\$150,000	6.0	\$1,200	\$7,145	\$157,145	\$78,572	\$235,717	
	Link970		200	5.22	NF407	710.52	715	4.5	S-51	709.96	715.914	6.0	0.250	5.0	\$500	\$100,000	6.0	\$1,200	\$7,145	\$107,145	\$53,572	\$160,717	
	Link969		400	10.66	NF608	706.568	713.85	7.3	NF601	705.968	720	14.0	0.375	11.0	\$2,000	\$800,000	21.3	\$1,200	\$25,577	\$825,577	\$412,788	\$1,238,365	
	Link984		250	4.32	NF206N	698.096	700.9	2.8	S-37	697.096	702.931	5.8	0.200	4.0	\$900	\$225,000	5.8	\$1,200	\$7,002	\$232,002	\$116,001	\$348,003	
	L675.1		300	9.48	U606.1	704.708	713.663	9.0	NF602	703.2	713.2	10.0	0.600	9.0	\$1,950	\$585,000	10.0	\$2,000	\$20,000	\$605,000	\$302,500	\$907,500	
	Bevington Subtotal																				Cost (\$)	Contingency (50%)	Total Cost (\$)
																					\$6,470,374	\$3,235,187	\$9,705,561

Subtotal	\$8,165,954
Engineering and Contingency	\$4,082,977
Total	\$12,248,932

Table B.4 Long Term Upgrades

Upgrades	Link Name	Crossing Type	Length (m)	Average Depth (m)	Upstream Manhole	Upstream Invert Elevation (m)	Upstream Manhole Ground Elevation (m)	Upstream Depth (m)	Downstream Manhole	Downstream Invert Elevation (m)	Downstream Manhole Ground Elevation (m)	Downstream Depth (m)	Average Depth	Existing Diameter (m)	Replacement Diameter (m)	Average Depth	Unit Cost (\$)	Pipe Cost	MH VM	Unit Cost	MH Cost	Total	Contingency (50%)	Total Cost (\$)	
Z5 West	Link725		120	5.49	Node696	709.674	718	8.326	Node697	709.338	711.99	2.652	5.5	0.250	0.300	5.0	\$700	\$84,000	11.0	\$1,200	\$13,174	\$97,174	\$48,587	\$145,760	
	Link726		120	2.69	Node697	709.308	711.99	2.682	Node698	708.972	711.67	2.698	2.7	0.250	0.300	3.0	\$700	\$84,000	2.7	\$1,200	\$3,238	\$87,238	\$43,619	\$130,856	
	Link727	Road Crossing	120	2.90	Node698	708.942	711.67	2.728	Node699	708.606	711.67	3.064	2.9	0.250	0.300	3.0	\$8,227	\$987,186	3.1	\$1,200	\$3,677	\$990,863	\$495,431	\$1,486,294	
	Link728		120	2.92	Node699	708.556	711.67	3.114	Node700	708.22	710.95	2.73	2.9	0.250	0.300	3.0	\$700	\$84,000	2.7	\$1,200	\$3,276	\$87,276	\$43,638	\$130,914	
	Link729		102	3.03	Node700	708.19	710.95	2.76	Node701	707.904	711.21	3.306	3.0	0.250	0.300	3.0	\$700	\$71,400	3.3	\$1,200	\$3,967	\$75,367	\$37,684	\$113,051	
	Link730		80	3.55	Node701	707.874	711.21	3.336	Node691	707.6	711.37	3.77	3.6	0.250	0.300	4.0	\$700	\$56,000	3.8	\$1,200	\$4,524	\$60,524	\$30,262	\$90,786	
	Link720		82	4.50	Node691	707.6	711.37	3.77	Node692	707.267	712.49	5.223	4.5	0.300	0.450	4.0	\$700	\$57,400	5.2	\$1,200	\$6,268	\$63,668	\$31,834	\$95,501	
	Link721		120	5.48	Node692	707.237	712.49	5.253	Node693	706.745	712.45	5.705	5.5	0.300	0.450	5.0	\$900	\$108,000	5.7	\$1,200	\$6,846	\$114,846	\$57,423	\$172,269	
	Link722		120	5.97	Node693	706.715	712.45	5.735	Node694	706.223	712.43	6.207	6.0	0.300	0.450	6.0	\$1,400	\$168,000	6.2	\$1,200	\$7,448	\$175,448	\$87,724	\$263,173	
	Link724		89	5.80	Node694	706.193	712.43	6.237	N267.1	705.688	711.06	5.372	5.8	0.300	0.450	6.0	\$1,400	\$124,600	5.4	\$1,200	\$6,446	\$131,046	\$65,523	\$196,570	
																						Z5 West Subtotal	Cost (\$)	Contingency (50%)	Total Cost (\$)
																							\$1,883,449	\$941,725	\$2,825,174
Bevington Trunk North	L379		45	5.48	N361	655.71	661.17	5.46	N362	655.45	660.96	5.51	5.5	0.525	0.600	5.0	\$1,100	\$49,500	11.0	\$2,000	\$21,940	\$71,440	\$35,720	\$107,160	
	L388		86	4.75	N362	654.72	660.96	6.24	N371	653.38	656.63	3.25	4.7	0.525	0.600	5.0	\$1,100	\$94,600	3.3	\$2,000	\$6,500	\$101,100	\$50,550	\$151,650	
	L389		39	4.31	N371	653.35	656.63	3.28	N370	652.76	658.09	5.33	4.3	0.525	0.600	4.0	\$900	\$35,100	5.3	\$2,000	\$10,660	\$45,760	\$22,880	\$68,640	
	L390		24	4.20	N370	652.73	658.09	5.36	N372	652.35	655.39	3.04	4.2	0.525	0.600	4.0	\$900	\$21,600	3.0	\$2,000	\$6,080	\$27,680	\$13,840	\$41,520	
																						Bevington Trunk North Subtotal	Cost (\$)	(50%)	(\$)
																						\$245,980	\$122,990	\$368,970	

Subtotal	\$2,129,429
Engineering and Contingency	\$1,064,715
Total	\$3,194,144

Table B.6 Ultimate Upgrades

Upgrades	Link Name	Crossing Type	Length (m)	Average Depth (m)	Upstream Manhole	Upstream Invert Elevation (m)	Upstream Manhole Ground Elevation (m)	Upstream Depth (m)	Downstream Manhole	Downstream Invert Elevation (m)	Downstream Manhole Ground Elevation (m)	Downstream Depth (m)	Average Depth	Existing Diameter (m)	Replacement Diameter (m)	Average Depth	Unit Cost (\$)	Pipe Cost	MH VM	Unit Cost	MH Cost	Total	Contingency (50%)	Total Cost (\$)
Acheson Trunk	L27	Road Crossing	90	5.82	MH27	695.871	702.221	6.35	MH28	695.313	700.598	5.285	5.8	0.600	0.750	6.0	\$5,785	\$520,611	11.6	\$1,200	\$13,962	\$534,573	\$267,286	\$801,859
	L28		102	4.47	MH28	695.288	700.598	5.31	MH29	694.701	698.336	3.635	4.5	0.600	0.750	4.0	\$1,350	\$137,700	3.6	\$1,200	\$4,362	\$142,062	\$71,031	\$213,093
	L29		150	3.32	MH29	694.676	698.336	3.66	MH30	689.329	692.314	2.985	3.3	0.600	0.750	3.0	\$1,000	\$150,000	3.0	\$1,200	\$3,582	\$153,582	\$76,791	\$230,373
	L30		135	3.46	MH30	689.304	692.314	3.01	MH31	686.013	689.918	3.905	3.5	0.600	0.750	3.0	\$1,000	\$135,000	3.9	\$1,200	\$4,686	\$139,686	\$69,843	\$209,529
	L31		135	3.86	MH31	685.988	689.918	3.93	MH31A	685.49	689.275	3.785	3.9	0.600	0.750	4.0	\$1,350	\$182,250	3.8	\$1,200	\$4,542	\$186,792	\$93,396	\$280,188
	Acheson Trunk																					Cost (\$)	Contingency (50%)	Total Cost (\$)
Acheson Trunk HWY 16	L38B	Highway Crossing (HWY 16)	128	3.72	MH97-1	667.788	671.8	4.012	MH39	666.091	669.526	3.435	3.7	0.600	0.750	4.0	\$5,785	\$740,424	7.4	\$1,200	\$8,936	\$749,360	\$374,680	\$1,124,041
	L38A		22	3.85	MH38	668.124	671.804	3.68	MH97-1	667.788	671.8	4.012	3.8	0.600	0.750	4.0	\$1,350	\$29,700	4.0	\$1,200	\$4,814	\$34,514	\$17,257	\$51,772
	L39		90	2.88	MH39	666.066	669.526	3.46	MH39A	664.926	667.221	2.295	2.9	0.600	0.750	3.0	\$1,000	\$90,000	2.3	\$1,200	\$2,754	\$92,754	\$46,377	\$139,131
	Acheson Trunk HWY 16																					Cost (\$)	Contingency (50%)	Total Cost (\$)
Bevington Trunk	L618		150	5.78	S-51	709.934	715.914	5.98	S-50	709.007	714.589	5.582	5.8	0.600	0.900	6.0	\$2,300	\$345,000	11.6	\$1,200	\$13,874	\$358,874	\$179,437	\$538,312
	L664		220	4.41	N300	710.136	713	2.864	S-51	709.96	715.914	5.954	4.4	0.600	0.900	4.0	\$1,500	\$330,000	6.0	\$1,200	\$7,145	\$337,145	\$168,572	\$505,717
	L619		150	5.73	S-50	708.93	714.589	5.659	S-49	708.176	713.982	5.806	5.7	0.525	0.675	6.0	\$1,000	\$150,000	5.8	\$1,200	\$6,967	\$156,967	\$78,484	\$235,451
	L620		150	5.69	S-49	708.097	713.982	5.885	S-48	706.949	712.442	5.493	5.7	0.525	0.675	6.0	\$1,000	\$150,000	5.5	\$1,200	\$6,592	\$156,592	\$78,296	\$234,887
	Bevington Trunk																					Cost (\$)	Contingency (50%)	Total Cost (\$)
Z5 West	Link710		120	3.07	Node681	709.718	712.89	3.172	Node682	709.382	712.34	2.958	3.1	0.250	0.375	3.0	\$700	\$84,000	6.1	\$1,200	\$7,356	\$91,356	\$45,678	\$137,034
	Link711		91	2.58	Node682	709.352	712.34	2.988	Node683	709.098	711.27	2.172	2.6	0.250	0.375	3.0	\$700	\$63,700	2.2	\$1,200	\$2,606	\$66,306	\$33,153	\$99,460
	Link712		120	2.82	Node683	709.068	711.27	2.202	Node684	708.732	712.17	3.438	2.8	0.250	0.375	3.0	\$700	\$84,000	3.4	\$1,200	\$4,126	\$88,126	\$44,063	\$132,188
	Link713		25	3.50	Node684	708.682	712.17	3.488	Node685	708.613	712.13	3.517	3.5	0.250	0.375	4.0	\$700	\$17,500	3.5	\$1,200	\$4,220	\$21,720	\$10,860	\$32,581
	Link714		120	3.58	Node685	708.563	712.13	3.567	Node686	708.227	711.82	3.593	3.6	0.250	0.375	4.0	\$700	\$84,000	3.6	\$1,200	\$4,312	\$88,312	\$44,156	\$132,467
	Link718		65	3.61	Node686	708.197	711.82	3.623	Node690	708.016	711.61	3.594	3.6	0.250	0.375	4.0	\$700	\$45,500	3.6	\$1,200	\$4,313	\$49,813	\$24,906	\$74,719
	Link719		120	3.67	Node690	707.986	711.61	3.624	Node691	707.65	711.37	3.72	3.7	0.250	0.375	4.0	\$700	\$84,000	3.7	\$1,200	\$4,464	\$88,464	\$44,232	\$132,696
Z5 West																					Cost (\$)	Contingency (50%)	Total Cost (\$)	
Subtotal																						\$494,097	\$247,048	\$741,145

Subtotal	\$3,536,998
Engineering and Contingency	\$1,768,499
Total	\$5,305,497

Table B.7 Ultimate Extensions

Location	Link Name	Crossing Type	Length (m)	Average Depth (m)	Upstream Manhole	Upstream Invert Elevation (m)	Upstream Manhole Ground Elevation (m)	Upstream Depth (m)	Downstream Manhole	Downstream Invert Elevation (m)	Downstream Manhole Ground Elevation (m)	Downstream Depth (m)	Diameter (m)	Average Depth	Unit Cost (\$)	Pipe Cost	MH VM	Unit Cost	MH Cost	Cost (\$)	Contingency (50%)	Total Cost (\$)
Acheson Trunk	Link908		500	3.84	U1113_LS	702.618	706.82	4.2	NF007	701.518	705	3.5	0.300	4.0	\$600	\$300,000	7.7	\$1,200	\$9,220.80	\$309,200	\$154,600	\$463,800
	L689		400	4.19	U701	709.38	711.27	1.9	LT702	708.5	715	6.5	0.300	4.0	\$600	\$240,000	8.4	\$1,200	\$10,068.00	\$250,100	\$125,050	\$375,200
	L692		500	5.47	U708	707.863	715	7.1	LT707	706.763	710.56	3.8	0.300	5.0	\$600	\$300,000	10.9	\$1,200	\$13,120.80	\$313,100	\$156,550	\$469,700
	Link952		530	6.97	U705	708.039	715	7.0	U899.1	706.873	713.844	7.0	0.300	7.0	\$1,150	\$609,500	13.9	\$1,200	\$16,718.40	\$626,200	\$313,100	\$939,300
	Link951		800	4.58	U705N	709.787	716.29	6.5	NF673	706.587	709.24	2.7	0.200	5.0	\$800	\$640,000	9.2	\$1,200	\$10,987.20	\$651,000	\$325,500	\$976,500
	Link952.1	Highway	400	7.11	U899.1	706.843	713.844	7.0	LT671.1	705.963	713.189	7.2	0.300	7.0	\$1,150	\$460,000	14.2	\$1,200	\$17,072.40	\$477,100	\$238,550	\$715,700
	Link1010		450	5.01	U1502	705.99	712	6.0	NF501N	705	709	4.0	0.300	5.0	\$600	\$270,000	10.0	\$1,200	\$12,012.00	\$282,000	\$141,000	\$423,000
Acheson Trunk Subtotal																				\$2,908,700	\$1,454,350	\$4,363,100
Big Lake	L589		212	6.05	N565	650.946	656.76	5.8	N566	650.48	656.76	6.3	0.300	6.0	\$800	\$169,600	12.1	\$1,200	\$14,512.80	\$184,100	\$92,050	\$276,200
	L592		450	5.85	U901	651.621	657.51	5.9	N565	650.946	656.76	5.8	0.375	6.0	\$900	\$405,000	11.7	\$1,200	\$14,043.60	\$419,000	\$209,500	\$628,500
	Link920		400	7.31	U645	656.16	667.23	11.1	N483	654.4	657.95	3.6	0.200	7.0	\$1,000	\$400,000	14.6	\$1,200	\$17,544.00	\$417,500	\$208,750	\$626,300
	Link790		92	5.76	Node761	653.79	659.02	5.2	N566	650.48	656.76	6.3	0.200	6.0	\$800	\$73,600	11.5	\$1,200	\$13,812.00	\$87,400	\$43,700	\$131,100
Big Lake Subtotal																				\$1,108,000	\$554,000	\$1,662,000
Bevington	L269		500	1.69	U206	703.86	705	1.1	NF206S	702.76	705	2.2	0.300	2.0	\$600	\$300,000	3.4	\$1,200	\$4,056.00	\$304,100	\$152,050	\$456,200
	L709		382	3.41	U808N	712.599	716.95	4.4	U807N.1	711.53	714	2.5	0.250	3.0	\$400	\$152,800	6.8	\$1,200	\$8,185.20	\$161,000	\$80,500	\$241,500
	L709.1		318	4.28	U807N	712.42	718.5	6.1	U807N.1	711.53	714	2.5	0.250	4.0	\$400	\$127,200	8.6	\$1,200	\$10,260.00	\$137,500	\$68,750	\$206,300
	L673		1000	7.22	U806N	709.281	716.5	7.2	U803	707.781	715	7.2	0.375	7.0	\$1,300	\$1,300,000	14.4	\$1,200	\$17,325.60	\$1,317,300	\$658,650	\$1,976,000
	L674		500	7.52	U803	707.751	715	7.2	U606	707.251	715.05	7.8	0.525	8.0	\$1,750	\$875,000	15.0	\$2,000	\$30,096.00	\$905,100	\$452,550	\$1,357,700
	L675		500	8.38	U606	707.231	715.05	7.8	U606.1	704.731	713.663	8.9	0.600	8.0	\$1,850	\$925,000	16.8	\$2,000	\$33,502.00	\$958,500	\$479,250	\$1,437,800
	L678		100	7.06	U802	705.58	715	9.4	U802.1	705.3	710	4.7	0.300	7.0	\$1,150	\$115,000	14.1	\$1,200	\$16,944.00	\$131,900	\$65,950	\$197,900
	Link880		232	4.23	U203	695.17	700	4.8	NF811	694.52	698.15	3.6	0.250	4.0	\$400	\$92,800	8.5	\$1,200	\$10,152.00	\$103,000	\$51,500	\$154,500
	Link979	Highway	480	6.91	U807S	710.367	717	6.6	U806N	709.311	716.5	7.2	0.300	7.0	\$1,150	\$552,000	13.8	\$1,200	\$16,586.40	\$568,600	\$284,300	\$852,900
	Link998		750	6.20	U405	702.825	707	4.2	LT406A	700.2	708.42	8.2	0.375	6.0	\$900	\$675,000	12.4	\$1,200	\$14,874.00	\$689,900	\$344,950	\$1,034,900
	Link1009		350	4.25	U806S_LS	711.137	713	1.9	U807S	710.367	717	6.6	0.300	4.0	\$600	\$210,000	8.5	\$1,200	\$10,195.20	\$220,200	\$110,100	\$330,300
	Link1008		350	4.25	U807S_LS	711.137	713	1.9	U807S	710.367	717	6.6	0.300	4.0	\$600	\$210,000	8.5	\$1,200	\$10,195.20	\$220,200	\$110,100	\$330,300
Bevington Subtotal																				\$5,717,300	\$2,858,650	\$8,576,000
Atim	L680		400	5.19	U1110	685	690	5.0	U1107	679	684.38	5.4	0.300	5.0	\$600	\$240,000	10.4	\$1,200	\$12,456.00	\$252,500	\$126,250	\$378,800
	L681		400	5.46	U1107	679	684.38	5.4	U1105	672	677.55	5.5	0.450	5.0	\$750	\$300,000	10.9	\$1,200	\$13,116.00	\$313,100	\$156,550	\$469,700
	L682		800	5.45	U1105	672	677.55	5.5	U1104	660	665.35	5.4	0.450	5.0	\$750	\$600,000	10.9	\$1,200	\$13,080.00	\$613,100	\$306,550	\$919,700
	L683		800	5.90	U1104	660	665.35	5.4	U659	655	661.45	6.5	0.450	6.0	\$1,150	\$920,000	11.8	\$1,200	\$14,160.00	\$934,200	\$467,100	\$1,401,300
	L684	Highway	740	7.23	U659	655	661.45	6.5	U1101	652	660	8.0	0.525	7.0	\$1,550	\$1,147,000	14.5	\$2,000	\$28,900.00	\$1,175,900	\$587,950	\$1,763,900
	L685		800	4.69	U1108	686	690	4.0	U1107	679	684.38	5.4	0.300	5.0	\$600	\$480,000	9.4	\$1,200	\$11,256.00	\$491,300	\$245,650	\$737,000
	L686		500	4.79	U1102	653.5	655.07	1.6	U1101	652	660	8.0	0.300	5.0	\$600	\$300,000	9.6	\$1,200	\$11,484.00	\$311,500	\$155,750	\$467,300
	L699		635	6.07	U1102	651.957	655.07	3.1	LT901	650.56	659.58	9.0	0.300	6.0	\$800	\$508,000	12.1	\$1,200	\$14,559.60	\$522,600	\$261,300	\$783,900
	L687		900	3.86	U1109	695	697.72	2.7	U1110	685	690	5.0	0.300	4.0	\$600	\$540,000	7.7	\$1,200	\$9,264.00	\$549,300	\$274,650	\$824,000
	Link888		500	9.98	U1112	685.04	700	15.0	U1110	685	690	5.0	0.300	10.0	\$2,000	\$1,000,000	20.0	\$1,200	\$23,952.00	\$1,024,000	\$512,000	\$1,536,000
Atim Subtotal																				\$6,187,500	\$3,093,750	\$9,281,300

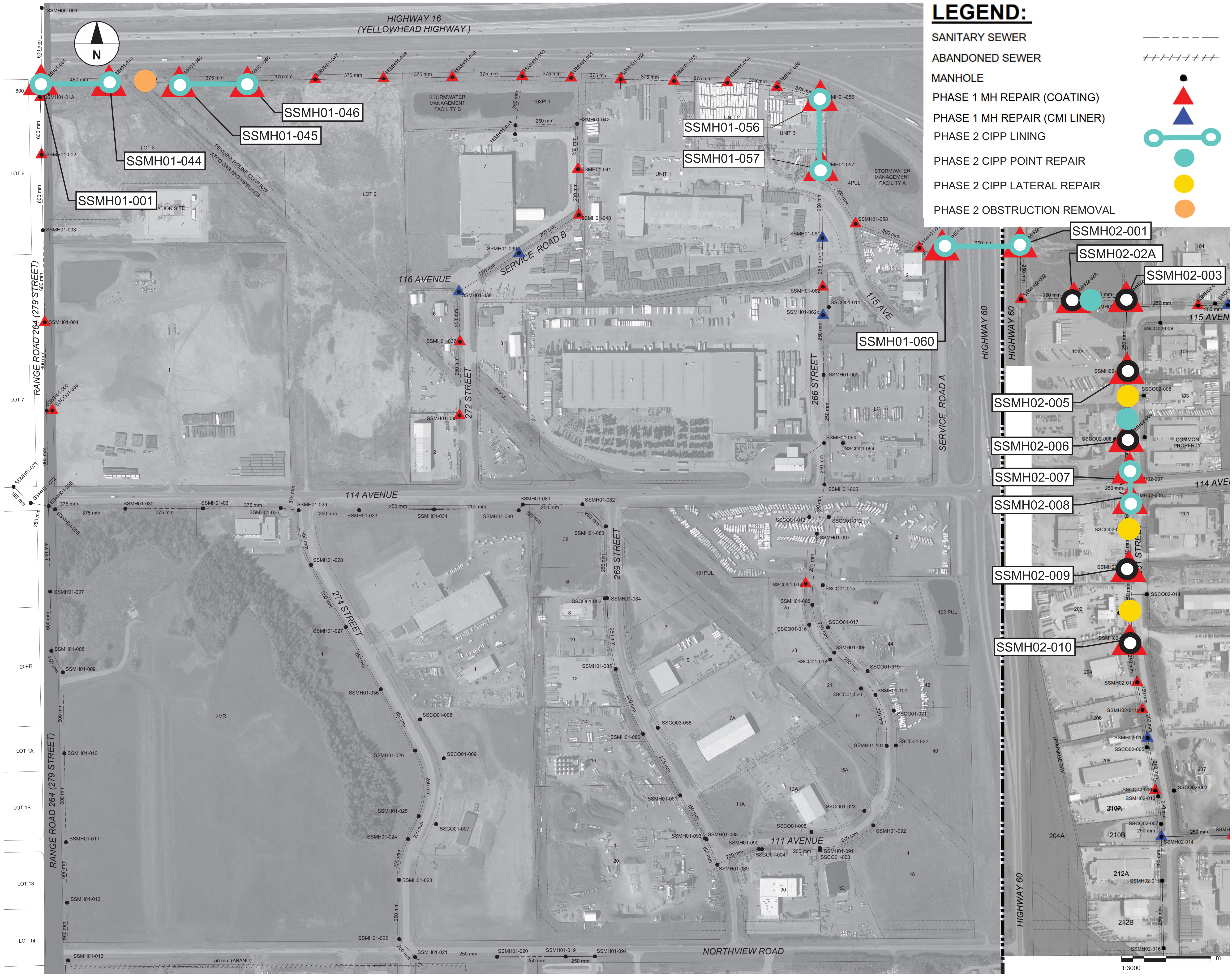
Subtotal	\$15,921,500
Engineering and Contingency	\$7,960,750
Total	\$23,882,250

Table B.8 Lift Station Costs

	Station				Sizing (L/s)			Ultimate Pumps					Notes:		Excavation/ Backfill	Barrels	Pump, Piping, Building	Total	Contingency	
	Dimension		Depth		Initial	Long Term	Ultimate	QTY	Model	Flow	Head	HP								
FLS 1	3.00	m DIA	6.00	m	18.00		78.30	2	NP 3153 MT	78.30	8.21	12.0	Piping and Valves Sized for Ultimate. Replace pumps at Ultimate	m	\$33,929.20	\$56,204.00	\$1,168,301.61	\$1,258,434.81	50%	\$1,890,000
FLS 2	2.44	m DIA	5.50	m	23.40			2	NP 3102 MT	23.40	10.00	5.5		s	\$20,574.16	\$35,106.50	\$1,007,379.47	\$1,063,060.13	50%	\$1,590,000
FLS 3	6 x 6	m	9.00	m	70.80	144.40	391.40	4 (1 standby)	NP 3153 LT	130.00	7.00	20.0	Install 3 - 35 L/s pumps initially. 4 - 48 L/s pumps LT, Twin forcemain and install 4 - 130 L/s Ultimate					\$3,872,948	50%	\$5,810,000
FLS 4	3.00	m DIA	5.10	m	43.00			2	NP 3153 MT	43.00	15.50	15.0		l	\$28,839.82	\$49,706.00	\$1,490,145.90	\$1,568,691.72	50%	\$2,350,000
FLS 5	3.00	m DIA	5.00	m	44.80		75.10	2	NP 3127 LT	75.10	7.80	11.0	Piping and Valves Sized for Ultimate. Replace pumps at Ultimate	m	\$28,274.33	\$48,984.00	\$1,168,301.61	\$1,245,559.94	50%	\$1,870,000
FLS 6	2.44	m DIA	5.60	m	29.50			2	NP 3127 MT	29.50	9.90	7.5		s	\$20,948.24	\$35,568.00	\$1,007,379.47	\$1,063,895.71	50%	\$1,600,000
FLS 7	3.00	m DIA	5.60	m	45.00			2	NP 3153 MT	45.00	13.20	14.0		l	\$31,667.25	\$43,495.20	\$1,490,145.90	\$1,565,308.35	50%	\$2,350,000
FLS 8	2.44	m DIA	5.40	m	21.70			2	NP 3127 HT	21.70	10.90	7.5		s	\$20,200.09	\$34,645.00	\$1,007,379.47	\$1,062,224.56	50%	\$1,590,000
FLS 9	3.00	m DIA	3.00	m	31.90			2	NP 3153 HT	31.90	25.80	20.0		l	\$16,964.60	\$34,544.00	\$1,490,145.90	\$1,541,654.50	50%	\$2,310,000
FLS 10	3.00	m DIA	8.50	m	32.00			2	NP 3153 HT	32.00	27.60	20.0		l	\$48,066.37	\$74,254.00	\$1,490,145.90	\$1,612,466.26	50%	\$2,420,000
FLS 11	3.00	m DIA	8.50	m	31.50			2	NP 3153 HT	31.50	27.00	20.0		l	\$48,066.37	\$74,254.00	\$1,490,145.90	\$1,612,466.26	50%	\$2,420,000
FLS 12	2.44	m DIA	5.30	m	13.70			2	NP 3085 SH	13.70	12.50	4.0		s	\$19,826.01	\$34,183.50	\$1,007,379.47	\$1,061,388.98	50%	\$1,590,000
FLS 13	2.44	m DIA	4.00	m	25.20			2	NP 3127 MT	25.20	10.40	7.5		s	\$14,963.03	\$28,184.00	\$1,007,379.47	\$1,050,526.50	50%	\$1,580,000
FLS 14	2.44	m DIA	5.30	m	16.90			2	NP 3102 MT	16.90	9.40	5.5		s	\$19,826.01	\$34,183.50	\$1,007,379.47	\$1,061,388.98	50%	\$1,590,000
FLS 15	2.44	m DIA	5.30	m	16.90			2	NP 3102 MT	16.90	9.40	5.5		s	\$19,826.01	\$34,183.50	\$1,007,379.47	\$1,061,388.98	50%	\$1,560,000
Zone 5	6 x 6	m	6.65				440.00	4 (1 standby)	NP 3153 LT	146.00	5.49	15.0	New 750 dia HDPE DR11 Forcemain 4 - 146 L/s pumps					\$3,872,948	50%	\$5,810,000
Zone 7	Existing 3 x 4	m		m	23.81		160.35	2	NP 3301 HT 3 - 462	78.94	56.50	105.0	Pumps selected by V3 Companies of Canada, 2 duty 1 standby, transfer switch, service, and piping sized for ultimate. MCC and Pumps need to be replaced.	s			\$1,039,380.00	\$1,039,380.00	50%	\$1,560,000

Appendix C

Zone 1 and Zone 2 I/I Reduction Upgrades

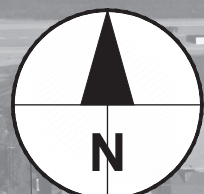
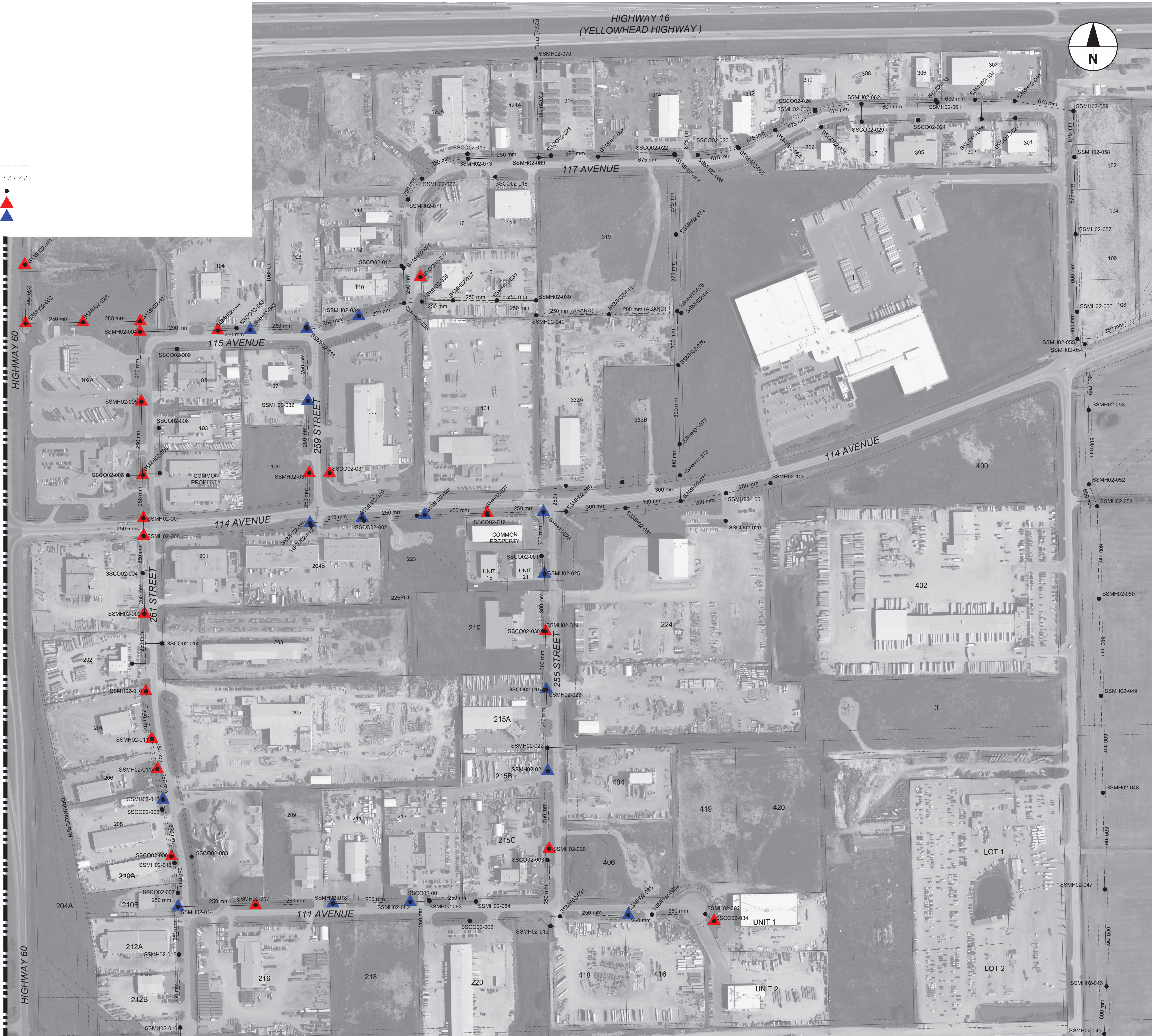
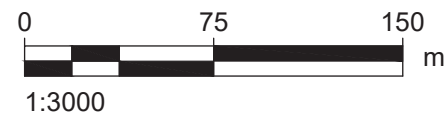
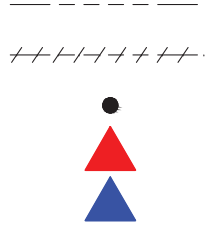


LEGEND:

- SANITARY SEWER
- ABANDONED SEWER
- MANHOLE
- PHASE 1 MH REPAIR (COATING)
- PHASE 1 MH REPAIR (CMI LINER)
- PHASE 2 CIPP LINING
- PHASE 2 CIPP POINT REPAIR
- PHASE 2 CIPP LATERAL REPAIR
- PHASE 2 OBSTRUCTION REMOVAL

LEGEND:

- SANITARY SEWER
- ABANDONED SEWER
- MANHOLE
- MANHOLE REPAIR (PRIORITY A, B OR C)
- MANHOLE REPAIR (PRIORITY D, E OR F)



PROJECT

Acheson Zone 1 and 2
Wastewater Manhole
Rehabilitation Program

Acheson, Alberta

CLIENT

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REGISTRATION

ISSUE/REVISION

I/R	DATE	DESCRIPTION
0	2020-06-22	ISSUED FOR CONSTRUCTION

PROJECT NUMBER

60585908

SHEET TITLE

MANHOLE REPAIRS
LOCATION PLAN
ZONE 2

SHEET NUMBER

01-C-1002

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