City of Leduc

Final Report

2018 Sanitary Servicing Study

2018-0179

COLE

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October 18, 2019
Reference No. 2018-0179

City of Leduc
#1 Alexandra Park
Leduc, AB T9E 4C4

Attention: **Ryan Graham**
Infrastructure Manager

Re: **2018 Sanitary Servicing Study**

Dear Mr. Graham,

We are pleased to submit the final version of the 2018 Sanitary Servicing Study in support of the ongoing planning for the City of Leduc's sanitary sewer system. This final report reflects comments received from the City on June 26, 2019. The report is an update of the 2013 report and its findings have been consolidated with a number of servicing updates and investigations completed to the end of 2017. The assessment of sanitary servicing was supported using a hydraulic PCSWMM (personal computer stormwater management model) of the existing sanitary collection system, which has been updated with 2016, 2017, and 2018 flow monitoring data.

The outcome of this work identifies the servicing needed to support growth in the City from the short term through to ultimate build-out conditions. The servicing strategies also consider the rainfall-derived inflow and infiltration in the existing sanitary sewer system and identify infrastructure improvements to address existing and future capacity needs.

Best Regards,
COLE ENGINEERING GROUP LTD.

Philip Gray, P.Eng.
Project Manager

PG/ad

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Issues and Revisions Registry

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Draft Report	December 21, 2018	For client review
Draft Final Report	March 29, 2019	For client review
Final Report	May 30, 2019	For client review
Final Report	October 15, 2019	For client review
Final Report	October 18, 2019	Final Submission

Statement of Conditions

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Abbreviations

ACRWC	Alberta Capital Regional Wastewater Commission
DWF	dry weather flow
HGL	hydraulic grade line
ICI	Industrial / Commercial / Institutional
I/I	Inflow / infiltration
LOS	level of service
PCSWMM	PCSWMM hydrologic / hydraulic model
SERTS	Southeast Regional Trunk Sewer
WWF	wet weather flow

Executive Summary

The City of Leduc (the City) is expecting continued growth over the next 20-years and beyond. This growth was originally identified in the City's 2012 Municipal Development Plan. Growth, at a regional scale, was also identified in the 2011 City of Leduc / Leduc County Intermunicipal Development Plan, which addressed future land use related to neighbouring communities in Leduc County.

In 2013, the City completed a sanitary sewer modelling and servicing study to plan and prepare for projected growth. Following the completion of the 2013 Servicing Plan, the City continued to collect additional sanitary system information. It also updated system information and refined growth projections. Consequently, an update to the original 2013 Servicing Plan is required to incorporate new and updated information, reassess system capacity and develop updated servicing strategies to meet the City's future sanitary servicing needs. The 2018 Sanitary Servicing Study takes into consideration the previous servicing strategies and refines and modifies them in response to 2018 conditions.

The 2018 Sanitary Servicing Study builds on the 2013 system assessments and servicing strategies using an updated hydraulic model to analyze the capacity of the existing system.

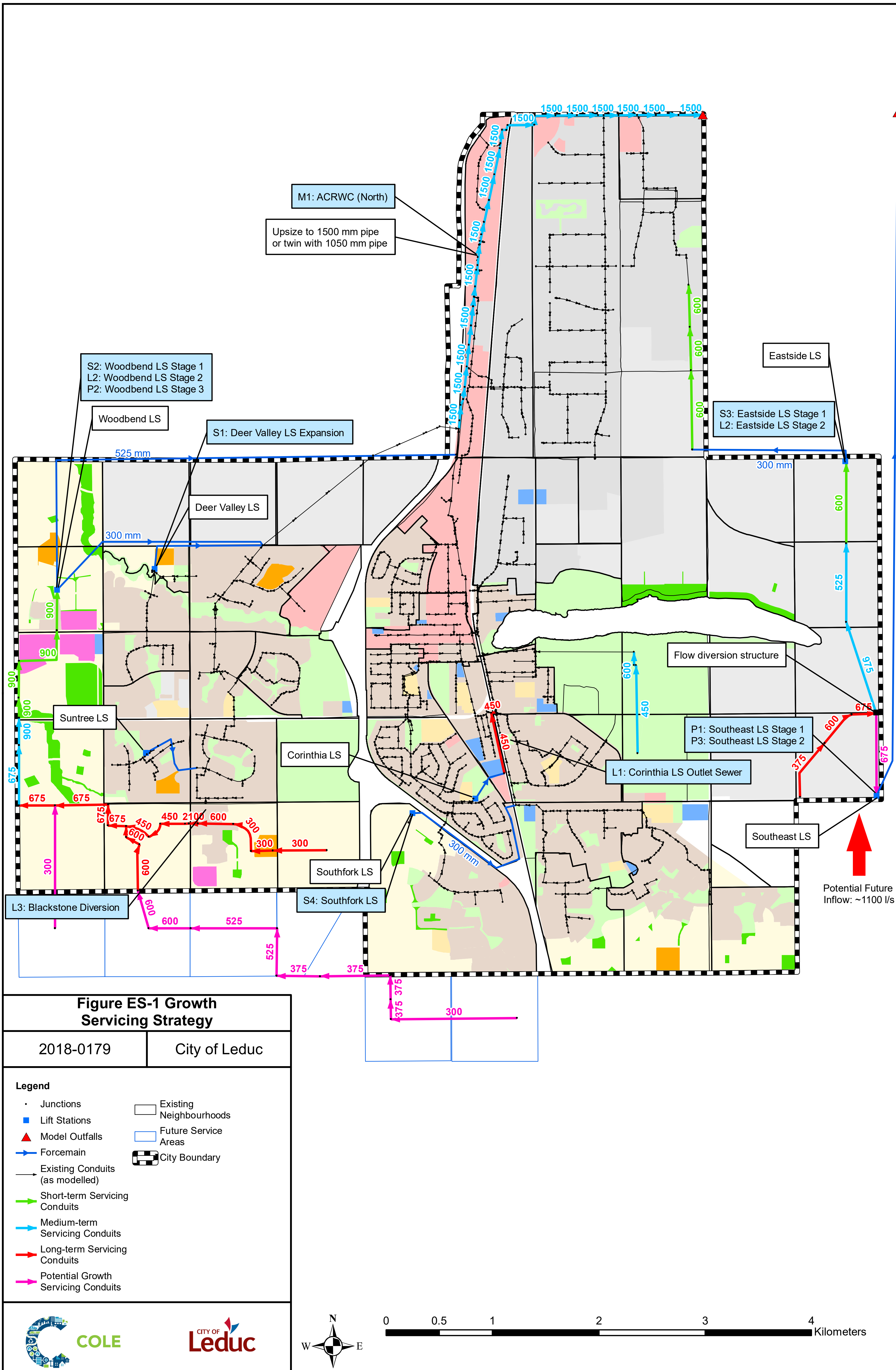
Figure ES-1 shows the proposed servicing strategy based on short, medium, and long term conditions as well as potential growth conditions. The timing of new infrastructure associated with growth is subject to change given actual development conditions and realization of new sanitary flow. Although servicing may be identified in one timeframe, it does not preclude servicing being deferred or accelerated based on actual needs. Monitoring growth and system capacity needs is required to determine when best to initiate improvements. The recommendations provide a roadmap to future servicing for the City of Leduc and stakeholders. The roadmap presents a sequencing plan for services that can be adjusted if growth happens differently. The following is a summary of infrastructure improvements.

Baseline

- In the existing system, critical surcharge was identified on 44St between 47Ave and 46Ave. A system improvement to replace the existing pipe with a 300 mm pipe 145 m is identified.

Short Term

- The existing Deer Valley Lift Station will require expansion from a firm capacity of 85 L/s to 198 L/s. The timing of the upgrade depends on development associated with the 65 Avenue Area Structure Plan in the Grayson (NE33) and Tawa Landing (NE34) quarter sections. The station capacity will need to increase to accommodate growth by changing the existing pumps (2) for larger pumps with the necessary controls and piping to provide a firm capacity of 198 L/s;



RS 2019-10-11 P:\oak\2018\2018-0179\600_GIS\20_Maps\Report figures 20181207\Figure ES-1 Growth Servicing Strategy 20191011.mxd

- A new lift station, Woodbend LS has been constructed and is expected to be in service in 2019. This lift station is required for short term growth and has a firm capacity of 60 L/s. The station will discharge into the Bridgeport Trunk Sewer just north of Birchmont Crescent through a 300 mm forcemain;
- Subject to the need for additional ICI lands, it is expected a new Eastside Lift Station will be required at the end of the short term period or beginning of medium term. The lift station will discharge into a 600 mm sanitary pipe extended through the Leduc Business Park. The new Eastside LS will be staged, with the first stage having a capacity of 70 to 80 L/s. The station should be designed for the potential growth area with a peak design flow of 185 L/s to optimize the downstream capacity; and,
- The Southfork ASP (updated April 2018) includes a local area lift station in the north west quarter section. The peak design flow to the proposed lift station under full build out condition would be approximately 72 L/s. The new lift station will discharge through a 300 mm forcemain 1,700 m long to 50th Street and Rollyview Road. The Southfork LS conveys growth flow away from the Corinthia Drive and Corinthia LS resulting in improved performance of existing infrastructure.

Medium Term

- The capacity of the north section of the ACRWC trunk sewer (1050mm – north of 65Ave) requires improvement to convey future flows. The ACRWC trunk sewer needs to be upgraded or paralleled to provide additional capacity north of the Bridgeport connection. An upgrade pipe of 1500 mm or a twin 1050 mm pipe is to meet medium term as well as potential growth condition needs. Subsequent sanitary servicing strategies are based on capacity improvements to the northern section of the ACRWC trunk sewer from the Bridgeport Trunk connection to the City of Leduc Boundary (Airport Road and Range Road 250) (approximately 4,850 m).

Long Term

- Construct a new 450 mm sewer approximately 580 m in length to intercept flow from the Corinthia LS and provide capacity relief to the existing pipe receiving Corinthia LS discharge running parallel to the railway tracks (east side) north of Rollyview Road to Black Gold Drive. The new pipe will intercept the Corinthia LS flow on the west side of the railway tracks then run north behind the Fire Station and north through a public right-of-way to Black Gold Drive. At Black Gold Drive, the existing 200 mm pipe under the rail line would need to be increased to 450 mm (or twinned);
- Under long term conditions there are minor capacity issues in the Bridgeport Trunk Sewer. At this time, no improvements are recommended; however, the trunk should be monitored to track flow trends over time. Typically, with a well-constructed sanitary system, design flows are greater than actual flows;

- Stage 2 expansion of the Woodbend LS will be needed for long term growth. The station peak inflow is 237 L/s under long term conditions. This will require additional pumps be added to the station. It is proposed that two new pumps with a capacity of 170 L/s be added (P3 and P4) connected to the second wet well. In addition, one of the original pumps would be replaced with similar 170 L/s pump to provide a station firm capacity of 240 L/s. At the same time the Stage 2 forcemain is required. The station design has a provision for a second forcemain (525 mm) that will discharge directly into the ACRWC trunk sewer at 65Ave and 50St;
- Sanitary flow from the Blackstone neighbourhood can now be diverted into the West Trunk system and be disconnected from the Windrose system;
- In the long term, peak design flows to the Eastside LS will be approaching 185 L/s. This will require the Eastside LS be upgraded through pump replacement (Stage 2); and,
- In the East Telford Lake ASP a flow diversion is proposed to divert flows in excess of 185 L/s to a future Stage 1 Southeast LS once the capacity of the Eastside LS is reached. It is expected the Stage 1 Southeast LS will not be required until the end of the long term time frame.

Potential Growth

- The Woodbend LS will need a final upgrade (Stage 3) to accommodate the potential growth conditions with a peak design flow of 512 L/s. To achieve the final upgrade, the one remaining original pump would be changed to a 170 L/s pump;
- The Eastside LS firm capacity of 185 L/s is suitable for the potential growth condition. The peak design flow is 153 L/s;
- Beyond the long term condition, the Stage 1 Southeast LS will be required. This initial stage will convey sanitary flow from a portion of the Telford Lake District directed south through the flow diversion to the new Stage 1 Southeast LS that will discharge to the ACRWC trunk system through Leduc County north of Airport Road. The initial peak design flow to the Stage 1 Southeast LS is 150 L/s. This is considered the first phase of the Southeast LS, which will service the sanitary needs within the existing City boundary; and,
- The capacity at the Southeast LS station will need to be increased. Given the uncertainty of this growth scenario, a Stage 2 Southeast LS would be required with total peak design flow of 1,215 L/s to serve a potential growth area. The capacity expansion will be best accomplished with a new lift station constructed in phases to adapt to the potential development area. The Stage 2 Southeast LS would discharge to the ACRWC trunk sewer through Leduc County north of Airport Road; and,

Other Initiatives

The following initiatives are proposed to support the sanitary servicing strategies:

- Develop an I/I source identification program to identify the primary sources of I/I in the sanitary sewer. Source identification will guide the development of remedial measures. The I/I source identification typically includes a combination of flow monitoring, smoke and dye testing and CCTV inspection; and,
- Continue to collect flow monitoring data on a regular basis to track the change in flows related to growth. Collecting flow data around proposed improvements and new infrastructure will improve sequencing of projects.

1 Introduction

1.1 Background

The City of Leduc (the City) is expecting continued growth over the next 20-years. This growth was originally identified in the City's 2012 Municipal Development Plan. Growth, at a regional scale, was also identified in the 2011 City of Leduc / Leduc County Intermunicipal Development Plan, which addressed future land use related to neighbouring communities in Leduc County. Furthermore, the Capital Region Growth Plan identified the City as a priority growth area, projecting an average annual population increase of 1.6% to 2044 and a 1.8% increase in average annual employment over the same period.

The City, through the 2012 Municipal Development Plan, defined a 2035 vision where the City of Leduc will be a vibrant community where growth is balanced and sustainable. One component of this vision is to provide wastewater servicing to support growth over this period.

In 2013, the City completed a sanitary sewer modelling and servicing study to plan and prepare for projected growth. Following the completion of the 2013 Servicing Plan, the City continued to collect additional sanitary system information. It also updated system information and refined growth projections. Consequently, an update to the original 2013 Servicing Plan is required to incorporate new and updated information, reassess system capacity and develop updated servicing strategies to meet the City's future sanitary servicing needs.

Follwoing the completion of the 2013 Servicing Plan, the City continued to improve its understanding of the wastewater system by undertaking flow-monitoring studies in 2015, 2017, and 2018 to measure wastewater flows. This information has been used to expand the 2013 hydraulic model and update the model calibration and the capacity assessment of existing systems.

The 2018 Sanitary Servicing Study builds on the 2013 system assessments and servicing strategies using an updated hydraulic model to analyze the capacity of the existing system. The study identifies servicing strategies to support future growth in the City of Leduc. Through the City's planning efforts, future development is generally expected to be in the south, west, and east of the City, as documented in the 2012 Municipal Development Plan. The 2018 Sanitary Servicing Study takes into consideration the previous servicing strategies and refines and modifies them in response to 2018 conditions. As well, the 2018 Sanitary Servicing Study takes into consideration the Alberta Capital Regional Wastewater Commission (ACRWC) Wet Weather Regulatory Framework, which outlines the requirements for each member municipality with regard to managing wet weather flows.

1.2 Study Area

Figure 1.1 shows the City of Leduc and surrounding area. Currently, wastewater servicing is provided through approximately 160 km of sanitary sewer pipes. There are three lift stations in the service area: Suntree, Deer Valley, and Corinthia. All local wastewater is conveyed to a regional wastewater trunk sewer, the Southeast Regional Trunk Sewer (SERTS), which is owned and operated by the ACRWC.

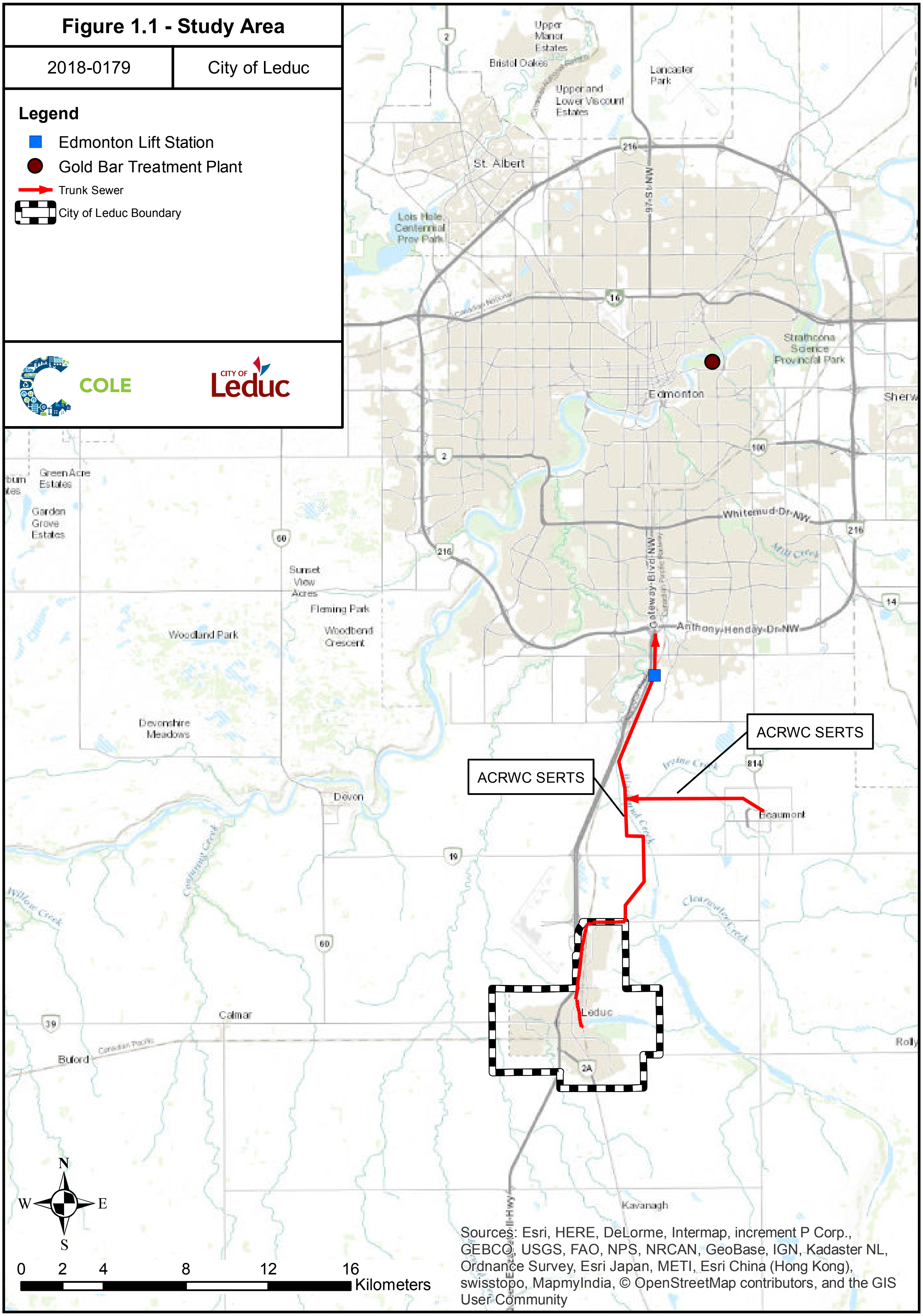


Figure 1.1 - Study Area

RS 03/29/2019 P:\oak\2018\2018-0179\600_GIS\20_Maps\Report figures 20181207\Figure 1.1 Study Area 20190329.mxd

The SERTS starts just south of 50 Avenue and extends north, running parallel to the railway tracks to Airport Road (10 Avenue) where it again heads north on Range Road 250. Ultimately, the SERTS conveys Leduc's wastewater flows to the City of Edmonton's Gold Bar Wastewater Treatment Plant.

In 2013, the City of Leduc's residential population was approximately 24,000; by 2017, the residential population had increased to approximately 30,500. Over a 20- to 30-year planning horizon, the residential population within the current City boundary is expected to be around 58,500, with an ultimate residential population of 65,000.

In addition to residential growth, the City has identified growth in its industrial and commercial lands over the same time period. In 2017, the employment population was estimated to be approximately 16,500, which is expected to increase to 34,400 over a 20- to 30-year planning horizon. Beyond the City of Leduc, the Edmonton International Airport also contributes wastewater flows into the local City system and then directly into the ACRWC trunk system.

1.3 Study Objectives

The goal of this project is to prepare an updated sanitary servicing study for the City of Leduc to address current wastewater issues and future servicing needs. To accomplish this goal requires the following key objectives be accomplished:

- Update, validate, and calibrate the City's sanitary system 2013 hydraulic PCSWMM (personal computer stormwater management model) with 2015, 2017, and 2018 flow-monitoring data;
- Update the capacity assessment of the existing sanitary system;
- Identify the sanitary servicing capacity needs to service growth areas to the south, west, and east of the City; and,
- Identify sanitary servicing strategy options to support future growth in the residential and employment populations.

1.4 Scope of Work

This project proceeded based on the following scope of work:

- Review planning boundaries for future growth areas and population projections;
- Analyze available sanitary sewer flow-monitoring data;
- Update the dry and wet weather flow characterizations;
- Update, validate, and calibrate a hydraulic PCSWMM for defined timelines (short, medium, long, ultimate);
- Assess the capacity of the existing baseline sanitary system;
- Assess capacity needs to support future growth; and,

- Develop sanitary servicing strategies to support future growth for defined timelines (short, medium, long, ultimate).

1.5 Report Organization

This report documents the project methods and results leading to recommendations for the City's sanitary servicing strategy. The main report is supported by appendices that provide additional details and results.

- **Section 1: Introduction** — States the project background, study area, study objectives, and scope of work;
- **Section 2: Sanitary Collection System** — Provides an overview of the existing sanitary collection system, local sewage pumping stations, and the ACRWC;
- **Section 3: Review and Summary of Flow Data** — Includes a review of the 2015, 2017, and 2018 flow and rainfall data for the purpose of updating the PCSWMM model;
- **Section 4: Land Use and Future Growth** — Includes a summary of the land use, future population growth, and flow projections;
- **Section 5: Update of 2018 PCSWMM** — Describes the methodology used to update the physical network, catchment delineation, and model calibration to represent 2018 conditions;
- **Section 6: Baseline Sanitary System Capacity Assessment** — Presents the updated 2018 baseline sanitary system capacity assessment for a range of conditions, including the ACRWC's level of service (LOS) assessment;
- **Section 7: ACRWC Capacity Assessment** — Assesses the ACRWC objective for LOS compared with the City's flow contributions and assesses the wet weather extraneous flow (inflow / infiltration [I/I]) from the City of Leduc's sanitary system;
- **Section 8: Growth Servicing Needs** — Presents the capacity assessments for future growth as well as servicing strategies developed for the updated population scenarios. These are founded on the 2013 servicing plan and updated development information; and,
- **Section 9: Conclusions and Recommendations** — Provides an overall summary of the 2018 update of the sanitary sewer model and servicing study with recommendations.

2 Sanitary Collection System

2.1 Sanitary System Overview

Figure 2.1 depicts the existing sanitary collection system that serves the City and its distribution by age. The City owns and operations approximately 160 km of sanitary sewer pipe. Most of the sanitary system (82%) pipes are 300 mm in diameter or less. The largest sanitary sewer is 750 mm; sanitary flow from the City discharges into the SERTS, which ultimately conveys the City's wastewater to the City of Edmonton's Gold Bar Wastewater Treatment Plant. **Table 2.1** summarizes the age of the sanitary collection systems.

Table 2.1 Age of Sanitary System

Construction Timeline	Length (m)	Percentage of Total Sanitary Pipe (%)
1952 to 1970	14,882	9
1971 to 1980	41,131	26
1981 to 1990	21,810	14
1991 to 2000	9,890	6
2001 to 2010	45,643	28
2011 to present	27,260	17
Total	**160,617**	**100%**

Close to a majority of the sanitary system (44%) was installed within the past 20-years. The 1970s were also a period when a significant amount of the sanitary system was installed (**Figure 2.1**).

Table 2.2 presents a summary of the pipe material used. The City now primarily uses concrete and polyvinyl chloride (PVC) pipes. Historically, vitrified clay pipe was used mainly for local sanitary sewers.

Table 2.2 Sanitary System Pipe Material

Pipe Material (Code)	Percentage Use of Material in Sanitary Pipe (%)	Years Used
Asbestos cement (AC)	1	1952 to 1990
Concrete (CONC)	17	1952 to present
High-density polyethylene (HDPE)	< 1	1986 to 2002
Polyvinyl chloride (PVC)	56	1971 to present
Steel (Steel)	< 1	1971 to 1990
Vitrified clay pipe (VCT)	25	1952 to 1990

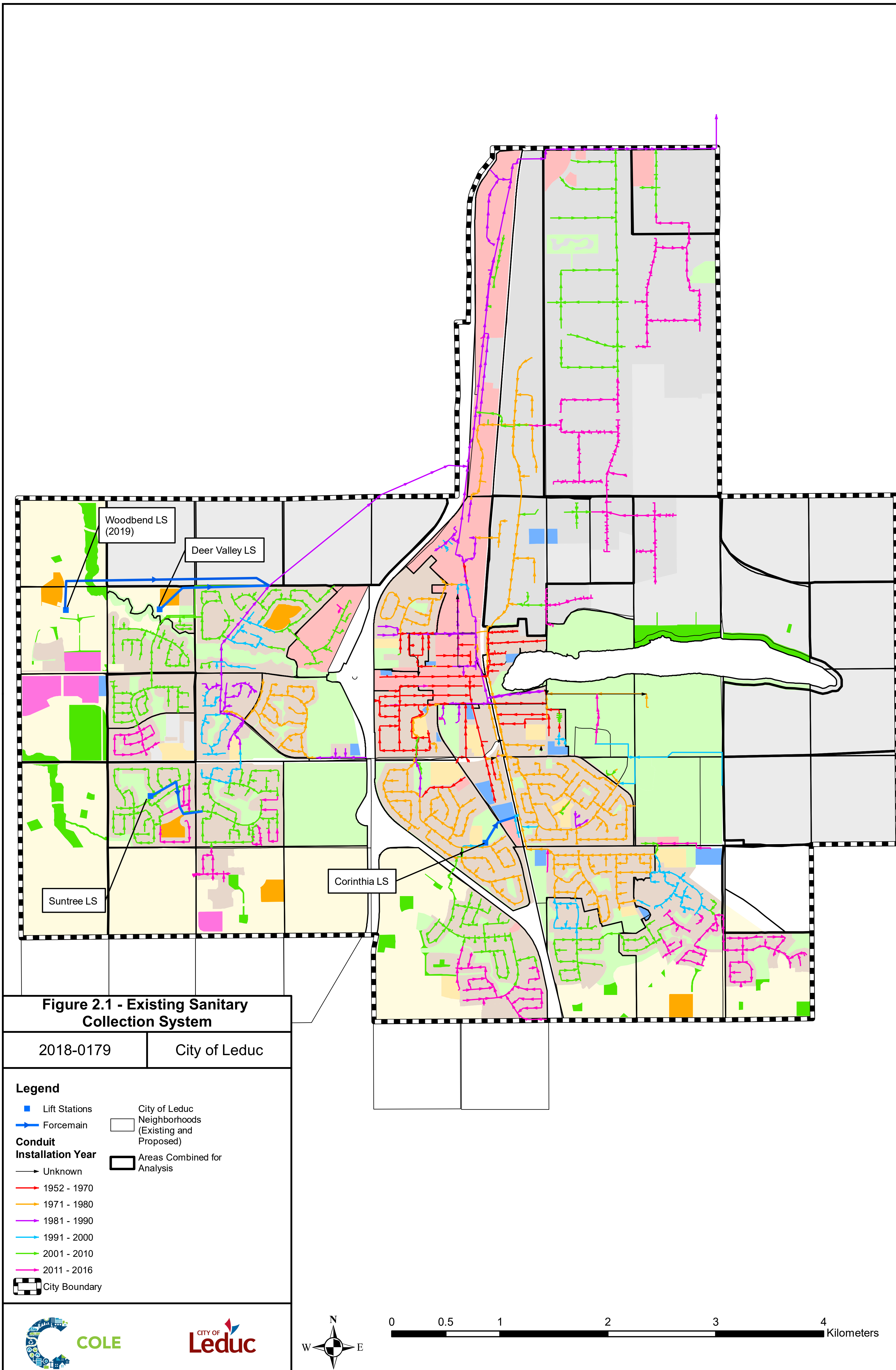


Figure 2.1 - Existing Sanitary Collection System

RS 2019-10-10 P:\oak\2018\2018-0179\600_GIS\20_Maps\Report figures 20181207\Figure 2.1 Ex sani collection system 20191010.mxd

The system includes two wastewater storage facilities. The first is located in Kinsmen Park south of Black Gold Drive adjacent to Camelot Avenue. This storage is in the form of an oversized in-line pipe where excess flow is diverted to storage and a controlled outlet allows the wastewater back into the main sanitary line.

The second facility passes through Notre Dame Park, where a parallel storage pipe is used for excess flows. The storage pipe is gravity-fed and wastewater returns back to the main system by gravity.

In 2000, the Corinthia Park sanitary sewer–relief project established a diversion structure where the sanitary flow at Bella Coola Drive and Corinthia Drive splits. Originally, this structure maintained dry weather flow and a portion of wet weather flow to continue northwest on Corinthia Drive. Under some wet weather conditions, excess flow would overflow to the north toward the new Corinthia Lift Station (LS).

In 2013, this structure was modified (weir plate removed) to allow more flow to the Corinthia LS, as the lack of use at the station was creating maintenance issues. The Corinthia LS is estimated to receive approximately 30 percent of the typical dry weather flows because of the flow diversion at the intersection of Corinthia Drive and Bella Coola Drive. Operator information indicates under normal dry weather operating conditions about 3 to 5 L/s is diverted to the Corinthia LS. In wet weather, the proportion is more when the downstream Corinthia Drive sanitary sewer experiences capacity issues.

2.2 Local Sewage Pumping Stations

Table 2.3 identifies the three local wastewater lift stations that are owned and operated by the City and the firm capacity of each. A fourth station is expected to be online in 2019.

Table 2.3 Wastewater Lift Stations

Name of Lift Station	Firm Pumping Capacity (L/s)[1]
Suntree	135
Deer Valley[2]	85
Corinthia	123
Woodbend[3]	60

[1] Firm capacity is based on the largest pump being out of service.

[2] A future growth-associated upgrade to 198 L/s is planned for Deer Valley.

[3] Woodbend is expected to go into service in 2019.

2.3 Alberta Capital Regional Wastewater Commission

The City does not have a wastewater treatment plant; all wastewater from the City discharges into the SERTS, which starts just south of 50 Avenue and extends north, running parallel to the railway tracks to Airport Road (10 Avenue) where it again heads north on Range Road 250 and out of the community. In the City, the SERTS is approximately 7.2 km long, ranging in diameter from 750 mm to a maximum of 1050 mm. The wastewater is ultimately conveyed to the City of Edmonton’s Gold Bar Wastewater Treatment Plant.

An agreement between the ACRWC and the member communities, including the City of Leduc, establishes the criteria for the Level of Service (LOS) the ACRWC will provide with respect to the transmission of wastewater and the provision of treatment.

In September 2014, the ACRWC adopted a management strategy for wet weather flow that was developed in consultation with the member municipalities. Under the strategy, it was expected that each member municipality would have its own unique approach for meeting the strategy's requirements. The strategy specified that each municipality would be issued a wastewater discharge permit that would allow it to discharge wet weather flows into the regional system. To ensure consistency across the region, the discharge permit has the following minimum requirements:

- Member municipalities must perform an assessment of their sanitary systems at least once every 10-years to identify and characterize I/I sources. The ACRWC and its members have developed minimum standards for these assessments. The first assessment report must be submitted to the ACRWC before December 31, 2019. Depending on the size of the municipality, a phased assessment approach may be considered, starting with the locations with the highest probability of generating wet weather flows;
- Member municipalities must develop specific strategies to manage the wet weather flow. They must also develop an implementation plan to reduce the impact of wet weather flows on the regional system. These plans must be submitted to the ACRWC by December 31, 2020;
- ACRWC member municipalities are required to include I/I management and testing criteria within their development-control regulations and/or infrastructure design standards by December 31, 2019. The ACRWC and its members have developed minimum standards that must be included. Member municipalities must submit an annual summary report that includes compliance / verification of their standards for new development and projects; and,
- Member municipalities are required to submit other relevant information (where available) to the ACRWC annually, such as monitoring data, reports, and studies on wet weather flow; data on sewer conditions; and data on sewer assets.

This 2018 Sanitary Servicing Study addresses the first assessment of the existing sanitary sewer system through the collection of flow-monitoring data, the preparation of a hydraulic model, and the performance of a system analysis.

3 Review and Summary of Flow Data

Following the 2013 Sanitary Sewer Modelling and Servicing Study, the City collected additional flow-monitoring data in 2015, 2017, and 2018 to support the extension and calibration of the 2013 wastewater hydraulic model. This section presents a summary of the flow data collected.

3.1 Flow and Rainfall Monitoring Programs

Flow monitoring was first undertaken between November 2011 and January 2012, followed by a second period between June 2012 and September 2012. In 2015, additional flow monitoring was undertaken between July 2015 and October 2015, a duration of approximately three and a half months. In 2017 and 2018, the flow-monitoring program was conducted between July 2017 and the end of September 2017, followed by a second period from late October 2017 through to late January 2018. For all programs, rainfall was collected in rain gauges located at the Leduc Civic Centre and/or the Operations Building. Rainfall was also collected at an independent location during the 2017 and 2018 programs. Flow-monitoring summary reports were prepared for each of the programs. These were used to characterize dry and wet weather conditions in the sanitary collection system.

Table 3.1 presents a summary of the flow data collected by the City since 2011, including the most recent 2017 and 2018 flow data. All the flow and rainfall data collected was reviewed and used, as appropriate, to develop and update the City's PCSWMM of the sanitary collection system. **Figure 3.1** shows the location of flow meters and rain gauges for all programs.

Table 3.1 Flow Data Collected by the City

Flow Monitoring Program (Year)	Number of Meters Installed	Monitoring Period
2011	10	November 2011 to January 2012
2012	14	June 2012 to September 2012
2015	12	July 3, 2015 to October 21, 2015
2017	10	July 1, 2017 to September 30, 2017
2017–2018	5	October 20, 2017 to January 22, 2018

In addition, the ACRWC installed three flow meters for a separate program to monitor flows from the City to the regional trunk system. This is an ongoing program that started in 2017. The ACRWC flow and rainfall data for the period between January 1, 2017 and December 31, 2017 was provided by the City in CSV format. The ACRWC's 2017 wet weather report notes that, to date, the highest flow in the trunk system recorded under the program occurred on May 25, 2017.

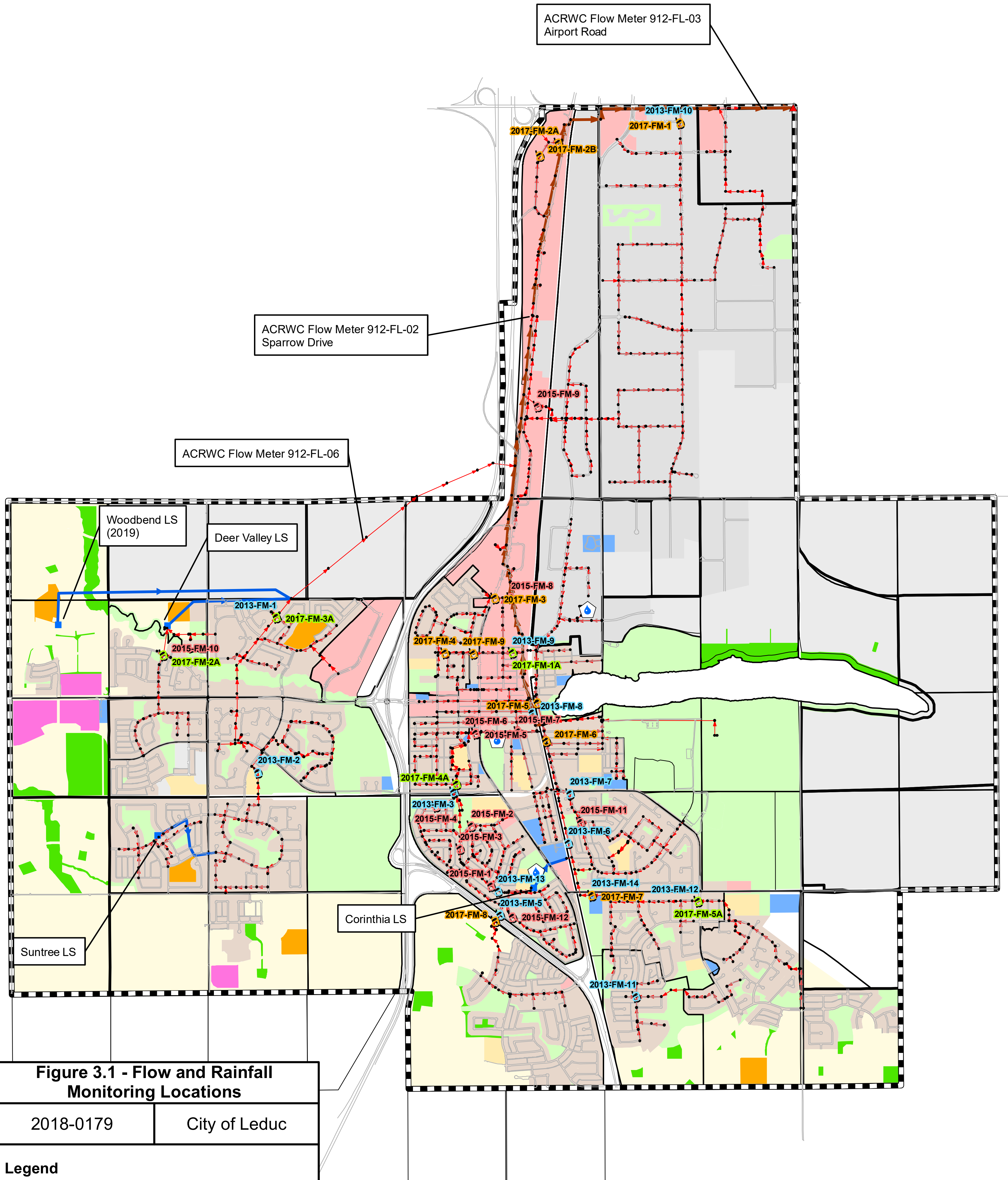


Figure 3.1 - Flow and Rainfall Monitoring Locations

2018-0179	City of Leduc

Legend

- Rain Gauge
- 2013 Flow Monitor
- 2015 Flow Monitor
- 2017 Flow Monitor
- 2018 Flow Monitor
- Model Junctions
- Lift Stations
- Model Outfall
- Curb
- ACRWC Trunk Sewer
- Modelled Sanitary Conduits
- Forcemain
- City of Leduc Neighborhoods
- City Boundary

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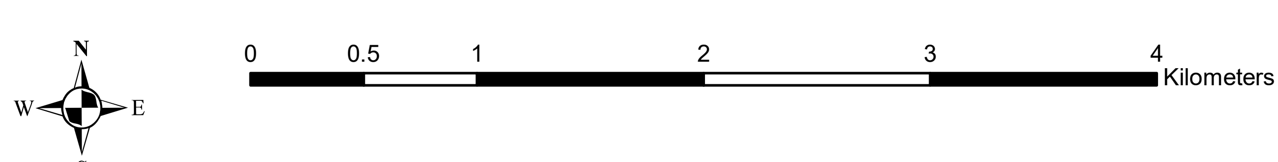
CITY OF Leduc



3.2 Flow Monitoring Program (2017–2018)

The 2013 and 2015 flow-monitoring data was analyzed at the time it was collected to characterize dry weather flow and to identify wet weather periods for model development and calibration. Previous reports summarize the data analysis that was completed. A similar data analysis process was used for the 2017–2018 flow data to characterize dry weather flow conditions for the purpose of updating the hydraulic model calibration and to isolate wet weather events. The flow data was used to validate the existing model for dry and wet weather conditions as part of continually refining the hydraulic model.

Appendix A presents a summary memorandum of the 2017–2018 flow data collected. The following is a summary of the data assessment; further details can be found in **Appendix A**.

3.2.1 Dry Weather Flow Characterization

Table 3.2 presents the dry weather flow (DWF) characteristics for the 2017–2018 data set.

Table 3.3 compares the average and peak DWF of the historical flow data (2011–2012 and 2015) with the 2017–2018 data set (where the sites were the same) to identify any changes in the dry weather flow characteristics. As indicated in **Table 3.3**, there was an increase in DWFs where development had occurred in the upstream contributing area. Development occurred upstream of FM08, FM03A_2018, and FM05A_2018, which corresponds to growth in Southfork, Windrose, Robinson, and Meadowview Park, respectively. For other locations, the historical average DWF is comparable to the recent 2017–2018 data collected.

3.2.2 Wet Weather Flow Periods

The 2017–2018 flow-monitoring data set was reviewed along with rainfall data to identify wet weather flow periods suitable for validating and refining the hydraulic model, if needed. **Table 3.4** identifies four suitable rainfall events that occurred during the 2017 flow-monitoring program.

From the ACRWC dataset for 2017, there are three wet weather events that can be used to validate the City's hydrologic / hydraulic model as the final validation that the model is representing total sanitary flows from the City of Leduc into the ACRWC system.

Table 3.2 Dry Weather Flow Characteristics

Site ID	Drainage Area (ha)	Average DWF (L/s)	Peak DWF (L/s)	Peaking Factor[1]	Minimum DWF (L/s)	GWI (L/s)[2]	GWI Rate (L/s/ha)	Estimated Sanitary Flow (L/s)[3]
2015 Data								
1	10.6	1.5	3.1	2.1	0.32	0.27	0.026	1.20
2	7.1	1.2	1.6	1.4	0.50	0.43	0.060	0.57
3	53.7	4.5	7.8	1.7	1.62	1.38	0.026	3.13
4	14.1	0.4	0.7	1.9	0.09	0.08	0.005	0.32
5	28.6	6.6	9.6	1.5	3.05	2.59	0.091	4.03
6	80.7	6.8	10.5	1.5	3.00	2.55	0.032	4.21

Table 3.2 Dry Weather Flow Characteristics

Site ID	Drainage Area (ha)	Average DWF (L/s)	Peak DWF (L/s)	Peaking Factor[1]	Minimum DWF (L/s)	GWI (L/s)[2]	GWI Rate (L/s/ha)	Estimated Sanitary Flow (L/s)[3]
7	33.3	2.2	3.2	1.5	1.04	0.88	0.027	1.33
8	45.3	3.1	4.4	1.4	1.73	1.47	0.032	1.60
9	172.9	2.5	6.2	2.4	0.35	0.30	0.015	2.24
10	67.2	9.4	15.7	1.7	2.84	2.41	0.036	6.94
11	76.9	5.3	8.8	1.7	2.10	1.79	0.023	3.48
12	12.2	0.6	1.1	2.1	0.19	0.16	0.013	0.39
Airport (2014)[4]	763.0	19.2	28.1	1.5	9.20	7.82	0.025	11.4
2017 Data								
FM01	167	2.2	5.9	2.7	0.67	0.57	0.003	1.6
FM02A[4]	763	16.6	46.4	2.8	3.42	2.91	0.004	13.7
FM02B	24	1.6	2.4	1.5	0.78	0.66	0.028	0.9
FM03	21	3.4	4.9	1.5	1.87	1.59	0.076	1.8
FM04	18	2.6	4.5	1.7	0.99	0.84	0.046	1.8
FM05	65	0.2	1.4	6.4	0.08	0.01	0.0001	0.2
FM06	337	23.4	48.2	2.1	3.40	2.89	0.009	20.5
FM07	150	8.8	18.6	2.1	1.38	1.17	0.008	7.6
FM08	75	7.3	12.8	1.8	0.05	0.04	0.001	7.2
FM09	34	3.1	4.7	1.5	0.90	0.77	0.023	2.3
2017–2018 Data								
FM01A_2018	43.1	5.8	10.1	1.7	1.00	0.9	0.020	5.0
FM02A_2018	67.2	10.3	17.9	1.7	2.66	2.3	0.034	8.0
FM03A_2018	248.1	18.3	33.9	1.9	0.44	0.4	0.001	17.9
ACRWC 2017 Data								
Sparrow Drive	1,258	88.2	128.4	1.5	38.2	32.5	0.026	55.7
Airport Road	1,583	115.4	164.7	1.4	54.6	46.4	0.029	69.0
South of Airport	339	28.2	39.65	1.4	11.8	10.0	0.030	18.2

ACRWC = Alberta Capital Regional Wastewater Commission; DWF= dry weather flow; GWI = groundwater infiltration.

[1] Peaking factor = peak DWF ÷ average DWF.

[2] GWI = 0.85 × minimum DWF.

[3] Estimated sanitary flow = average DWF minus GWI.

[4] The airport and area FM02A include the Edmonton International Airport property.

Table 3.3 Dry Weather Flow Comparison

Site Identifier (2017–2018) (Contributing Area)	DWF (L/s)		Historical Site Identifier	DWF (L/s)	
	Average	Peak		Average	Peak
FM01 (Leduc Business Park)	2.2	5.9	2013_10	2.3	2.9
FM07 (Caledonia, Tribute Meadowview Park, and Robinson)	8.8	18.6	2013_14	7.1	16.7
FM08 (Southfork)	7.3	12.8	2013_5	5.0	7.8
FM02A_2018 (Deer Valley, West Haven and West Haven Park)	10.3	17.9	2015_10	9.4	15.7
FM03A_2018 (Suntree, Windrose, Blackstone [partial], Lakeside Estates, Leduc Estates, Bridgeport and Leduc Common)	18.3	33.9	2013_1	11.5	13.0
FM05A_2018 (Meadowview Park [partial] and Robinson)	6.1	11.1	2013_12	3.2	4.1
FM02A (Northwest commercial and Edmonton International Airport)	16.6	46.4	2014_Airport	19.2	28.1

DWF = dry weather flow.

Table 3.4 Rainfall Analysis Summary

Event Identifier	Begin Date / Time	End Date / Time	Duration (Hours:Minutes)	Total Rainfall Volume During Period (mm)
2015 Rain Gauge, Civic Centre				
E1	July 16, 2015, 03:30	July 17, 2015, 12:00	32:30	37.6
E2	July 21, 2015, 22:00	July 21, 2015, 23:00	1:00	9.1
2015 Rain Gauge, Operations Building				
E1	July 16, 2015, 03:30	July 17, 2015, 12:00	32:30	50.3
E2	July 21, 2015, 22:00	July 21, 2015, 23:00	1:00	18.5
E3	Sept 6, 2015, 00:00	Sept 6, 2015, 04:00	4:00	15.8
E4	Sept 15, 2015, 04:00	Sept 16, 2015, 02:00	22:00	16.2
2017 Rain Gauge, Corinthia Park				
WWE1	July 13, 2017 17:50	July 13, 2017, 19:30	1:40	16.0
WWE2	Jul 27, 2017, 19:40	Jul 27, 2017, 21:45	2:05	12.0
WWE3	Aug 13, 2017, 17:35	Aug 24, 201,7 0:35	7:00	10.5
WWE4	Sep 18, 2017, 21:30	Sep 19, 2017, 11:25	13:55	24.5
ACRWC Rain Gauge, Civic Centre				
WWE1	May 24, 2017, 4:40	May 24, 2017, 8:25	13:45	38.6
WWE2	Jul 27, 2017, 19:15	Jul 27, 2017 22:25	3:10	11.8
WWE3	Aug 03, 2017, 21:55	Aug 03, 2017 16:40	18:45	14.2

3.3 Flow Data Summary

The 2015, 2017, and 2018 data provides additional dry and wet weather flow data to validate and refine the original 2013 sanitary system hydraulic PCSWMM. The data supplements the original flow data collected in 2011 and 2012, which was used for model calibration.

The 2015, 2017, and 2018 flow data collected led to the following conclusions:

- The 2015, 2017, and 2018 data provides more coverage and can be used to refine model calibration, providing a more refined characterization of local flow conditions;
- The 2015, 2017, and 2018 flow data is consistent with historical data collected at the same location where there has been little in the way of growth or system changes. Where there has been growth upstream of a flow-monitoring location, the average DWF has increased;
- The ACRWC flow data provides further validation of the model, as the three monitoring locations characterize ACRWC trunk flows, which is the total sum of flow generated by the City of Leduc; and,
- There were four wet weather events in 2015 and 2017 that can be used to update the 2013 hydraulic model. As a result, the 2015, 2017, and 2018 flow data can be used to update the dry weather and wet weather model calibration.

4 Land Use and Future Growth

The City's growth projections identify the location of growth areas inside and outside the current urban boundary as well as the timing and type of growth (residential or employment) expected. The residential and employment growth for each planning horizon has been refined based on planning documents, such as area structure plans and ongoing communication with the development community to identify future growth areas.

The projections in the 2018 Sanitary Servicing Study use the best available information, starting with 2016 as the baseline for the existing residential and employment population. The intent of the sanitary servicing plan is to identify what projects are required to support projected growth and to sequence these projects to show how the City will respond to growth.

These growth projections form the basis for the wastewater generation estimates used to develop the expected sanitary flows for future conditions.

4.1 Planning Horizons and Population Growth Estimates

The updated residential and employment growth projections examine population growth from the current (2016) levels to the short-, medium- and long-term planning horizon, and to a potential growth condition that is beyond the 30-year planning horizon. The refined growth information is distributed according to traffic zones for convenience. These projections for residential and employment populations are planning-level estimates and are subject to change. Actual population increases, and timing may change as development applications are received and approved. For this sanitary servicing plan, **Figure 4.1** shows both the urban boundary of the current sanitary service as well as a future servicing boundary and future neighbourhoods as shown in the 2012 Municipal Development Plan (as approved August 2017).

Table 4.1 presents the existing population as well as growth projections for the short, medium and long term time horizon. **Section 4.3** outlines the future flow projections. The long term growth represents a nearly full build out of the current urban boundary. Growth beyond the current urban boundary, identified as Ultimate Potential Growth, is expected to increase the total combined employment and population to 177,600 persons. Where the Ultimate Potential Growth will occur has yet to be determined, but it could potentially occur south of the current urban boundary.

The baseline population and land-use information provided is considered to represent 2017 conditions. This aligns with the 2017–2018 flow-monitoring data and system infrastructure to represent 2018 as the existing baseline condition.

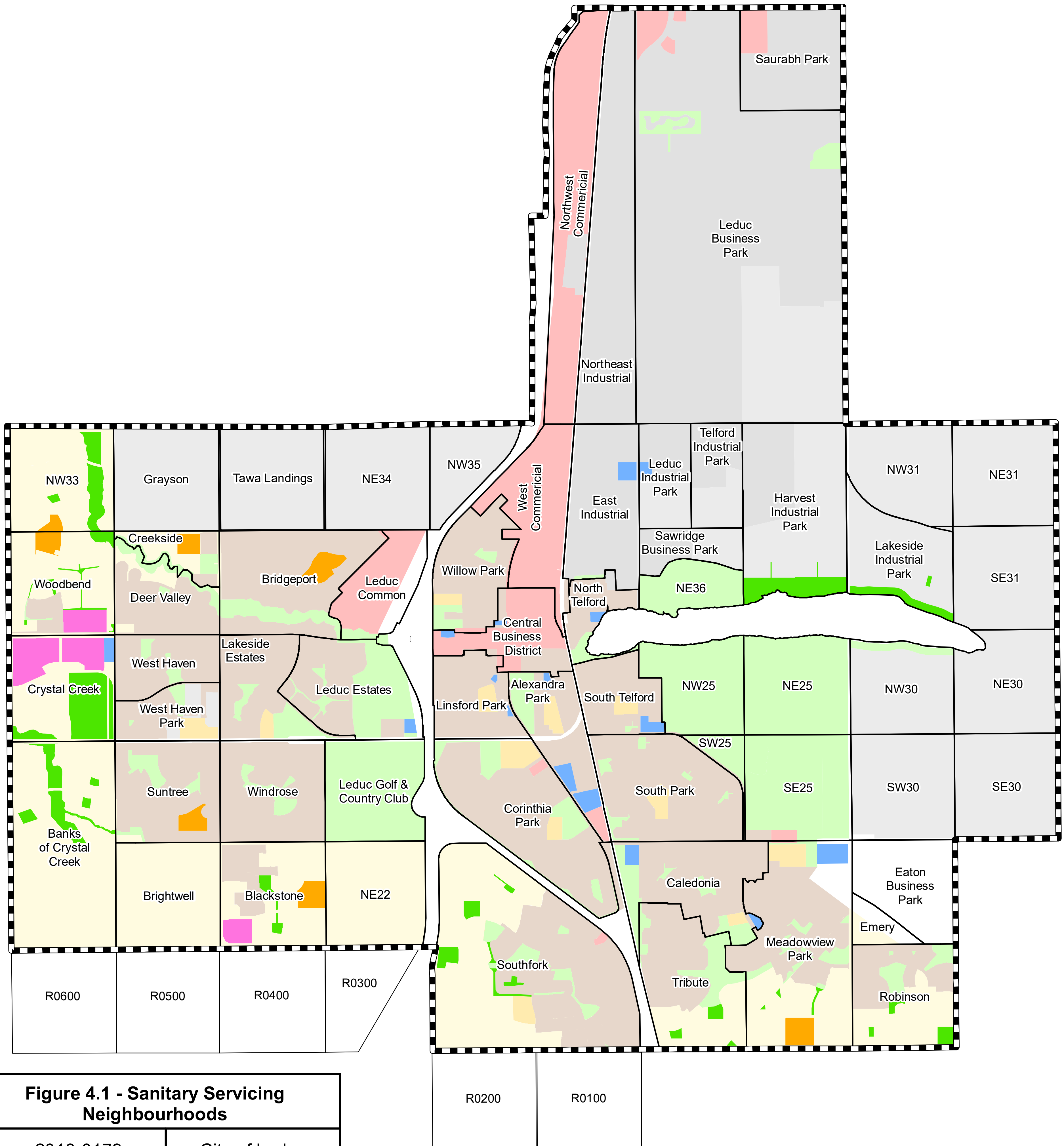


Figure 4.1 - Sanitary Servicing Neighbourhoods

2018-0179	City of Leduc

Legend

City of Leduc Neighbourhoods (Existing and Proposed)

Current City Boundary

COLE

CITY OF Leduc

RS 10/10/2019 P:\oak\2018\2018-0179\600_GIS\20_Maps\Report figures 20181207\Figure 4.1 Sanitary Servicing Neighborhoods 20191010.mxd

Table 4.1 Population Projections

Timeline	Approximate Year	Residential Population	Employment Population	Total (Residential Plus Employment)
Existing	2016	30,497	16,493	46,990
Short term	<10 years	36,679	20,580	57,259
Medium term	10-20 years	46,610	27,492	74,102
Long term	20 years-30 years	58,575	34,396	92,971
Ultimate Potential Growth	30 years +			177,598

4.2 Existing Sanitary Flows

For the existing service area, the flow data collected since 2011 is used to assign flows in the baseline model. The flows are assigned on a per-capita (L/c/d) and/or on an area basis (L/s/ha). The updated 2018 baseline model uses 2016 residential- and employment-population data and land-use information. Future flows are based on a combination of unit-flow rates in existing areas and/or design-flow calculations for new development areas.

4.3 Sanitary Flow Projections

Figure 4.2 presents a summary of peak design flows associated with the short, medium, long, and ultimate planning horizons. The design flows are developed differently, depending on the existing and future land use. The future sanitary flows to be added to existing flow conditions were developed using the following approaches, which depend on the extent of existing development and land use:

- Existing areas with residential / mixed portions: Growth flows use the incremental residential and employment populations to generate design flows based on design per-capita rates, peak flow, and I/I allowance. These areas are actively under development and already contribute flow to the sanitary system model;
- Existing industrial, commercial, and institutional (ICI) areas with ICI growth: The existing ICI flows are based on monitoring data. For growth, design flows for ICI areas are indicated using an area-based unit rate (L/s/ha). The flow contribution of new growth is increased proportionally to the growth in employment population provided;
- New residential areas: Design flows are based on design per-capita rates, peak flow, and I/I allowance;
- New ICI areas: The design flow is based on a calculation of area design flow (L/ha/s). The population growth will be used to estimate the proportion of the area that will be developed; and,
- New mixed areas: The residential population will be used for design-flow calculations plus area-based ICI design flows.

Figure 4.2 shows the sanitary design flows associated with growth for each neighbourhood or quarter section. For the purpose of sanitary servicing the Ultimate Potential Growth design flow (1,100 L/s) is shown to be from the southeast beyond the City's current urban boundary. Where growth will occur, the amount of growth and associated flow is uncertain and subject to change.

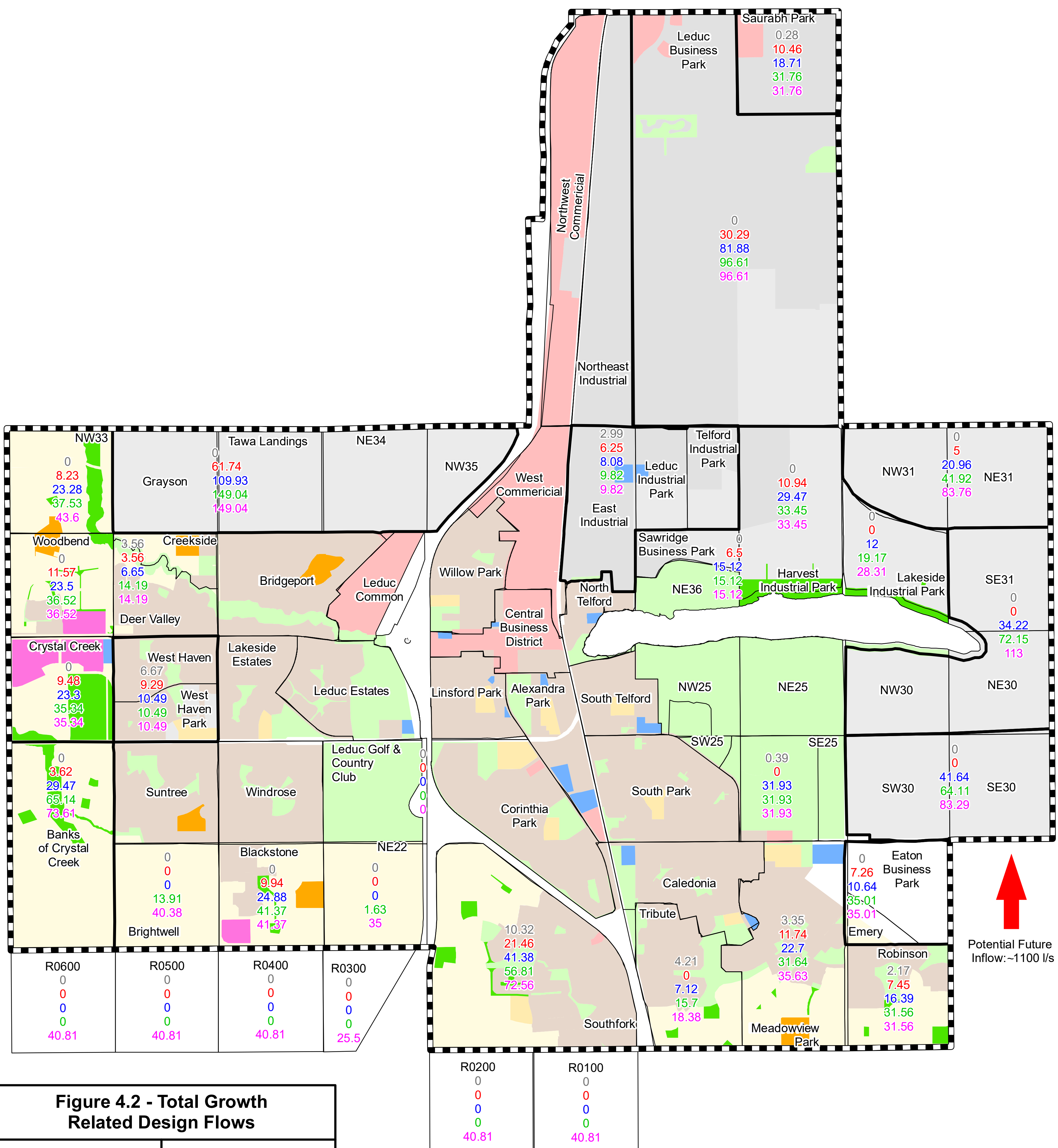


Figure 4.2 - Total Growth Related Design Flows

2018-0179	City of Leduc

Legend

City of Leduc Neighbourhoods (Existing and Proposed)

Areas Combined for

Current City Boundary

Future Growth Areas - Incremental Flow (l/s)

Hollands	Neighbourhood
0	Existing
8	Short
23	Medium
37	Long
43	Potential

Flow projection for unserviced areas:

Residential = (Area x 0.2 L/s/ha) + (Pop x 300 Lpcd x PF)
ICI = (Area x 0.05 L/s/ha) + (Area x 0.2 L/s/ha x 3)

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N
W E
S

0 0.425 0.85 1.7 2.55 3.4
Kilometers

RS 10/10/2019 P:\oak\2018\2018-0179\600_GIS\20_Maps\Report figures 20181207\Figure 4.2 Growth flow projections 20191010.mxd

5 Update of 2018 PCSWMM

This section outlines the steps taken to update the 2013 hydraulic PCSWMM. The model was updated with 2015 flow-monitoring data in 2016. Most recently, it has been updated with the 2017 and 2018 flow data. The updating process involved the following activities:

- redistribution of residential and employment 2016 population data in the model; and,
- recalibration of dry and wet weather flow in the model, building on previous dry and wet weather calibration updates.

The baseline model is updated to represent 2018 City of Leduc conditions in the PCSWMM.

5.1 Physical Network and Catchments

The 2013 PCSWMM had 713 junctions, 730 conduits, and 136 catchments covering 1,402 ha. The model has since been updated, adding 400 junctions and 416 conduits with 190 catchments covering 1,572 ha. The 2018 baseline model has a more extensive physical network and more catchments delineated than does the original 2013 model. The 2018 model is not an all-pipes model; however, it does include the currently serviced areas as sub-catchments.

The physical network was extended to better represent the local collection systems corresponding with the points where flow data was collected. The updating process involved the following activities:

- identifying additional collection system networks to be included in the model;
- reviewing network attributes and inferring the data missing from the existing information;
- changing the 2013 node names to correspond to the City's geographic information system (GIS) manhole names throughout the model; manhole / node names not in the GIS were assigned a unique identifier;
- updating the conduit names to correspond to the City's GIS; where there was no conduit name, a name was assigned that combined the names of the upstream and downstream nodes, separated with a period; and,
- adding six new catchment areas to the model and subdividing 48 existing catchments into smaller catchments to correspond with the extension of the modelled network to incorporate the new flow-monitoring locations.

Figure 5.1 shows the extent of the sanitary collection system and catchments for the 2018 baseline PCSWMM.

5.2 Update Dry Weather Calibration

Care was taken to preserve the original dry weather characteristics, where appropriate. Unit rates were updated, and diurnal flow patterns were refined in the PCSWMM where necessary based on the flow data from the 2015, 2017, and 2018 data sets.

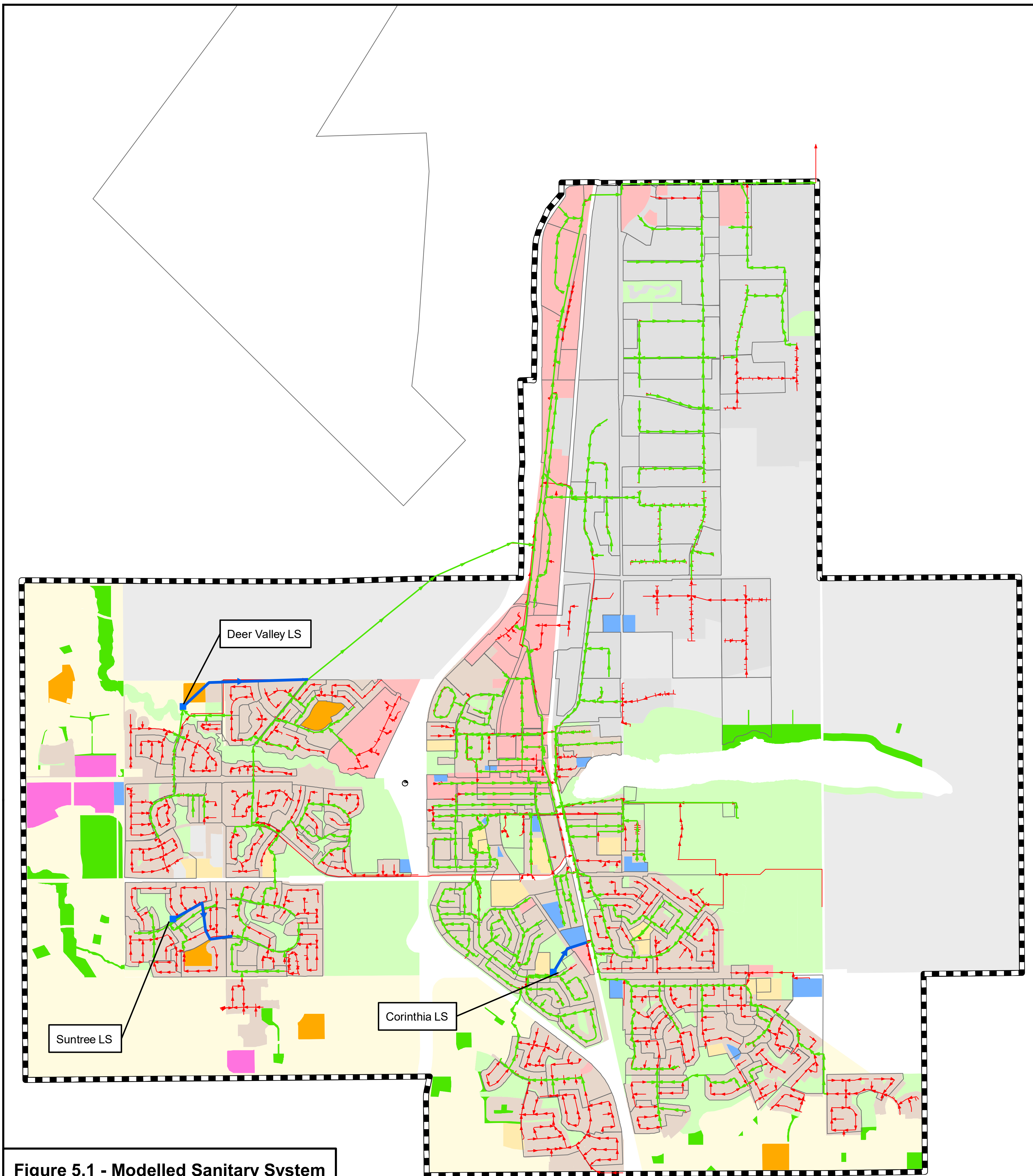


Figure 5.1 - Modelled Sanitary System

2018-0179	City of Leduc

Legend

- Lift Stations
- Forcemain
- Modelled Conduits
- Sanitary Pipes (City GIS)
- Model Subcatchments
- City Boundary

Appendix B presents the typical diurnal DWF profiles used in the 2017 model of the existing system. These profiles are based on the flow data collected and analyzed in 2010, 2011, 2015, 2017, and 2018. Dry weather calibration and validation curves are presented as part of the wet weather calibration validation curves.

5.3 Update of Wet Weather Calibration

Data sets of wet weather events from 2015, 2017, and 2018 were used to refine the wet weather calibration. The following events were used to update the model calibration:

- July 16, 2015 (37 mm)
- July 21, 2015 (18 mm)
- September 6, 2015 (16 mm)
- September 15, 2015 (16 mm)
- July 13, 2017 (16 mm)
- July 27, 2017 (12 mm)
- August 13, 2017 (10.5 mm)
- September 18, 2017 (24.5 mm)

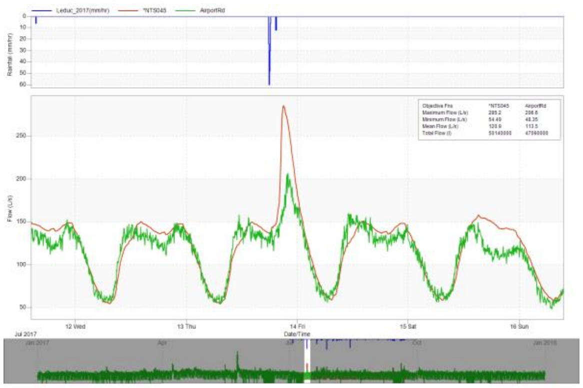
Appendix B presents the wet weather calibration curves for the 2015, 2017, and 2018 flow-monitoring locations. The 2017 and 2018 data sets and events resulted in the need for some minor adjustments to the wet weather calibration parameters. The calibration curves are provided only for locations where the flow data was considered usable for calibration; therefore, not all sites are shown for all events.

5.4 Model Validation

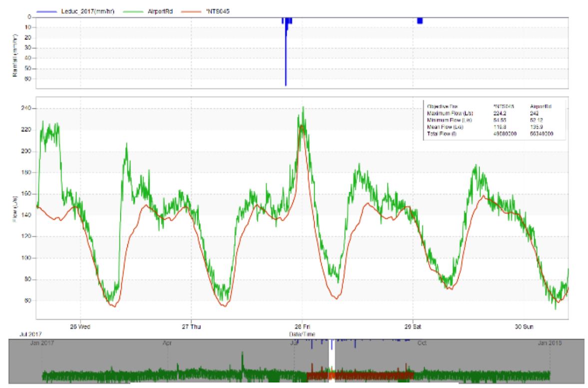
The ACRWC data is used to validate the model. Previously, there was no data available for the ACRWC system. The flow data collected at the most downstream location (912-FI-03 [Airport Road]) represents the total wastewater flow leaving the City. At this downstream ACRWC location, the flow data is compared with the measured data for the four 2017 calibration events. ACRWC data was available for these events and for the May 24–25, 2017 event captured as part of the ACRWC monitoring program (no local City data is available for the May 24, 2017 event).

Figure 5.2 presents the ACRWC 912-FI-03 (Airport Road) flow hydrographs and the updated calibrated model hydrograph for the same events. Over the five events compared, there is good agreement between the modelled and measured flows, with no adjustments to the updated calibrated model required. There is some variation between the modelled and measured flows for the July 13 and May 24 events. The short (one-hour) duration of the July 13 event likely indicates a thunderstorm event, which may not have covered the entire City; therefore, the modelled peak flows are higher than measured. For the May 24, 2017 event, the DWF is in good alignment, whereas the wet weather response measured is higher than the modelled flows and extends for a longer time before returning to normal DWF conditions. The difference is attributed to the antecedent conditions in May (spring), which tends to be a wetter month, resulting in more pronounced wet weather response to rainfall than during the summer or fall period when the majority of flow data has been collected.

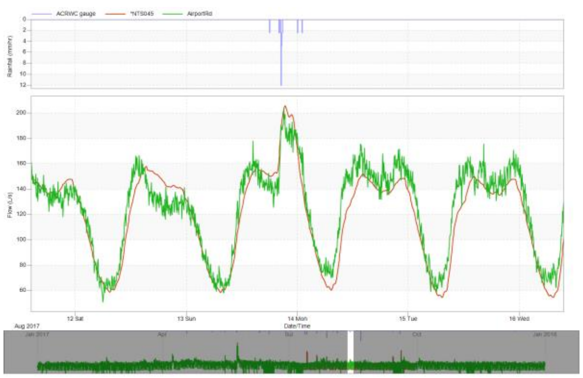
Appendix B presents the ACRWC-measured flow versus the modelled flows for the four 2017 events and the May 24, 2017 event. Overall, the modelled and observed flows at the ACRWC sites compare well with the calibration events under dry and the wet weather condition.



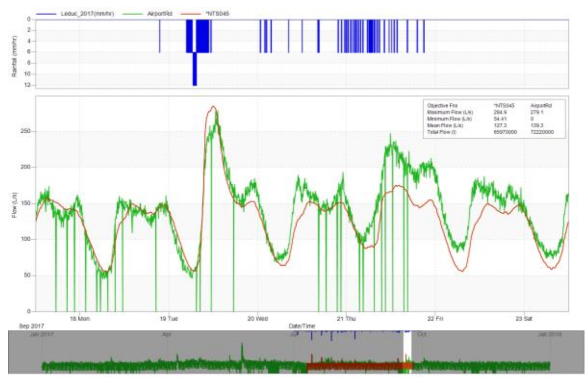
July 13, 2017 (16 mm)



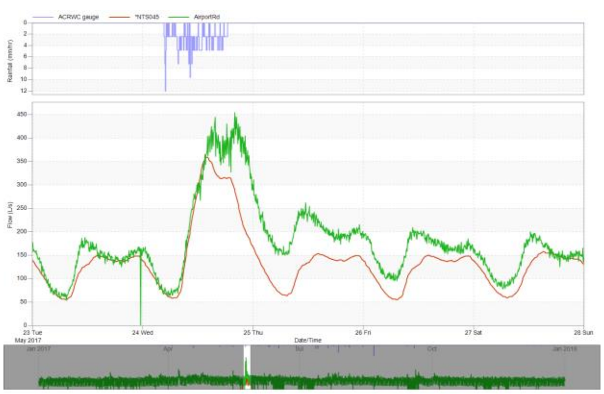
July 27, 2017 (12 mm)



Aug 13, 2017 (10.5 mm)



Sep 18, 2017 (24 mm)



May 24, 2017 (38 mm)

Figure 5.2 ACRWC 912-FI-03 (Airport Road) Model Validation Events

A final validation of the model was done to compare the historical 2015 and 2012 flow data with the updated model. This comparison was done to determine whether the adjustments to the model are reasonable and consistent with the data collected previously. The July 17, 2015 and July 15, 2012 events were simulated, and the modelled flows were compared to the actual measured flow. Overall, there was reasonable agreement at the historical sites, although there were some sites where the original data did not compare well.

In reviewing the dry and wet weather calibration curves in combination with the validation events (ACRWC and historical), the model is considered to reasonably represent existing system flows under dry and wet weather conditions. The calibration of the hydraulic model has been improved and refined with the collection of additional flow data and expanded geographical coverage. Future flow-monitoring programs can be used to continue to refine the model. The current model is considered calibrated and validated to a level suitable to assess dry and wet weather capacity for existing and future conditions in the City's sanitary collection system.

6 Baseline Sanitary System Capacity Assessment

This section presents the updated capacity assessment of the wastewater collection system serving the City using the updated and calibrated hydrologic / hydraulic PCSWMM of the main sanitary collection systems.

A baseline capacity analysis was completed on the basis of two conditions: peak dry weather and a 25-year design storm condition. This assessment was completed to identify existing system deficiencies using the same capacity criteria that were used in the 2013 Sanitary Servicing Study.

6.1 Sanitary System Capacity Criteria

The City's wastewater system capacity has been evaluated using the following criteria for dry and wet weather conditions.

Under DWF, a sanitary sewer is considered to have capacity issues if the pipe is more than 86% full. This criterion is used as a guideline and represents the maximum depth of flow under peak dry weather and peak design-flow conditions. If the depth of flow exceeds 86% of the pipe's diameter, the pipe is considered undersized. There are exceptions, as minor changes in the pipe slopes represented in the model may result in an exceedance even when the system, as a whole, does provide sufficient capacity. It should be recognized that using a model will produce results that are different from the sanitary design sheets traditionally used for new pipe design. This DWF criterion is used to evaluate capacity based on actual as well as peak design-flow conditions.

The "full" percentage of the pipe is calculated as **d** divided by **D** (where **d** = flow depth and **D** = pipe diameter), which is shown on the thematic maps as follows:

- green: pipe flow depth is less than 50%;
- orange: pipe flow depth is greater than 51% and less than 85%; and,
- red: pipe flow depth is greater than 86%.

For DWF and design-flow conditions, the "red" pipes exceed the 86% criterion and warrant further investigation.

To evaluate capacity under wet weather conditions (wet weather flow), a 25-year design storm is applied, and capacity is assessed on the basis of the maximum elevation of the water surface at junctions (i.e. maximum hydraulic grade line [HGL]). To protect against sewer backup into sanitary service laterals, the maximum water surface elevation is expected to be more than 2 m below the ground surface, referred to as "freeboard" under the 25-year, 24-hour design storm. This wet weather flow criterion is used as a guideline and some exceptions may apply.

The maximum HGL used to determine the freeboard (i.e. rim elevation to top of maximum water surface elevation) is generated from the head time series, where the maximum head is subtracted from the rim elevation. If the freeboard is within 2 m of the surface it is shown in red; if greater than 2 m, it is shown in green.

If a junction (manhole) shows up as red and the connecting pipes are not red, then it is a shallow manhole and not considered a capacity issue. For wet weather conditions, performance is shown on the thematic maps as follows:

- pipe flow depth less than 100% (green—not surcharged);
- pipe flow depth greater than 100% (red—surcharged);
- junctions: HGL greater than 2 m below ground (green); and,
- junctions: HGL less than 2 m below ground (red).

6.2 Existing System Baseline Capacity Assessment

6.2.1 Baseline Dry Weather Capacity Assessment

In **Figure 6.1**, which shows the capacity assessment thematic map representing existing dry weather baseline sanitary sewer conditions, the following is concluded:

- The sanitary system operates well under existing average and peak DWF conditions; and,
- There are no (modelled) pipe segments that are greater than 86% full.

6.2.2 Baseline Wet Weather Capacity Assessment

The need for capacity improvements under existing conditions is premised on limiting the maximum HGL to more than 2 m below the ground surface for the 25-year design storm, which is meant to reduce the risk of basement flooding.

Figure 6.2 shows the wet weather capacity assessment thematic map for the 25-year design storm with existing DWF baseline conditions. Under the 25-year design storm event, there are areas with potential capacity issues where the sanitary sewer is surcharged.

Wet weather capacity issues, represented by surcharged sanitary sewers, are evident east of Highway 2 in the older part of the city, as follows:

- South Park Drive;
- 44 Street north from South Park Drive through the schoolyard;
- 48 Street just south of Black Gold Drive;
- Corinthia Drive between Bella Drive and Camelot Avenue;
- Athapaskan Drive from Cayuga Street to Corinthia Drive and a small portion of Haida Avenue;
- one branch of the Corinthia Drive system north of Black Gold Drive to 47 Avenue;
- a portion of 47 Avenue from 52 Street to 50 Street and 52 Street south of 47 Avenue;
- 57 Avenue, west of 50 Street and a small portion of 50 Street and 55 Avenue;
- 49 Street south of 59 Avenue;
- 54 Avenue west of 49 Street; and,
- 44 Street and 46a Avenue.

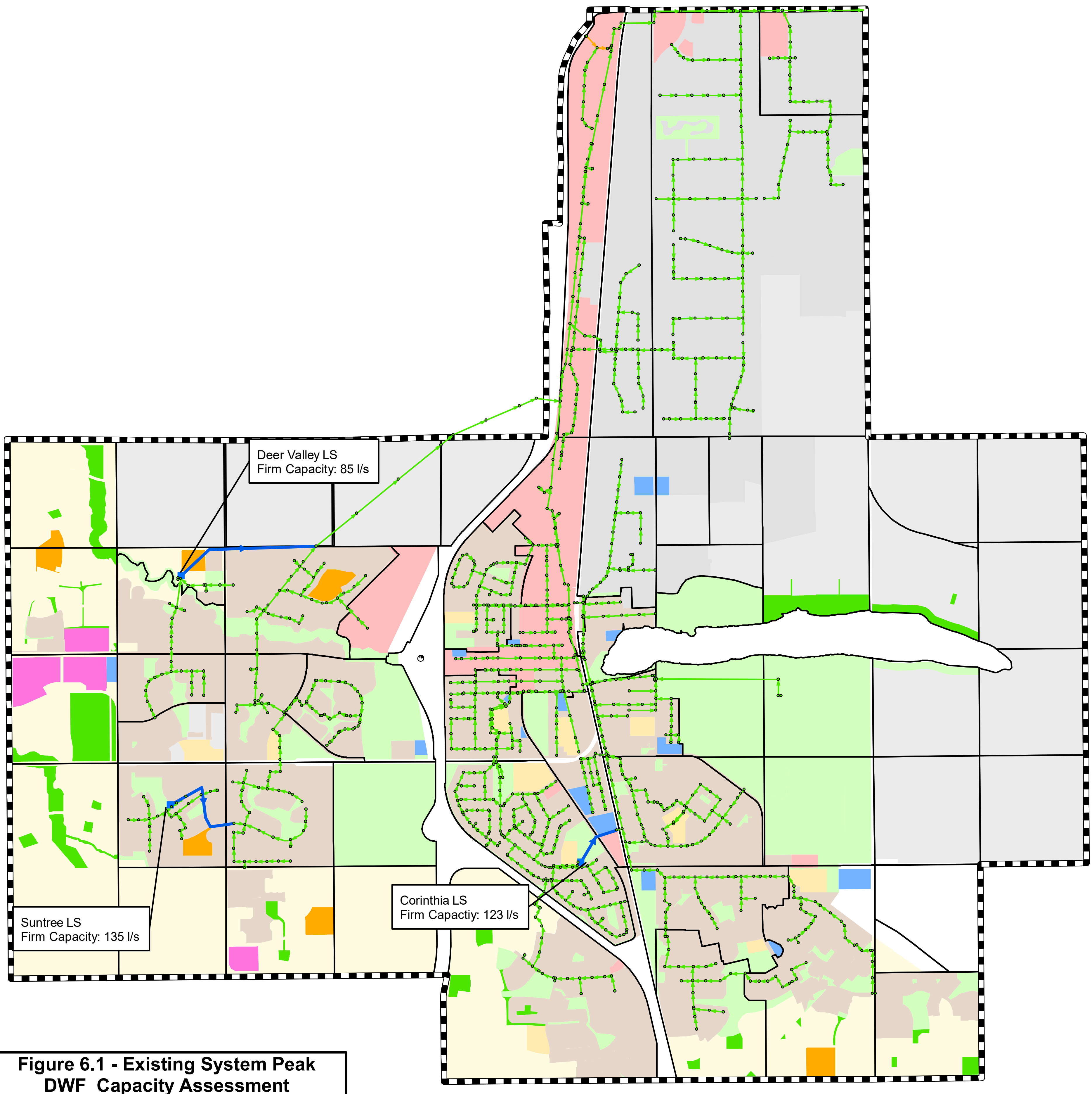


Figure 6.1 - Existing System Peak DWF Capacity Assessment

2018-0179	City of Leduc

Legend

- Junctions
- Lift Stations
- Pumps
- City of Leduc Neighbourhoods
- City Boundary

Depth Utilization

- < 50 % Full
- 50-86% Full
- > 86% Full

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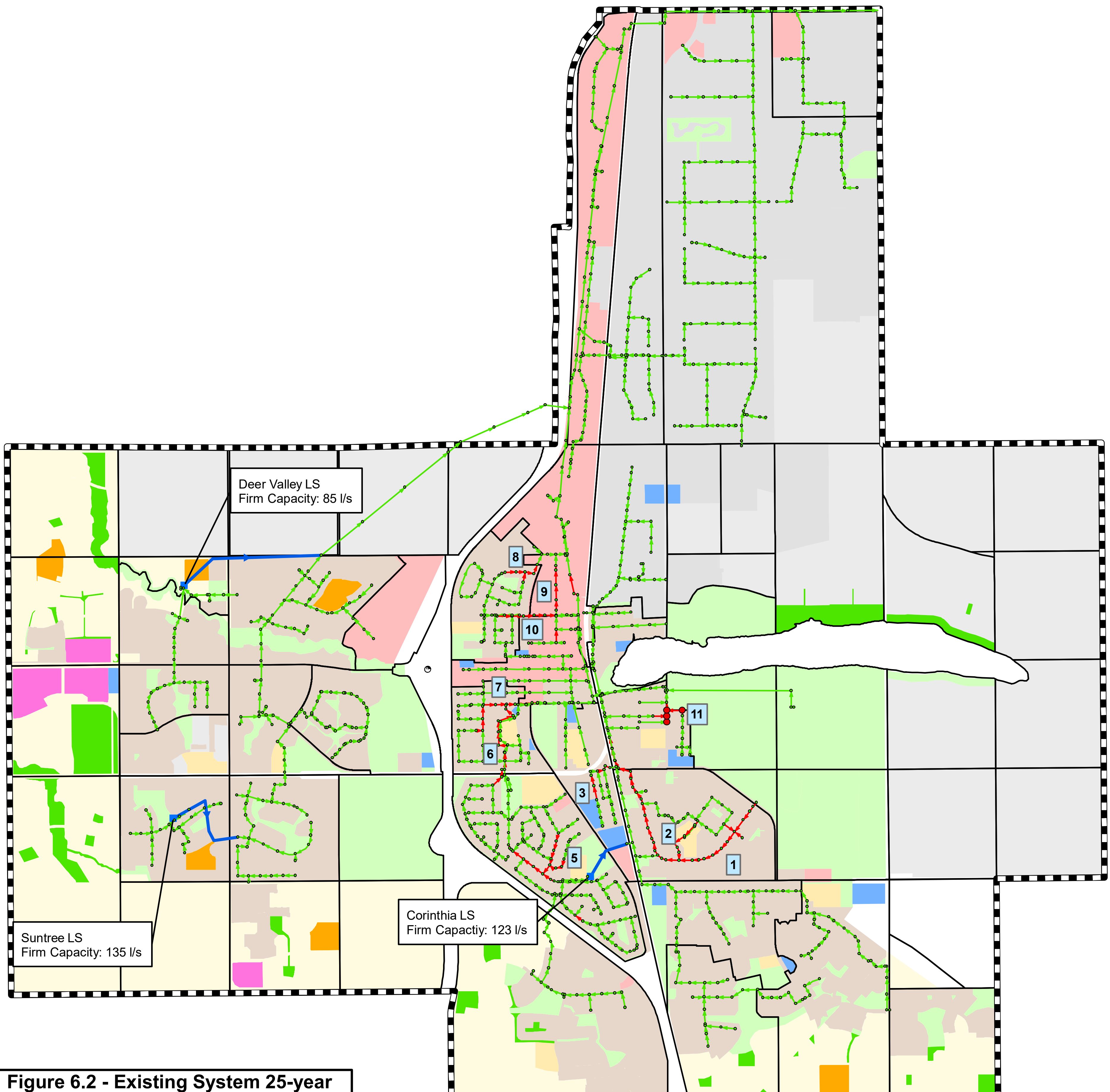

Figure 6.2 - Existing System 25-year Design Storm Capacity Assessment

2018-0179	City of Leduc

Legend

Node Freeboard

- < 2 m
- > 2 m
- Lift Stations
- Forcemain

Depth Utilization

- < 100% Depth Utilization
- > 100% Depth Utiliztation

- City of Leduc Neighbourhoods
- City Boundary
- 1 Surcharge Location Reference

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CITY OF Leduc

0 0.5 1 2 3 4 Kilometers

RS 10/10/2019 P:\oak\2018\2018-0179\600_GIS\20_Maps\Report figures 20181207\Figure 6.2 Ex system 25yr design storm 20191010.mxd

Of the surcharged pipes under the 25-year design storm condition, most surcharging is not considered critical. In reviewing HGL profiles at the 11 locations, the surcharge is minor and the maximum water surface elevation (HGL) is more than 2 m below the ground elevation. Therefore, the risk of basement flooding is low.

There is only one area, location 11 (44 Street and 46a Avenue), where the surcharging poses an increased risk of flooding.

In comparing the 2018 wet weather assessment with the 2013 and 2015 capacity assessments, there are differences. The differences are attributed to the additional network added to the model, additional catchments, and the updated model calibration based on the additional flow data collected to more accurately reflect wet weather responses in the existing sanitary system. In the 2015 update, there were more capacity issues identified in the areas of 50 Street and north of 52 Avenue; with the addition of the 2017–2018 flow data, however, there is now better information for this area, allowing for a more realistic distribution of flow and a better understanding of system response. It was identified previously that, based on 2015 data, the I/I rate for this area was considerably higher; this has been addressed through the additional monitoring and calibration in areas where the wet weather response was found to be more moderate.

6.2.3 Existing System Servicing Improvements

Table 6.1 provides a summary of pipe improvements, related to existing conditions, that were identified through the modelling based on the 25-year design storm conditions. **Figure 6.3** shows the location of the improvements proposed. The system improvements address only the one location where the maximum water surface elevation is within 2 m of the ground elevation, which presents a risk of basement flooding.

Table 6.1 Existing System Improvements

ID (44 Street)	Upstream	Downstream	Ups-MH Node ID	Dwn-MH Node ID	Length (m)	Existing Diameter (mm)	Upgraded Diameter (mm)
1	46 Avenue	46a Avenue	704	705	43.4	200	300
2	46a Avenue	South of 47 Avenue	705	706	42.1	200	300
3	South of 47 Avenue	47 Avenue	706	707	60.7	200	300

dwn-MH = downstream manhole; ID = identifier; Ups-MH = upstream manhole.

Prior to making any improvements associated with this location, it is recommended that the City, through its ongoing flow-monitoring program, undertake some short-term flow monitoring in these specific locations, as the parameters in the model are based on downstream information that may not reflect actual local conditions.

Figure 6.3 44 Street Existing System Improvements

6.3 Existing System Capacity Assessment Summary

Overall, the existing sanitary system operates well for dry weather conditions. For the conduits included in the model, no capacity issues were identified for existing conditions under peak DWF.

Under wet weather flow conditions, there is evidence of I/I in the form of extraneous flow entering the sanitary system. In newer areas of the City (i.e. west of Highway 2), the amount of I/I is minimal. I/I is more prevalent in the older parts of the City (e.g. central business district).

Under wet weather conditions, the model shows sanitary system surcharges in 11 locations throughout the City. There is one area (44 Street / 46 Avenue) where the system surcharges to within 2 m of the ground surface, representing a risk of basement flooding. System upgrades will be required in this area to provide needed capacity. In reviewing the remaining 10 locations, the amount of surcharge is minimal and does not warrant system upgrades for existing conditions.

To reduce the amount of I/I in the local system, especially in the 11 areas with surcharged conditions, the City should consider an I/I reduction program. The flow monitoring and modelling results provide some insight into the potential sources of I/I. Where there have been quick responses to rainfall, there is likely a more direct connection, such as through roof leader and foundation drains or cross-connected catch basins. The components of an I/I reduction program start with identifying probable sources through a combination of flow monitoring, smoke and dye testing, and closed-circuit camera inspection. Once it understands the sources, the City can then determine corrective actions, costs, and expected benefits. The objective of the I/I reduction program is to remove the most direct sources of extraneous flows, which is the most cost-effective way to reduce peak flow in a sanitary system.

7 Alberta Capital Regional Wastewater Commission Capacity Assessment

The ACRWC accepts wastewater flow from its member municipalities, including the City. The ACRWC trunk system conveys wastewater flows to the City of Edmonton's Gold Bar Wastewater Treatment Plant.

The capacity of the trunk system is based on the ACRWC's LOS design criteria, which are similar to local design criteria but with some minor differences. This section compares the ACRWC LOS design criteria flow with the City's flow contributions, based on actual wastewater flows under a 25-year, 24-hour design storm (i.e. the criteria set by the ACRWC for planning). Furthermore, the ACRWC's Wet Weather Flow Management Strategy includes an I/I assessment completed by each member municipality.

This section compares the ACRWC's LOS with the City's flow contribution and assesses the I/I under the ACRWC. For this assessment, the flow contribution from the Edmonton International Airport (EIA)is not considered a City of Leduc flow contribution to the ACRWC. The average flow from the airport based on flow monitoring is approximately 19 L/s, with a maximum observed flow of 50 L/s to 60 L/s. Flow from the airport is regulated through an on-site pump station with variable frequency drives that can operate at up to 107 L/s under normal conditions. The station can discharge a maximum 137 L/s under emergency conditions only.

The on-site station discharge capacity of 107 L/s is based on the downstream sanitary sewer operating at approximately 80% full under design-flow conditions. For evaluating flow capacity in the City system, the discharge from the airport is fixed at 107 L/s. The 107 L/s flow rate is considered the maximum allowable discharge from the EIA to the City system; any additional discharge resulting from future EIA improvements will need to be routed directly to the ACRWC trunk system, rather than the City of Leduc municipal system with its limited downstream capacity of 107.0 L/s.

7.1 Alberta Capital Regional Wastewater Commission Level of Service Comparison

Flow entering the regional wastewater trunk system is not to exceed the ACRWC's LOS criteria. The ACRWC LOS is intended to provide sufficient capacity to convey peak flows, including an allowance for I/I, as follows:

- average and peak flows in residential areas;
  - average sewage generation rate: 320 L/capita/day;
  - peaking factor: $2.6 \times (P \div 1{,}000)^{-0.1}$, where P = contributing population; and,
  - I/I allowance: 0.28 L/s/ha.
- average and peak flows in commercial and industrial areas;
  - average sewage generation rate: 6,170 L/ha/day;
  - peaking factor: 3; and,
  - I/I allowance: Included in average sewage generation rate.

- average and peak flows in neighbourhood commercial/institutional areas; and,
    - average sewage generation rate: 6,170 L/ha/day;
    - peaking factor: 3; and,
    - I/I allowance: 0.28 L/s/ha.
- existing I/I is to be based on the 25-year 24-hour rainfall event.

The ACRWC's system-planning process compares the peak design flows generated using the ACRWC's LOS design criteria for the City of Leduc's calibrated model with the existing flows defined through monitoring plus the simulation of the 25-year 24-hour rainfall event.

Three ACRWC-derived models have been prepared:

- ACRWC design model based on the ACRWC design criteria;
- ACRWC planning model based on the City's monitored flow and a 25-year 24-hour design storm; and,
- ACRWC planning model with a 5-year four-hour design storm, which is part of the ACRWC's assessment requirements for its wet weather strategy.

The difference between the ACRWC design model and the ACRWC planning model are evaluated at 12 connection points in the ACRWC system and at the most downstream point of the ACRWC system as sanitary flow leaves the City. For all simulations, flow contribution from the Edmonton International Airport is restricted to a maximum of 107 L/s.

Figure 7.1 shows the location of the 12 connection points and where flow leaves the City's boundary, and **Table 7.1** summarizes peak flows for all scenarios at the ACRWC connection points.

Table 7.1 shows that the City contributes approximately 5% higher peak wet weather flow to the ACRWC system when flow leaves the City for the 25-year design storm event. Along the length of the ACRWC system within the City, there are inflows that are up to two to three times greater than the ACRWC design LOS.

From a community perspective, the peak flow leaving the City in the ACRWC system is 579 L/s and 913 L/s under the 5-year and 25-year design storm conditions, respectively. Compared with the ACRWC LOS under a 5-year storm event, the City is only 66% of the ACRWC's LOS. For the 25-year design storm, the City's peak flow exceeds the ACRWC's LOS criteria by approximately 5%, based on an ACRWC LOS peak flow of 871 L/s.

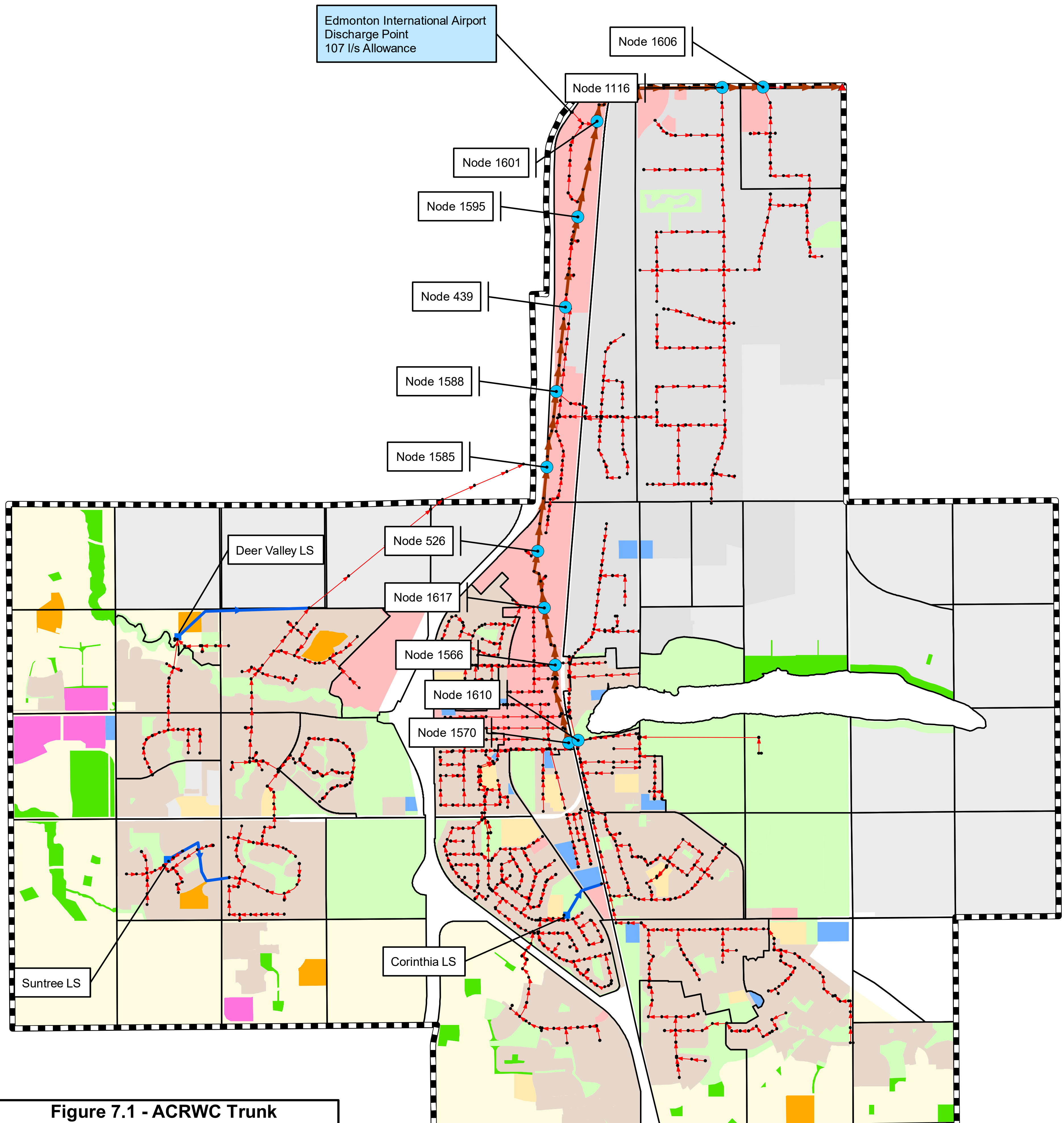

Figure 7.1 - ACRWC Trunk Connection Points

2018-0179	City of Leduc

Legend

- ACRWC Tunk Connection Point
- Model Junctions
- Lift Stations
- Model Outfall
- ACRWC Trunk Sewer
- Modelled Sanitary Conduits
- Forcemain
- City of Leduc Neighbourhoods
- City Boundary

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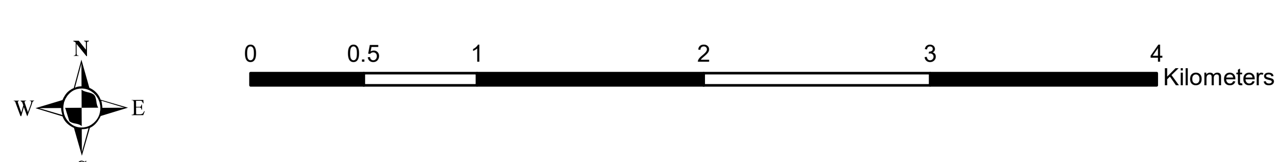

Table 7.1 Alberta Capital Regional Wastewater Commission Level of Service Assessment

ACRWC Junction ID	Location	ACRWC Design LOS Peak Flow (L/s)	Existing System with 5Y4H Storm Peak Flow (L/s)	Existing System with 25Y24H Storm Peak Flow (L/s)	Percentage Difference LOS Versus 5-Year (%)	Percentage Difference LOS Versus 25-Year (%)
Outlet	Airport Road / 9 Street	**871**	**579**	**913**	**66**	**105**
1606	Airport Road / 7 Street	13	5	8	38	62
1116	Airport Road / 39 Street	38	23	45	61	118
1601	Sparrow Drive / Sparrow Crescent	110	115	120	105	109
1595	Sparrow Drive / Sparrow Crescent	4	4	7	100	175
439	Sparrow Drive	8	12	18	150	225
1588	Sparrow Drive	47	14	26	30	55
1585	Sparrow Drive / north of 65 Avenue	237	146	254	62	107
526	50 Street / 62 Avenue	2	3	5	150	250
1617	47 Street / 59 Avenue	25	57	84	228	336
1566	47 Street/54 Avenue	22	39	68	177	309
1570	47 Street / 47 Avenue	99	113	160	114	162
1610[1]	46 Street / north of 47 Avenue	245	155	272	63	111

25Y24H = 25-year 24-hour rainfall event; 5Y4H = 5-year 4-hour rainfall event; ACRWC = Alberta Capital Regional Wastewater Commission; LOS = loss of service.

[1] At junction 1601, the Edmonton International Airport flow is fixed at 107 L/s (0.107 m^3/s) for all simulations.

7.2 Alberta Capital Regional Wastewater Commission Inflow/Infiltration Evaluation

A component of the ACRWC Wet Weather Flow Management Strategy is an I/I assessment. In March of 2017, the ACRWC outlined the general terms of reference for I/I assessment and a timeline. Through the development of the sanitary service plan, which started in 2013, the City has completed the major components required in the wet weather flow strategy. The primary components completed by the City include:

- Flow monitoring (2010, 2011, 2015, 2017 / 2018);
- Model development and calibration (developed in 2013 and updated in 2015 and 2018); and,
- System performance assessment (2013 and 2018 sanitary servicing plans).

Through continued work by the City, flow monitoring has been used to characterize dry and wet weather flows throughout the local collection system. Additional flow monitoring has been used to refine the flow contributions geographically and update the hydraulic PCSWMM of the sanitary system.

Following the ACRWC I/I assessment protocol, two wet weather hydraulic performance assessments of the system were completed using the 5-year four-hour and the 25-year 24-hour design storm events.

Figures 7.2 and **7.3** show hydraulic performance for the 5-year and 25-year events, respectively. The hydraulic performance is showed thematically using the same metrics outlined in Section 6.1 for wet weather scenarios. **Figure 7.4** shows the maximum HGL profile of the ACRWC for the two scenarios, plus the ACRWC LOS design condition.

Figures 7.2, **7.3**, and **7.4** provide the following conclusions:

- For existing conditions and the 5-year design storm, the ACRWC operates well with no capacity issues evident under peak flow conditions;
- For existing conditions and the 25-year design storm, the ACRWC operates well. There is one section that shows minor surcharge under peak flow conditions; and,
- The HGL profile shows the maximum water surface elevation along the ACRWC. This shows the trunk sewer is operating well under both design conditions and actual (existing) flow conditions for 5- and 25-year design storms.

In the ACRWC I/I assessment, the City is to identify wet weather flows that exceed 0.28 L/s/ha. The 0.28 L/s/ha metric does not identify the time basis for determining an I/I rate, which varies with rainfall. **Figure 7.5** shows the I/I event analysis for the 5-year and 25-year design storms at the most downstream location of the ACRWC system before flow leaves the City. For the 5-year assessment, the peak I/I rate is 0.25 L/s/ha based on the peak 5-minute flow duration, while over the four-hour event duration, the I/I rate is 0.05 L/s/ha. For the 25-year design event, the peak and event I/I rates are 0.43 L/s/ha and 0.09 L/s/ha, respectively.

Over the duration of the 5-year and 25-year events, the I/I rate of 0.05 L/s/ha and 0.09 L/s/ha, respectively are both less than 0.28 L/s/ha. The peak I/I rate is greater than 0.28 L/s/ha over a five-minute peak period for the 25-year de nsign storm (0.43 L/s) and below the 5-minute peak period for the 5-year design storm (0.25 L/s).

In reviewing the characteristics of the I/I response in the flow-monitoring data, there is evidence of inflow (quick response) into the sanitary system, generally in the older part of the City. The sources of I/I could range from roof leaders to foundation drains and possible cross-connections of catch basins. In 2014, the City undertook smoke testing in the Willow Park and Corinthia Park areas. In total, there were only six incidents where smoke indicated the possibility of I/I related to cracked manholes or cracked laterals. There was no evidence of roof leaders being connected to the sanitary system. The smoke testing identified a limited number of I/I locations related to cracked laterals, which usually do not show up in smoke testing unless there are more significant defects. This indicates lateral defects may be a more widespread source of I/I when considering the flow data; however, the condition of laterals can be verified only through additional investigations, such as inspection with CCTV.

An I/I reduction program is an effective way to identify possible sources and to determine the most cost-effective way to reduce I/I in the system.

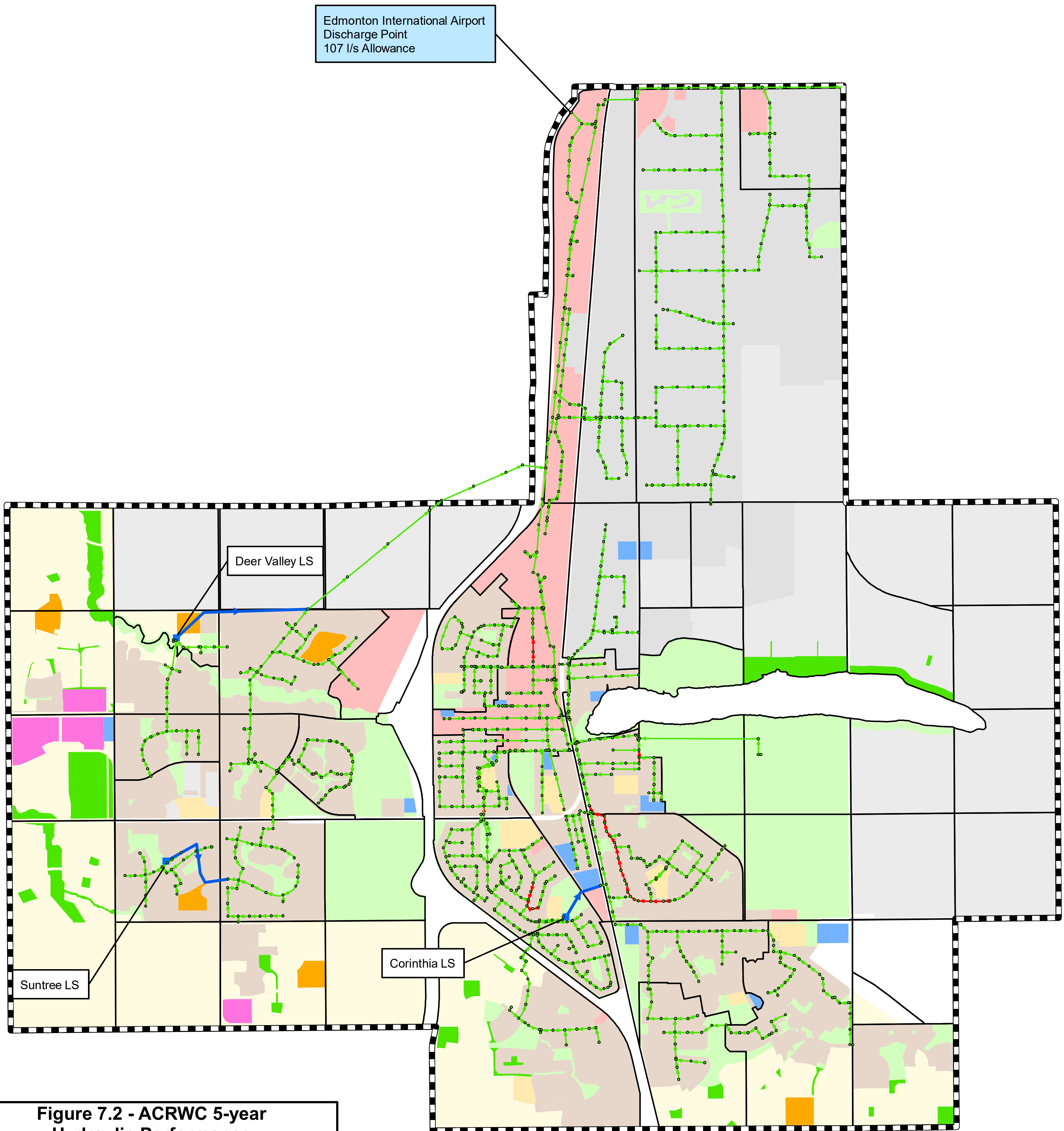

Figure 7.2 - ACRWC 5-year Hydraulic Performance

2018-0179	City of Leduc

Legend

Node Freeboard

- < 2 m
- > 2 m
- Lift Stations
- Forcemain

Depth Utilization

- < 100% Depth Utilization
- > 100% Depth Utiliztation

City of Leduc Neighbourhoods

City Boundary

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RS 2019-10-11 P:\oak\2018\2018-0179\600_GIS\20_Maps\Report figures 20181207\Figure 7.2 ACRWC 5yr Hydraulic Performance 20191011.mxd

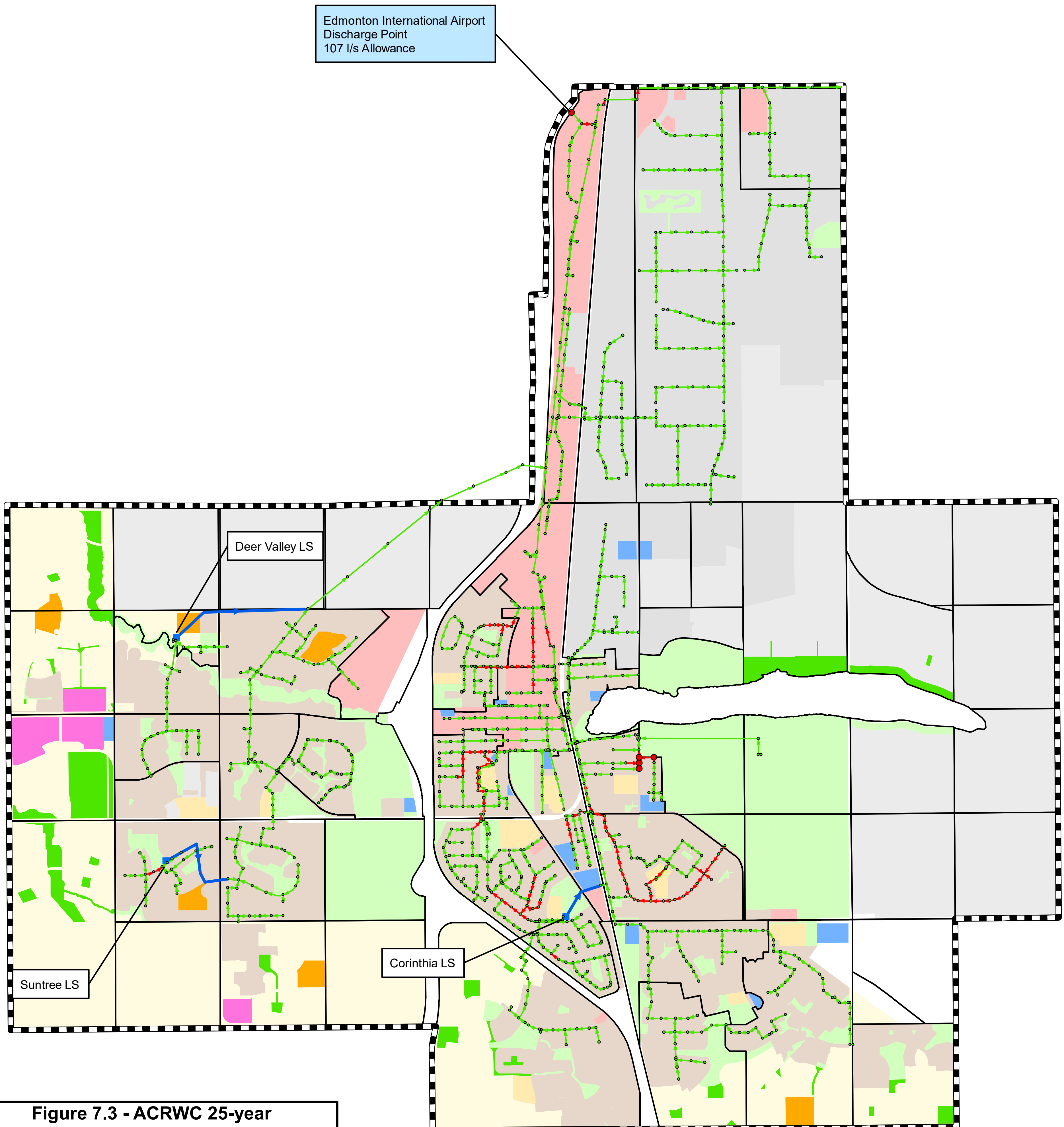

Figure 7.3 - ACRWC 25-year Hydraulic Performance

2018-0179	City of Leduc

Legend

Node Freeboard

- < 2 m
- > 2 m
- Lift Stations
- Forcemain

Depth Utilization

- < 100% Depth Utilization
- > 100% Depth Utiliztation

- City of Leduc Neighbourhoods
- City Boundary

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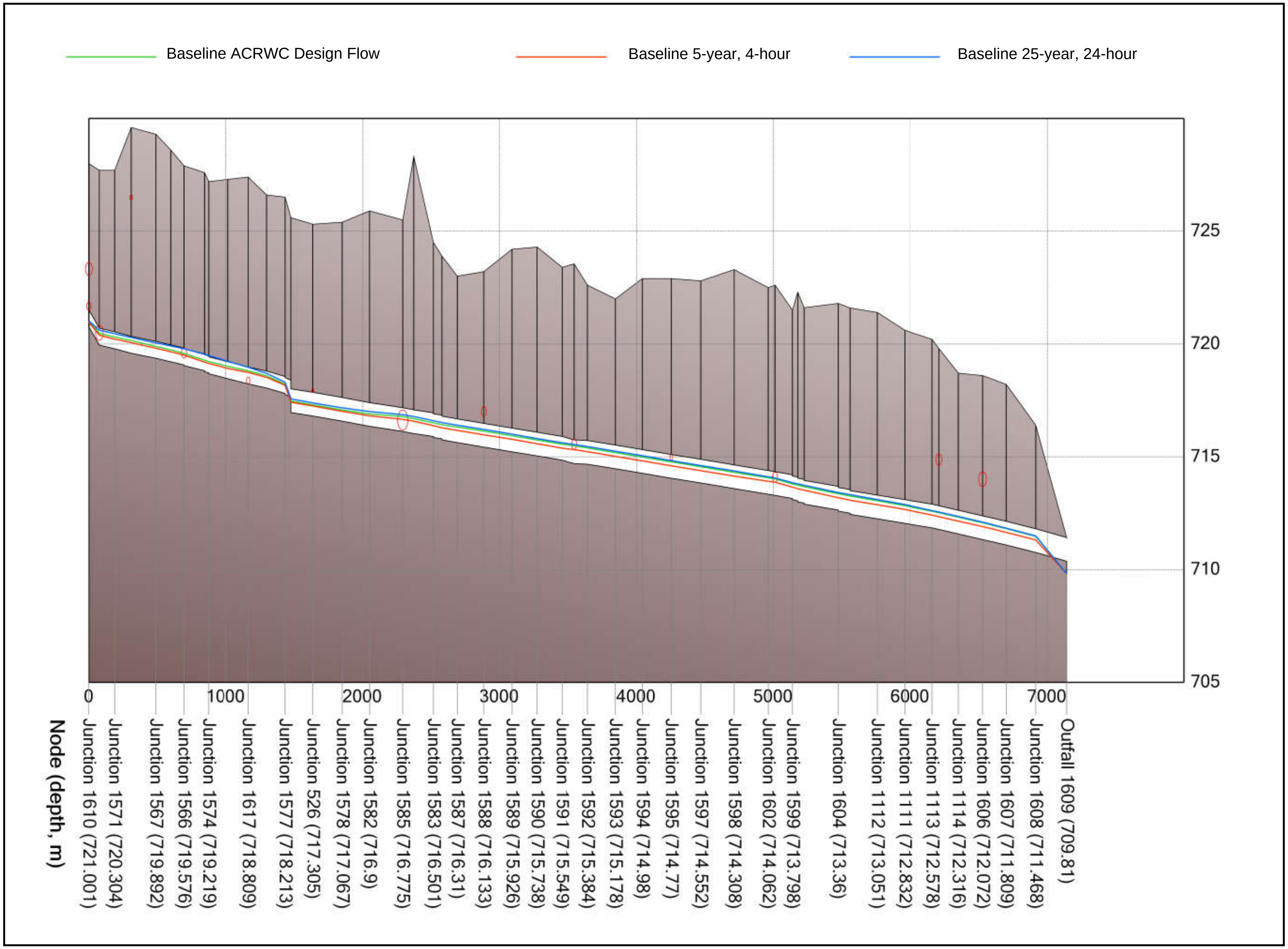
N W E S

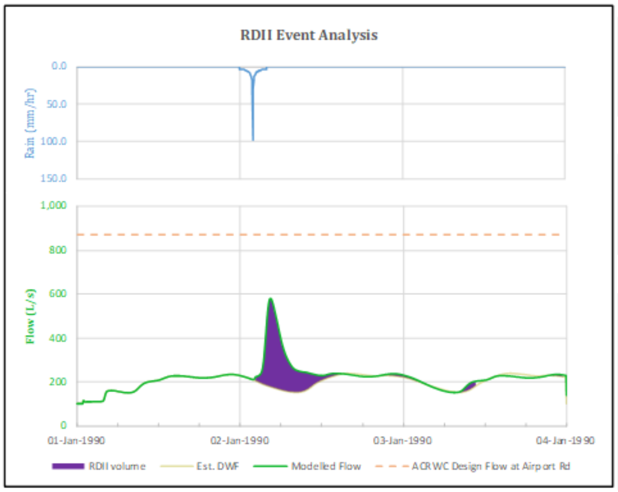
0 0.5 1 2 3 4 Kilometers

Figure 7.4 ACRWC Trunk Maximum HGL Profiles (Design, 5-year, and 25-year)



City of Leduc (AirportRd) RDII Event Analysis

Chicago 5Y 4H Design Storm



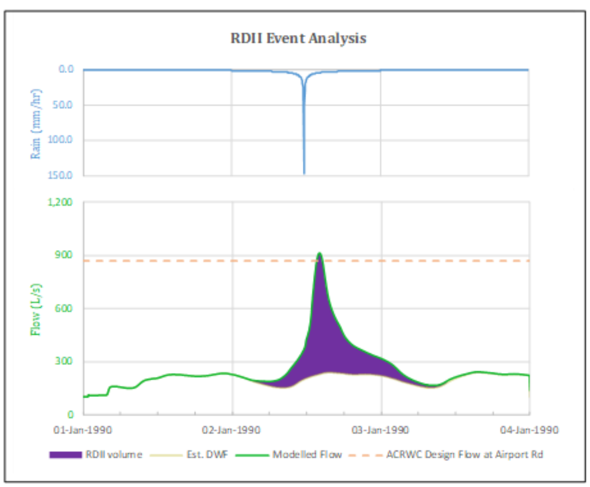
Storm Statistics	
Rain Gauge Name	5Y4Hr Design Storm
Total Rainfall	37.06 mm
Peak Intensity	97.86 mm/hr
Duration	4 hours

Monitored Area Statistics	
Site ID	ACRWC - Airport Rd
Drainage Area	1583 ha
Average DWF	115 L/s
Groundwater Infiltration rate	0.0293 L/s/ha

RDII Event Statistics	
Modelled Peak Flow	580 L/s
DWF at Time of Peak	178 L/s
Groundwater Infiltration	46 L/s
Peak RDII Flow	402 L/s
Peak 5-min RDII Flow Rate	0.25 L/s/ha
Average RDII Flow Rate over Event	0.05 L/s/ha
RDII Volume	5,638 m^3
Volumetric Coefficient	1.0%
Total Vol./ DWF Vol.	1.15

City of Leduc (AirportRd) RDII Event Analysis

Chicago 25Y 24H Design Storm



Storm Statistics	
Rain Gauge Name	25Y24Hr Design Storm
Total Rainfall	100.00 mm
Peak Intensity	146.71 mm/hr
Duration	24.00 hours

Monitored Area Statistics	
Site ID	ACRWC - Airport Rd
Drainage Area	1583 ha
Average DWF	115 L/s
Groundwater Infiltration rate	0.029 L/s/ha

RDII Event Statistics	
Modelled Peak Flow	914 L/s
DWF at Time of Peak	229 L/s
Groundwater Infiltration	46 L/s
Peak RDII Flow	685 L/s
Peak 5-min RDII Flow Rate	0.43 L/s/ha
Average RDII Flow Rate over Event	0.09 L/s/ha
RDII Volume	15,736 m^3
Volumetric Coefficient	1.0%
Total Vol./ DWF Vol.	1.65

5Y 4H = 5-year four-hour; 25Y 24H = 25-year 24-hour; ACRWD = Alberta Capital Regional Wastewater Commission; DWF = dry weather flow; ID= identifier; RDII = rainfall-derived infiltration and inflow.

Figure 7.5 ACRWC Inflow / Infiltration Analysis (5-Year and 25-Year)

8 Growth Servicing Needs

8.1 Overview

The following section outlines the future sanitary servicing needs for the City of Leduc premised on the residential and employment growth identified in **Section 4**. The servicing strategies presented are based largely on the following background information:

- The 2013 Sanitary Servicing Study and intermediate capacity investigations;
- Updated residential and employment growth projections and expanded boundaries;
- Approved and updated Area Servicing Plans (ASPs); and,
- More detailed servicing plans in active development areas.

The servicing strategies presented accommodate growth associated with approved plans and growth beyond the current urban boundary. Servicing strategies and infrastructure sizing are all based on City of Leduc peak design flows values. Each servicing strategy identifies infrastructure requirements and sequencing. Future strategies also identify necessary capacity improvements in the ACRWC system associated with City growth based on peak design flows.

In preparing future servicing strategies, the capacity of existing systems needs to be considered where new development flows discharge into existing systems. To develop and assess servicing strategies for short, medium, and long term conditions as well as a potential growth area condition a two-step process was undertaken, as follows:

1. **Local Growth Servicing Needs:** An assessment of the existing sanitary system to accommodate growth and to determine the size and phasing of new infrastructure. For these simulations, the discharge to the ACRWC trunk system is assumed a "free outlet." Under these conditions, capacity constraints in local systems related to growth can be clearly identified and addressed. The assessment is based on Peak Design Flows showing required infrastructure to meet servicing needs; and,
2. **ACRWC Servicing Needs:** An assessment of the ACRWC trunk capacity to support growth. The previous sanitary servicing study identified the ACRWC will be under sized in the future. The ACRWC capacity needs and phasing are identified after incorporating local servicing strategies developed in the first step. The ACRWC infrastructure needs are based on Peak Design Flows.

The final component of assessing future servicing needs is to test the future servicing strategies and infrastructure under operational conditions. The operational condition assessment is based on actual dry weather flow in the existing system, plus a 25-year design storm event representing wet weather conditions, plus the peak design flow associated with the potential growth area scenario.

8.2 Growth Servicing Needs

Peak Design Flow conditions for short, medium, long and potential growth area conditions were modelled. Each growth scenario shows the sanitary servicing strategy. The future sanitary infrastructure identified starts with the 2013 sanitary servicing study and has now taken into consideration active developments, updated and new ASP submissions and other future growth potential areas. Future servicing needs on the west side have moved to the point of construction with the Woodbend LS to be commissioned in 2019. On the east side, future sanitary infrastructure has also evolved with active development plans around Telford Lake. Under the potential growth scenario there are flows from a yet defined expanded servicing boundary being considered. In the Southfork neighbourhood (south), active servicing plans have evolved to include a local lift station in the north east quarter section of Southfork.

The timing of new infrastructure associated with growth is subject to change given actual development conditions and realization of new sanitary flow. Although servicing may be identified in one timeframe, it does not preclude servicing being deferred or accelerated based on actual needs. Monitoring growth and system capacity needs is required to determine when best to initiate improvements. The recommendations provide a roadmap to future servicing for the City of Leduc and stakeholders. The roadmap presents a sequencing plan for services that can be adjusted if growth happens differently.

All Figures and Tables for **Section 8.2** are located at the end of the **Section 8**.

8.2.1 Short Term Servicing Strategy

Figure 8.1 shows the short term servicing strategy and system capacity performance.

The following provides a summary of infrastructure needs:

- Under short term development conditions, there are no capacity issues in the local system of ACRWC system under peak design flow conditions;
- The Leduc West ASP, East Telford Lake ASP, and Southfork ASP updates are incorporated in the short term servicing strategy;
- The local collection system in the Leduc Business Park at the eastern boundary is to be extended south with a 600 mm sanitary sewer. In the future, this sanitary sewer will receive a portion of the sanitary flow from the Telford Lake ASP development area;
- The existing Deer Valley LS will require expansion from a firm capacity of 85 L/s to 198 L/s in the short term. The timing of expansion depends on development associated with the 65 Avenue Area Structure Plan in the Grayson (NE33) and Tawa Landing (NE34) quarter sections. Based on proposed development and timing, the peak design flow to the Deer Valley station is estimated to be 115 L/s in the short term. The station capacity will need to increase to accommodate growth by changing the existing pumps (2) for larger pumps with the necessary controls and piping to provide a firm capacity of 198 L/s;

- A new lift station is required in the Woodbend neighbourhood. The new Woodbend LS has been constructed and is expected to be in service in 2019. This lift station is required for short term growth and has a firm capacity of 60 L/s. The projected peak design flow to the station is approximately 47 L/s. The station will discharge into the Bridgeport Trunk Sewer just north of Birchmont Crescent through a 300 mm forcemain;
- Land use on the east side of Leduc is industrial / commercial (ICI). The east side timeline for development and corresponding servicing is subject to the uptake of existing ICI serviced lands such that they are near fully developed before proceeding with additional ICI lands on the east side. Subject to the need for additional ICI lands, it is expected a new Eastside LS (Stage 1) is required at the end of the short term period or beginning of medium term. In this timeframe, the peak design flow is approximately 10 L/s. The lift station will discharge into a 600 mm sanitary pipe extended through the Leduc Business Park. The 600 mm is limited to approximately 185 L/s. The new Eastside LS is to be constructed for the potential growth area with a peak design flow of 185 L/s to optimize the downstream capacity. The initial lift station design (Stage 1) should be sufficient to manage design flows on the order of 75 to 80 L/s. Growth in the future will add to the station to the maximum design flow of 185 L/s;
- The new west side sanitary system will discharge into the Woodbend LS and service Woodbend, Crystal Creek and Banks of Crystal Creek neighbourhoods (900 mm);
- The new east side sanitary system will discharge into the new Eastside LS to service the East Telford Lake initially. Local servicing will be through a 600 mm sanitary collector sewer; and,
- The Southfork ASP was updated (April 2018) to include a local area lift station in the north west quarter section. The proposed outlet for the lift station is to the local sanitary sewer just south of Highway 2A that continues north to Corinthia Drive. The peak design flow to the proposed lift station under full build out condition would be approximately 72 L/s.

The Southfork ASP has all flows from the neighbourhood entering the Corinthia Drive sanitary sewer by gravity with excess flows being diverted to the Corinthia LS. The Corinthia LS was constructed in 2000 as a wet weather pumping station where excess flows during wet weather would be diverted to the station. In the 2013 City Sanitary Servicing Plan, capacity concerns were identified in the Corinthia Drive sanitary sewer based on available information and capacity analysis. The collection of additional flow data in 2015 in the Corinthia Drive system identified less rainfall derived I/I in the system than the original assessment. With updated information collected as part of the 2018 Sanitary Servicing Update, the Corinthia Drive sanitary sewer and Corinthia LS were re-assessed with respect to capacity, operation and the storage project previously identified at the Corinthia LS. Additional storage was identified as a requirement at the Corinthia LS so the station could operate as a sanitary lift station. Given that Corinthia LS was originally designed as a wet weather pump station, it currently has a very small wet well (9 m^3) and a relatively high pumping capacity (123 L/s). With the Southfork short term development flows and the current diversion weir setting, the station is likely to cycle approximately 120 times a day with an average inflow of approximately 10 to 15 L/s (10-minutes to fill 1-2-minutes to empty). Beyond the short term, flows will continue to increase to the station with increased cycling. This operation is not sustainable. Good practice for wastewater lift station design stipulates that wastewater should not sit for more than 30-minutes and the pump on cycle should be longer than 5-minutes. To achieve good operation, the wet well volume would need to be approximately 60 m^3. Given the Corinthia LS configuration, it is not possible to simply add on a 60 m^3 wet well, the station would need to be rebuilt as a proper sanitary pump station. The estimated cost of a new Corinthia LS is $4.5 million based on a 60 m^3 wet well volume and a firm capacity of 123 L/s.

Taking into consideration the need for a local lift station in Southfork originally discharging into the Corinthia Drive system including the Corinthia LS, there is an opportunity for an alternative servicing strategy. By removing the new development flow to the proposed Southfork LS from the Corinthia Drive system, the need to replace the Corinthia LS as a sanitary pump station is no longer required, it can remain as a wet weather pump station. This requires the Southfork LS to discharge to an alternative location with capacity.

The discharge point for the Southfork LS would be into a 525 mm sanitary sewer at 50th Street and Rollyview Road on the east side of the railway line. **Figure 8.1** shows the general alignment. The 300 mm forcemain would be approximately 1,700 m with two crossings (Highway 2A, and railway) with an estimated cost of approximately $1.81 million.

The cost of the Southfork LS forcemain is less than the cost of replacing the Corinthia LS and avoids the energy cost of re-pumping sanitary flow at the Corinthia LS. The timeline for Southfork LS before the new forcemain connection to Rollyview Road is required is subject to the rate of development as limited capacity in Corinthia system remains before the operation of the Corinthia LS becomes problematic. Approximately, 750 units could be accommodated in existing system as an interim servicing approach before the Southfork LS flows need to be diverted to the Rollyview Road. The Southfork LS configuration for interim and long term servicing to Rollyview Road will be developed through the Southfork servicing report.

This alternative replaces the storage requirement project at Corinthia LS with a forcemain project to convey Southfork LS flow to Rollyview Road.

8.2.2 Medium Term Servicing Strategy

Figure 8.2a shows the medium term servicing strategy and system capacity performance. In reviewing **Figure 8.2a** the ACRWC system is surcharging and results in backwater into the Bridgeport system and other local City systems. **Figure 8.2b** shows the system performance with capacity improvements to the ACRWC system.

The following provides a summary of infrastructure needs building on the short term needs:

- Under medium term development conditions, there are capacity issues in the northern portion of the ACRWC shown in **Figure 8.2a** (1050mm – north of 65Ave). The ACRWC is shown to back up into the local systems (i.e. Bridgeport, 54Ave, and 47Ave) under peak design flow conditions. The ACRWC needs to be upgraded or paralleled to provide additional capacity north of the Bridgeport connection. An upgrade pipe of 1500 mm or a twin 1050 mm pipe is required to provide capacity for medium term that will also meet the potential growth condition needs (see Section 8.2.5). Subsequent sanitary servicing strategies are based on capacity improvements of the northern section of the ACRWC trunk system from the Bridgeport Trunk connection to the end of the ACRWC system at the City boundary (approximately 4,850 m);

- For the southern portion of the ACRWC system, the 1050 mm section south of Bridgeport trunk to 47St operates below 86% full. When the ACRWC changes to 750 mm, the system is greater than 86% full and there is minor surcharging reaching back to the starting point of the ACRWC;
- The southern part of the ACRWC is greater than 86% full under design flow conditions. It is effectively 100% full with minor surcharge under design flow conditions. The depth of the ACRWC (greater than 7.0m deep) is such that there is a low risk of capacity issues or flooding under peak design flow conditions. In reviewing the maximum HGL, the ACRWC does backwater the local City system on 54Ave from the ACRWC west to 50St. The local system is also affected on 47Ave to the west to 48St. The local influence is not critical under peak design flow conditions. **Figure 8.3** shows the HGL of the local sanitary sewers on 54Ave and 47Ave that are influenced by ACRWC conditions;
- Under medium term development conditions, there are some minor capacity issues in the local system in Linsford Park area and on 47Ave under peak design flow conditions. Although pipe full conditions are shown, the condition is not considered critical;
- The peak design flow into the Deer Valley LS is 147 L/s, this is within the station's firm capacity of 198 L/s;
- The Woodbend LS will likely not need to be upgraded to support medium term growth. The medium term peak design inflow to the station is approximately 88 L/s. The peak design flow can be managed with a station firm capacity of 60 L/s. The Woodbend LS will continue to discharge into the Bridgeport trunk sewer. This will result in the Bridgeport trunk being approximately 95% full under peak design flow conditions;
- The Eastside LS peak inflow will be on order of 67 L/s. The peak inflow is limited to 185 L/s because of downstream constraints. Inflows should be monitored to the station to identify when actual flows approach the station firm capacity;
- The eastside network will extend further south into the East Telford Lake area as defined in the East Telford Lake ASP (525 mm); and,
- The westside network will extend further south into the Banks of Crystal Creek (675 mm).

8.2.3 Long Term Servicing Strategy

Figure 8.4 shows the long term servicing strategy and system capacity performance.

The following provides a summary of infrastructure needs building on the short and medium term needs:

- Under long term development conditions, there continues to be minor capacity issues in the local system in Linsford Park area and on 47Ave under peak design flow conditions. These conditions existed under medium term conditions and are no worse for the long or the potential growth condition; and,
- Under long term development conditions, there are local capacity issues (greater than 86% full) north of Rollyview Road, east and parallel of the railway tracks to Black Gold Drive. The local system experiences minor surcharging under peak design flow conditions. Additional capacity in the form of a parallel pipe (375mm) or an upgraded pipe from 525mm to 600mm would provide suitable capacity where the pipe becomes less than 86% full under peak design flow conditions. The constructability of a parallel pipe would be problematic because of other sewer services in the right-of-way.

  Alternatively, a new pipe can be installed that intercepts the Corinthia LS flow on the west side of the railway tracks then run north behind the Fire Station and north through a public right-of-way to Black Gold Drive. At Black Gold Drive, the existing 200 mm pipe under the rail line would need to be increased to 450 mm (or twinned). The new pipe is 450 mm and approximately 580 m in length.

  The new pipe provides a new discharge point for Corinthia LS thereby removing flow into the 525 mm sanitary sewer on the east side of the railway tracks. As well, this flow diversion has other potential benefits with respect to wet weather flow management. Diverting flow away from the Southpark Drive sanitary sewer reduces the level of surcharge, this is particularly beneficial in wet weather conditions. As well, it is possible to oversize the new sewer to provide some inline storage for wet weather flow management. The available storage in a 450 mm pipe is approximately 90 m^3 or 250 m^3 if the pipe has a diameter of 750mm.
- The peak design flow into the Deer Valley LS is 160 L/s, this is within the station’s firm capacity of 198 L/s. No further improvement is required at this lift station;
- Under long term conditions there are minor capacity issues in the Bridgeport Trunk Sewer. The pipe is approximately 95% full, which exceeds the target of 86% full for design flows. At this time, no improvements are recommended; however, the trunk should be monitored to track flow over time. Typically, with a well-constructed sanitary system, design flows are greater than actual flows;
- For the southern portion of the ACRWC system (750 mm – 50Ave north to 65Ave) the system is greater than 86% full and there is surcharging that now affects the local systems. The local systems influenced by the ACRWC are as previously identified and include 54Ave from the ACRWC west to 50St and 47Ave west to 48St. The extent of the influence is marginally greater than medium term (see Section 8.2.5). The local influence is not critical under peak design flow conditions; therefore, no local improvements are proposed;

- The Woodbend LS will need to be expanded (Stage 2) for long term growth in the current urban boundary. The station peak inflow is 237 L/s for long term conditions. The station firm capacity will need to expand to accommodate long term growth. This will require additional pumps be added to the station. At this time, it is suggested that two new pumps with a capacity of 170 L/s be added (P3 and P4) connected to the second wet well. In addition, one of the original pumps would be replaced with similar 170 L/s pump to provide a station firm capacity of 240 L/s. At the same time the Stage 2 forcemain is required. The station design has a provision for a second forcemain (525 mm) that will discharge directly into the ACRWC at 65Ave and 50St;
- Sanitary flow from the Blackstone neighbourhood can now be diverted into the West Trunk system and be disconnected from the Windrose system;
- In the long term, peak design flows to the Eastside LS will be approaching 185 L/s. This will require the Eastside LS be upgraded (Stage 2) through pump replacement;
- In the East Telford Lake ASP a flow diversion is proposed to divert flows in excess of 185 L/s to a future Stage 1 Southeast LS once the capacity of the Eastside LS is reached. It is expected the Stage 1 Southeast LS will not be required until the end of the long term time frame;
- The eastside sanitary services continue to expand south; and,
- The westside network will extend further to the west into Brightwell and Blackstone neighbourhoods.

8.2.4 Ultimate Potential Growth Serving Strategy

Figure 8.5 shows the potential growth servicing strategy and system capacity performance. The potential growth strategy considers sanitary servicing beyond the current City boundaries.

The following provides a summary of infrastructure needs building on the long term needs:

- Under this scenario there is very little growth related flows contributing to existing systems from Southfork, Tribute, Meadowview Park and Robinson. Consequently, the performance is similar to the long term scenario;
- Under potential growth development conditions, there are no new local capacity issues (greater than 86% full);
- The northern portion of the ACRWC upgraded previously (medium term) has no capacity issues under potential growth conditions;
- The Woodbend LS will need a final upgrade (Stage 3) to accommodate the potential growth conditions with a peak design flow of 512 L/s. To achieve the final upgrade, the one remaining original pump would be changed to a 170 L/s pump;
- The Eastside LS firm capacity of 185 L/s is suitable for the potential growth condition. The peak design flow is 153 L/s;

- Beyond the long term condition, the Stage 1 Southeast LS will be required. This initial stage will convey sanitary flow from a portion of the Telford Lake District directed south through the flow diversion to the new Stage 1 Southeast LS that will discharge to the ACRWC system through Leduc County north of Airport Road. The initial peak design flow to the Stage 1 Southeast LS is 150 L/s. This is considered the first phase on the Southeast LS, which will service the sanitary needs within the existing City boundary;
- The capacity at the Southeast LS station will need to be increased. Given the uncertainty of this growth scenario a Stage 2 Southeast LS would be required with total peak design flow of 1,215 L/s to service the potential growth area. The capacity expansion will be best accomplished with a new lift station constructed in phases to adapt to the potential development area. The Stage 2 Southeast LS would discharge to the ACRWC through Leduc County north of Airport Road; and,
- Both the west and east side sanitary systems expand south to service new growth areas currently beyond the City urban boundary.

8.2.5 ACRWC Capacity Assessment Summary

To assess the capacity requirements of the ACRWC, simulations of the existing system and the growth scenarios (short, medium, long, and potential) were completed for Peak Design Flow conditions.

For these simulations, improvements identified in the existing local system associated with growth are included to ensure growth flows are conveyed to the ACRWC. The objective of this simulation is to identify the following:

- In what timeframe will the ACRWC trunk capacity need to be improved; and,
- What size will the upgraded ACRWC trunk sewer need to be?

Based on the ACRWC focused simulations, the following sequence of improvements are required:

- Under the medium term growth scenario, the ACRWC trunk system will require capacity improvements in the northern section from 65Ave north to the northeast City boundary (**Figure 8.2a**). The current pipe is 1050 mm and a 1500 mm will provide the required capacity for ultimate conditions. Alternatively, a twin 1050 mm pipe will provide the required capacity. The existing system length is approximately 4,850 m. This improvement is critical to future servicing, without this improvement, the ACRWC will severely backwater the Bridgeport trunk sewer as well south down to 54Ave and 47Ave;
- For both the long and potential growth conditions, the ACRWC from 50Ave north to 65Ave (1,470 m of 750 mm) is shown to exceed the 86% full criteria for design flow conditions. At this time, the need to improve the 750 mm section of the ACRWC is not fully warranted. The ACRWC has no direct residential connections and is a deep system (greater than 7.0 m), exceeding the 86% full criteria under peak design flow conditions is not considered problematic; and,

- The flow in the ACRWC system should be monitored in the southern section. The Capital Region has placed monitors in in the northern section, north of 65Ave on Sparrow Road and Airport Road. The objective of monitoring is to complement the existing Capital Region program and track actual flows in the southern sections to identify flows that approach a threshold where the ACRWC is approximately 86% full.

The servicing study identifies the need to improve the capacity of the ACRWC system through the heart of the City. The servicing study clearly shows the need to improve the capacity of the northern section of the ACRWC north of where the Bridgeport Trunk sewer connection at 65Ave. The need to improve southern portion of the ACRWC (750 mm) from 47Ave north to 50St is not critical but does need to be considered based on future flow conditions.

At this time the route and construction methods have not been determined. Replacing the existing pipe would be difficult to accomplish because of the location and needing to maintain the sewer during expansion. Twinning the pipe following the same alignment may be possible; however, conflicts and spacing between infrastructures may be compromised. Finally, there is the option of constructing a parallel sewer that follows a different alignment.

8.3 Operational Servicing Needs

The previous simulations (short, medium, long, potential and ACRWC) are all based on Peak Design Flows to identify infrastructure needs associated with growth. The final capacity assessment considers the operation of a future system based on existing system performance using actual dry weather flow and wet weather response (25-year design storm) associated with the existing system, plus the peak design flow for new growth areas. The objective of the operational assessment is to determine if additional growth related improvements are required that are not evident using a static design flow approach to capacity assessment.

This simulation includes local system improvements identified in the baseline assessment (**Table 6.1**) and the local improvements associated with growth including the northern section of the ACWRC trunk system. The objective of this simulation is to identify any additional servicing needs related to the operation of the sanitary system under the potential growth condition and a dynamic wet weather condition (25-year). Under these conditions, any surcharging is evaluated and is deemed critical if the maximum water surface elevation comes within 2.0m of the ground surface.

Figure 8.6 shows the thematic map under maximum surcharge and freeboard conditions. In reviewing **Figure 8.6** the following is revealed:

- Existing and growth related improvements in the existing system and the ACWRC are still valid. These include;
  - 44St capacity improvement (146 m of 300 mm);
  - ACRWC north improvement (4,850 m of twin 1050 mm, or new 1500 mm);
  - Improvements to the Corinthia LS and redirection of the Corinthia LS to a new 450 mm sewer adjacent to the railway on the west side;

  - Southfork LS with a peak design flow on 72 L/s discharging through a 300 mm forcemain 1,700 m in length to Rollyview Road and 50St on the east side of the railway tracks; and,
  - Capacity improvements to the Deer Valley LS, Woodbend LS, East LS and Southeast LS in various stages.

- Under operational peak flow conditions, the following observations are made;
  - None of the sanitary systems surcharge to within 2.0m of the ground surface;
  - The Bridgeport Trunk sewer is operating at full capacity with no capacity issues;
  - The southern section of the ACRWC (750 mm) becomes surcharged. Under dry weather conditions there is no surcharge and the ACRWC is approximately 65% full. Under peak flow conditions the ACRWC is surcharged. The surcharge is greater than 2.0m below the ground elevation;
  - 54Ave and 47Ave local systems are backwatered from the ACRWC under peak wet weather flow conditions. The maximum surcharge level is greater than 2.0m below the ground surface elevation. Under peak dry weather flow conditions, the local system is on the order of 30% full;
  - There are local surcharge conditions observed in the Corinthia Drive sanitary sewer between Athapaskan Drive and Camelot Avenue, as well as on Athapaskan Drive. The surcharge is not within 2.0 m of the surface. Under dry weather conditions the local sewers are less than 50% full;
  - There are local surcharge conditions in the Linsford Park Area on 47Ave; 52St from 45Ave north to 47Ave; 52St and 46Ave and 51St. The surcharge is not within 2.0 m of the surface. Under dry weather conditions the local sewers are less than 50% full;
  - There are local surcharge conditions observed in the Willow Park area on 57Ave west of 50St; 50St from 57Ave to 59Ave; and, 49St south of 59Ave. The surcharge in is not within 2.0 m of the surface. Under dry weather conditions the local sewers are less than 50% full;
  - The sanitary pipe on Southpark Drive is surcharged. The surcharge is not within 2.0 m of the surface. Under dry weather conditions the local sewers are generally less than 65% full; and,
  - The sanitary pipe from Rollyview Road to Black Gold Drive parallel to the railway line experiences some surcharge, but not within 2.0 m of the surface. Under dry weather conditions the sanitary sewer is less than 86% full.

8.4 Summary of System Improvements

Table 8.1 summarizes the existing system deficiencies and **Table 8.2** the growth related projects. All projects presented are represented in **Figure 8.7**. The costs presented are capital cost for various projects identified. The costs include the project capital cost, engineering fee (10%) and an engineering contingency (20%). The costs are planning level costs.

Table 8.1 Existing System Deficiencies Project Summary

Project	Name / Location	Description	Estimated Cost [1]
D1	44St from 47Ave to 46 Ave	• Upgrade of existing system • 146 m of 300 mm sanitary sewer	$205,000

[1] Costs include Engineering Fee 10% and Engineering Contingency 20%

Table 8.2 Growth Project Summary

Project	Name / Location	Description	Estimated Cost [1]
Short			
S1	Deer Valley Lift Station Expansion	• Expansion to 198 L/s firm capacity • Replace existing two pumps with larger capacity pumps	$1,040,000
S2	Woodbend Lift Station, Stage 1	• New lift station to service west side • Stage 1, firm capacity of 60 L/s • Station to be commissioned in 2019	$ NA
S3	Eastside Lift Station, Stage 1	• Timeline subject to development and uptake of existing ICI lands • Stage 1, peak design flow 10 L/s. • Ensure Stage 1 is sized for approximately 70 to 80 L/s to accommodate growth beyond the short term. • 300 mm forcemain 1,500 m discharging into a 600 mm in Leduc Business Park	$6,255,000
S4	Southfork Lift Station	• New Lift station in Southfork neighbourhood for peak design flow of 72 L/s. • 300 mm forcemain 1,700 m discharging to Rollyview Road and 50St. • Two crossings (Highway 2A, railway)	$1,810,000
Medium			
M1	ACRWC (north)	• Upgrade existing 1050 mm with 1500 mm pipe • Alternatively, install parallel 1050 mm pipe • Approximately 4,850 m in length • North of 65 Avenue to City northeast boundary	$ NA
Long			
L1	Corinthia Lift Station Outlet Sewer	• New 580 m of 450 mm diameter pipe to receive Corinthia LS flow. • Through public right-of-way from behind the fire station north to Black Gold Drive. • Requires upgrade of existing pipe 200 mm pipe under the railway line to 450 mm • Removes wet weather flow from South Park system	$1,005,000
L2	Eastside Lift Station Stage 2	• Replace existing pumps with larger pumps for a firm capacity of 185 L/s	$800,000

Table 8.2 Growth Project Summary

Project	Name / Location	Description	Estimated Cost [1]
L3	Woodbend Lift Station Stage 2	• Peak design flow of 237 L/s will require two additional pumps (170 l/s) be added to the station along with upgrading one of the original pumps (170 L/s). This would require upgrading controls • A second 525 mm forcemain 4,800 m long will be required that will discharge into the ACRWC directly at 65 Avenue and 50 Street.	$8,040,000
L4	Blackstone Diversion	• The Blackstone neighbourhood temporary connection through Windrose will be eliminated. • Blackstone community will be connected to the westside sanitary system	$ NA
Potential			
P1	Southeast Lift Station Stage 1	• Stage 1 of the Southeast Lift Station where future flows from East Telford Lake and Telford Lake District will be diverted to the new lift station • The station will discharge through Leduc County directly into ACRWC.	$7,275,000
P2	Woodbend Lift Station Stage 3	• Peak design flow of 512 L/s will require the one remaining original pump to be upgraded to a larger pump (170 L/s).	$455,000
P3	Southeast Lift Station (Stage 2)	• Stage 2 of the Southeast Lift Station. • Peak design flow of 1,215 L/s with a 6.5 km forcemain (600 mm) • Replace Stage 1 lift station with larger lift station for potential growth area.	$33,130,000

[1] Costs include Engineering Fee 10% and Engineering Contingency 20%

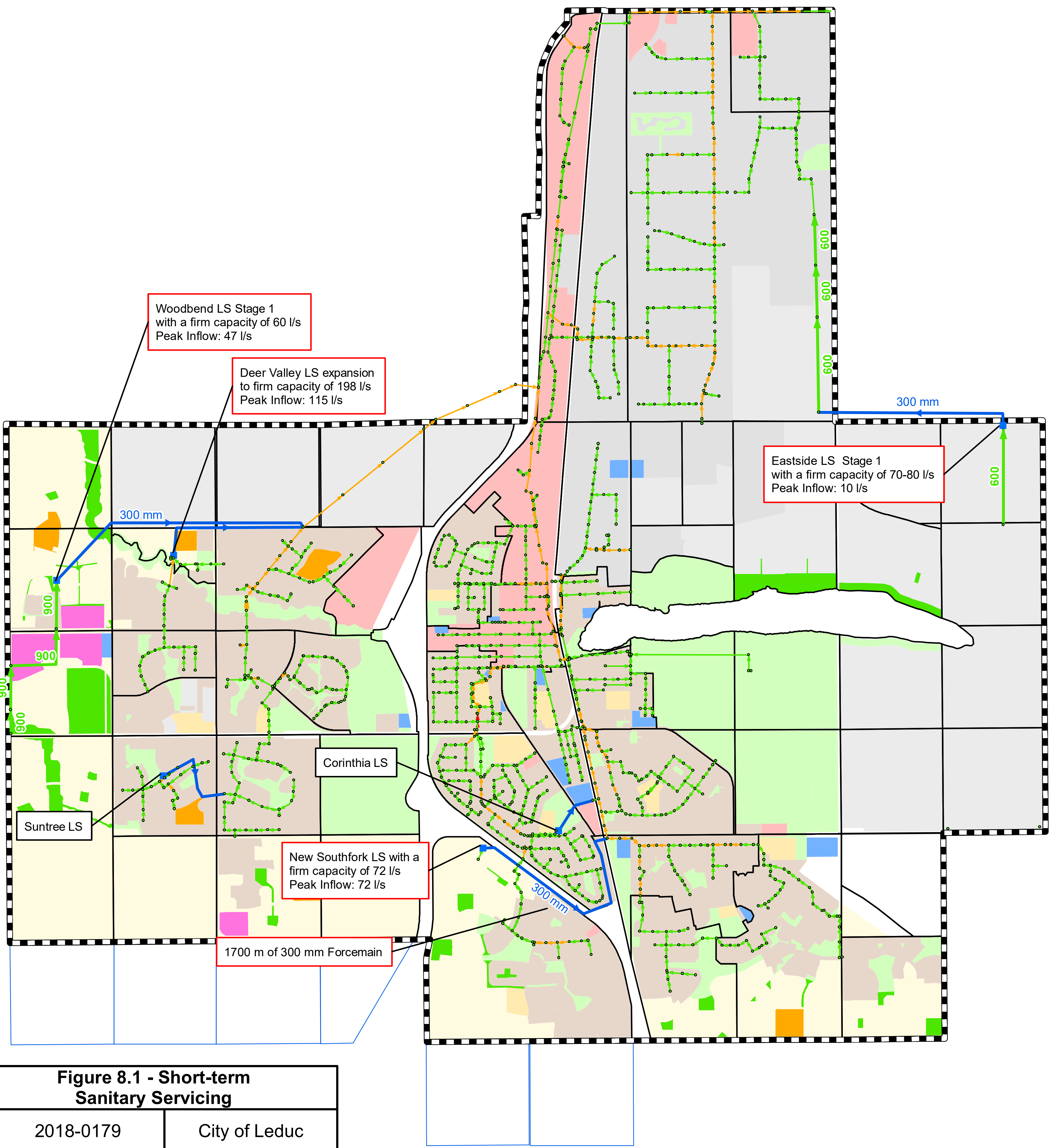


Figure 8.1 - Short-term Sanitary Servicing

2018-0179	City of Leduc

Design Flow Condition

Legend

Junctions

Lift Stations

Forcemain

Short-term Servicing Conduits

Existing Neighbourhoods

Future Service Area

City Boundary

Depth Utilization

< 50 % Full

50-86% Full

> 86% Full

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RS 2019-10-11 P:\oak\2018\2018-0179\600_GIS\20_Maps\Report figures 20181207\Figure 8.1 Short term sanitary servicing 20191011.mxd

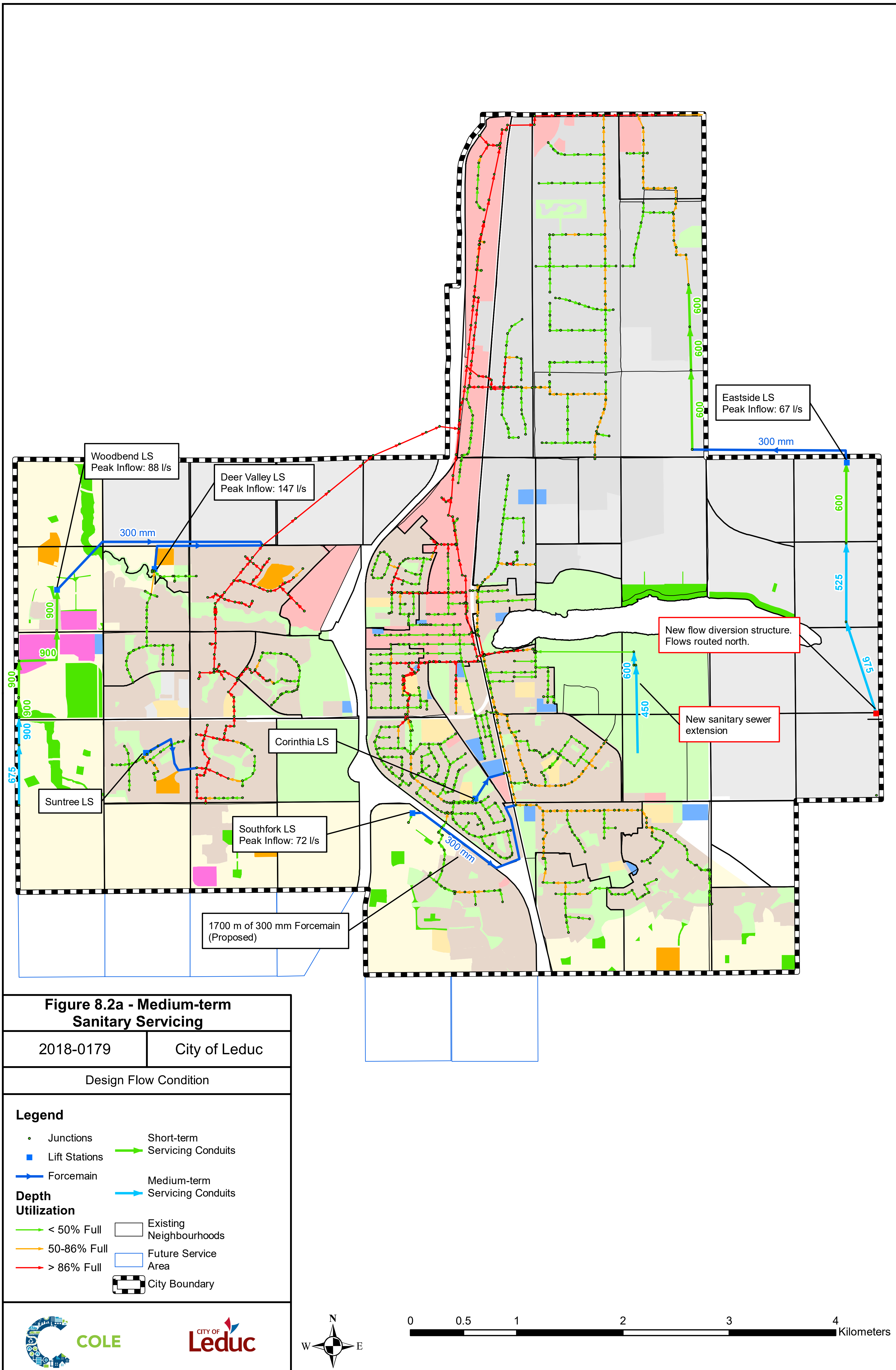

Figure 8.2a - Medium-term Sanitary Servicing

2018-0179	City of Leduc

Design Flow Condition

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CITY OF Leduc

RS 2019-10-11 P:\oak\2018\2018-0179\600_GIS\20_Maps\Report figures 20181207\Figure 8.2a Medium term sanitary servicing 20191011.mxd

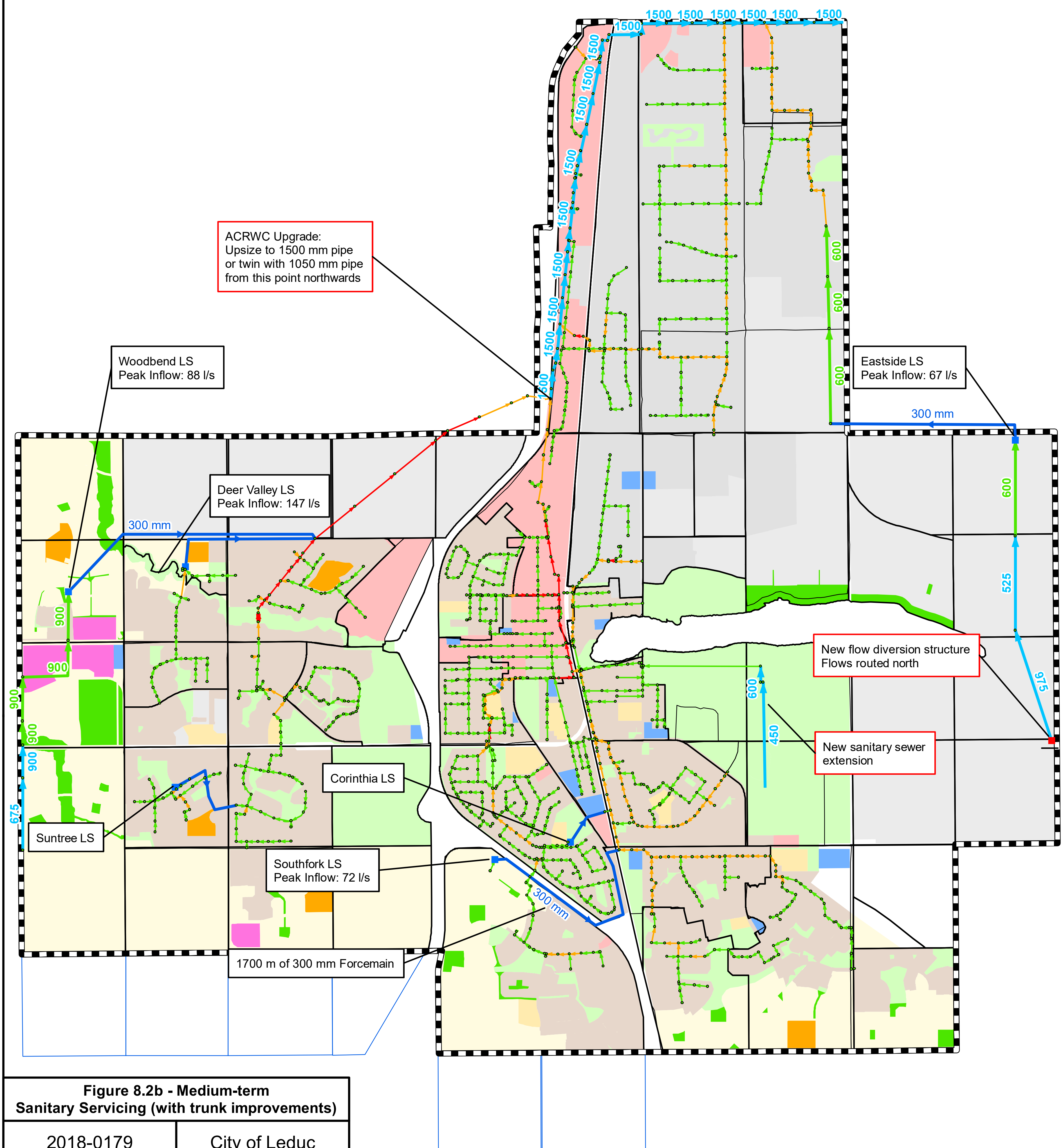

Figure 8.2b - Medium-term
Sanitary Servicing (with trunk improvements)

2018-0179	City of Leduc

Design Flow Condition

Legend

- Junctions
- Lift Stations
- Forcemain
- Short-term Servicing Conduits
- Medium-term Servicing Conduits
- Existing Neighbourhoods
- Future Service Area
- City Boundary

Depth Utilization

- < 50% Full
- 50-86% Full
- > 86% Full

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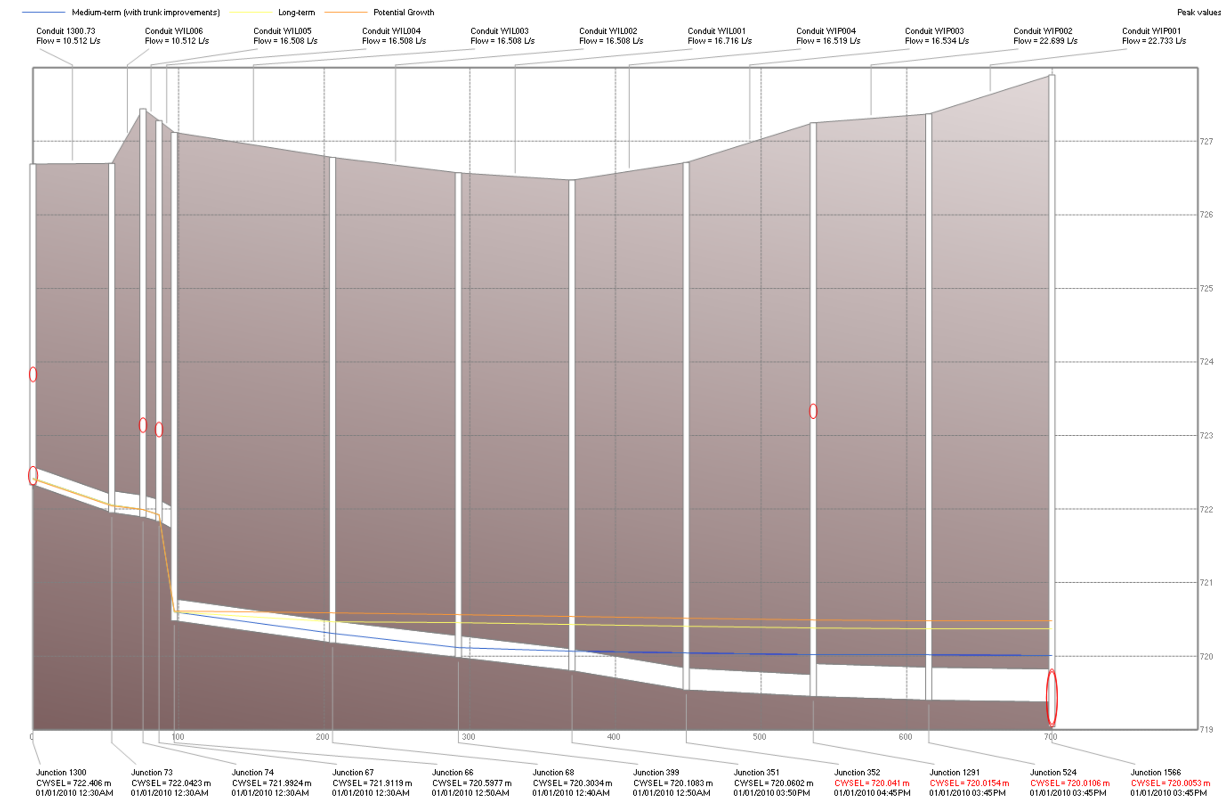
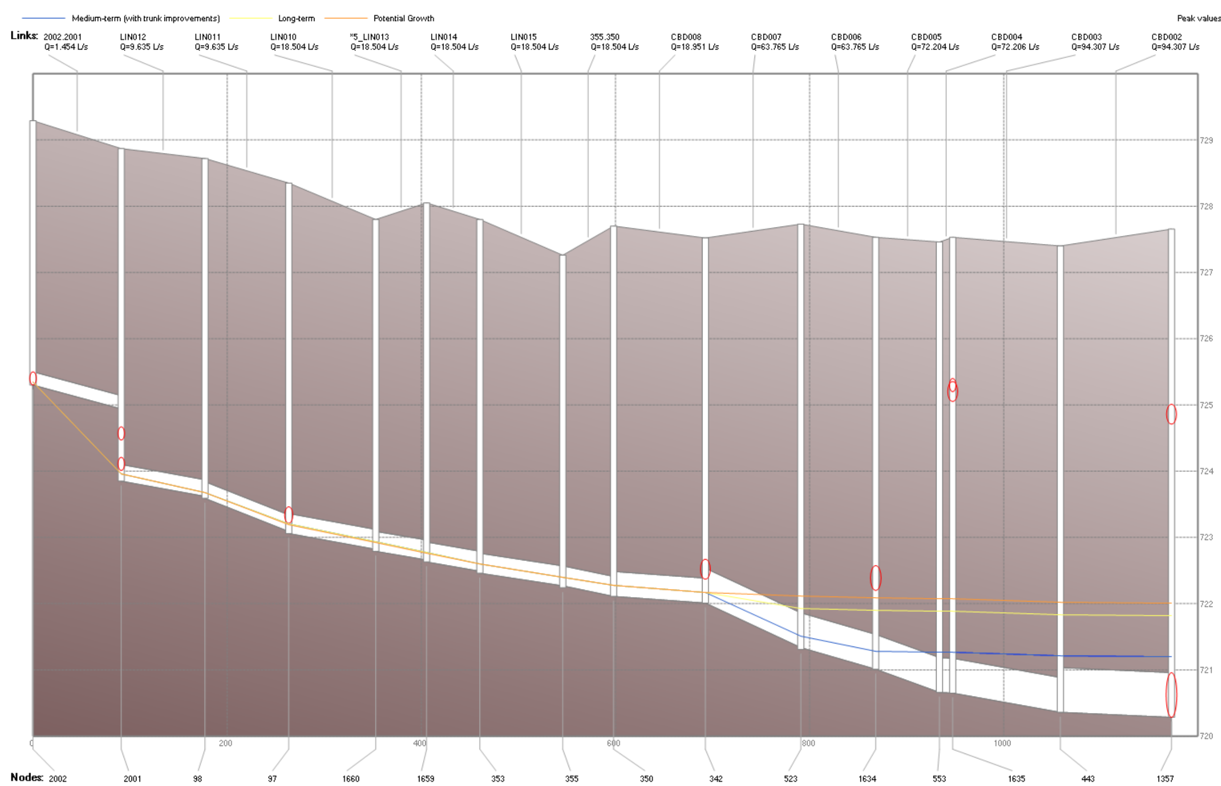
Figure 8.3 ACRWC – 54Ave and 47Ave Maximum Hydraulic Grade Line

54Ave



47Ave



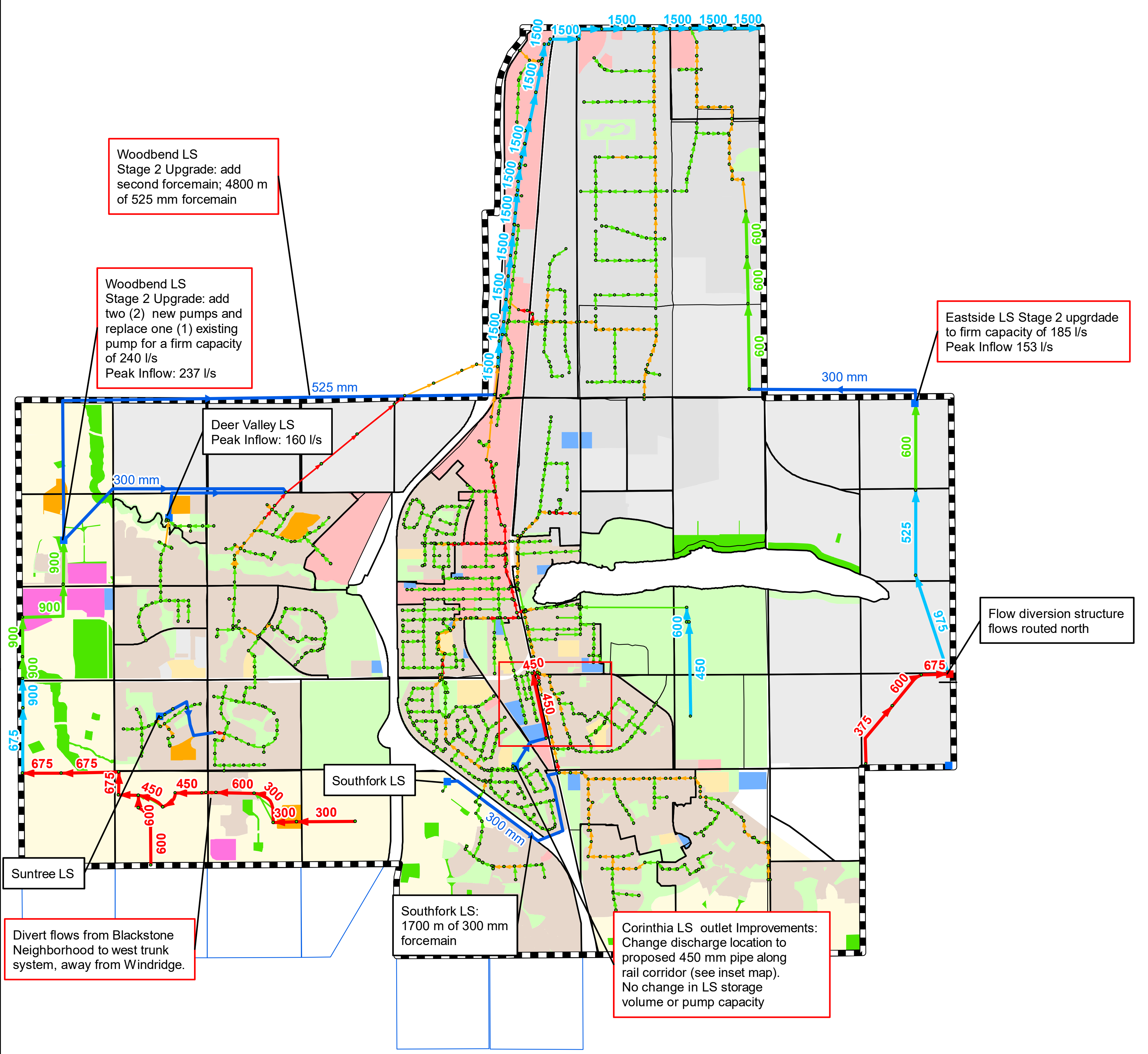


Figure 8.4 - Long-term Sanitary Servicing

2018-0179	City of Leduc

Design Flow Condition

Legend

- Junctions
- Lift Stations
- Forcemain
- Short-term Servicing Conduits
- Medium-term Servicing Conduits
- Long-term Servicing Conduits
- Existing Neighbourhoods
- Future Service Area
- City Boundary

Depth Utilization

- < 50 % Full
- 50-86% Full
- > 86% Full

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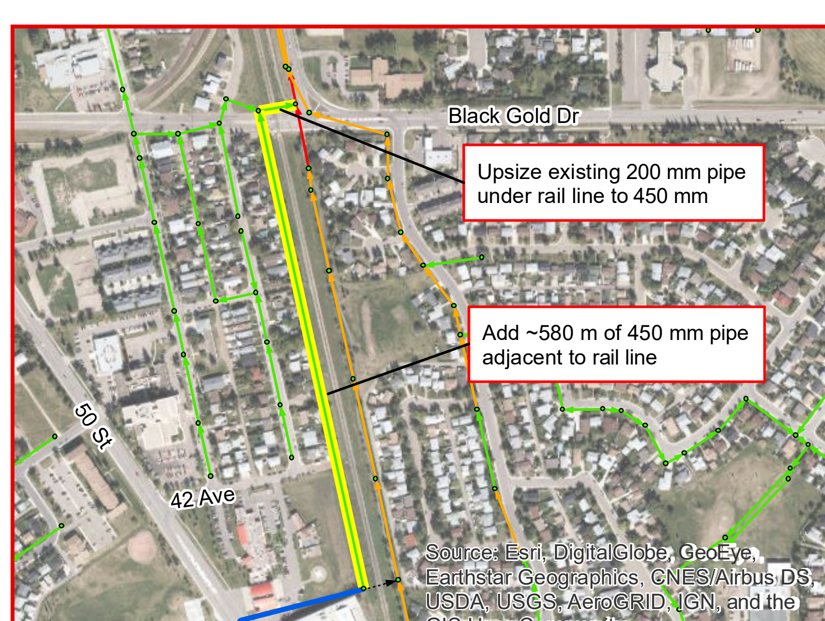

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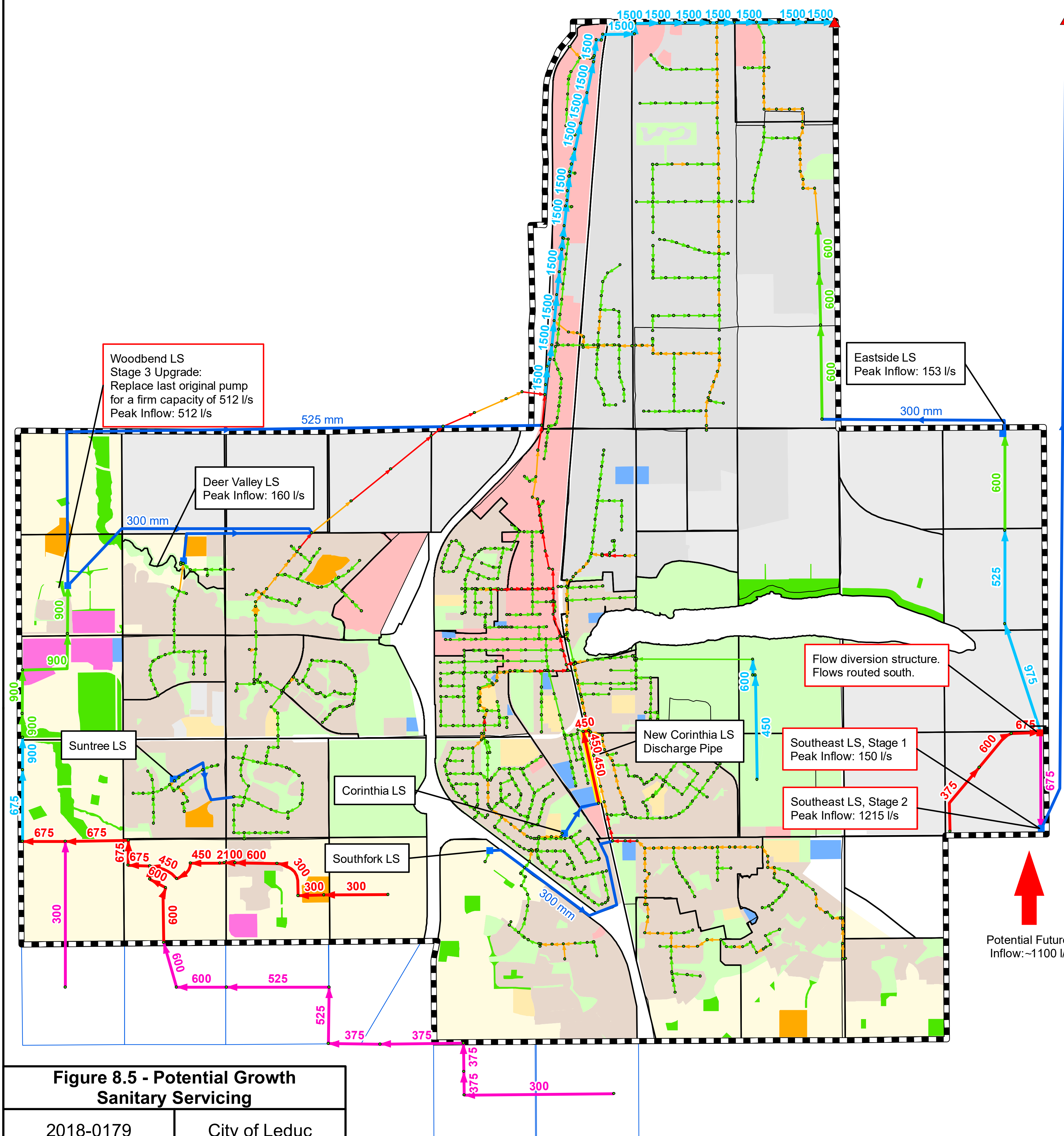

Figure 8.5 - Potential Growth Sanitary Servicing

2018-0179	City of Leduc

Design Flow Condition

Legend

- Junctions
- Lift Stations
- Model Outfalls
- Forcemain

Depth Utilization

- < 50 % Full
- 50-86% Full
- > 86% Full
- Short-term Servicing Conduits
- Medium-term Servicing Conduits
- Long-term Servicing Conduits
- Potential Growth Servicing Conduits
- Existing Neighbourhoods
- Future Service Area
- City Boundary

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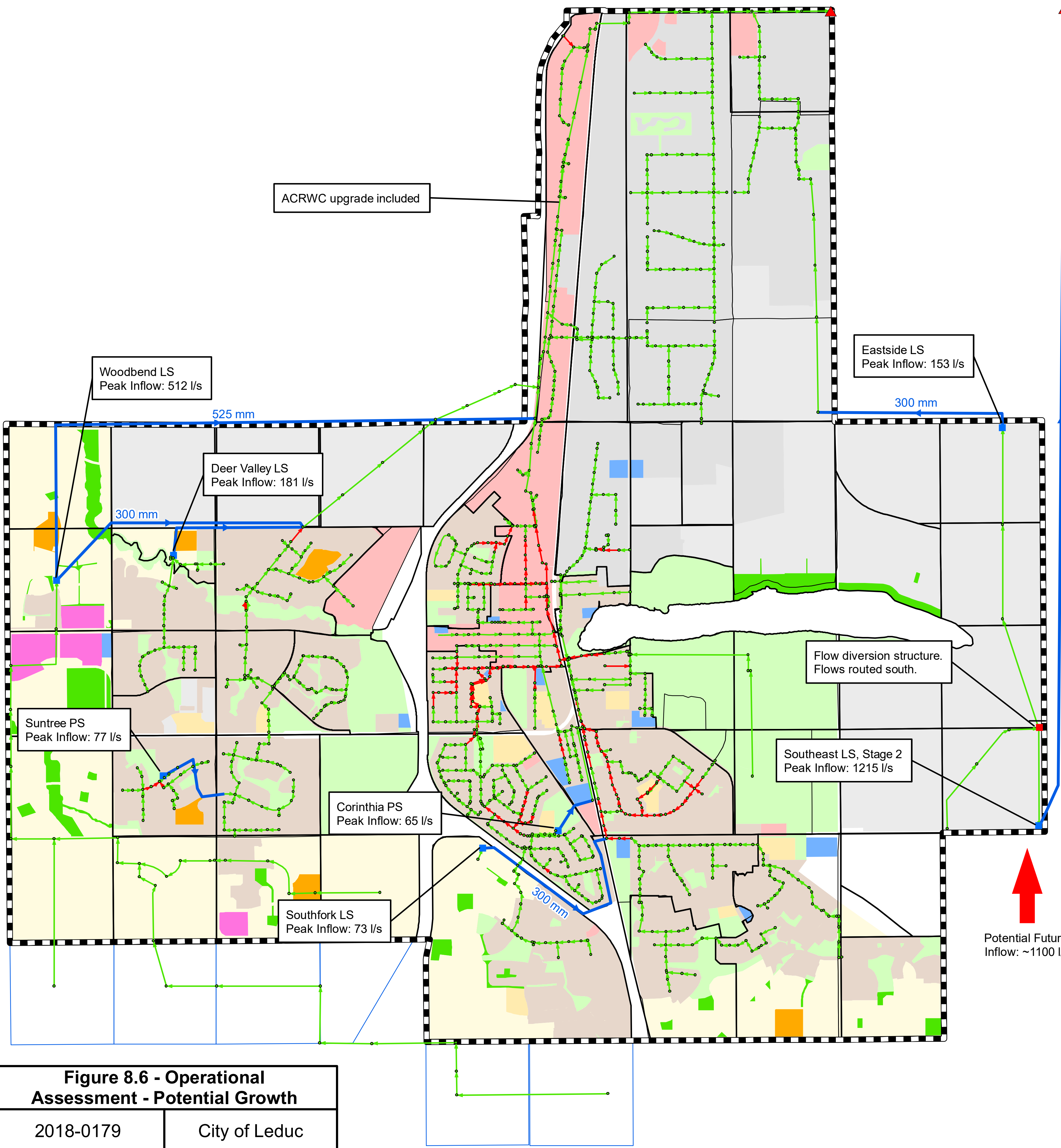

Figure 8.6 - Operational Assessment - Potential Growth

2018-0179	City of Leduc

Operational Flow Condition

Legend

Node Freeboard
- < 2 m
- > 2 m
- Lift Stations
- Model Outfalls
- Forcemain

Depth Utilization
- < 100% Depth Utilization
- > 100% Depth Utiliztation

- Existing Neighbourhoods
- Future Service Area
- City Boundary

This scenario considers monitored sanitary flows for exisint areas, design flows for future service areas and the 25-year, 24-hour design storm.

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RS 2019-10-11 P:\oak\2018\2018-0179\600_GIS\20_Maps\Report figures 20181207\Figure 8.6 Operational Assesment Ult 20191011.mxd

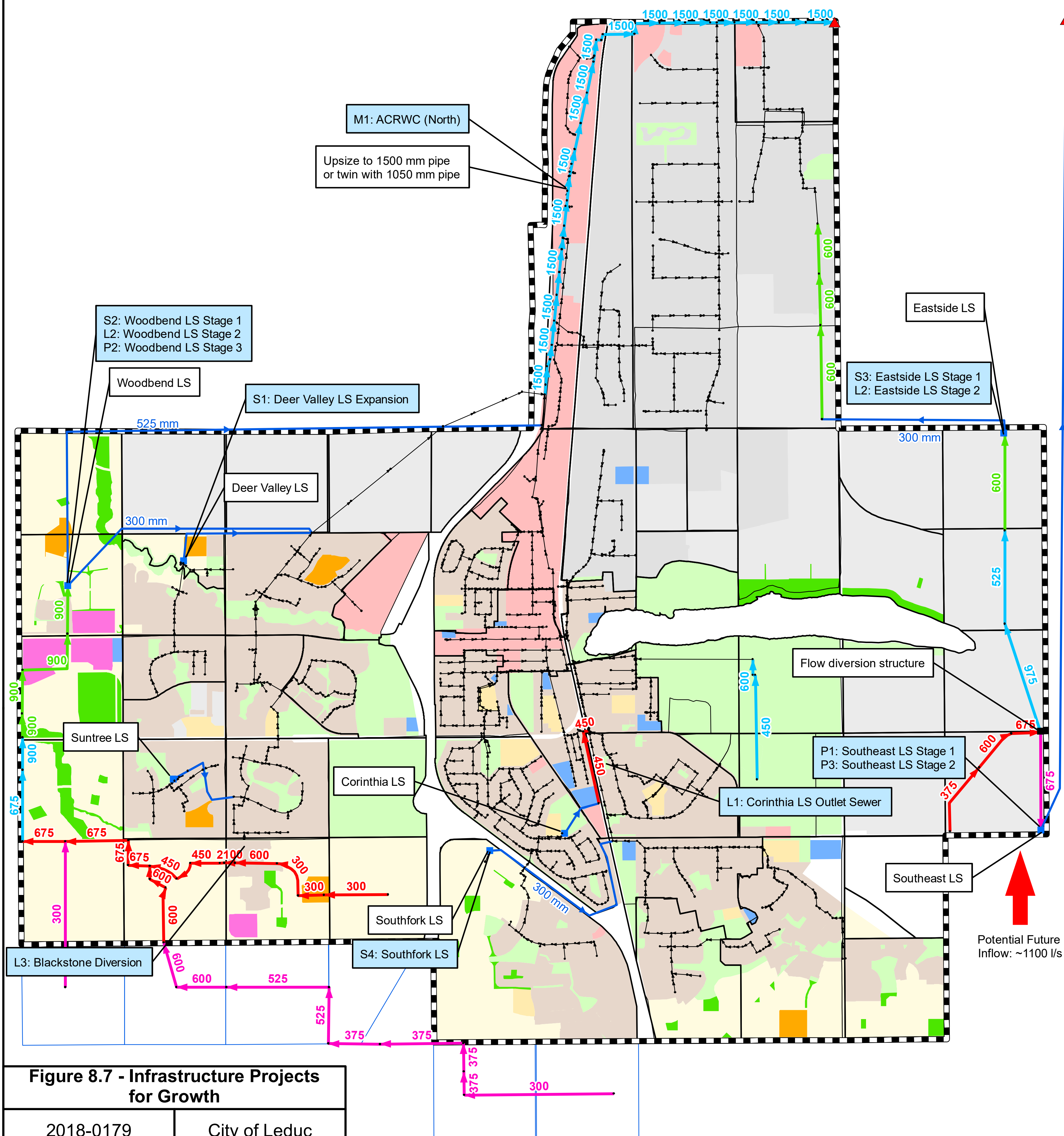

Figure 8.7 - Infrastructure Projects for Growth

2018-0179	City of Leduc

Legend

- Junctions
- Lift Stations
- Model Outfalls
- Forcemain
- Existing Conduits (as modelled)
- Short-term Servicing Conduits
- Medium-term Servicing Conduits
- Long-term Servicing Conduits
- Potential Growth Servicing Conduits
- Existing Neighbourhoods
- Future Service Areas
- City Boundary

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RS 2019-10-11 P:\oak\2018\2018-0179\600_GIS\20_Maps\Report figures 20181207\Figure 8.7 Infrastructure Projects 20191011.mxd

9 Conclusions and Recommendations

The goal of the 2018 Sanitary Servicing Study is to prepare an updated sanitary servicing study for the City of Leduc to address current wastewater issues and future servicing needs. To accomplish this goal the City's PCSWMM hydraulic model was updated using flow monitoring data collected in 2017 / 2018, revised population estimates were used for future scenarios and the current Area Service Plans were considered.

9.1 Flow Monitoring Program and Analysis

Flow data collected in 2017 / 2018 was found suitable for updating the model augmenting the data collected in 2011 / 2012 and 2015. From the flow monitoring program and data analysis the following conclusions were made:

- Most of the data collected was usable for model calibration;
- The data collected augmented historical data and improved model calibration and understanding of wet weather responses in local areas;
- Future monitoring should focus on growth areas to track flow increases into existing systems; and,
- Flow or level monitoring in the southern portion of the ACRWC system would be beneficial to track flow increases with development. The servicing study shows potential capacity concerns in the future.

Figure 9.1 shows historical flow monitoring locations and identifies future monitoring location to track development flow.

9.2 Sanitary System Model

The 2013 PCSWMM hydraulic model was updated as follows:

- 400 junctions and 416 conduits were added to the original 2013 model extending the modelled collection network to include systems where flow data was collected in 2015 and 2017 / 2018;
- The existing system population were updated to represent 2016 / 2017 population. Growth estimates were based on the best available information. Four growth scenarios are considered: Short term; Medium term; Long term; and a Potential condition; and,
- The model calibration was updated using the 2015 and 2018 flow data for dry and wet weather conditions. The updated model was further validated using flow data collected by the Capital Region in the ACRWC.

9.3 Capacity Assessment

Capacity in the City of Leduc wastewater collection system was evaluated on the following basis:

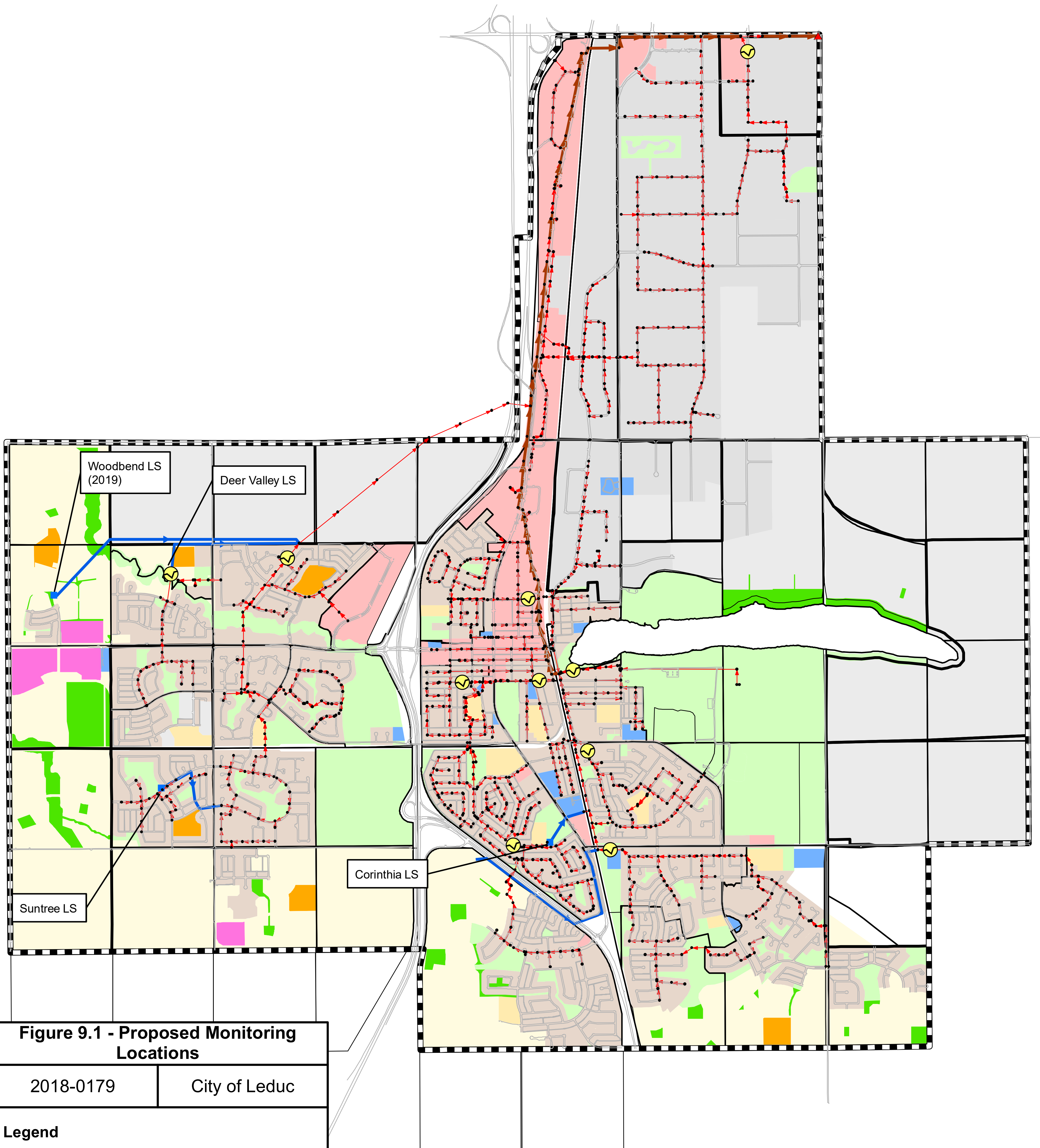

Figure 9.1 - Proposed Monitoring Locations

2018-0179	City of Leduc

Legend

- Proposed Monitoring Locations
- Model Junctions
- Lift Stations
- Model Outfall
- Curb
- ACRWC Trunk Sewer
- Modelled Sanitary Conduits
- Forcemain
- City of Leduc Neighborhoods
- City Boundary

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CITY OF Leduc

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RS 2019-10-11 P:\oak\2018\2018-0179\600_GIS\20_Maps\Report figures 20181207\Figure 9.1 Proposed Monitoring Locations 20191011.mxd

- **Dry Weather Conditions**: For existing dry weather flow and/or peak design flow conditions capacity was evaluated on the basis of flow depth in conduits being less than 86% full. If flow depth was greater than 86% there is possibility of a capacity issue;
- **Wet Weather Conditions**: A 25-year, 24-hour design storm was used to assess wet weather capacity. If the maximum Hydraulic Grade Line (HGL) is within 2.0 m of the ground surface a capacity issue was identified. Under a dynamic wet weather conditions, surcharging is also identified (100% full);
- **For Growth Conditions**: Peak design flow is used to evaluate capacity. Peak design flow is based on City design criteria for sanitary flow, peaked, plus an extraneous flow allowance. Capacity was reviewed based on flow depth being less than 86% full. When evaluating future growth, each section shown to be greater than 86% in depth full is reviewed and improvements considered. Improvements proposed are sized for the maximum potential condition scenario;
- **ACRWC Level of Service**: An ACRWC Level of Service (LOS) assessment was completed. The assessment is done using ACRWC design values to determine peak design flows and comparing them to a calibrated subjected to a 25-year 24-hour design storm. Compared with the ACRWC LOS the City's peak flow under the 25-year event exceeds the ACRWC's LOS criteria by approximately 5%. The ACRWC LOS design flow is 871 L/s, while the calibrated model with a 25-year event generates a peak flow of 913 L/s at where flow leaves the City's boundaries; and,
- **ACRWC I/I Evaluation**: In response to ACRWC's wet weather strategy an I/I evaluation was completed for the 5-year and 25-year designs storm events to determine if the City's I/I rate is less than 0.28 L/s/ha. I/I rates for the 5-year design storm are 0.25 L/s/ha based on a peak 5-minute period, or 0.05 L/s/ha based on the duration of the design storm. Similarly, for the 25-year design storm the peak 5-minute I/I rate is 0.43 L/s/ha and the event duration I/I rate is 0.09 L/s/ha. For a peak I/I condition (5-minute) the I/I rate is less than 0.28 L/s/ha for the 5-year event (0.25 L/s/ha), but higher for the 25-year event (0.43 L/s/ha). The event I/I rate for the 5- and 25-year events are both lower than 0.28 L/S/ha, 0.05 L/s/ha and 0.09 L/s/ha respectively.

9.3.1 Baseline Condition

For baseline conditions the following capacity issues were observed:

- The sanitary system operates well under existing average and peak dry weather flow conditions. There are no pipe segments (modelled) that are greater than 86% full;
- Based on a 25-year design storm condition the existing sanitary system presents wet weather capacity issues represented by surcharged sanitary sewers at 11 locations generally in the older part of the City east of Highway No. 2.; and,

- Of the 11 locations, only one area (44St and 46AAve) shows surcharging where the maximum water surface elevation is within 2.0 m of the ground surface. Pipe improvements proposed are 145 m of 300 mm to eliminate the surcharge conditions.

9.3.2 Growth Servicing Strategies

City of Leduc growth estimates included four scenarios: short term; medium term; long term; and, a potential condition. The impact of growth on the existing system was assessed along with the identification of new infrastructure to support growth.

Figure 9.2 shows a summary of new or upgraded infrastructure to support growth. The timing of new infrastructure associated with growth is subject to change given actual development conditions and realization of new sanitary flow. Although servicing may be identified in one timeframe, it does not preclude servicing being deferred or accelerated based on actual need. **Figure 9.2** provides a roadmap to future servicing using available information.

The infrastructure shown in **Figure 9.2** have been sized based on Peak Design Flow, and subsequently evaluated using actual dry weather flow with wet weather (25-year) to validate the improvements in the local systems.

The servicing strategies have evolved from the original 2013 servicing strategies building on new information, updated population estimates, and updated ASPs submitted to the City. The growth servicing strategies can change or be modified in response to actual growth rates and patterns.

The growth servicing strategies largely deal with growth in the west and east side of the City. The growth strategies identify the need to improve capacity in the ACRWC trunk system in the northern portion. The improvement has been shown as upgraded pipes or twin pipes, although it is possible to parallel the northern portion of the ACRWC following an alternative route.

When developing growth servicing strategies operational issues were identified at the Corinthia LS. The lift station was designed to pump excess wet weather flow and as such does not have a wet well volume designed to support regular sanitary flow. As growth proceeds more dry weather flow will be diverted to the Corinthia LS and once the inflow exceeds approximately 15 L/s the station will not operate efficiently. The Southfork LS will control the future flows to the Corinthia Drive and Corinthia LS system allowing the Corinthia LS to operate as it was originally intended for high flow conditions during wet weather. Secondly, by diverting Corinthia LS flow to a new sanitary pipe on the west side of the railway flow can be stored and controlled before it enters the 46St system north of Black Gold Drive.

9.4 Findings and Recommendations

The following recommendations are made to support growth in the City of Leduc:

- The existing sanitary system operates well under dry weather conditions;
- The existing system under wet weather conditions also operates well; however, there are 11 locations where surcharging could occur under larger storm events. Only one location was shown to be at risk of basement flooding;

- An I/I Reduction program in the Central Business Area, Linsford Park, Corinthia Park, South park, and Caledonia neighbourhoods may identify extraneous flow sources that can be removed;
- Future flow monitoring programs focus on growth areas and downstream systems;
- The timing and need for new infrastructure can change based on development pressures and needs. The servicing strategy to support short, medium, long and potential conditions will support expected growth. As well, the recommended servicing strategy can change with conditions; and,
- The City needs to engage in discussion with the Alberta Capital Regional Wastewater Commission regarding future servicing needs and a wet weather strategy.

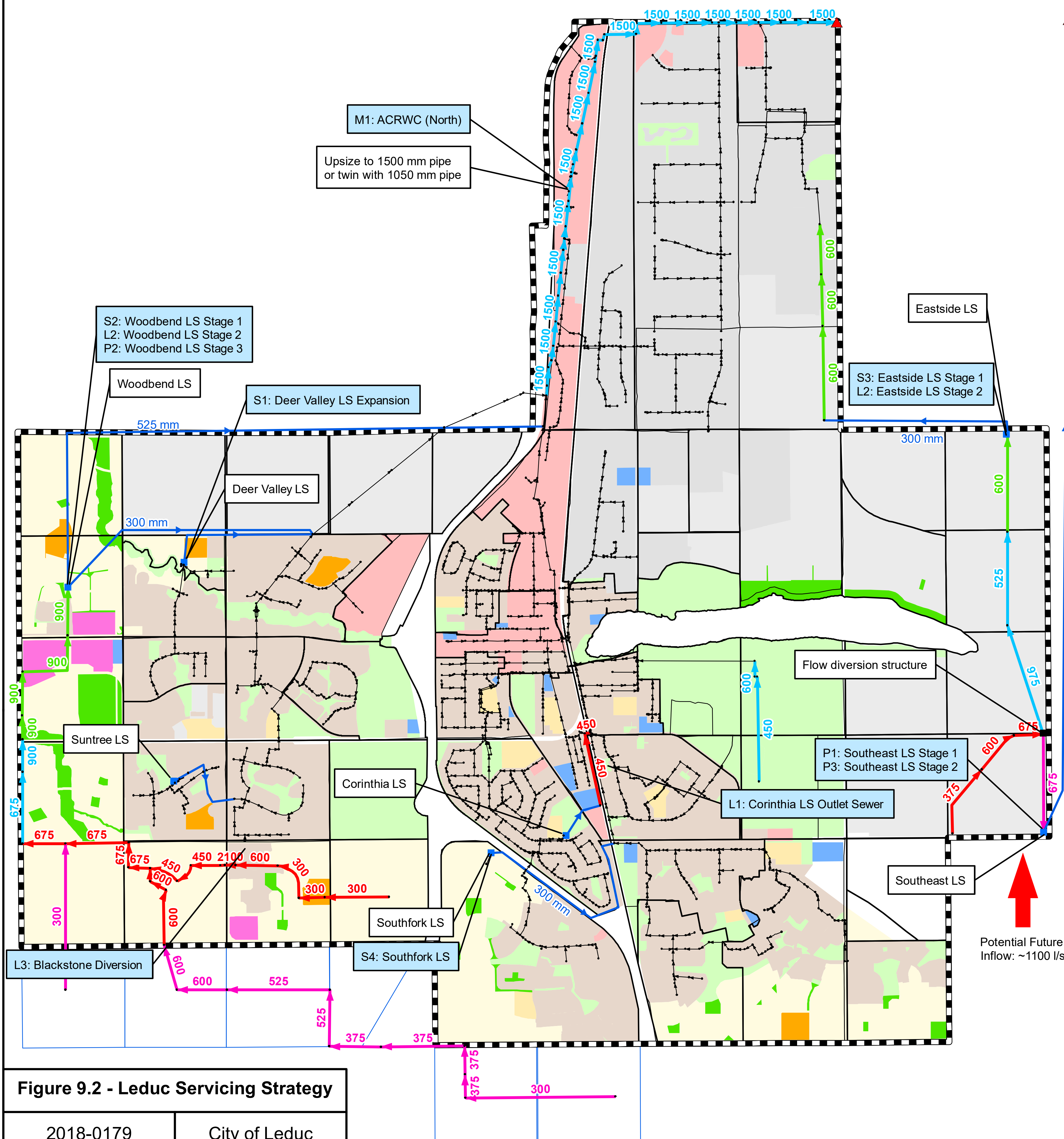

Figure 9.2 - Leduc Servicing Strategy

2018-0179	City of Leduc

Legend

- Junctions
- Lift Stations
- Model Outfalls
- Forcemain
- Existing Conduits (as modelled)
- Short-term Servicing Conduits
- Medium-term Servicing Conduits
- Long-term Servicing Conduits
- Potential Growth Servicing Conduits
- Existing Neighbourhoods
- Future Service Areas
- City Boundary

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CITY OF Leduc

RS 2019-10-11 P:\oak\2018\2018-0179\600_GIS\20_Maps\Report figures 20181207\Figure 9.2 Ultimate servicing strategy 20191011 v2.mxd