April 2018

Prepared for:

TOWN OF PONOKA MASTER SERVICING STUDY

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2131-00247-14

OQM | Organizational Quality Management Program

Certified ISO 9001:2008

April 4, 2018

Town of Ponoka
Engineering Department
5102 48th Ave, Ponoka, AB T4J 1P7
Attention: Justin Caslor, CET, Engineering Technician

Town of Ponoka Master Servicing Study

McElhanney Consulting Services Ltd. (McElhanney) is pleased to submit the Town of Ponoka Master Servicing Study Report for the Town of Ponoka (the Town). The report is prepared in reference to the Master Servicing Study and provides a summary of the analysis completed during the study and outlines the recommended water, wastewater and stormwater servicing strategies. This document incorporates all comments that have been received to date from the Town. The document has been separated into four sections: A) General Introduction, B) Water Servicing Study, C) Wastewater Servicing Study, D) Stormwater Servicing Study.

The report covers the water, wastewater and stormwater analysis completed within the Town of Ponoka. A detailed investigation and assessment was undertaken by McElhanney to determine any deficiencies in the existing water, wastewater and stormwater systems and evaluate and recommend alternatives to improve the existing servicing of the Town. The water, wastewater and stormwater systems were evaluated using computational modeling and recommendations have been provided to perform upgrades to the existing systems to adequately meet the servicing needs of the Town. In addition, analysis was completed on future development scenarios of 5, 10 and 25 years to develop servicing strategies for the future development areas. Recommendations have been provided for the construction of water, wastewater and stormwater infrastructure to service these new development areas and upgrade the existing system.

We trust this report provides all the necessary information for the Town and look forward to receiving comments following your review. Please contact the undersigned should you have any immediate questions or comments related to this study.

Yours truly,
McELHANNEY CONSULTING SERVICES LTD.

Chris Longoz, P.L.(Eng.)
Infrastructure Project Manager
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Report Signature

This report is prepared for the sole use of the Town of Ponoka. No representation of any kind, are made by McElhanney Consulting Services Ltd. or its employees to any party not affiliated with the Town of Ponoka. The information provided in this report represents McElhanney's best professional judgement in light of the knowledge available to McElhanney during the time of preparation.

Please direct any questions or clarification regarding the contents of this report to the following team members who prepared this report.

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4 April 2018

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Permit to Practice

Revision History

Submission. Number	Submission	Description
1	December 4, 2017	Town of Ponoka Master Servicing Study - Draft
2	March 29, 2018	Town of Ponoka Master Servicing Study

Table of Contents

Tables

Figures

Appendices

List of Abbreviations

AC: Asbestos Cement

ADD: Average Day Demand

CHI: Computational Hydraulics International

CI: Cast Iron

CMP: Corrugated Metal Pipe

CONC: Concrete

CT: Clay Tile

DI: Ductile Iron

FUS: Fire Underwriters Survey

HDPE: High-density polyethylene

HGL: Hydraulic Grade Line

ICI: Industrial, Commercial and Institutional

McElhanney: McElhanney

MDD: Maximum Day Demand

NRDRWSC: North Red Deer River Water Services Commission

Perforated CI: Perforated Cast Iron

PE: Polyethylene

PHD: Peak Hour Demand

PVC: Polyvinyl Chloride

PZ1: Pressure Zone 1

PZ2: Pressure Zone 2

SWMF: Stormwater Management Facility

SWMM: Stormwater Management Model

Town: Town of Ponoka

USEPA: United States Environmental Protection Agency

VCT: Vitrified Clay Pipe

A. Background and Planning Context

McElhanney Consulting Services Limited (McElhanney) was retained by the Town of Ponoka (the Town) in 2017 to provide an update the Town's latest Master Servicing Study. The previous Master Servicing Study update was completed in 2013 and focused on the lands that were annexed by the Town in 2011. As directed by the Town the Master Servicing Study focuses on the Town's existing Water, Sanitary and Stormwater systems. The plan will also examine options for the expansion of the Water, Sanitary and Stormwater systems to service future developments and a growing population.

The goals of the Master Servicing Study update include:

1. Generating and inventory of the Towns existing water, sanitary and stormwater infrastructure. This data is gathered from GIS data, as-builts and previously completed reports.
2. Analyse the Town's existing water, sanitary and stormwater infrastructure under existing loading conditions and current populations.
3. Develop upgrade strategies and costing for upgrades to the Towns existing water, sanitary and stormwater infrastructure based on the analysis of the existing system.
4. Develop servicing strategies for future development areas.

A.1. Related Studies

Engineering, planning and feasibility reports have previously been completed by the Town. McElhanney has reviewed these existing documents to gain a comprehensive understanding of the Town's servicing and constraints. These documents provided the basis for the analysis. In the process of the study McElhanney has completed four Technical Memorandums which have been submitted to the Town (*Appendix A-1*).

Some of the key background documents that McElhanney has reviewed include:

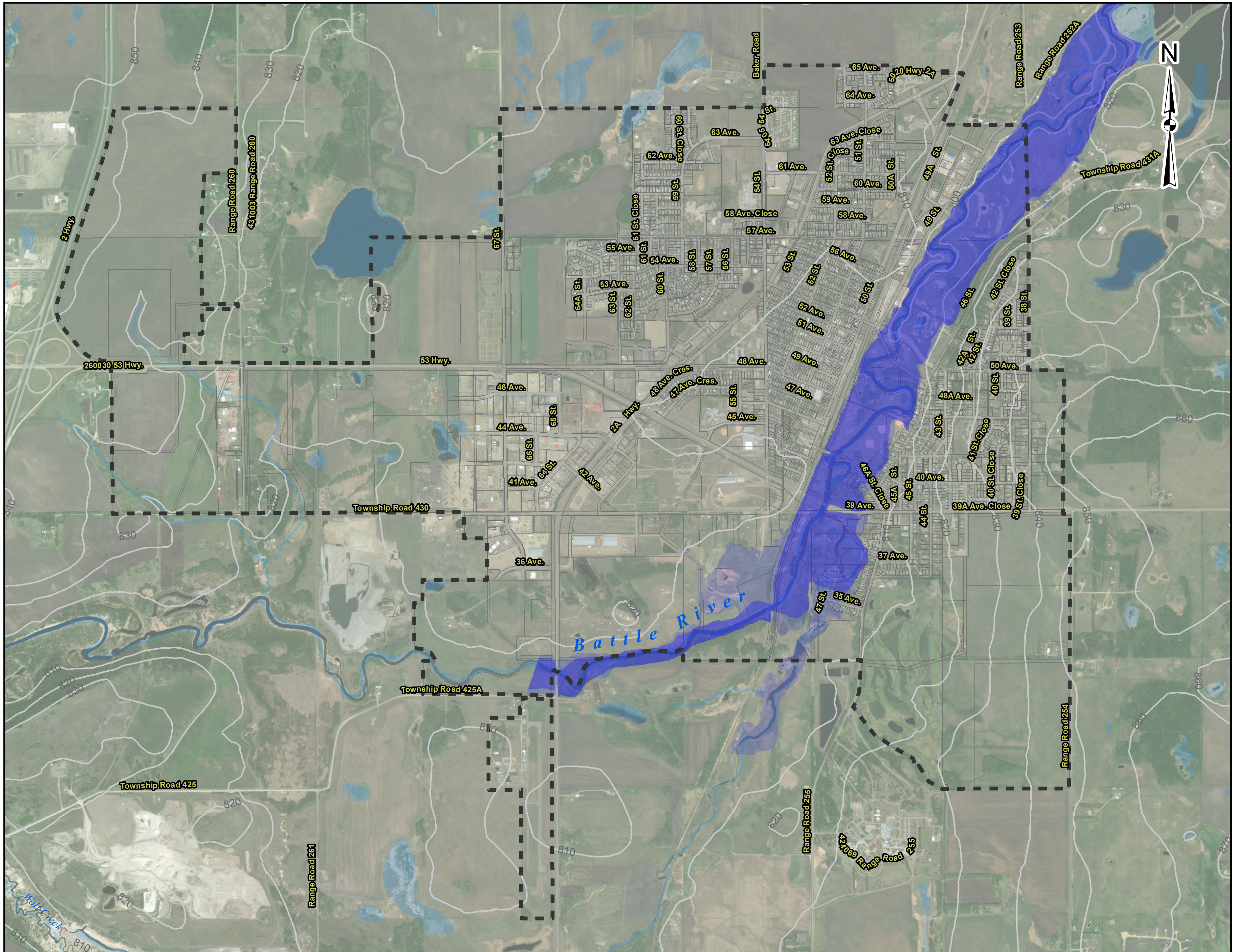
- Town of Ponoka Master Servicing Study (Tagish Engineering, 2005)
- Town of Ponoka Master Servicing Study Update (Tagish Engineering, 2013)
- North West Stormwater Management Plan (Tagish Engineering Ltd., 2009)
- Design Guidelines 2016 Edition, The City of Red Deer Engineering Services (2016)
- Town of Ponoka Master Servicing Study 2013 Update Review (McElhanney, 2016)
- Hudson's Green Area Structure Plan (Tagish Engineering Ltd., 2009)
- Town of Ponoka Municipal Development Plan (Tagish Engineering Ltd., 2009)
- Town of Ponoka Municipal Development Plan (2013)
- Alberta Environment and Sustainable Resources - Approved Water Management Plan for the Battle River

- Caledera Area Structure Plan, Stantec (2009)
- Town of Ponoka Growth Study 2009-2059 (2010)
- Town of Ponoka, Underground Utilities (2010) and Town of Ponoka, Underground Utilities, Pre-2014 Update (2014)
- 47 Ave Storm Upgrades (McElhanney,2016)
- Southwest Industrial Stormwater Management Plan (2005)
- Stormwater Management Plan Report 60th Street Development Town of Ponoka, Alberta (McElhanney, 2016)
- 2015 Annual Water Distribution Report, Town of Ponoka, January 2016
- 2016 Annual Water Distribution Report, Town of Ponoka, January 2017
- Infiltration & Inflow Study (2013)
- Sewage Lagoon Plan of Record (2004)
- 2015 Facultative Storage Facility Cell #3 Forcemain Extension (2015)

A.2. Study Area

The study area covers the Town of Ponoka municipal boundary including the areas annexed in 2011. The Town of Ponoka is located along the Battle River within the Battle River Valley and within the Calgary-Edmonton Corridor. The Battle River is the dominant feature in the Town, flowing through the Town from southwest to northeast. The western part (west of 67 St) of the Town is largely undeveloped with significant wetlands and a permanent water body. The current developed part of the Town is generally located along the west and east banks of the Battle River. LiDAR data for the Town was provided to McElhanney by the Town of Ponoka. The Town obtained the data from AltaLIS Ltd and is a part of their AltaLIS LiDAR15 DEM package. The data was gathered for the Town in 2013. AltaLIS Ltd provided an estimated horizontal accuracy of 0.5 m and an estimated vertical accuracy of 0.3 m.

The Flood Hazard Map by Alberta Environment and Parks (last updated February 2016) is referenced for the 100 Year floodway and flood fringe alignments along the developed Town site. The floodway information for the west side of the Battle River is not available and is not included in this master plan. *Figure A-1* depicts the Town boundary and extent of the analysis.



Master Servicing Study

Ponoka

Legend

TownBoundary

Floodway

Flood Fringe

McElhanney

0 255 510 1,020 1,530 (m)

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Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 29, 2018

Topographic Map

Figure A1

Document Path: L:\Proj\Projects\2131 - Edmonton\2131-00247-00 Engineering Services Town of Ponoka\2131-00247-14 Master Servicing Study Re-Write\2.0 Documents\2.4 Reports\2.4.5 Figures\General\Figure A1 - Topographic Map.mxd Author: hshin

A.3. Legislative and Policy Planning Context

Maintenance and expansion of water, sanitary and stormwater systems require significant financial investment on the part of the municipality. The Master Servicing Study provides a guide for the Town's administration to assess the condition of the existing infrastructure and the infrastructure expansions required to accommodate new development in the development horizons set out by the Town (5, 10 and 25 years). The information presented in this Master Servicing Study will aid in budgeting and the planning of future capital investments.

Regulatory approvals for drainage ponds and additional outfalls into the Battle River will require Alberta Environment and Parks approval. Upgrades at the wastewater treatment plant and changes in wastewater discharge rates will also require Albert Environment and Parks Approval.

A.4. Water, Wastewater, and Stormwater Servicing Principles and Policies

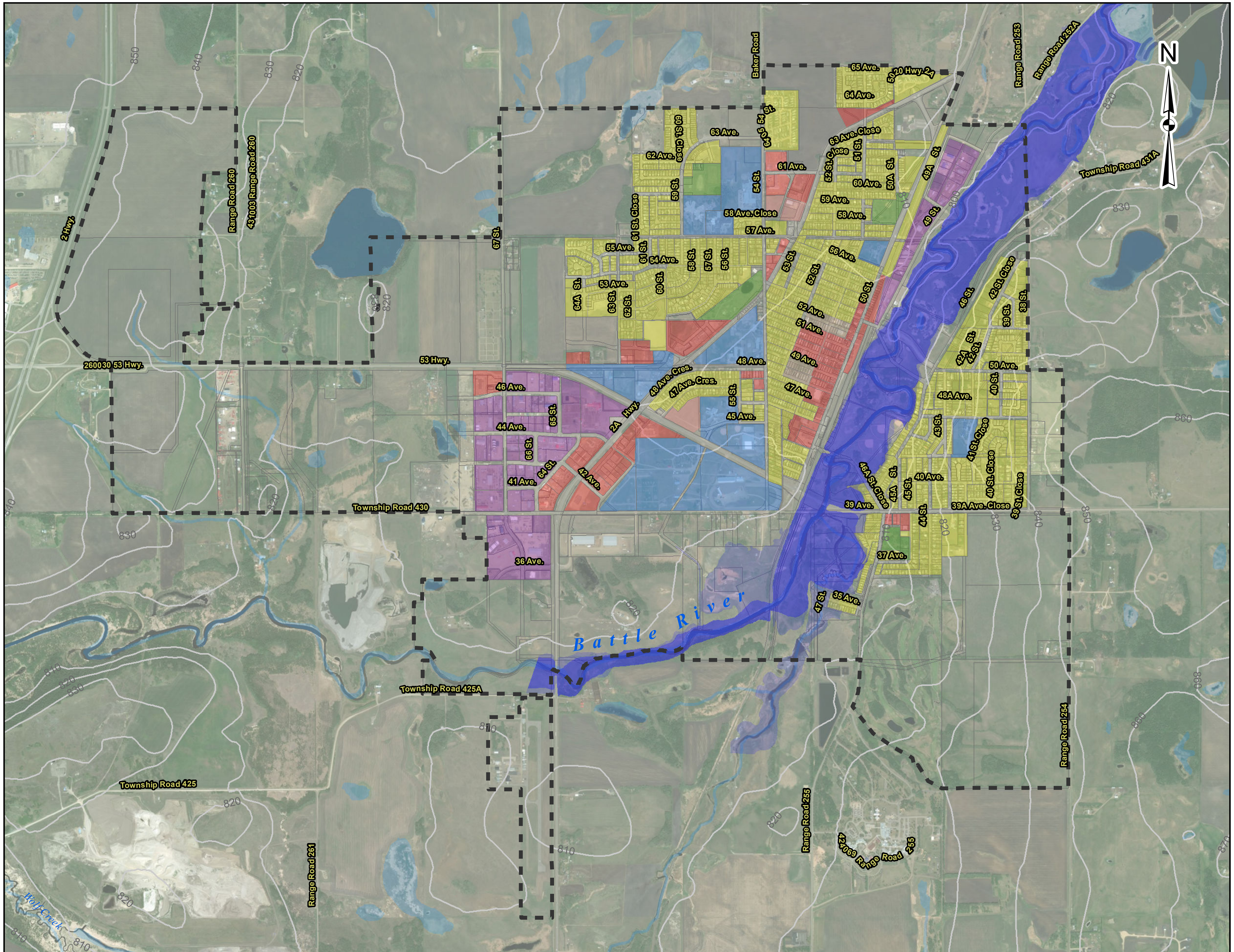
As directed by the Town, the City of Red Deer Engineering Design Guidelines have been relied upon for the development of design criteria.

A.5. Population and Employment Growth Forecasts

The Town is situated along Highway 2 in the Calgary-Edmonton corridor. The Town is also situated on Highway 2A and Highway 53. The Town of Ponoka Municipal Development Plan (2013) and the Town of Ponoka Growth Study 2009-2059 (2010) project strong growth within the Town. In 2011 the Town annexed approximately 390 ha of land to be targeted for industrial, commercial and residential expansion. The servicing of these future development areas has been addressed within this study.

Land uses are required to determine water demand and sanitary and stormwater loading rates. The Town provided both existing land uses and projected land uses for the proposed developments. The existing land use plan shown in *Figure A-2* includes the following land uses:

1. Residential
2. Commercial
3. Institutional
4. Industrial
5. Parks / Open Space
6. Direct Control
7. Residential Expansion
8. Commercial Expansion
9. Industrial Expansion



Master Servicing Study

Ponoka

Legend

- TownBoundary
- Floodway
- Flood Fringe

Land Use

- Commercial
- Commercial Expansion
- Direct Control
- Industrial
- Institutional
- Parks Open Space
- Residential
- Residential Expansion

McElhanney

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Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 29, 2018

Existing Land Use Plan

Figure A2

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Author: hshin

Future growth horizons are required in order to determine future water demands and sanitary and stormwater loading rates. The future growth horizons provide the framework needed to develop the staged infrastructure capital works program. For the Master Servicing Study, the Town provided direction that growth horizons of 5, 10 and 25 years would be used. The projected growth rates for the 5, 10 and 25 year horizons are developed based on the following documents:

1. Master Servicing Study 2013 Update (2013)
2. Town of Ponoka Growth Study 2009-2059 (2010, annotated with Town comments)
3. Discussions with the Town (2017)

Figure A-3 depicts the future land use areas outlined by the Town. The Ponoka Growth Study provides three long term population projections, but states that the Medium Growth Rate is the recommended scenario to be used for determining land and servicing requirements. *Table A-1* presents this population projection completed as part of the study. Based on the medium growth rate of 1.5% *Table A-2* outlines the estimated projected populations for the 5, 10 and 25-year horizon. As per Statistics Canada (2016) data the current population of the Town is 7,229 people, with a projected growth rate of 1.5% the 5, 10 and 25 year populations with be 7,771, 8,354 and 10,234 people, respectively.

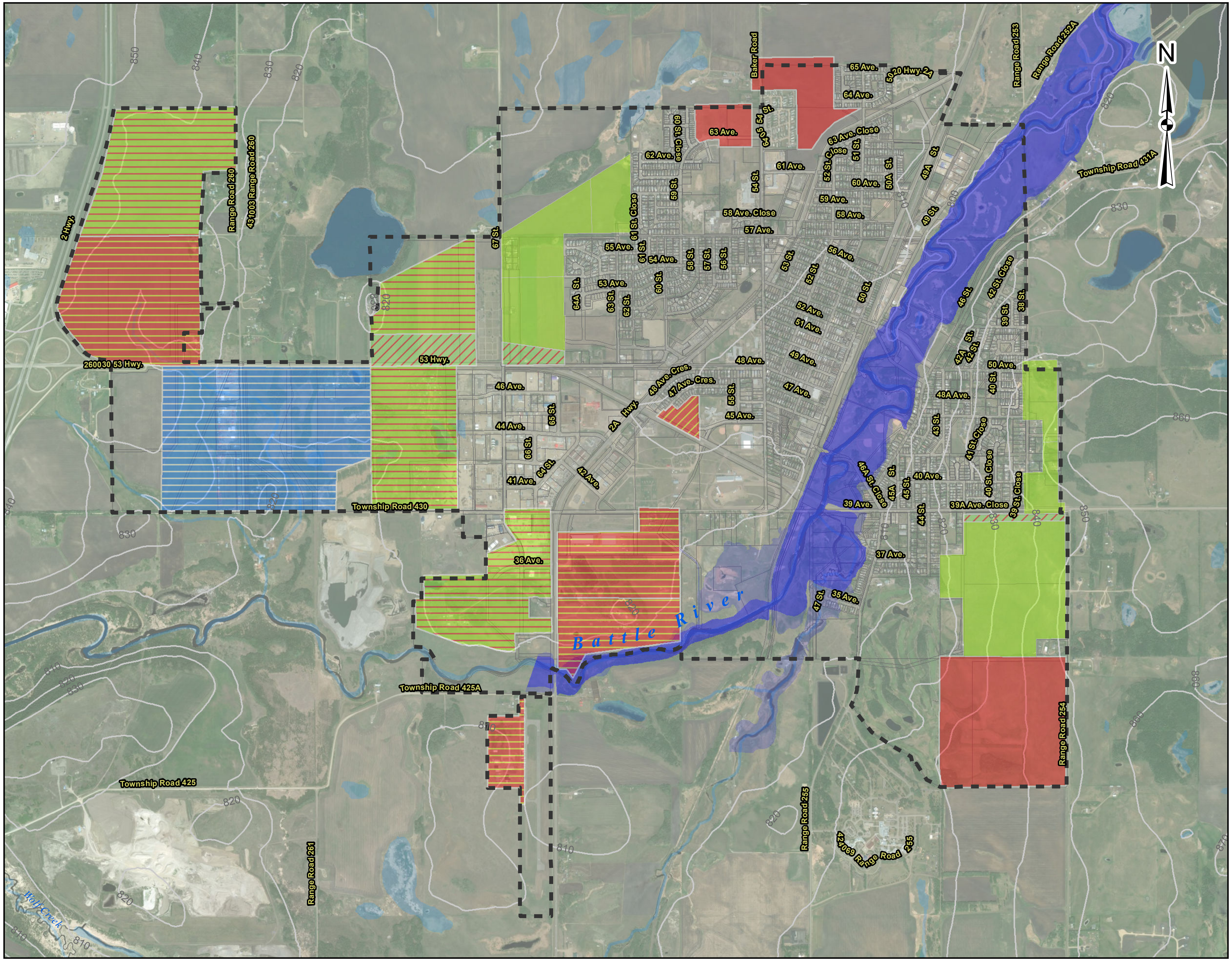
Table A-1: Recommended Growth Rate Projection (Taken from Town of Ponoka Growth Study 2009-2059 [2010, annotated with Town comments])

Town of Ponoka – Long Term (50 Year) Population Projection (10 year Intervals)						
Year	2009	2019	2029	2039	2049	2059
Projection #1 (Low)	6,775	7,484	8,267	9,132	10,087	11,143
Annual Growth Rate	1%	1%	1%	1%	1%	1%
Projection #2 (Medium)	6,792	7,786	9,035	9,035	10,486	12,922
Annual Growth Rate	0.75%	1.5%	1.5%	1.5%	1%	1%

Table A-2: Recommended Growth Rate Projection

Town of Ponoka Population Projections				
Development Horizon	Current* (2017)	5 (2022)	10 (2027)	25 (2042)
Projection	7,229	7,771	8,354	10,234
Annual Growth Rate		1.5%	1.5%	1.5%

* Based on 2016 Statistics Canada Census



Master Servicing Study

Ponoka

Legend

TownBoundary

Floodway

Flood Fringe

Future Land Use

5 Years - Commercial

5 Years - Industrial

5 years - Residential

10 Years - Commercial

10 Years - Industrial

10 Years - Residential

25 Years - Industrial

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Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 29, 2018

Population Growth and Future Land Use Plan

Figure A3

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Author: hshin

A.6. Existing Environmental and Servicing Conditions and Future Considerations

The western part (west of 67 St) of the Town is currently largely undeveloped with significant wetlands and a permanent water body (*Figure A-1*). At present, the western part of the Town has experienced little development. The Municipal Development Plan (2016) indicates that due to the significance of these wetlands, they need to be left in their natural state, therefore, any future developments plans should not allow for development of this natural area. The 2013 Master Servicing Study Update, however, considered the Hudson's Green area to be fully developed in the future. Following discussions with the Town, it was decided that the full area will not be used for future development. Instead, only the southeastern portion of this area is included in the future growth area.

The Flood Hazard Map by Alberta Environment and Parks (last updated February 2016) is referenced for the 100 Year floodway and flood fringe alignments along the developed Town site. The floodway information for the west side of the Battle River is not available and is not included in this master plan. Development within the flood fringe must ensure that it meets all requirements as outlined by the municipal and provincial governments.

B. Water Master Plan

This section presents the proposed Water Master Plan for the Town of Ponoka (the Town). The activities undertaken as part of this plan include:

1. A review of all completed water studies and background information;
2. Development of an inventory of the Town's existing distribution system and facilities;
3. Development and calibration of a hydraulic model to analyse the existing system;
4. Use of the hydraulic model to identify system deficiencies;
5. Identify proposed upgrades for the existing system;
6. Complete a water servicing strategy for the future proposed development areas; and
7. Prepare cost estimates for the various phased development stages.

As part of the analysis, McElhanney reviewed all the data available on the existing infrastructure including the reservoirs, booster stations and distribution network. McElhanney conducted a field investigation of the reservoirs and booster stations; the results of this field review can be found in *Appendix B-1*. This study identifies capacity limitations in the existing system and provides a recommended servicing strategy to satisfy the demands of the expected future development.

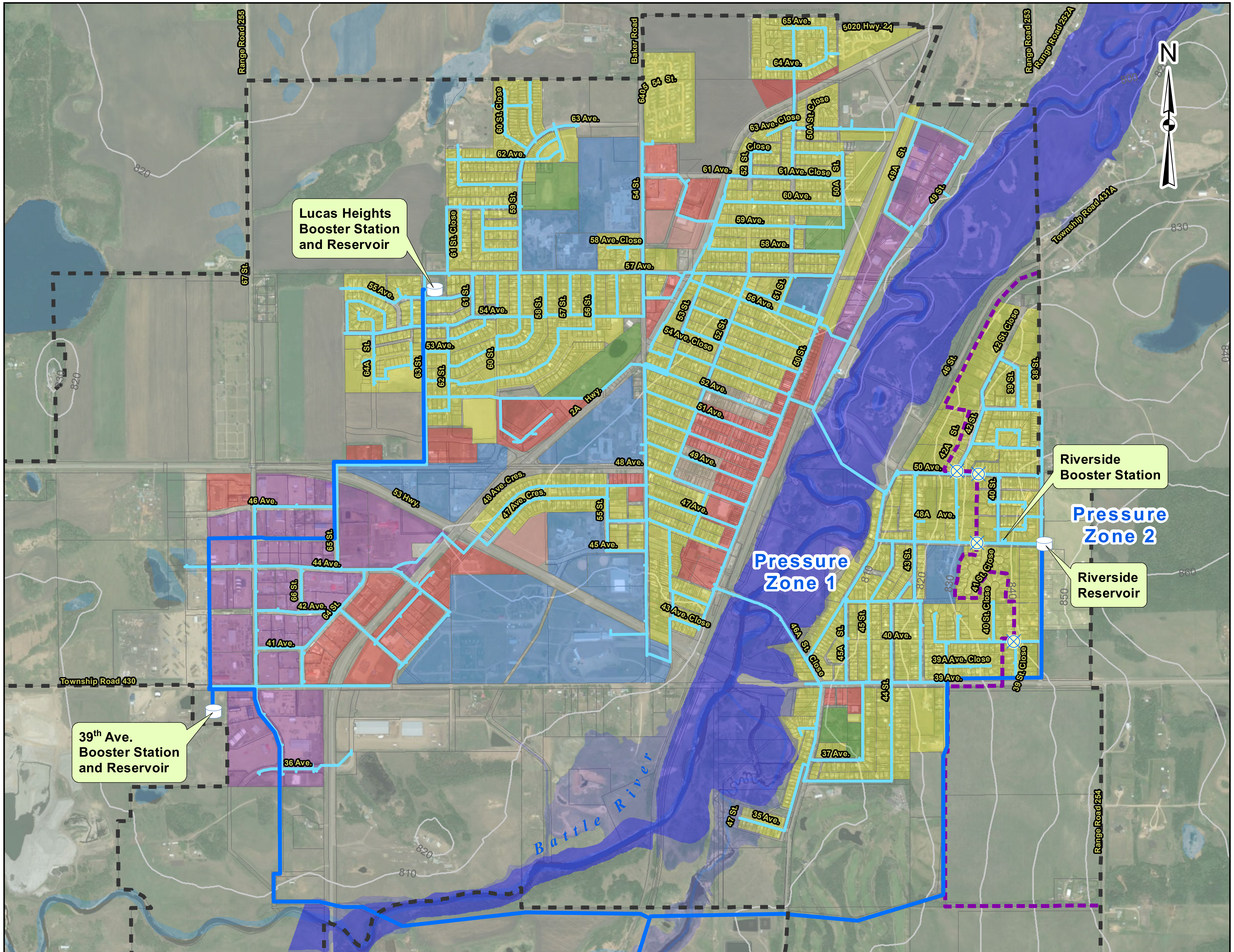
B.1. Introduction and Background

B.1.1 Background

The Town of Ponoka's water distribution system supplies potable water to approximately 7,229 residents and commercial and industrial business. This system includes over 62 kilometres of pipes, three reservoirs, three booster stations and three supply connections to the North Red Deer River Water Services Commission (NRDRWSC) regional system. *Figure B-1* illustrates the Town's distribution system and its main components.

Population

As described in *Section A-5* of this report, population data and growth estimates were obtained from various sources, including the Town of Ponoka Growth Study 2009-2059 and the Canada 2016 Census. *Table B-1* summarizes the existing population estimate and the projection for 5 years, 10 years and 25 years.



Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Control Valves (assumed locations)
- Reservoirs
- NRDRWSC Regional System
- Pressure Zone Division Line
- Watermains

Land Use

- Commercial
- Commercial Expansion
- Direct Control
- Industrial
- Institutional
- Parks Open Space
- Residential
- Residential Expansion

McElhanney

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Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 28, 2018

Existing Water Distribution System

Figure B1

Table B-1: Population Summary

File No.	Population Estimate
Current	*7,229*
5 years	*7,771*
10 years	*8,354*
25 years	*10,234*

Water Source, Reservoirs and Booster Stations

The NRDRWSC regional system feeds the 39th Avenue, Lucas Heights and Riverside reservoirs. Each reservoir is paired with a booster station that pumps water into the distribution system. The water network is separated into two independent distribution networks connected by gate valves that are closed under normal operations (Pressure Zones 1 and 2). *Figure B-1* shows the location of the booster stations and the approximate location of the gate valves that separate the pressure zones. The hydraulic grade line (HGL) of these pressure zones are approximately 862m (PZ1) and 877m (PZ2).

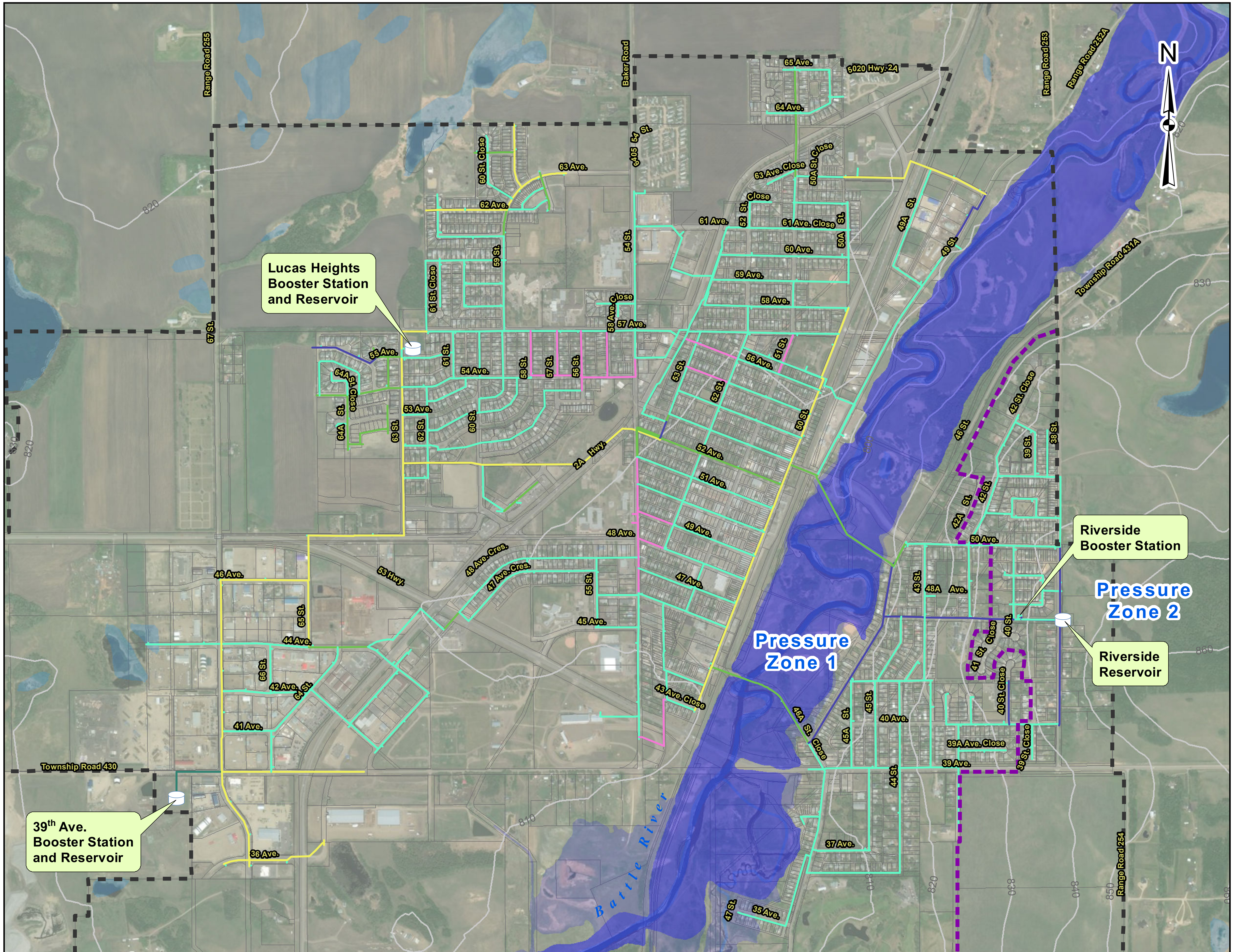
The configuration of the Riverside and 39th Avenue booster stations was determined from information provided by the Town and confirmed during a site investigation carried out on August 04, 2017. *Table B-2* summarizes the number and model of pumps in the 39th Avenue and Riverside booster stations, and the number of pumps in the Lucas Heights Booster Station.

Table B-2: Booster Stations Summary

	Pressure Zone 1								Pressure Zone 2			
	Lucas Heights Booster Station				39th Avenue Booster Station				Lucas Heights Booster Station			
	Model	No. of Pumps	Model	No. of Pumps	Model	No. of Pumps	Model	No. of Pumps	Model	No. of Pumps	Model	No. of Pumps
Distribution Pump	-	2	-	-	Pentair 411 BF	3	38	60.67	Grundfos 20709-IC	2	20.2	39.6
Auxiliary Pump	-	1	-	-	-	-	-	-	-	-	-	-
Fire Pump	-	1	-	-	Pentair 481 BFH	1	158	63.4	Pentair 411 BF	1	88	60.6

Watermain information

Table B-3 provides a summary of the watermains in the Town. The conduits and nodes from the GIS shape files were analyzed to identify any missing diameters. The missing sizes were obtained from utility maps, record DWG files and through discussions with Staff from the Town. The watermain sizes range from 100mmΦ to 400mmΦ. As shown in *Table B-3*, most of the water network is comprised of asbestos cement pipes. *Figures B-2 and B-3* illustrates graphically the size and materials of the watermains.



Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Reservoirs
- Pressure Zone Division Line

Watermain Sizes (mmØ)

- 100
- 150
- 200
- 250
- 300
- 400

McElhanney

0 160 320 640 960 (m)

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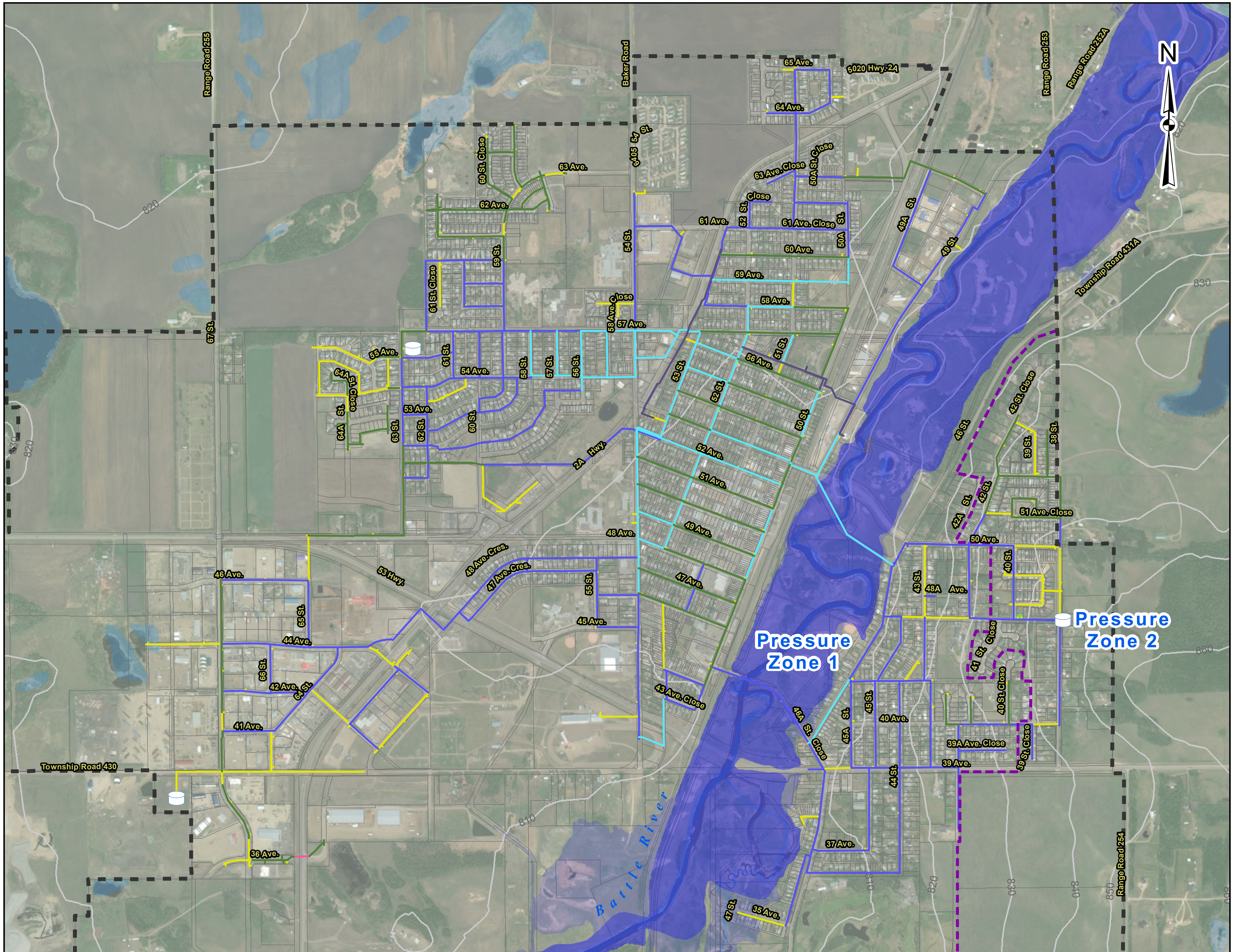
Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 28, 2018

Existing Watermain Sizes

Figure B2

Document Path: C:\Users\hshin\Downloads\ArcGIS\Ponoka\2.4.5 Figures\Water\Figure B2 - Existing Watermain Sizes.mxd Author: hshin



Document Path: C:\Users\hshin\Downloads\ArcGIS\Ponoka\2.4.5 Figures\Water\Figure B3 - Existing Water Pipe Materials.mxd Author: hshin

Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Reservoirs
- Pressure Zone Division Line

Pipe Materials

- Unknown
- AC
- CI
- Ductile Iron
- HDPE
- PE
- PVC

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 28, 2018

Existing Watermain Materials

Figure B3

Table B-3: Watermain Information

Material	Smallest Size (mm)	Largest Size (mm)	Length (m)
Unknown	100	400	9,795.0
AC	100	300	28,073.4
CI	100	300	8,694.2
DI	150	150	171.1
HDPE	300	300	60.4
PE	150	300	1,586.8
PVC	50	300	14,137.2
Total			**62,518.1**

Site Investigation

A site investigation was conducted on August 4, 2017. The three reservoirs and booster stations were visited and the pressure and flow rates at the outlets of the booster stations were read from the control panels. These rates are shown in *Table B-4* below.

Table B-4: Pressure and Flow Readings at the Booster Stations' Outlets

Booster Station	Flow Rate (l/s)	Discharge Pressure	
		(PSI)	(m)
Lucas Heights	31.4	61.7	43.4
39th Avenue	0	78.8	55.4
Riverside	0.4	60.0	42.2
Total	**31.8**	-	-

The pumps at the 39th Avenue booster station were not operating at the time of the visit. The Town's operations staff informed that the 39th Avenue and Lucas Heights booster stations alternates every 12 hours (i.e. only one booster station functions at single time). The Town's staff also informed that the distribution pumps in the three booster stations have a lead-lag configuration and are controlled by a variable frequency drive.

Select photos of the site visit can be found in *Appendix B-1*.

B.1.2 Review of Previous Studies

McElhanney reviewed the following background information relevant to the water planning undertaken as part of this study:

- Town of Ponoka Master Servicing Study, Tagish Engineering, November 2005
- Town of Ponoka Growth Study 2009-2059, Armin A. Preiksaitis & Associates ltd., August 2010
- Town of Ponoka Master Servicing Study Update, Tagish Engineering, October 2013
- 2015 Annual Water Distribution Report, Town of Ponoka, January 2016
- Design Guidelines 2016 Edition, The City of Red Deer Engineering Services, 2016
- Town of Ponoka Master Servicing Study 2013 Update Review, McElhanney, June 2016
- 2016 Annual Water Distribution Report, Town of Ponoka, January 2017

Table B-5 summarizes the record information provided by the Town of Ponoka in digital format. This information was used to create the water distribution pipe network, as described in *Section B.4*.

Table B-5: List of GIS and record information provided by the Town of Ponoka

File No.	File Name	Extension	Description
1	*Water_Distribution_Link*	.shp	GIS information of the Town's water distribution pipes, and the NRDRWSC regional system feeding pipes.
2	*Water_Distribution_Link_update*	.shp	Additional GIS information of the Town's water distribution pipes.
3	*Water_Distribution_Node*	.shp	GIS information of the Town's water distribution hydrants and fittings, and the NRDRWSC regional system fittings.
4	*Water_Distribution_Node_update*	.shp	Additional GIS information of the Town's water distribution hydrants and fittings.
5	*2009_AS BUILT_from_Tagish*	.dwg	Plan-view maps of the existing water, sanitary and drainage utilities compiled by Tagish Engineering in February 2007.
6	*waterbase*	.dwg	Plan-view information of the existing water, sanitary and drainage utilities. Similar to File no. 5.
7	*Underground_utilities_GIS*	.pdf	Plan-view maps of the existing water, sanitary and drainage utilities with an aerial photo background. (From November 2010)
8	*map_book_combined*	.pdf	Updated plan-view maps of the existing water, sanitary and drainage utilities. (No date specified)
9	*WaterTransmissionPipelineContract3RecordDrawings*	.pdf	NRDRWSC regional system record drawings

B.1.3 Master Servicing Plan Objectives

The objective of this study is to develop a Water Master Plan to guide the management of the City water distribution system. The Water Master Plan will evaluate the existing and future growth, proposing upgrades for the existing system and proposing new water infrastructure required to service the future growth areas.

For the existing water system, the study objectives include inventory of the existing system, analyzing the system using a calibrated hydraulic model, and proposing potential upgrades.

For the future growth areas, the proposed water system is designed considering the future peak-hour demand and fire flow requirement.

Modelling of the water infrastructure follows base mapping, existing infrastructure information provided by the Town, future development plans and site information collected through field reviews.

B.2. Methodology

B.2.1 Design Criteria

The City of Red Deer's *Design Guidelines 2016*, the Alberta Environment and Parks' *Standard and Guidelines for Municipal Water Works 2012* and the Fire Underwriters Survey's *Water Supply for Public Fire Protection 1999* have been relied upon as the primary sources for design for this study.

Key design criteria are summarized below:

Potable Water Storage

- Total storage requirement = A + B + (the greater of C or D)

  Where

  A = Fire storage

  B = Equalization storage (approximately 25% of MDD)

  C = Emergency storage (minimum of 15% of ADD)

  D = Disinfection contact time storage

Minimum Size of Distribution Mains

- Residential: 150mm diameter
- Industrial: 200mm diameter

Residential Demands

- Average Day Demand (ADD): 375 litres per capita per day.
- Maximum Day Demand (MDD): 600 litres per capita per day.
- Peak Hour Demand (PHD): 1200 litres per capita per day.

Non-Residential Demands

- Commercial, Institutional and Industrial Land Uses: 0.15 l/s/ha.

Fire Flow Requirements

- Minimum fire flow for single family residential areas: 4,500 litres/minute (1000 igpm)
- Maximum spacing of hydrants in commercial, institutional and multi-family residential areas: 90m
- Maximum spacing of hydrants in single-family residential areas: 180m

Pressure

- Minimum residual pressure during Maximum Day Demand plus fire flow: 22 PSI (150 kPa)
- Minimum residual pressure during Peak Hour Demand: 44 PSI (300 kPa)

Velocity

- Maximum velocity during Maximum Day Demand plus fire flow: 2.5 m/s
- Maximum velocity during Peak Hour Demand: 1.5 m/s

B.3. Water Demand

B.3.1 Existing Demands

Table B-6 shows the annual influent and effluent volumes to the Town's reservoirs, according to the annual water distribution reports for the years 2015 and 2016.

Table B-6: Annual Influent and Effluent Volumes

Year	Total Influent to Reservoirs (m^3)	Total Effluent to Reservoirs (m^3)
2015	721,380	802,874
2016	637,511	725,504

The discrepancy between the influent and effluent volumes in the 2015 annual report is mainly due to a 48,400 m^3 volume difference at the 39th Avenue reservoir. The discrepancy in the 2016 annual report is largely because the influent was not metered at the Riverside Reservoir, and therefore there is a volume difference of 68,412 m^3. The 2016 Master Servicing Study 2013 Update Review prepared by McElhanney recommended taking a corrective action to fix this problem and cross checking the influent and effluent volumes for each reservoir in future annual reports.

The analysis in the Town of Ponoka Master Servicing 2013 Study Update did not consider ICI demands and assumed that the entire volume measured by the water meters was used by residential customers. Following this premise, and considering the largest effluent volume of 802,874 m^3, the residential Average Day Demand per capita is estimated to be 305 litres per day. This value is lower than the residential ADD specified in the City of Red Deer Design Guidelines (375 l/cap/day). If the industrial, commercial and institutional (ICI) demands are also considered, the residential ADD would be even lower.

B.3.2 Future Demands

The existing residential and ICI instantaneous demands calculated with the City of Red Deer Design Guidelines are shown in *Table B-7*. The future instantaneous demands for the 5-years, 10-years and 25-years projections are shown in *Table B-8*.

Table B-7: Residential and ICI Instantaneous Demands (Existing - City of Red Deer Design Guidelines)

	Existing				
	Area (ha)	Pop.	ADD (l/s)	MDD (l/s)	PHD (l/s)
Residential	-	7,229	31.4	50.2	100.4
Industrial	74.4	-	11.2	11.2	11.2
Commercial	59.5	-	8.9	8.9	8.9
Institutional	88.3	-	13.2	13.2	13.2
Total			64.7	83.2	133.7

Table B-8: Residential and ICI Instantaneous Demands (Future - City of Red Deer Design Guidelines)

	5-year					10-year					25-year				
	Area (ha)	Pop.	ADD (l/s)	MDD (l/s)	PHD (l/s)	Area (ha)	Pop.	ADD (l/s)	MDD (l/s)	PHD (l/s)	Area (ha)	Pop.	ADD (l/s)	MDD (l/s)	PHD (l/s)
Residential	-	7,771	33.7	54.0	107.9	-	8,354	36.3	58.0	116.0	-	10,234	44.4	71.1	142.1
Industrial	212.3	-	31.8	31.8	31.8	394.3	-	59.1	59.1	59.1	510.0	-	76.5	76.5	76.5
Commercial	59.5	-	8.9	8.9	8.9	80.5	-	12.1	12.1	12.1	80.4	-	12.1	12.1	12.1
Institutional	88.3	-	13.2	13.2	13.2	88.3	-	13.2	13.2	13.2	88.3	-	13.2	13.2	13.2
Total			87.7	108.0	161.9			120.7	142.5	200.5			146.2	172.9	243.9

The total ADD, MDD and PHD are presented in *Table B-9*. The average demands per capita are above the Canadian average of 510 l/p/day reported by the *Municipal Water Use Report* (Environment Canada, 2011). However, the Columbia Basin Water Smart Initiative found that between 2009 to 2015, the average demand per capita among 25 communities in the Columbia Basin (British Columbia) ranged between 551 to 1784 l/p/day. The existing and future ADD per capita calculated for the Town of Ponoka falls within this range.

Table B-9: Total Daily Demand

	ADD (l/day)	ADD (l/p/day)	MDD (l/day)	MDD (l/p/day)	PHD (l/day)	PHD (l/p/day)
Existing	5,590,587	773	7,217,112	998	11,554,512	1,598
5-year	7,581,021	976	9,329,496	1,201	13,992,096	1,801
10-years	10,430,526	1,249	12,310,176	1,474	17,322,576	2,074
25-years	12,633,961	1,235	14,936,611	1,460	21,077,011	2,060

B.4. Water Model Development

The conduits and nodes from the GIS shape files were used to create a steady-state model of the existing water distribution system in WaterCAD V8i. Ground elevations were automatically assigned to the nodes using the LiDAR15 digital elevation model created by AltaLIS and provided by the Town for this study.

The conduit materials were obtained from the GIS shape files, and the respective roughness coefficient (Hazen Williams "C") was initially assigned using the values recommended in the City of Red Deer Design Guidelines. These coefficients were further refined during the model calibration process.

B.4.1 Modelling Assumptions

Pump curves for the Lucas Heights booster station were obtained from the WaterCAD model prepared for the Master Servicing Study 2013 Update by Tagish Engineering.

The booster stations were modelled as variable speed pump batteries element. The pressure readings taken on August 4, 2017 (*Table B-4*) were used as the target pressures for the Riverside and Lucas Heights Booster Stations. In the 39th Avenue station, the pressure at the design point was used as the target pressure (*Table B-2*).

As explained in the *Section B.1.1*, the existing water network is separated into two independent networks by gate valves that are normally closed. The Master Servicing 2013 Study Update asserts that three flow gates separate the network, however, the location of these valves do not match the GIS Information provided by the Town. In addition, to completely isolate the networks as shown in the 2013 report, a fourth valve is required. Therefore, the four valves shown in *Figure B-1* were added into the model. The location of these valves was decided considering both the GIS information and the locations suggested in the 2013 Master Servicing report.

Appendix B-2 provides a summary of the model input parameters and their associated assumptions. *Appendix B-3* outlines the modelling scenarios employed for this assignment.

B.4.2 Model Calibration

The constructed model was calibrated using the results from a fire flow test performed in August 3, 2017. The calibration followed the assumption made in the Master Servicing Study 2013 Update which considered that residential demand consumes the entire reservoirs' effluent volume. Water sub-catchments were delineated using the properties' legal boundaries and the land use plan included in the Town of Ponoka Growth Study 2009-2059. These sub-catchments are shown in *Figure B-1*.

The annual water consumption for 2015 was converted to an instantaneous average-daily flow, as shown in the following calculation:

$$\frac{Total\ effluent\ volume\ (m^3) * 1000}{365\ d * 24\ h * 60\ min * 60s} = \frac{802{,}874 * 1000}{365 * 24 * 60 * 60} = 25.5\ l/s$$

However, the fire flow testing was carried out on a summer day, when the water demands are typically higher. This was confirmed by the pressure and flow readings at the booster stations' control panels. The readings shown in *Table B-4* were taken on August 4, 2017, a day after the fire flow testing was conducted. Both the flow readings and the fire flow testing were conducted during non-peak hours. Therefore, the total flow demand of 31.8 l/s was allocated uniformly to the residential sub-catchments.

Figure B-4 shows the four sites where the fire flow testing was performed. *Figure B-5, B-6, B-7* and *B-8* show the hydrants where the flow and residual pressures were measured. The readings are summarized in *Table B-10*.

The model was initially run with the MDD-31.8 l/s flow only (static condition, no fire flow). The 39th Avenue and Lucas Heights booster station were turned on alternatively, and the model was run with each booster station turned on to determine which one was running at the time of the hydrant test. The modelling scenario with the 39th Avenue turned on (and Lucas Heights turned off) provided static pressure values closer to the field records. *Table B-10* shows the percent difference between the model results and the readings. The static percent difference in most of the hydrants is below 5%, except in hydrant 4B where the difference is 11.4%. Therefore, this modelling scenario was used for the calibration.

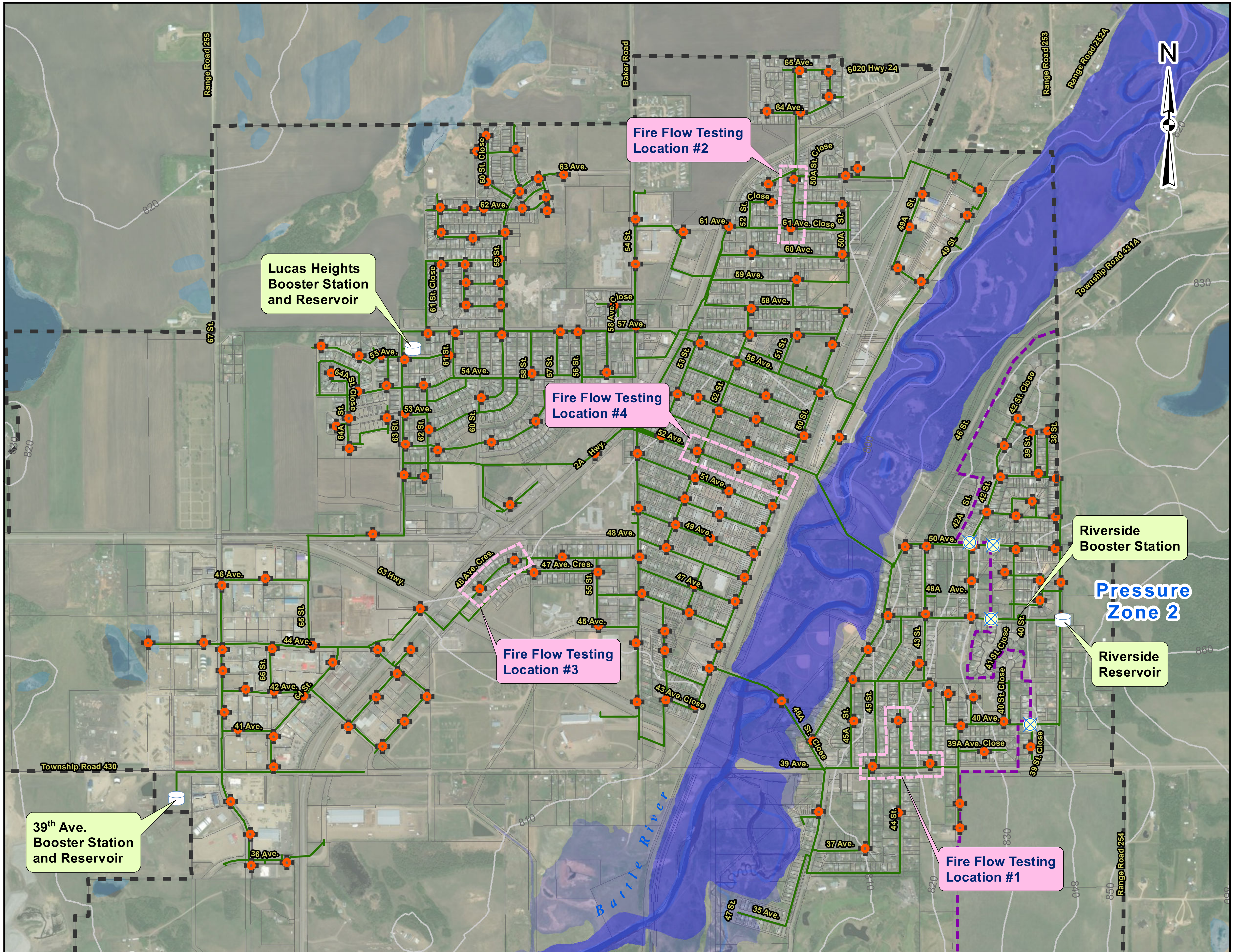
The measured flows were input into the model at the nodes representing the hydrants. The Hazen Williams “C” values for each pipe material was adjusted to get residual pressures similar to the hydrant measurements. The adjusted “C” values that provide the optimal correlation are shown in *Table B-11*. The percent difference in six (6) of the eight (8) hydrant measurements are below 6%, while the maximum difference being 20% for hydrant 4B.

Table B-10: Model Calibration

Flow test Location	Hydrant ID	Location	Flow (l/s)	Static Pressure (psi)			Residual Pressure (psi)		
				Test	Model	Percent Difference (%)	Test	Model	Percent Difference (%)
Test Location #1	1A (Flow Hydrant)	44 St – 40 Ave	60	-	-	-	-	-	-
	1B (Residual Hydrant)	39 Ave – 45 St	-	75	74	1.3	60	58	3.3
	1C (Residual Hydrant)	39 Ave – 43 St	-	60	59	1.7	40	41	2.5
Test Location #2	2A (Flow Hydrant)	63 Ave – 51 St	67.6	-	-	-	-	-	-
	2B (Residual Hydrant)	61 Ave – 51 St	-	75	76	2.3	65	55	15.4
Test Location #3	3A (Flow Hydrant)	5613 48 Ave	61.9	-	-	-	-	-	-
	3B (Residual Hydrant)	48 Ave Crescent	-	80	78	2.5	70	66	5.7
	3C (Residual Hydrant)	47 Ave Crescent	-	80	78	2.5	70	66	5.7
	3D (Residual Hydrant)	Alley (56 St. – 48 Ave Crescent)	-	80	78	2.5	70	66	5.7
Test Location #4	4A (Flow Hydrant)	52 Ave – 51 St	46.6	-	-	-	-	-	-
	4B (Residual Hydrant)	52 Ave – 52 St	-	70	78	11.4	60	72	20
	4C (Residual Hydrant)	52 Ave – 50 St	-	80	84	5	75	78	4

Table B-11: Calibrated Hazen Williams “C” coefficient

Material	Original Hazen Williams “C” coefficient	Calibrated Hazen Williams “C” coefficient
Unknown	130	150
AC	130	140
CI	100	100
DI	100	100
HDPE	150	150
PE	140	150
PVC	140	150



Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Fire Flow Testing Locations
- Pressure Zone Division Line
- Pipes
- Hydrants
- Control Valves
- Reservoirs

McElhanney

0 160 320 640 960 (m)

1:15,000

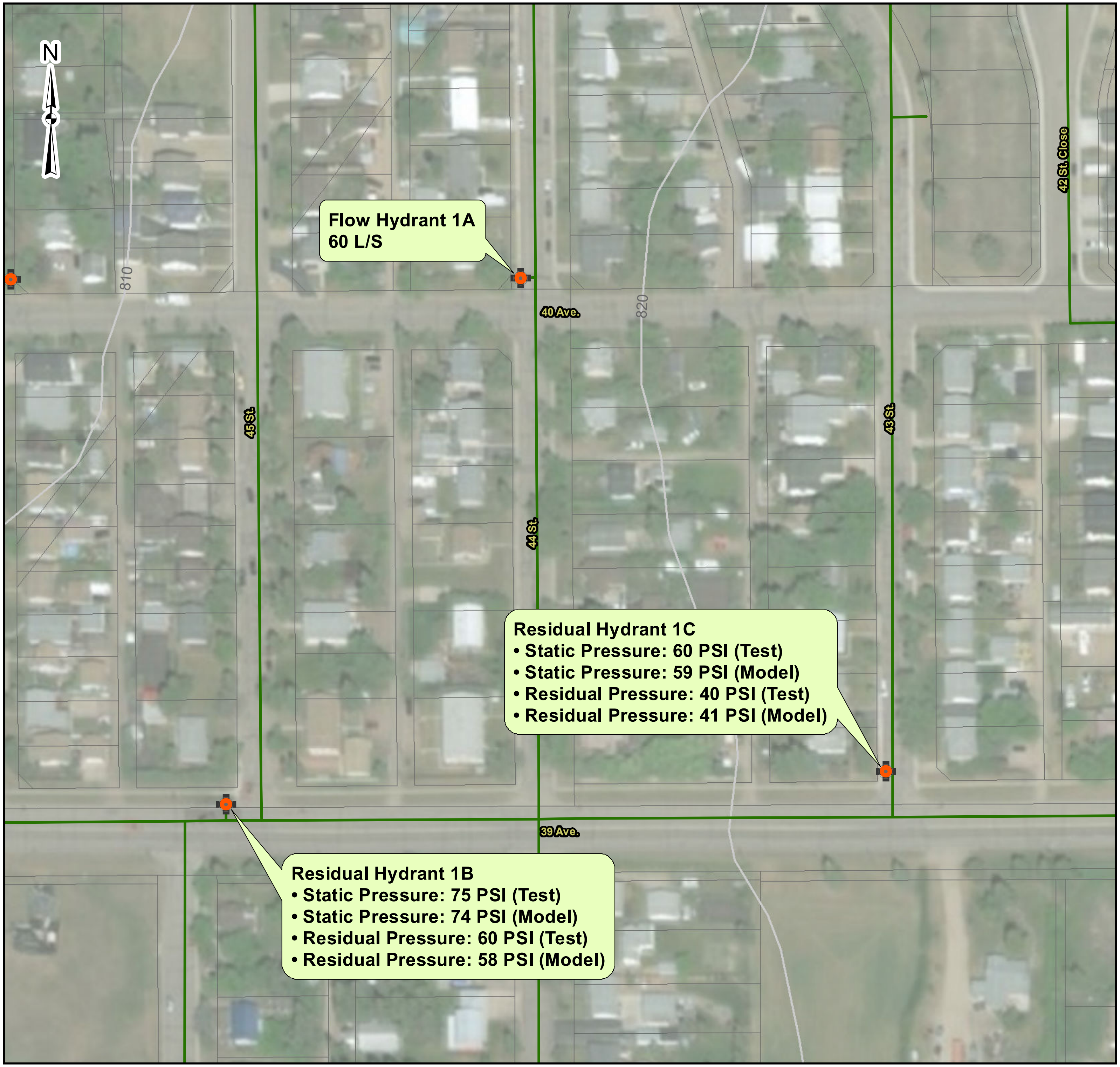
Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 28, 2018

Fire Flow Testing Location Map

Figure B4

Document Path: L:\Proj\Projects\2131 - Edmonton\2131-00247-00 Engineering Services Town of Ponoka\2131-00247-14 Master Servicing Study Re-Write\2.0 Documents\2.4 Reports\2.4.5 Figures\Water\Figure B4 - Fire Flow Testing Location Map.mxd Author: hshin



Master Servicing Study

Ponoka

Legend

- Hydrants
- Pipes

McElhanney

0 10 20 40 60 (m)

1:1,800

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 28, 2018

Fire Flow Testing Location #1

Figure B5

Document Path: C:\Users\hshin\Downloads\ArcGIS\Ponoka\2.4.5 Figures\Water\Figure B5 - Fire Flow Testing Location #1.mxd Author: hshin

Master Servicing Study

Ponoka

Legend

- Hydrants
- Pipes

McElhanney

0 10 20 40 60 (m)

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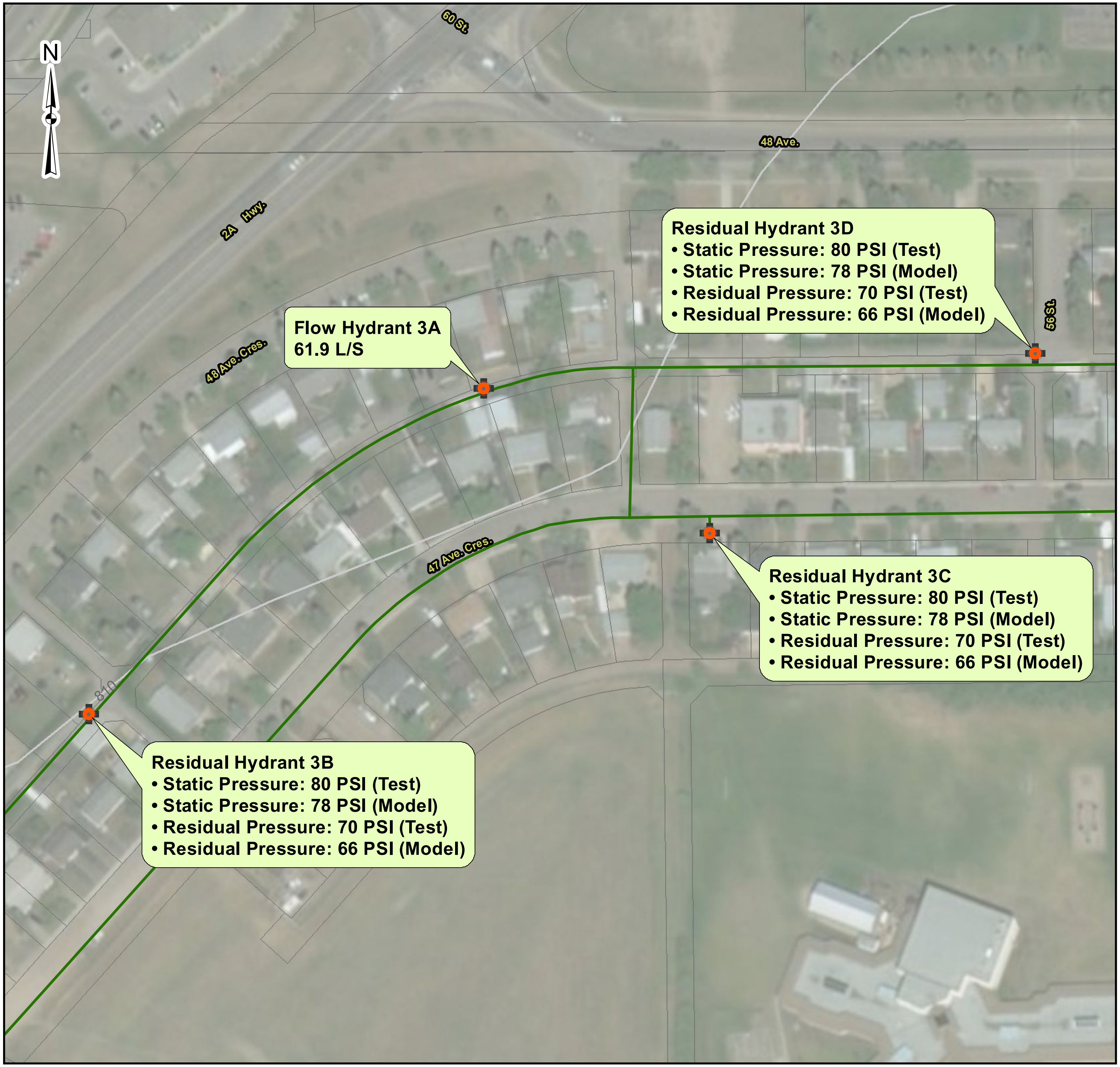
Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 28, 2018

Fire Flow Testing Location #2

Figure B6



Master Servicing Study

Ponoka

Legend

- Hydrants
- Pipes

McElhanney

0 10 20 40 60 (m)

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Coordinate System: NAD 1983 CSRS 3TM 114

Project No. 2131-00247-14

Date Mar 28, 2018

Fire Flow Testing Location #3

Figure B7

Document Path: L:\Proj\Projects\2131 - Edmonton\2131-00247-00 Engineering Services Town of Ponoka\2131-00247-14 Master Servicing Study Re-Write\2.0 Documents\2.4 Reports\2.4.5 Figures\Water\Figure B7 - Fire Flo

Document Path: C:\Users\hshin\Downloads\ArcGIS\Ponoka\2.4.5 Figures\Water\Figure B8 - Fire Flow Testing Location #4.mxd Author: hshin

Master Servicing Study

Ponoka

Legend

- Hydrants
- Pipes

McElhanney

0 10 20 40 60 (m)

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Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 28, 2018

Fire Flow Testing Location #4

Figure B8

B.5. Capacity Analysis of Existing Water System

B.5.1 Storage Reservoir Capacity

The storage capacity of the existing reservoirs according to the Master Servicing Study 2013 Update is summarized in *Table B-12*. This table also shows the storage capacity requirements.

Table B-12: Existing and Required Storage

Booster Station	Existing Storage (m^3)	[A] - Fire Storage (m^3)	[B] Equalization Storage (m^3)	[C] Emergency Storage (m^3)	Required Storage (m^3)
		13,500 l/min for 2 hours	25% of MDD	15% of ADD	[A] + [B] + [C]
39th Avenue	4,600	1620	1,805	840	4,265
Lucas Heights	4,600				
Riverside	900				
Total	**10,100**				

The City of Red's *Deer Design Guidelines 2016* and the Alberta Environment and Parks' *Standard and Guidelines for Municipal Water Works 2012* refer to the FUS 1999 *Water Supply for Public Fire Protection* for the calculation of fire flow requirements. In the required storage calculation of *Table B-12*, a fire flow of 13,500 l/min is used. This flow rate is typically used as the minimum requirement for the servicing of industrial areas.

According to the Master Servicing Study 2013 Update, the NRDRWSC Regional System requires a storage capacity of 3 days. Therefore, the required total volume is **12,795 m^3**. This value is above the existing storage capacity of **10,100 m^3**.

This storage calculation assumes that the emergency storage is greater than the required disinfection chorine contact time storage.

B.5.2 Booster Stations Capacity

The capacity of the Town's booster stations was reviewed to determine their ability to provide sufficient flow at an adequate pressure. The conducted simulations revealed that in general, the three booster stations have capacity to provide existing PHD at adequate pressures. However, the pressure at certain nodes falls below the minimum 300 KPa. Similarly, during the MDD plus fire flow scenario, the pressure at certain nodes falls below the minimum 150 kPa when delivering the minimum fire flow for industrial and commercial areas. The results of this assessment are further described in the following sections.

B.5.3 Distribution Network Capacity

The capacity assessment of the water distribution network was carried out using the existing demands summarized in *Table B-7*. These demands were calculated using the per capita (residential) and per unit area (ICI) demands recommended by the City of Red Deer Design Guidelines.

The demands were added to the calibrated WaterCAD model and steady-state simulations for the ADD, MDD and PHD scenarios were carried out to review service pressures and pipe velocities throughout the system. The results from these simulations are summarized in the following sub-sections.

Average Day Demand

The ADD for the entire town is estimated to be 64.7 l/s. This demand is higher than the ADD calculated from the annual metered water consumption (section B.4.2). The 64.7 l/s ADD can be interpreted as the total demand considering the full development of the existing servicing areas. Under current conditions, many of the ICI areas have been partially developed.

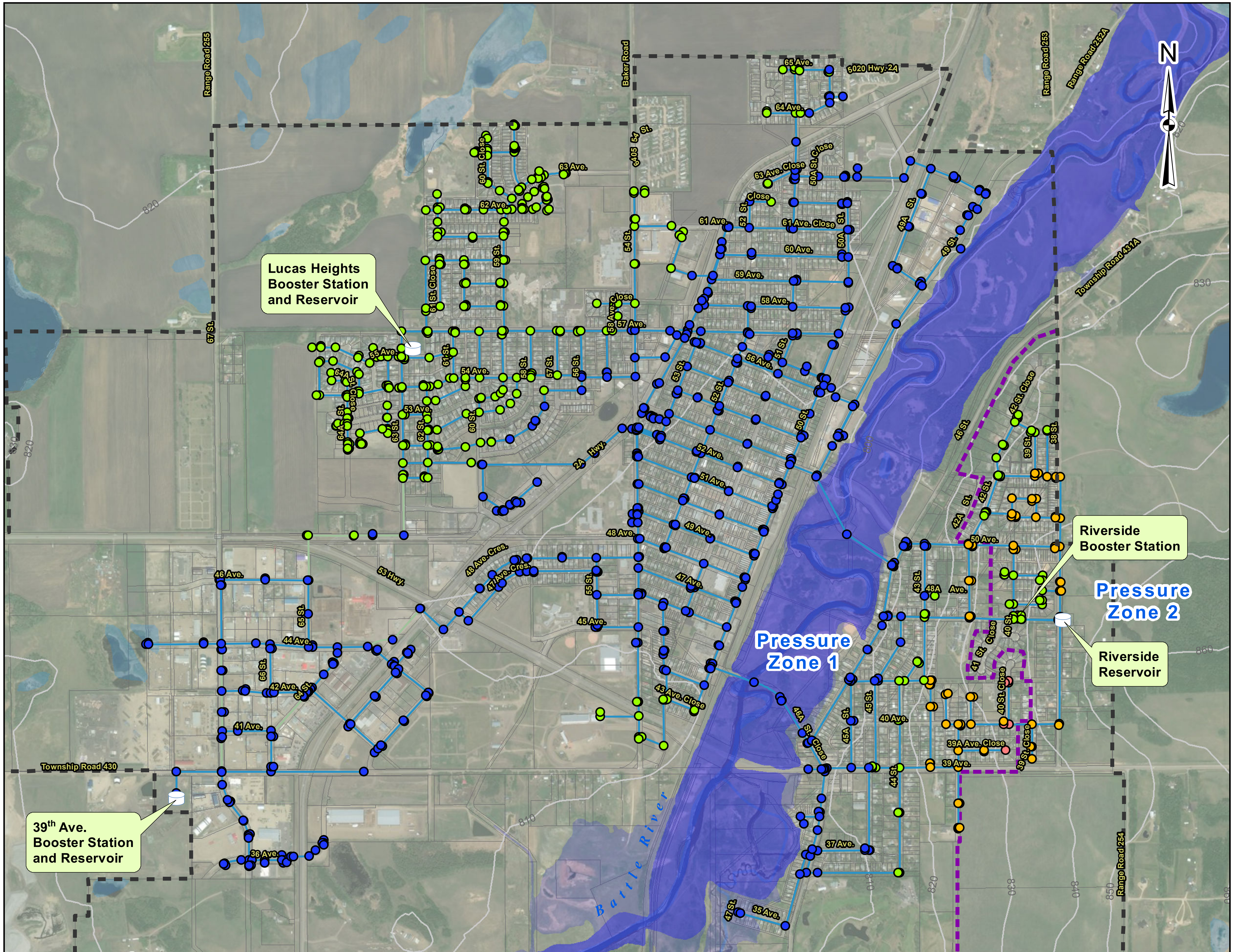
Figure B-9 illustrates the node pressures and pipe velocities under this scenario. 6 nodes experience pressures below 300 kPa, all of them located in PZ1 along 40 Street Close and 39A Avenue Close. The low pressures occur at the higher elevated areas of PZ1. This suggests that the current boundary between pressure zones may need to be adjusted. The node pressures at the industrial area west of Highway 2A ranges between 500 and 600 kPa. The maximum pipe velocity under this scenario is 0.7 m/s.

Maximum Day Demand

The MDD for the entire town is estimated to be 83.2 l/s. This demand is higher than the MDD estimated from the pressure readings conducted during the site visit (section B.1.3). The 83.2 l/s MDD can be interpreted as the total demand considering the full development of the existing servicing areas. *Figure B-10* illustrates the node pressures and pipe velocities under the MDD scenario. Seven (7) nodes experience pressures below 300 kPa, all of them located in PZ1 along 40 Street Close and 39A Avenue Close. The maximum pipe velocity under this scenario is 0.9 m/s.

Peak Hour Demand

The PHD for the entire town is estimated to be 133.7 l/s. *Figure B-11* illustrates the node pressures and pipe velocities under the PHD scenario. Twenty-eight (28) nodes experience pressures below the minimum 300 kPa pressure specified by the City of Red Deer Design Guidelines. All the low-pressure nodes are located at the higher elevated areas of PZ1, east of 43 Street. The minimum pressure is 224 kPa at the end of 40 Street Close. The maximum pipe velocity under this scenario is 1.34 m/s. Therefore, all the pipes in the system meet the velocity limit of 1.5 m/s for PHD conditions.



Document Path: C:\Users\hshin\Downloads\ArcGIS\Ponoka\2.4.5 Figures\Water\Figure B9 - Average Day Demand Analysis of Existing System.mxd
Author: hshin

Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Pressure Zone Division Line
- Reservoirs

Velocity (l/s)

- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- Above 2.0

Pressure (kPa)

- 200 - 300
- 300 - 400
- 400 - 500
- 500 - 600

McElhanney

0 160 320 640 960 (m)

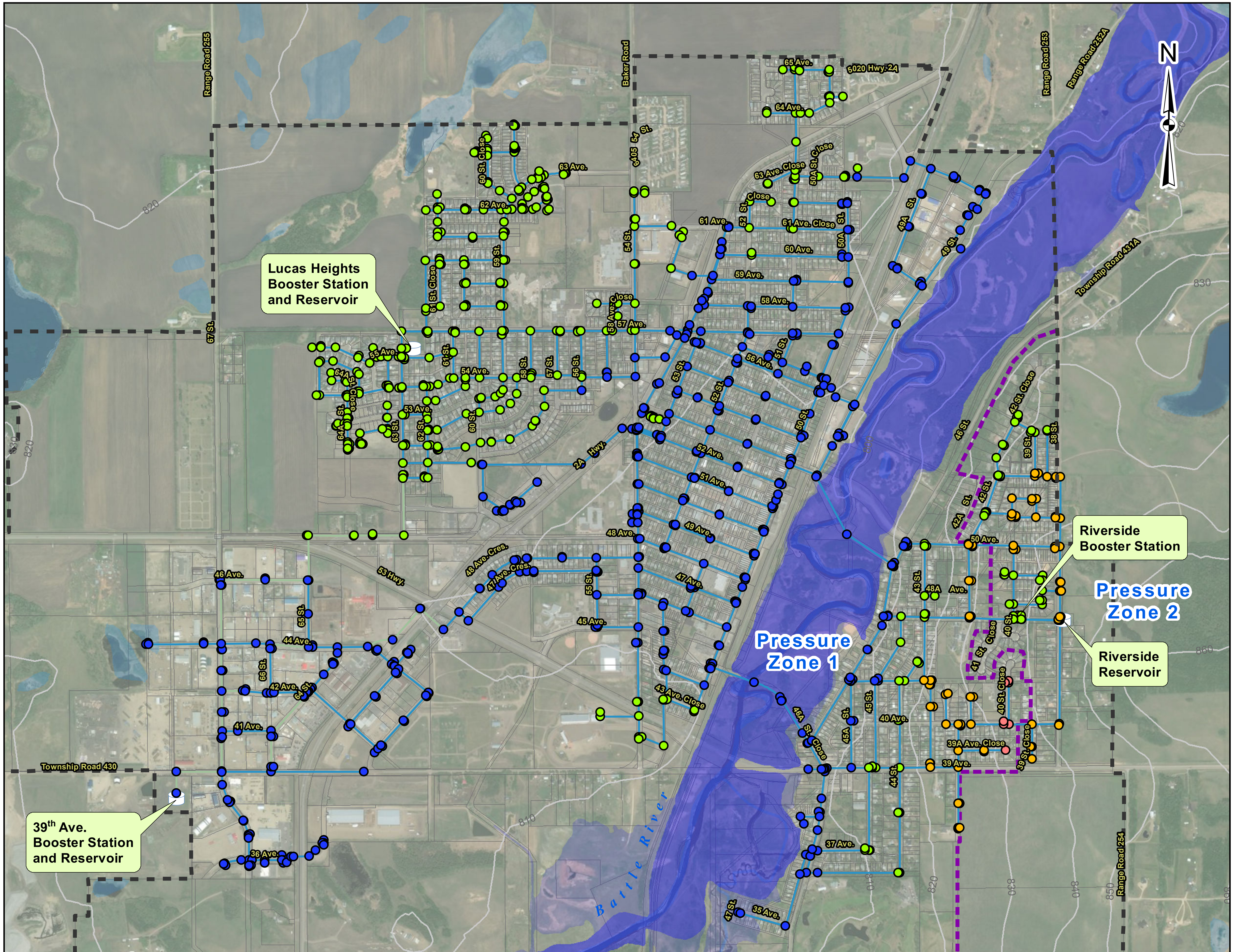
1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 28, 2018

Average Day Demand Analysis of Existing System

Figure B9



Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Pressure Zone Division Line
- Reservoirs

Velocity (l/s)

- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- Above 2.0

Pressure (kPa)

- 200 - 300
- 300 - 400
- 400 - 500
- 500 - 600

McElhanney

0 160 320 640 960 (m)

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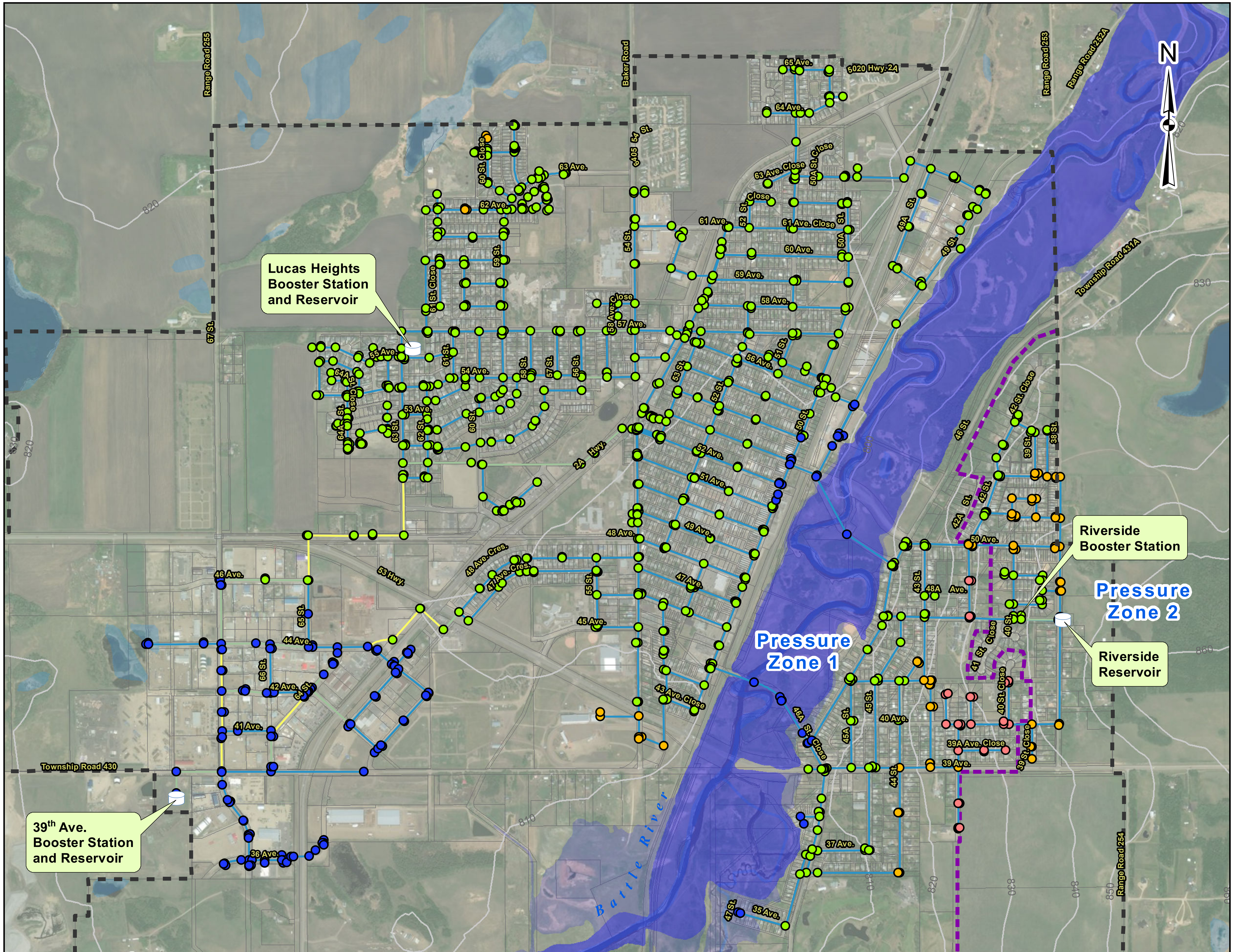
Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 28, 2018

Maximum Day Demand Analysis of Existing System

Figure B10



Master Servicing Study

Legend

Town Boundary

Floodway

Flood Fringe

Pressure Zone Division Line

Reservoirs

Velocity (l/s)

- 0.0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- Above 2.0

Pressure (kPa)

- 200 - 300
- 300 - 400
- 400 - 500
- 500 - 600
- 600 - 700

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 28, 2018

Peak Hour Demand Analysis of Existing System

Figure B11

B.5.4 Fire Flow Capacity Analysis

A Fire Flow Capacity Analysis was conducted in WaterCAD to determine the maximum flow that can be delivered at each node representing fire hydrants, while keeping the minimum residual pressure of 150 kPa in the system. The results from this analysis are depicted in *Figure B-12*.

The City of Red Deer's Design Guidelines requires a minimum fire flow of 75 l/s for single family residential areas. For other land uses, the design guidelines refer to the Fire Underwriters Survey's *Water Supply for Public Fire Protection.* For this study, the following minimum fire flows were considered:

- Residential: 75 l/s
- Commercial: 150 l/s
- Institutional: 150 l/s
- Industrial: 225 l/s

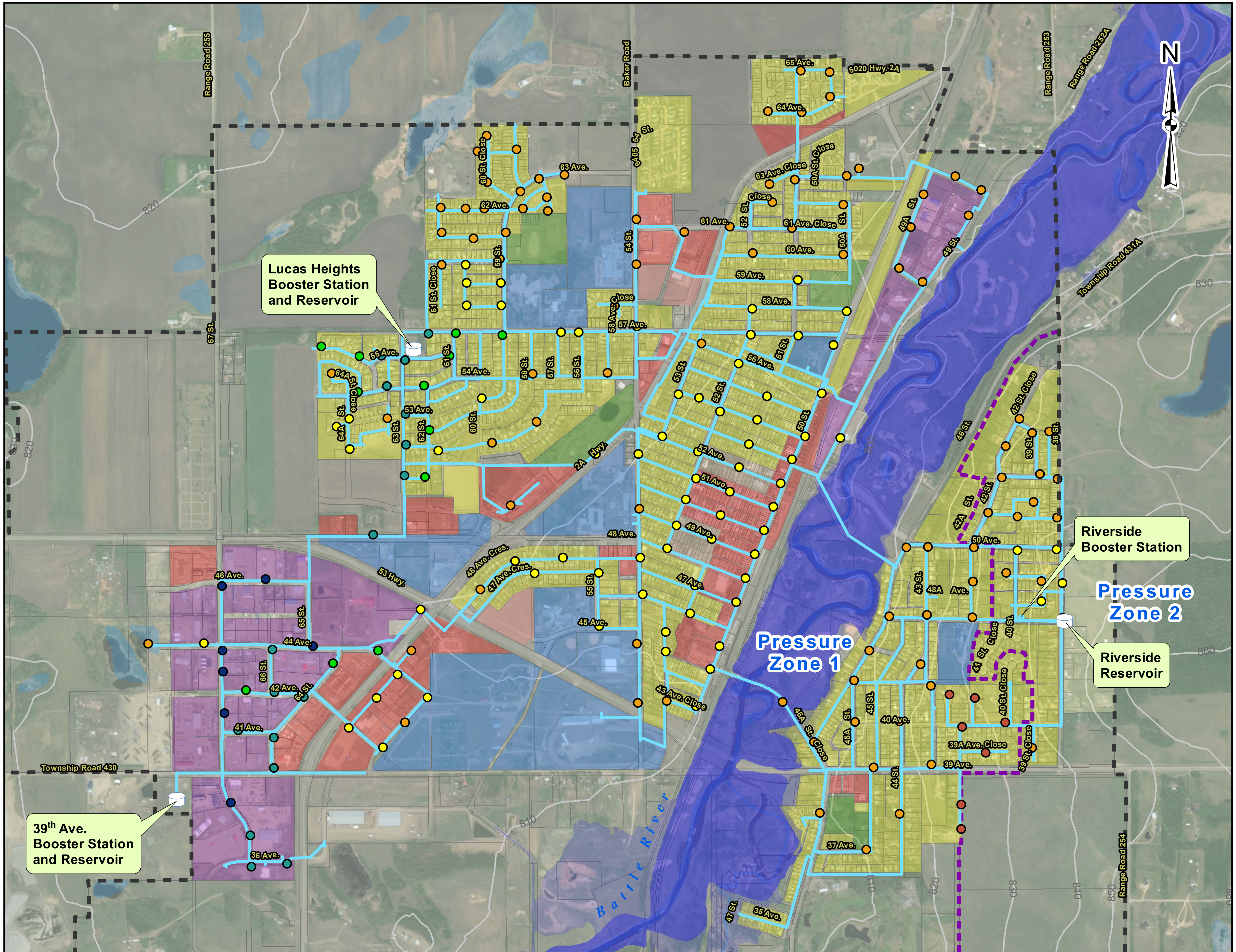
Table B-13 summarizes the number of nodes unable to supply the required fire flow at the minimum pressure. Most of the deficient hydrants are in the industrial areas east of Highway 2A, and in the industrial areas along 49 and 49A Streets.

Table B-13: Fire Flow Assessment Results

Land Use	Desired Fire Flow (l/s)	Number of Nodes with Deficient Fire Flow	Number of Nodes with Sufficient Fire Flow
Residential	75	7	117
Commercial	150	3	23
Institutional	150	6	14
Industrial	225	15	12
Total		**31**	**166**

B.5.5 Hydrant Coverage

Figure B-13 illustrates the location of the hydrants according to the Town's GIS information and the area of influence for each hydrant, considering a 180m diameter coverage for hydrants in residential areas, and 90m coverage in industrial, commercial and institutional areas. Most of the Town has a good fire hydrant coverage. However, in some areas the hydrant coverage seems to be limited. These areas include 38 Street, between 40 and 46 Avenue, and the industrial area east of Highway 2A. A site investigation is recommended to verify the hydrants locations from the GIS information and confirm the findings of this assessment. Hydrants should be installed in those areas where the limited hydrant coverage is confirmed.



Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Pressure Zone Division Line
- Pipes
- Reservoirs

Land Use

- Commercial
- Commercial Expansion
- Direct Control
- Industrial
- Institutional
- Parks Open Space
- Residential
- Residential Expansion

Total Flow Available at Hydrants (l/s)

- 50 - 75
- 75 - 150
- 150 - 200
- 200 - 250
- 250 - 300
- Above 300

McElhanney

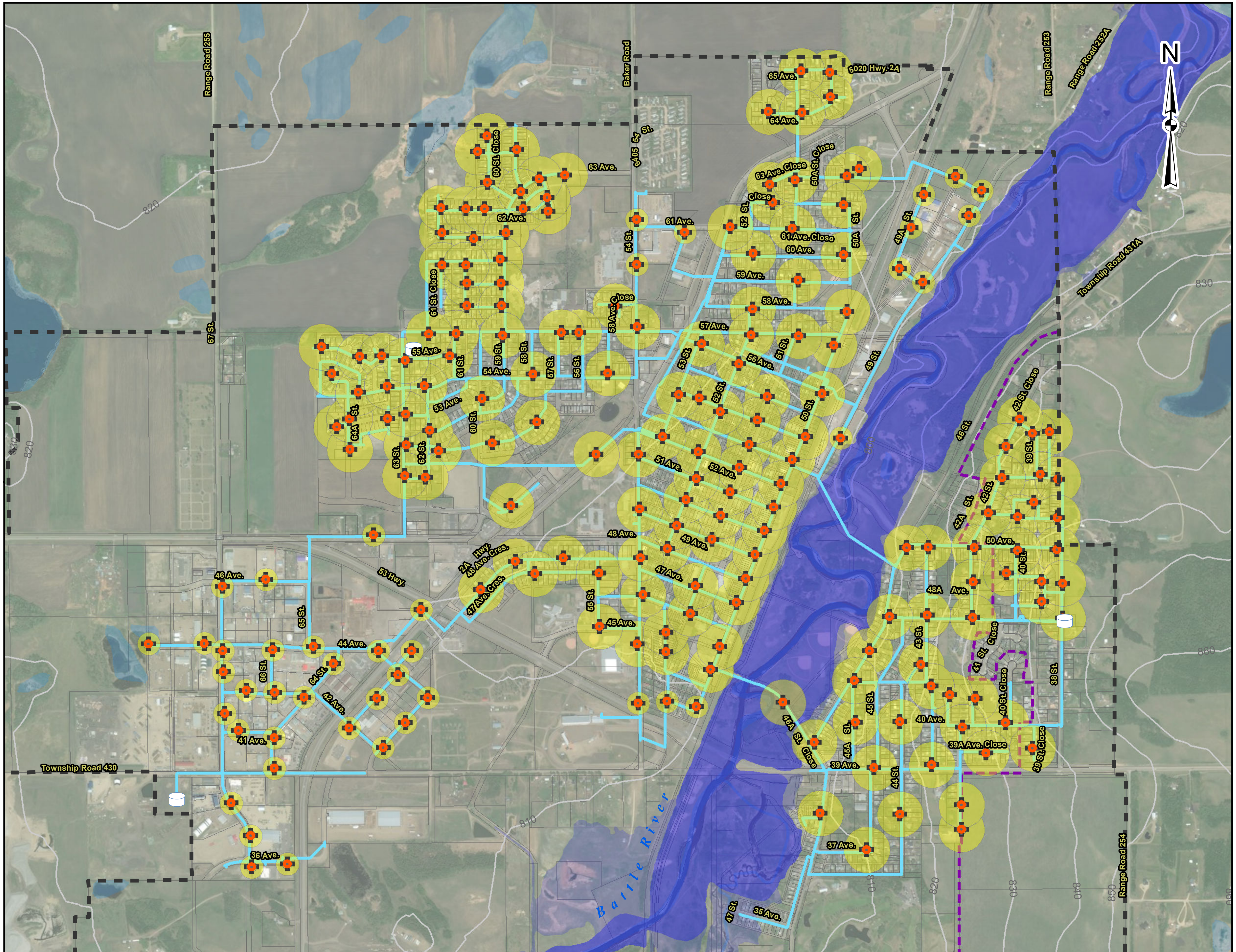
0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 28, 2018

Fire Flow Analysis: Total Flow Available (Considering Minimum Pressure) **Figure B12**



Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Hydrants Coverage
- Pressure Zone Division Line
- Pipes
- Hydrants
- Reservoirs

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 28, 2018

Hydrant Coverage

Figure B13

B.5.6 Upgrades to Existing Water System, Phasing and Implementation

The proposed work to overcome the deficiencies described in the previous sections is depicted in *Figure B-14* and summarized in *Table B-14*. These upgrades include the installation of a new PRV station to connect the two pressure zones that are currently isolated. An adjustment to the pressure zone boundary is recommended between 50 Avenue and 39 Avenue. Valve closures will be required at 50 Avenue and 48 Avenue, as shown in *Figure B-14*.

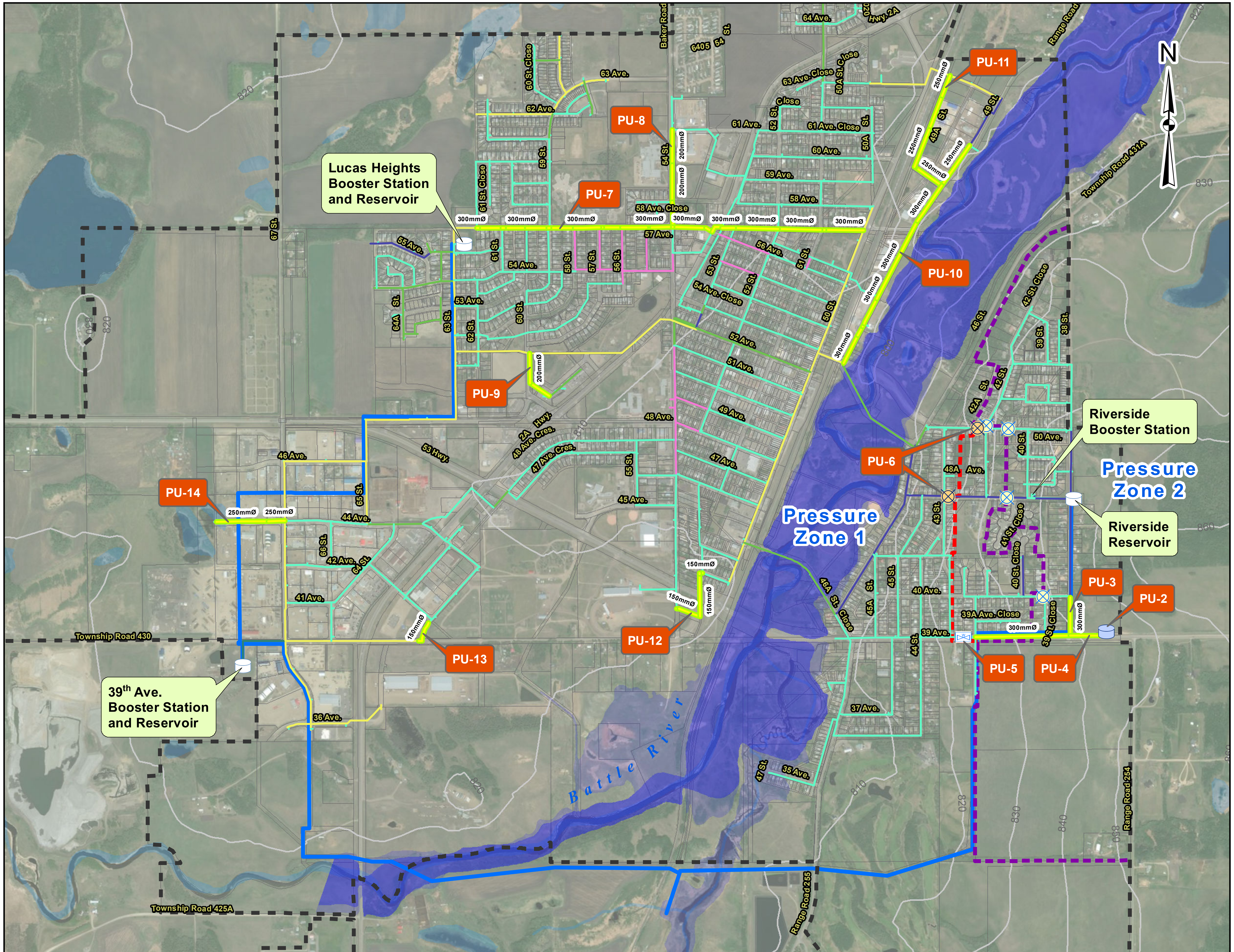
Table B-14: Existing System Upgrade Recommendations

Item	Proposed Work	Deficiency Resolved	Additional Recommendations
PU-1	New 150m - 300mmΦ supply connection from the NRDRWSC Regional System.		
PU-2	New 3,000 m^3 reservoir tank and new booster station east of 38 Street.	Storage capacity Low service pressures Reduced fire flow	
PU-3	New 160m - 300mmΦ watermain along 38 Street	Low service pressures Reduced fire flow	
PU-4	New 550m - 300mmΦ watermain along 39 Avenue	Low service pressures Reduced fire flow	
PU-5	New PRV station at 39 Avenue	Connect pressure zones	
PU-6	Open existing valves, and install and close new valves at 50 Avenue and 48 Avenue.	Adjustment of pressure zone boundary	Verify the location of the existing valves
PU-7	Upsize existing watermain at 57 Avenue: 1,600m - 300mmΦ	Reduced fire flow	
PU-8	Upsize existing watermain at 54 Street: 400m - 200mmΦ	Reduced fire flow	
PU-9	Upsize existing watermain at 60 Street: 225m - 200mmΦ	Reduced fire flow	
PU-10	Upsize existing watermain at 49 Street: 1050m - 300mmΦ	Reduced fire flow	
PU-11	Upsize existing watermain at 49A Street: 545m - 250mmΦ	Reduced fire flow	
PU-12	Upsize existing watermain at 52 Street: 300m - 150mmΦ	Reduced fire flow	
PU-13	New watermain at 62 Street: 110m - 150mmΦ	Reduced fire flow	
PU-14	Upsize existing watermain at 52 Street: 100m - 250mmΦ	Reduced fire flow	
PU-15	Install new hydrants	Reduced hydrant coverage	Not shown in Figure B-14. Number and location to be determined after site investigation

Upgrades PU-1 and PU-2 will provide the required storage capacity under existing conditions. Upgrade PU-3 to PU-15 aim to increase fire flow availability at critical areas. Therefore, all the upgrades should be considered as high-priority and should be addressed within the 5-year or 10-year development plan.

The following section describes the proposed water strategy plan to service future developments. This plan considers that the proposed upgrades to the existing system will be carried out before future development occurs.

The booster station recommended for PU-2 should be sized for the future development conditions (*Table B-16*).



Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Pressure Zone Division Line
- Proposed Pressure Zone Change
- NRDRWSC Regional System
- Upgraded Pipes
- Existing Control Valves
- Proposed Control Valves
- Existing Reservoirs
- Proposed Reservoir
- Prpoposed PRV

Pipe Sizes (mmØ)

- 100
- 150
- 200
- 250
- 300
- 400

McElhanney

0 170 340 680 1,020 (m)

1:16,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 28, 2018

Proposed Upgrades to Existing System

Figure B14

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Author: hshin

B.6. Future Water System

The Town of Ponoka has approximately 670 ha of undeveloped land scheduled to be developed as part of the MDP at present at the edges of Town, along with several undeveloped parcels within the Town. The proposed water servicing strategy to service the future development areas can be found in *Figure B-15*. The following sections describes the components of the future water system.

B.6.1 Storage Reservoir

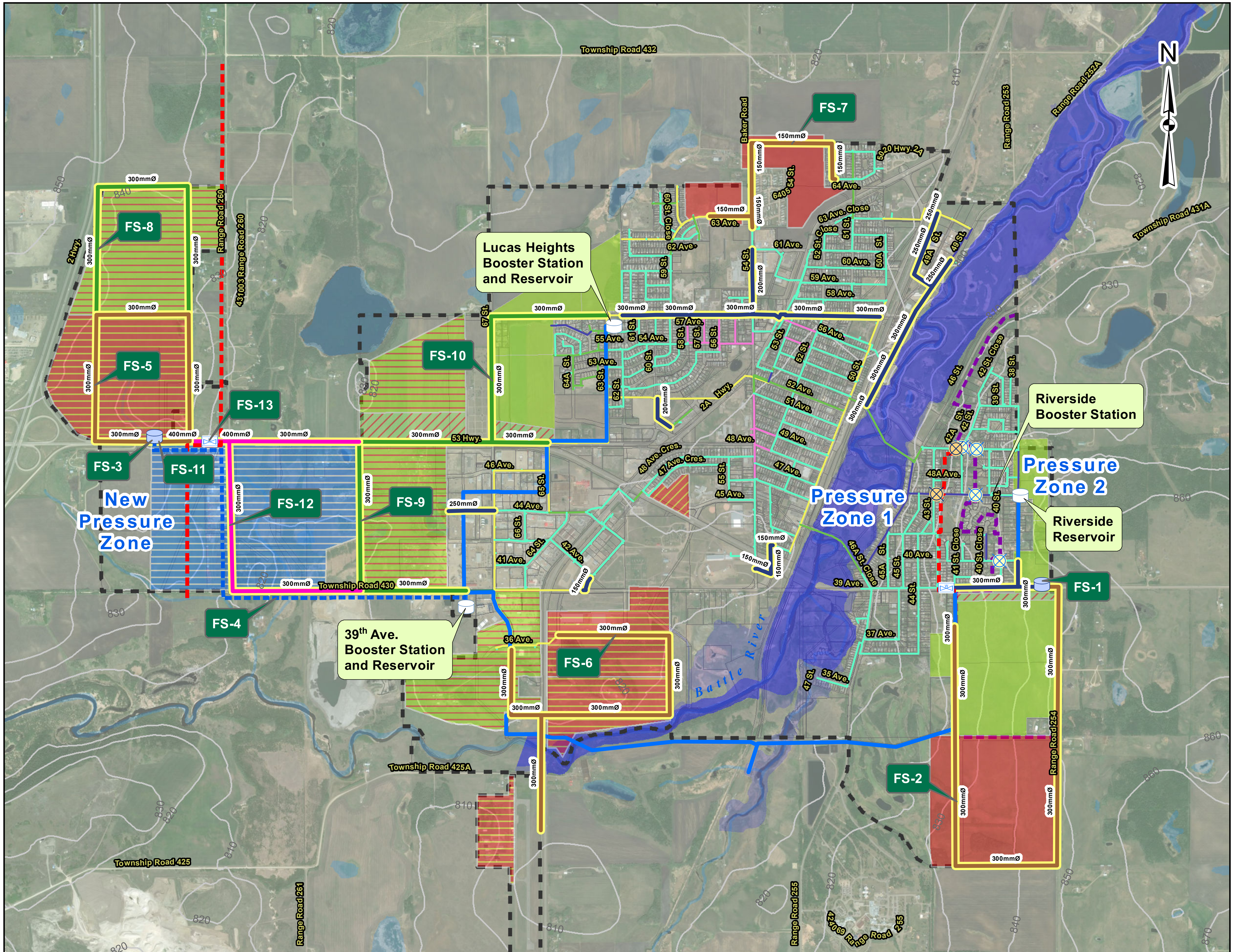
The calculation of the required storage for future conditions is summarized in *Table B-15*.

Table B-15: Required Storage

	[A] - Fire Storage (m^3)	[B] Equalization Storage (m^3)	[C] Emergency Storage (m^3)	Required Storage (m^3)	
	13,500 l/min for 2 hours	25% of MDD	15% of ADD	[A] + [B] + [C]	3-days Required Storage (m3)
Current	1,620	1,805	840	4,265	12,795
5-years	1,620	2,330	1,140	5,090	15,270
10-years	1,620	3,077	1,510	6,207	18,621
25-years	1,620	3,734	1,830	7,184	21,552

The future demands presented in *Table B-9* and a fire flow of 13,500 l/min are used in this calculation. In addition to the 3,000 m^3 reservoir recommended in *Section B.5.6*, an additional storage capacity of 8,500 m^3 is needed to satisfy the future 25-years requirement of 21,552 m^3. We recommend expanding the proposed 3,000 m^3 reservoir to 6,000 m^3, and the construction of a new 6,000 m^3 reservoir on highway 53, west of Range Road 260. The proposed location for this new reservoir is shown in *Figure B-15*.

Section B.6.5 describes the proposed phasing for the new reservoirs.



Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Pressure Zone Division Line
- Proposed Pressure Zone Change
- NRDRWSC Regional System
- Future NRDRWSC Regional System Connection
- Existing Control Valves
- Proposed Control Valves
- Existing Reservoirs
- Proposed Reservoir
- Proposed PRVs

Pipe Sizes (mmØ)

- 100
- 150
- 200
- 250
- 300
- 400

Future Land Use

- 5 Years - Commercial
- 5 Years - Industrial
- 5 years - Residential
- 10 Years - Commercial
- 10 Years - Industrial
- 10 Years - Residential
- 25 Years - Industrial

Propose Upgrade and Future Developments

- Upgrade
- 5 Years
- 10 Years
- 25 Years

McElhanney

0 255 510 1,020 1,530 (m)

1:24,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 28, 2018

Proposed System to Service Future Developments

Figure B15

Document Path: L:\Proj\Projects\2131 - Edmonton\2131-00247-00 Engineering Services Town of Ponoka\2131-00247-14 Master Servicing Study Re-Write\2.0 Documents\2.4 Reports\2.4.5 Figures\Water\Figure B15 - Proposed System to Service Future Developments.mxd

Author: hshin

B.6.2 Booster Stations

The proposed reservoirs should be paired with a new booster station. *Table B-16* presents the total flow and pressure head that these reservoirs will provide at the point of discharge under PHD and fire flow conditions. Booster station FBS-1 is required to satisfy both existing and future demands.

Table B-16: Future Booster Stations

Booster Station	Location	PHD		Fire Flow 13,500 l/min	
		Flow (l/s)	Head (m)	Flow (l/s)	Head (m)
FBS-1	39 Avenue and east of 38 Street	25	35	200	35
FBS-2	Highway 53 and west of Range Road 260	65	45	245	45

The proposed servicing strategy does not consider the upsizing of any pumps in the Lucas Heights, Riverside and 39th Avenue booster stations.

B.6.3 Distribution Network

Figure B-15 illustrates the distribution network that will service future developments. The proposed system is laid out as a looped-grid network connected to the existing watermains at several tie-in points. The final configuration considers the establishment of a new water pressure zone to the west of the town following the 820m contour. The hydraulic grade line (HGL) of this new pressure zone is approximately 880m. The proposed 6,000 m^3 reservoir will be located within the new pressure zone, and as shown in *Figure B-15*, a pressure reducing valve (PRV) will be required at the boundary of the pressure node.

A summary of total length and sizes of the future watermains are presented in *Table B-17*.

B.6.4 Phasing and Implementation

Future developments will determine the phasing for the proposed water system. The Town defined three develop horizons of 5, 10 and 25 years. *Table B-17* and *Figure B-15* presents the recommended phasing for each of the proposed components.

Table B-17: Proposed Infrastructure to Service Future Areas

Item	Proposed Work	Phasing
FS-1	Expansion/construction of reservoir tank east of 38 Street. Total capacity: 6,000 m^3.	Short-term
FS-2	New 4,000m - 300mmΦ grid south of 39th Avenue and east of 44 Street.	Short-term
FS-3	New 3,000 m^3 reservoir and booster station on Highway 53.	Short-term
FS-4	New 2,900m - 300mmΦ supply connection from the NRDRWSC Regional System.	Short-term
FS-5	New 2,800m - 300mmΦ grid to service industrial areas north of Highway 53	Short-term

FS-6	New 3,300m - 300mmΦ grid and watermain to service industrial areas west of Highway 2A and the future development south of Battle River	Short-term
FS-7	New 1600m - 150mmΦ grid and watermain to service the future residential developments around Baker Road.	Short-term
FS-8	New 2,200m - 300mmΦ grid to service industrial areas north of Highway 53	Intermediate-term
FS-9	New 2,800m - 300mmΦ grid to service industrial areas and connect the watermains on 39th Avenue and 48th Avenue	Intermediate-term
FS-10	New 1,500m - 300mmΦ grid to service industrial areas and connect the FS-9 grid to the existing watermain on 57th Avenue	Intermediate-term
FS-11	Expand FS -3 reservoir to provide a total storage capacity of 6,000 m^3	Long-term
FS-12	New 1,800m - 300mmΦ to connect FS-5 / FS-8 grid to the Town's distribution system	Long-term
FS-13	New PRV Station	Long-term

To service the short-term developments (5 years), the recommended 3,000 m^3 reservoir (FS-1 in *Figure B-15*) will have to be expanded to provide a total storage capacity of 6,000 m^3. The industrial developments south of 39 Avenue and east of 44 Street will be serviced by a new 300mmΦ looped grid (FS-2 in *Figure B-15*) connected to the existing system at the proposed watermain along 39 Avenue and at the existing watermain on 42 Street. A new 3,000 m^3 reservoir and booster station (FS-3) will service the industrial areas to the west of the Town. This reservoir will be connected to the NRDRWSC Regional System through a 300mmΦ supply main (FS-4). The booster station will feed a new 300mmΦ looped grid (FS-5) that will be temporarily disconnected from the Town's existing system. Another 300mmΦ looped watermain is needed to service the industrial areas west of Highway 2A and the future development south of Battle River (FS-6). This grid will connect to the existing system at the watermain along 36 Avenue. Finally, a new watermain is proposed at the future residential developments around Baker Road (FS-7). This 150mmΦ watermain will connect the existing watermains on 63 Avenue and 65 Avenue.

The intermediate-term developments (10 years) will require the extension of the proposed 300mmΦ grid on the west side of the Town (FS-8). A new grid will connect the watermains on 39 Avenue and 48 Avenue (FS-9), and a proposed 300mmΦ watermain will connect this grid to the existing watermains on 57 Avenue (FS-10). The future residential area south of 39 Avenue and east of 44 Street will be serviced by the 300mmΦ grid proposed as part of the short-term development (FS-2).

For the long-term developments (25 years), the new reservoir to the west of the Town will have to be expanded to provide a storage capacity of 6,000 m^3 (FS-11). This will increase the total storage capacity in the town's reservoirs to 22,100 m^3. The grid fed by this reservoir will be connected to the Town's distribution network (FS-12), as shown in *Figure B-15*. A PRV will be required to separate the proposed pressure zone (FS-13).

B.7. Costing

The costing completed is based on previous projects completed in the area, budget pricing provided by a contractor and the Price Averages Reports for the City of Calgary. *Table B-18* presents the preliminary costing for the recommended upgrades, and *Table B-19* provides the preliminary costing for the future water system. A full breakdown of the costs can be found in *Appendix B-4*.

Table B-18: Preliminary Costing for Proposed Upgrades

Item	Proposed Work	Preliminary Project total Estimate
PU-1	New 150m - 300mmΦ supply connection from the NRDRWSC Regional System.	**$76,650**
PU-2	New 3,000 m^3 reservoir tank east of 38 Street	**$11,550,000**
	New booster station east of 38 Street.	**$1,400,000**
PU-3	New 160m - 300mmΦ watermain along 38 Street	**$81,760**
PU-4	New 550m - 300mmΦ watermain along 39 Avenue	**$281,050**
PU-5	New PRV station at 39 Avenue	**$210,000**
PU-6	Install new gate valves at 50 Avenue and 48 Avenue.	**$12,600**
PU-7	Upsize existing watermain at 57 Avenue: 1,600m - 300mmΦ	**$817,600**
PU-8	Upsize existing watermain at 54 Street: 400m - 200mmΦ	**$156,800**
PU-9	Upsize existing watermain at 60 Street: 225m - 200mmΦ	**$88,200**
PU-10	Upsize existing watermain at 49 Street: 1050m - 300mmΦ	**$536,550**
PU-11	Upsize existing watermain at 49A Street: 545m - 250mmΦ	**$263,235**
PU-12	Upsize existing watermain at 52 Street: 300m - 150mmΦ	**$102,900**
PU-13	New watermain at 62 Street: 110m - 150mmΦ	**$37,730**
PU-14	Upsize existing watermain at 52 Street: 100m - 250mmΦ	**$48,300**

Table B-19: Preliminary Costing for Future Water System

Item	Proposed Work	Preliminary Project total Estimate
FS-1	Expansion of reservoir tank east of 38 Street.	**$11,550,000**
FS-2	New 4,000m - 300mmΦ grid south of 39th Avenue and east of 44 Street.	**$1,528,800**
FS-3	New 3,000 m^3 reservoir tank on Highway 53.	**$11,550,000**
	New booster station on Highway 53.	**$1,400,000**
FS-4	New 2,900m - 300mmΦ supply connection from the NRDRWSC Regional System.	**$1,108,380**
FS-5	New 2,800m - 300mmΦ grid to service industrial areas north of Highway 53	**$1,070,160**
FS-6	New 3,300m - 300mmΦ grid and watermain to service industrial areas west of Highway 2A and the future development south of Battle River	**$1,261,260**
FS-7	New 1600m - 150mmΦ grid and watermain to service the future residential developments around Baker Road.	**$414,400**
FS-8	New 2,200m - 300mmΦ grid to service industrial areas north of Highway 53	**$840,840**

FS-9	New 2,800m - 300mmΦ grid to service industrial areas and connect the watermains on 39th Avenue and 48th Avenue	**$573,300**
FS-10	New 1,500m - 300mmΦ grid to service industrial areas and connect the FS-9 grid to the existing watermain on 57th Avenue	**$573,300**
FS-11	Expand FS -3 reservoir	**$11,550,000**
FS-12	New 1,800m - 300mmΦ to connect FS-5 / FS-8 grid to the Town's distribution system	**$687,960**
FS-13	New PRV Station	**$210,000**

C. Wastewater Master Plan

This section presents the proposed Wastewater Master Servicing Plan for the Town of Ponoka. The following tasks were completed as part of the proposed plan:

1. A review of all completed wastewater studies and background information provided;
2. Development of an inventory of the Town's existing sewer collection system and facilities;
3. Development of a hydraulic model to analyse the existing system;
4. Use of the hydraulic model to identify system deficiencies;
5. Identify required upgrades for the existing system;
6. Complete a wastewater servicing strategy for the future proposed development areas; and
7. Prepare cost estimates for the various phased development stages.

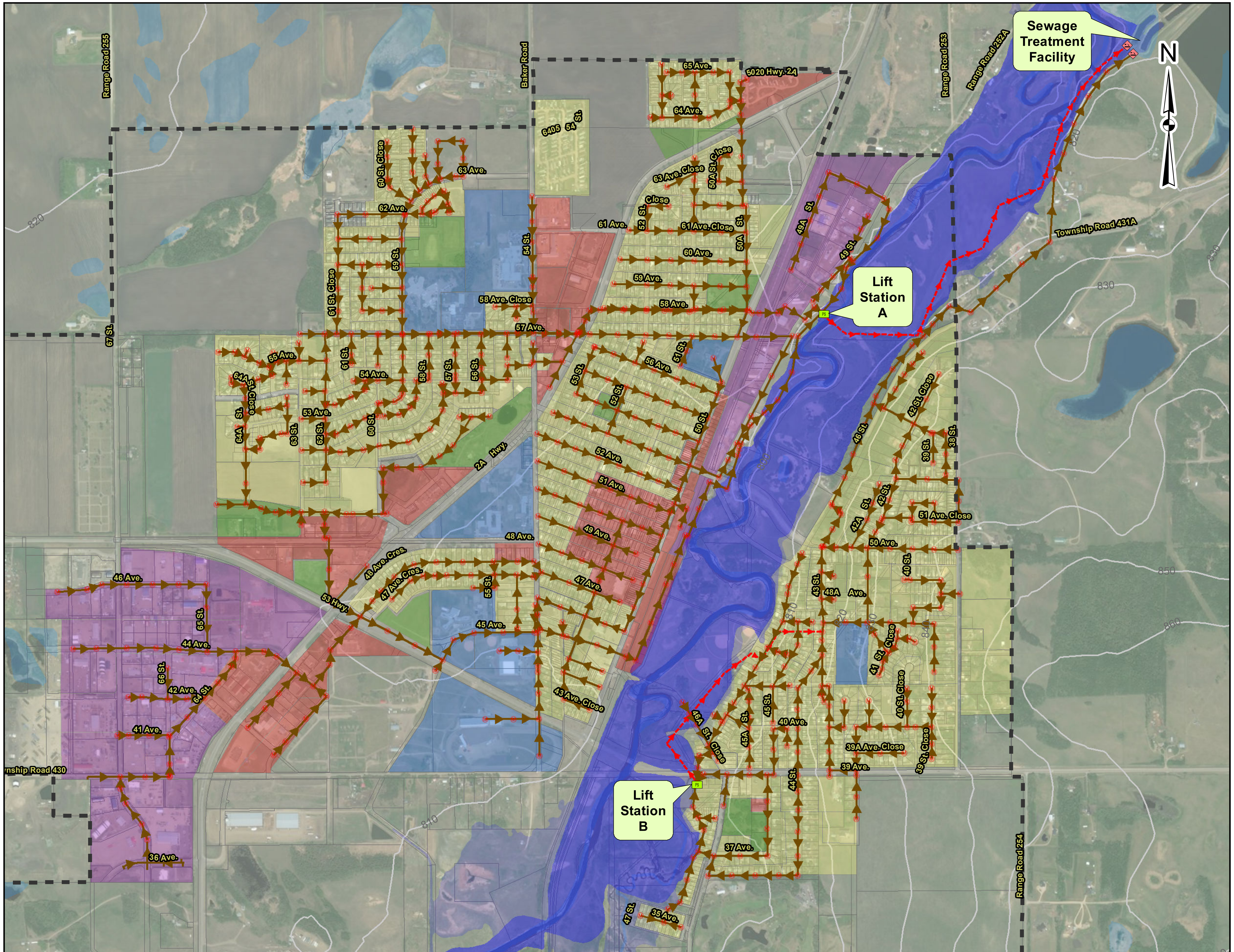
As part of the analysis McElhanney reviewed all the data available on the existing infrastructure. McElhanney conducted a field investigation of the lift stations and the treatment facility; the results of this field review can be found in *Appendix C-1*. This study identifies capacity limitations in the existing system and provides a recommended servicing strategy to allow for future expansion throughout the Town.

C.1. Introduction and Background

C.1.1 Background

The Town sanitary sewer system is comprised of a sanitary sewer gravity network, two lift stations (Lift Station A and Lift Station B), and two corresponding forcemains. Wastewater effluent is conveyed to the Town wastewater treatment facility; once treated, effluent is discharged to the Battle River. *Figure C-1* illustrates the Town's sewer collection system and its main components.

The Town's sanitary sewer system is essentially divided in two separate sections by the Battle River. Development west of the Battle River collects via a gravity sewer, and discharges to Lift Station A; Lift Station A pumps through a 500mm forcemain which discharges directly to the wastewater treatment facility. Currently, the furthest location serviced is the industrial park in the southwest. Development on the east side of the Battle River collects via a gravity sewer, and discharges to Lift Station B; Lift Station B pumps through a 200mm forcemain which discharges into a gravity sewer main. The gravity sewer main discharges to the wastewater treatment facility.



Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Existing Lift Stations
- Existing Manholes
- Existing Outfalls
- Existing Conduits
- Existing Force Mains

Land Use

- Commercial
- Industrial
- Institutional
- Residential
- Park

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 28, 2018

Existing Sanitary Collection System

Figure C1

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Author: hshin

Population

As described in *Section A.5*, population data and growth estimates were obtained from various sources, including the Town of Ponoka Growth Study 2009-2059 and the Canada 2016 Census. *Table C-1* summarizes the existing population estimate and the projected population for 5 years, 10 years and 25 years.

Table C-1: Population Summary

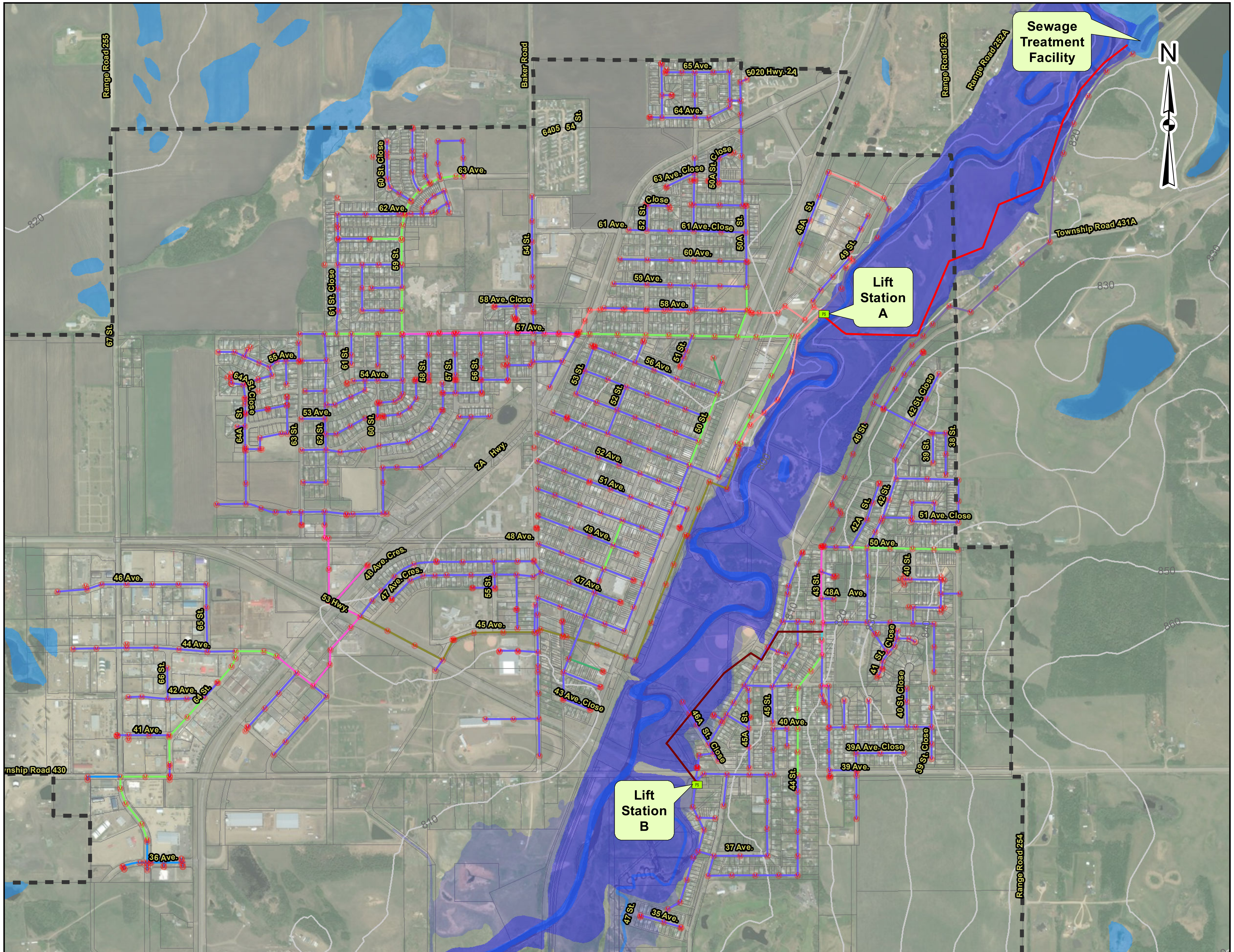
File No.	Population Estimate
Current	*7,229*
5 years	*7,771*
10 years	*8,354*
25 years	*10,234*

Sanitary Sewers

Table C-2 provides a summary of the sanitary sewers in the Town. The conduits from the GIS shape files were analyzed to identify any missing diameters. The missing sizes and invert elevations were obtained from utility maps, record DWG files and through discussions with staff from the Town. The sewer sizes range from 100mmΦ to 450mmΦ. As shown in *Table C-2* approximately 50% of the sanitary sewer network is comprised of vitrified clay pipes. *Figures C-2 and C-3* illustrates graphically the size and materials of the sewers.

Table C-2: Pipe Material Information

Material	Smallest Size (mm)	Largest Size (mm)	Length (m)
Unknown	100	375	14,389
AC	200	450	2,928
Concrete	450	450	2,012
HDPE	150	150	7
PE	150	150	45
PVC	200	450	13,336
Vitrified Clay Pipe	150	300	31,105
Total			63,822



Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Existing Lift Stations
- Existing Manholes

Pipe Sizes (mmØ)

- 100
- 150
- 200
- 250
- 300
- 375
- 400
- 450
- 1000

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

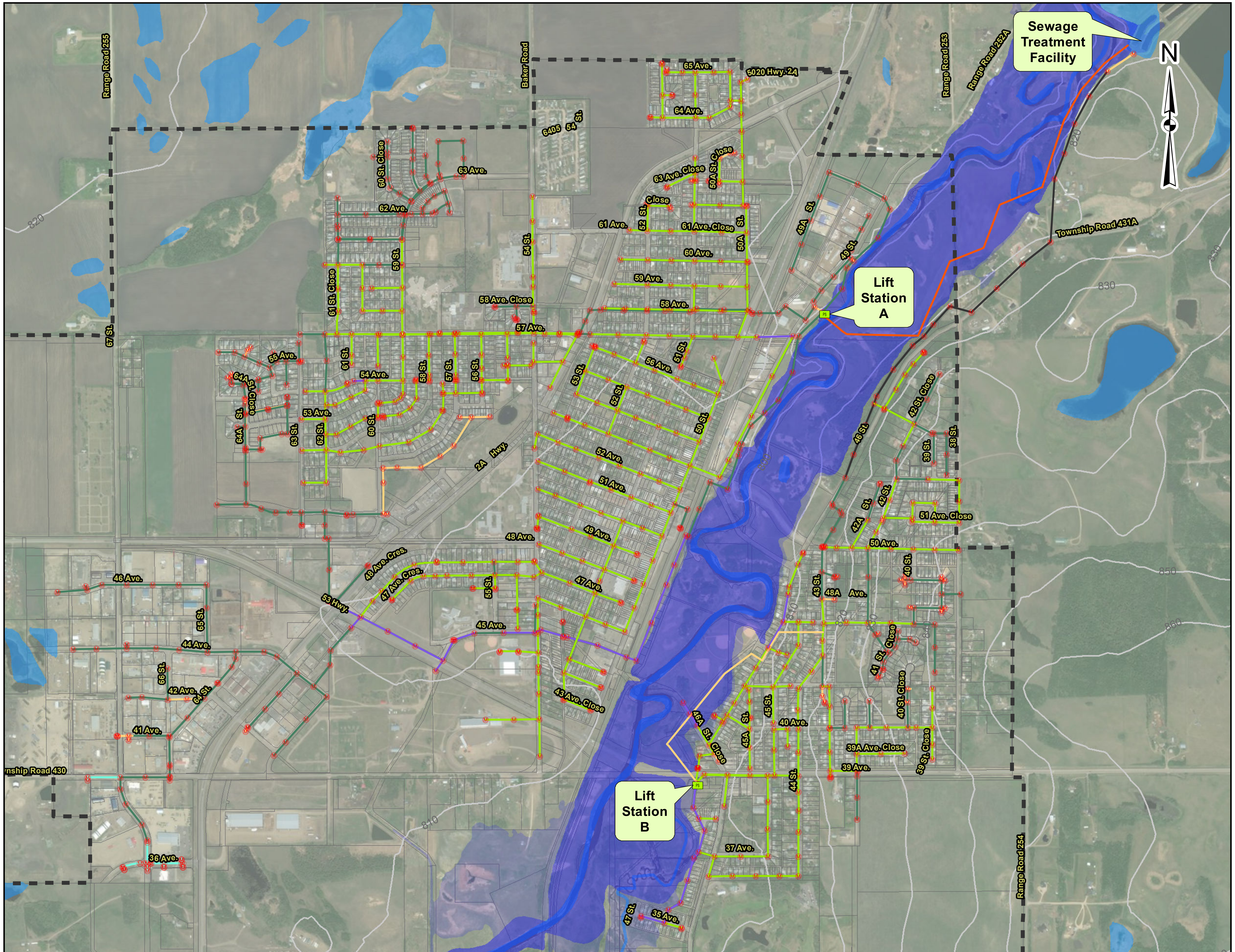
Project No.	Date
2131-00247-14	Mar 28, 2018

Existing Sanitary System: Pipe Sizes

Figure C2

Document Path: C:\Users\hshin\Downloads\ArcGIS\Ponoka\2.4.5 Figures\Sanitary\Figure C2 - Existing Sanitary System - Pipe Sizes.mxd

Author: hshin



Master Servicing Study

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Existing Lift Stations
- Existing Manholes

Pipe Materials

- Unknown
- AC
- Concrete
- HDPE
- PE
- PVC
- VCT

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 28, 2018

Existing Sanitary System: Pipe Material

Figure C3

Document Path: C:\Users\hshin\Downloads\ArcGIS\Ponoka\2.4.5 Figures\Sanitary\Figure C3 - Existing Sanitary System - Pipe Material.mxd Author: hshin

Lift Station A & Forcemain

Lift Station A is located on an access road east of 49 Street, south of 60 Avenue, near the Battle River. The lift station is comprised of two (2) constant-speed distribution pumps in lead-lag configuration, a back-up pump with a diesel generator and a wet-well for wastewater storage prior. The lift station discharges to a 500 mm, 1870 m long forcemain.

The lift station is complete with wet well level control, with an upper level limit of 1.50 m and a lower level limit of 0.85 m. The pump run time is continuously logged, and is compiled in an annual report.

The 500 m forcemain runs beneath the Battle River; the forcemain then continues through parkland near the Battle River, runs parallel to Municipal Road 431, and discharges to the wastewater treatment facility.

Table C-3: Lift Station A Distribution Pump & Wet Well Information

Parameter	Value
Distribution Pump	
Make	Vaughan
Serial Number	61014B
GPM	2000
TDH	50 ft
RPM	1170
Speed	Constant Speed
Wet Well	
Pump On	1.50 m
Pump Off	0.85 m

Lift Station B & Forcemain

As depicted in *Figure C-1*, Lift Station B is located south of 39 Avenue, at the west end of 38A Avenue Close. The lift station is comprised of two (2) constant-speed distribution pumps in lead-lag configuration, a back-up pump with a diesel generator and a wet-well for wastewater storage. The lift station discharges to a 200 mm, 1032 m long forcemain.

The lift station is complete with wet well level control, with an upper level limit of 0.90 m and a lower level limit of 0.50 m. The pump run time is continuously logged, and is compiled in an annual report.

The 200 mm forcemain crosses Hwy 53, through parkland and Municipal Rd 431, and connects to a 300 mm gravity sewer main near the intersection of 43 Street and 48 Avenue. The gravity main discharges to the wastewater treatment facility.

Table C-4: Lift Station B Distribution Pump & Wet Well Information

Parameter	Value
Distribution Pump 1	
Make	Gorman-Rupp
Serial Number	61014B
Model Number	T6C60SC-B/F
Speed	Constant Speed
Distribution Pump 2	
Make	Vaughan
Serial Number	64011B
Model Number	SP6K
GPM	500
TDH	95 ft
RPM	1500
Speed	Constant Speed
Wet Well	
Pump On	0.90 m
Pump Off	0.50 m

Site Investigation

A site visit was conducted August 3, 2017 by McElhanney, with orientation provided by the Town.

During the site investigation, the following general observations were made:

- The lift stations were functioning at the time of the inspection, no overflow was observed;
- Pump run-times were being recorded daily;
- The condition of the wet-wells were not assessed due to confined space access issues.

Select photos of the site visit can be found in *Appendix C-1*.

C.1.2 Review of Previous Studies

McElhanney reviewed the following background information relevant to the sanitary planning undertaken as part of this study:

- Town of Ponoka Growth Study 2009-2059, Armin A. Preiksaitis & Associates ltd., August 2010

- Infiltration & Inflow Study, Tagish Engineering, July 2013
- Town of Ponoka Master Servicing Study Update, Tagish Engineering, October 2013
- 2015 Annual Water Distribution Report, Town of Ponoka, January 2016
- Design Guidelines 2016 Edition, The City of Red Deer Engineering Services, 2016
- Town of Ponoka Master Servicing Study 2013 Update Review, McElhanney, June 2016
- 2015 Lift Station A Pumping Hours, Town of Ponoka, December 2015
- 2015 Lift Station B Pumping Hours, Town of Ponoka, December 2015
- 2016 Lift Station A Pumping Hours, Town of Ponoka, December 2016
- 2016 Lift Station B Pumping Hours, Town of Ponoka, December 2016
- 2015 Annual Wastewater Report, Town of Ponoka, February 2016
- 2015 Wastewater Annual Report, Town of Ponoka, February 2016
- 2016 Annual Wastewater Report, Town of Ponoka, January 2017
- 2016 Wastewater Annual Report, Town of Ponoka, January 2017

A summary of key previous studies is provided below:

Inflow and Infiltration Study, July 2013 – Tagish Engineering Ltd.

An inflow and infiltration study was conducted in 2013 to assess the impacts of inflow and infiltration on the sanitary collection, treatment and storage system. Data collection and analysis included site inspections, smoke testing, flow monitoring and as-built review. Major findings included:

- Eighty-five (85) residences (16%) had sump pumps connected to the sanitary sewer, this contributed over 446 m^3/day to the sanitary system;
- A total of ninety-four (94) commercial buildings were inspected and nineteen (19) of the sump pumps (20%) were found to be connected to the sanitary sewer, contributing over 20 m^3/day;
- One storm manhole connected to the sanitary sewer at the intersection of 51 Avenue and 51 Street, and four (4) upstream CBs appeared to discharge to this storm manhole. The report stated that even partial flow could result in an estimated 1,219 m^3/year;
- One (1) storm roof drain at the Street Bowling Alley at 4812 50th Street connected to the sanitary sewer;
- A 20% increase in flow was found from the summer to winter (650 m^3/day), during a rainfall event. This increased the flow rate by 7% over average day summer;
- In summary, inflow from sump pumps is estimated at 465 m^3/day, and groundwater infiltration is estimated at 200 m^3/day.

Several recommendations were made as a result of the findings. These recommendations include:

- Immediate Recommendations:

    - Continue with the replacement program;
    - Investigate and repair cross connection at 51 Avenue and 51 Street;
    - Divert Bowling Alley (4812 50 Street) roof drain to the street level;
    - Inspect depressed intersections and plug manhole cover vent holes as required; and
    - Inspect depressed back lanes and plug manhole cover vent holes as required.
- Future Recommendations:
    - Initiate program to disconnect sump pumps from sanitary sewer system; and
    - Initiate dye testing to confirm potential roof drain connections in the downtown commercial area, to the sanitary sewer.

Town of Ponoka Master Servicing Study 2013 Update, October 2013 – Tagish Engineering Ltd.

A Master Servicing Study was prepared by Tagish Engineering Ltd. in October 2013. The objective of the study was to review and evaluate water, sanitary sewer, stormwater, and transportation infrastructure.

A summary of the report findings is included below:

- To service future development areas west of Highway 2A, the report recommended upgrading the existing south trunk main from Lift Station A to the Highway 2A / Highway 53 intersection. Servicing the newly annexed lands west of the pre-annexation boundaries would require the following:
    - Construction of a lift station on 39 Ave west of the future 70 Street, to service annexed areas to the west, the Froman Industrial area, and the area west of the Cemetery site in NE6;
    - Construction of a forcemain from the future 39 Ave lift station along 44 Avenue to Highway 2A and tie in to a new 675 mm main extended south of the Highway 2A and Highway 53 intersection. The forcemain would service development west of Highway 2A and discharge to Lift Station A along an upgraded South Trunk Main.
- To service future development areas east of the Battle River, the report recommended the following:
    - Extending the existing Riverside gravity main, across Highway 53 at 44 Street, east one-half block to the back of lots and south in a right-of-way or lane, to service Country Hills Estates and Caledara [developments].
    - Upgrading Riverside gravity mains in select locations to permit additional loading from new developments.
- The report also identified new lift stations that will be required to service the SW industrial park, west and east of Highway 2A, along the Battle River and the Airport.
- Assumptions made during calculations include 320 L/day/cap for residential, 0.15 L/s/ha and 0.20 L/s/ha for I&I, with a Harmon peaking factor applied.

Town of Ponoka Master Servicing Study 2013 Update Review, June 2016 – McElhanney Consulting Services Ltd.

McElhanney Consulting Services Ltd. performed an update to the Tagish Master Servicing Study in 2016, so the report would reflect current conditions. The findings of the report are as follows:

- Update the study to confirm flood proofing upgrades to Lift Station A have been completed;
- Install a dedicated flow meter in Lift Station B, or at the terminus end of the associated force main;
- Remove storm water cross connections discharging into sanitary sewers; and
- A preliminary design and cost estimate for the installation of a 900 m long sanitary trunk main and a 3,100 m sanitary main along Highway 53 were created in 2015. It is recommended that the information from this design and cost estimate be included in the study.

Record Information

Table C-5 summarizes the record information provided by the Town of Ponoka in digital format.

Table C-5: List of GIS and record information provided by the Town of Ponoka

File No.	File Name	Extension	Description
1	*Sanitary_Sewer_Link*	.shp	GIS information of the Town's sanitary sewer pipes
2	*Sanitary_Sewer_Link_update*	.shp	GIS information of the Town's sanitary sewer pipes
3	*Sanitary_Sewer_Node*	.shp	GIS information of the Town's sanitary sewer manholes
4	*Sanitary_Sewer_Node_update*	.shp	GIS information of the Town's sanitary sewer manholes
5	*2009_AS BUILT_from_Tagish*	.dwg	Plan-view maps of the existing water, sanitary and drainage utilities compiled by Tagish Engineering in February 2007.
6	*Underground_utilities_GIS*	.pdf	Plan-view maps of the existing water, sanitary and drainage utilities with an aerial photo background.
7	*map_book_combined*	.pdf	Updated plan-view maps of the existing water, sanitary and drainage utilities

C.1.3 Master Servicing Study Objectives

The overall goals and objectives of the study can be summarized as follows:

- Review raw data describing the Town wastewater collection system, and evaluate the data to determine missing or inaccurate information.
- Coordinate with the Town to obtain missing information;
- Determine appropriate sanitary inflow rates for the Town, including average and peak flow, infiltration and inflow based on relevant standards;
- Delineate catchments based on pertinent land use maps and existing and proposed sewer layouts for use in computational model generation;
- Prepare a computational model of the existing sanitary sewer system to assess the capacity of the system to convey sanitary flows to the Town wastewater treatment lagoon.
- Identify areas experiencing surcharging and flooding based on the model results;
- Identify future growth areas for the 5, 10, and 25-year level and anticipated future loading, and assess the ability of the existing system to meet demands;
- Recommend upgrades to the Town sanitary sewer system based on anticipated demands with consideration given to project cost, and identify appropriate staging for upgrades.

C.2. Methodology

C.2.1 Design Criteria

As directed by the Town, the City of Red Deer's *Design Guidelines 2016* was used as the main design criteria for this study. The Alberta Environment and Parks' *Standard and Guidelines for Municipal Water Works 2012* were also used in the analysis. Assumptions in loading and population data were made using these regulations, as the design characteristics for the City of Red Deer were considered more suitable for comparison with the Town of Ponoka than a larger urban centre such as Edmonton or Calgary.

The following key design criteria are used in the analysis:

Residential Use

- Per Capita Flow: 320 litres per capita per day

Non-Residential Use

- Institutional Flows: 0.15 L/s/ha
- Commercial Flows: 0.15 L/s/ha
- Industrial Flows: 0.15 L/s/ha

Average Dry Weather Flow (ADWF)

- ADWF = Residential Flow + Institutional Flow + Commercial Flow + Industrial Flow

Harmon Peaking Factor (Pf):

$Pf = 1 + [14 / (4+\sqrt{P})]$

where:

$P = 7229$

$Pf = 1 + [14 / (4+\sqrt{7229})]$

$Pf = 3.093 \sim 3.1$

Peak Dry Weather Flows (PDWF):

$PDWF = Q \times Pf$

where:

Q = Area x Population Density x Residential Loading Rate

= [Area (ha)] x (21 population / ha) x (320 L/c/d)

= [Area (ha)] x 6720 L/ha/d

Pf = 3.1

PDWF = ([Area (ha)] x 6720 L/ha/d) * 3.1

PDWF = [Area (ha)] * 20832 L/ha/d

C.2.2 Peak Wet Weather Flow Calculations

As per the City of Red Deer Design Guidelines 2016 Edition, the average Inflow/Infiltration (I&I) used in the analysis is 0.20 L/s/ha. Therefore, the Peak Wet Weather Inflow (PWWF) is equal to the PDWF plus the I&I. The average I&I rates reported in the Inflow and Infiltration Study, (2013) were less than the 0.20 L/s/ha used in this analysis. The value of 0.20 L/s/ha was used to generate conservative flows.

C.3. Sanitary Sewer Model Development

C.3.1 Modelling Assumptions

Background

Data was provided by the Town in GIS file format. This data is used as the basis for the development of the sanitary model. Manhole rim and invert elevations, and pipe outlet and inlet inverts have all been retrieved from the provided GIS data.

Raw data was analyzed in ArcGIS to locate data gaps. Data gaps were identified and brought to the attention of the Town for clarification. The Town provided additional information to the extent that it could from alternate data sources such as updated GIS information and as-built information on-file. Assumptions were made on remaining data gaps, and were assumed according to minimum design criteria in the City of Red Deer Design Guidelines 2016 Edition.

Appendix C-2 provides a summary of the model input parameters and their associated assumptions.

Design Parameters

Table C-6 identifies the minimum slope and minimum cover requirements as outlined in the City of Red Deer Design Guidelines 2016 Edition.

Table C-6: Minimum Slope

Pipe Diameter	Minimum Grade
200 mm	0.40%
250 mm	0.28%
300 mm	0.22%
375 mm	0.15%
450 mm	0.12%
525 mm or greater	0.10%

The minimum and maximum cover for the sanitary pipe is 2.7 m and 5.5 m, respectively.

Inputs for Missing Data

Missing manhole rim elevation data was assigned based on LiDAR data provided by the Town. Depth of cover above recorded inverts was also evaluated when assigning missing manhole rim elevations.

Missing manhole inverts were assigned using a combination of interpolation and evaluating rim elevations. Interpolation between known inverts was used as the preferred method of assigning unknown inverts. For manholes located at the beginning of a sanitary sewer line, inverts were assigned by subtracting 2.9 m from the rim elevation (2.7 m for minimum elevation, 0.2 m to account for pipe diameter). If both the rim and invert were unavailable, minimum pipe slope from an downstream manhole invert was used as the basis for assigning invert and rim.

Missing pipe diameter was assigned based on pipe diameter upstream and downstream. Pipe diameter that could not be rationalized were instead investigated and confirmed by Town staff.

Force Main Alignment

The GIS information provided by the Town of Ponoka shows an incorrect alignment of the forcemain from lift station B. This was confirmed by Town staff, and McElhanney was directed to revise the alignment to match the alignment shown in the 2013 Master Servicing Study.

C.3.2 Catchment Delineation

Catchments were defined based on the existing land uses, Town of Ponoka Growth Study 2009-2059 (Figure 13). The catchments were divided according to residential, institutional, parks, commercial, and industrial. The catchments were further subdivided through analysis of sanitary sewer pipe layout and aerial photography through Google Earth.

C.3.3 Model Scenarios

PCSWMM

Modeling for the sanitary sewer system was performed with PCSWMM version 7.0. PCSWMM is an advanced modeling software utilizing the EPA SWMM5 model, with applications in stormwater, wastewater and watershed systems. PCSWMMs various features allows designers to accurately reflect existing conditions for performance analysis, and to analyze the system under different scenarios.

Parameters

The following boundary conditions and equations were used in the analysis:

- For analysis of the Ponoka Sanitary Sewer System, the system was evaluated under steady state conditions. This was considered a conservative approach, as the system is evaluated under continuous peak flow.
- The Manning's equation was used for gravity flow in the sanitary sewer pipe, as it is suitable for closed conduits not under pressure.
- For forcemains, the Hazen-Williams equation was used. The Hazen-Williams equation is typically used in water supply networks, and allows the designer to calculate pressure drop.

Scenario 1 – Existing Sanitary Collection System, Current Development

Scenario 1 was modelled to simulate actual conditions with the available data. Scenario 1 was prepared using current land use zones, with existing sanitary sewer infrastructure.

Aerial photo observation of areas zoned as institutional, commercial, and industrial catchments indicates that these land types have not currently been fully developed. Therefore, based on engineering judgement, the size of the catchments was reduced by 70% to more accurately reflect existing conditions. This effectively reduces volume generated by institutional, commercial, and industrial zones by 70% in the model. Residential loading has not been adjusted.

Scenario 2 – Existing Sanitary Collection System, Full Development

Scenario 2 is identical to Scenario 1, except the catchment sizes have not been reduced. The intention of this scenario is to evaluate the capacity of the existing sanitary sewer system once full build-out of the existing catchments have been completed. This effectively simulates volume generated by institutional, commercial, and industrial zones at 100% build-out, and represents the maximum loading that could conceivably be applied with the current land use.

Scenario 3 – Existing Sanitary Collection System, Full Development w/ Proposed Upgrades

Scenario 3 has been prepared to determine the effect of planned upgrades on the existing sanitary sewer system. Scenario 3 was prepared using current land use zones under full development conditions, with planned upgrades incorporated into the model.

Scenario 4 – Future Sanitary Collection System, Full Development w/ Proposed Upgrades

Scenario 4 was developed to determine the upgrades required to accommodate future land use zones as identified by the Town. Scenario 4 was prepared using future land use zones, with recommended upgrades. Recommended upgrades were produced as a result of iterative analysis to provide an efficient, complete solution.

Scenario 4 was prepared under consideration of growth at the 5, 10 and 25-year periods. Staging of the upgrades will be evaluated in *Section C.6*, and will consider performance, schedule and costing implications.

Appendix C-3 provides a list of the modelling files corresponding to each modelling scenario.

C.3.4 Model Validation

The model was prepared using the provided data to best approximate existing conditions. However, assumptions are required in the modeling process, and are generalizations which include conservative values. As such, flows determined in the modelling process are typically larger than actual flows, which can result in oversized upgrades if not accounted for.

One method of increasing the accuracy of the model is to perform flow monitoring. Flow monitoring will confirm the wastewater flow being produced under actual conditions, and can be used to calibrate the model. Flow monitoring of the sanitary sewer system was beyond the scope of this study, and therefore has not been included. The model was reviewed at the current stage to assess whether the model appeared reasonable, based on past experience.

Flow monitoring of the sanitary sewer system is recommended as a next step to more accurately define the size of the required upgrades, which is a potential cost-saving measure. As the model has already been built, and proposed development delineated, an update to the report with the calibrated model could be prepared at minimal expense.

C.4. Capacity Analysis of Existing Sanitary System

C.4.1 Existing Sanitary Sewer Collection System Capacity Analysis

Scenario 1 – Existing Sanitary Collection System, Current Development

As discussed in the previous section, the existing sanitary system was modelled with areas modified to simulate the current land use. As shown in *Figure C-4* and *Figure C-5*, there are several locations where the existing system does not have the capacity to convey current peak wet weather flows and as a result the HGL rises above the crown of the pipe (i.e. surcharge conditions). These sewers include the piping entering Lift Station A from the southern direction. The undersized pipe runs adjacent to the Battle River, and originates in the SW industrial park. Pipe capacity is also restricted in the sewer gravity main running along 57 Avenue.

Scenario 2 – Existing Sanitary Collection System, Full Development

As discussed in the previous section, the existing sanitary system was also modelled to simulate fully developed conditions. The results are shown in *Figures C-6 and C-7*. The results for Scenario 2 show similar trends to Scenario 1, with flooding / surcharging in the piping entering Lift Station A from the south side. The undersized pipe runs adjacent to the Battle River, and originates in the SW industrial park, and shows increased flooding from Scenario 1. The constrictions due to the undersized pipe result in flooding in the industrial park, and the south central residential / commercial area west of the Battle River.

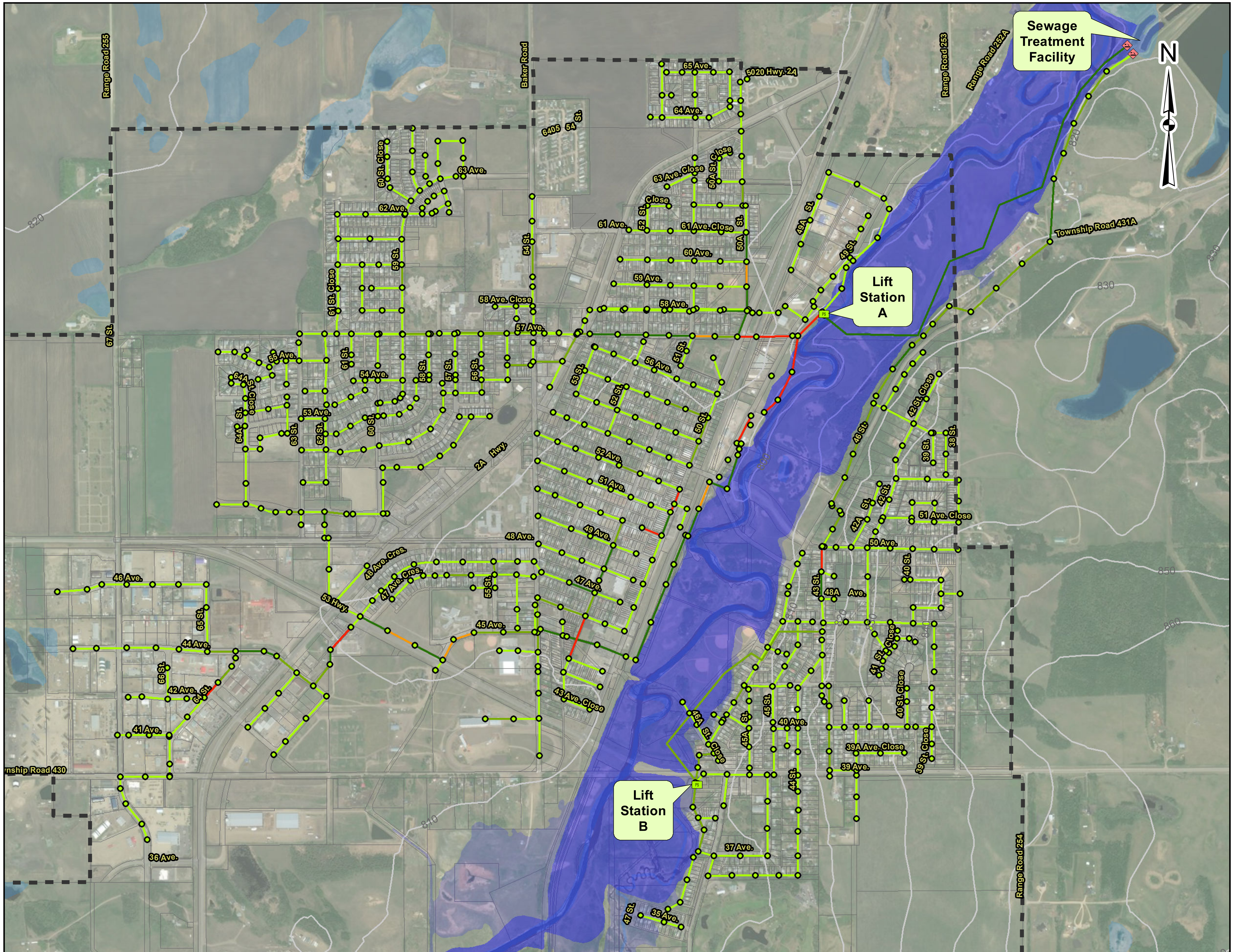
The model also shows flooding in the sewer gravity main running along 57 Avenue. There are also constrictions shown in the gravity main conveying flow from the southeast development to the wastewater treatment plant. As per *Figure C-5*, the constrictions due to the undersized pipe result in flooding in the subdivision bounded by 57 Street (south), Highway 2A (northwest) and 50 Street (east).

C.4.2 Lift Station Capacity Analysis

Lift Stations A and Lift Station B were evaluated under modeling scenarios 1 and 2.

Under Scenario 1 in which the catchment areas were reduced to simulate existing development, the lift stations were able to meet the demand. This matches expectations, as discussions with the foreman during the site inspection indicated the lift stations are functioning adequately and are not experiencing flooding.

Under Scenario 2 in which the catchment areas were modelled under full development, Lift Station A was unable to meet demand. Therefore, proposed upgrades to the existing system will target this lift station. The lift station would also be sized to accommodate future development, as will be discussed in a later section of the report.



Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Existing Lift Stations
- Existing Outfalls
- Junctions

Q_5 / Q_{cap}(%)

- 0 - 30
- 30 - 60
- 60 - 90
- 90 - 100
- > 100

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

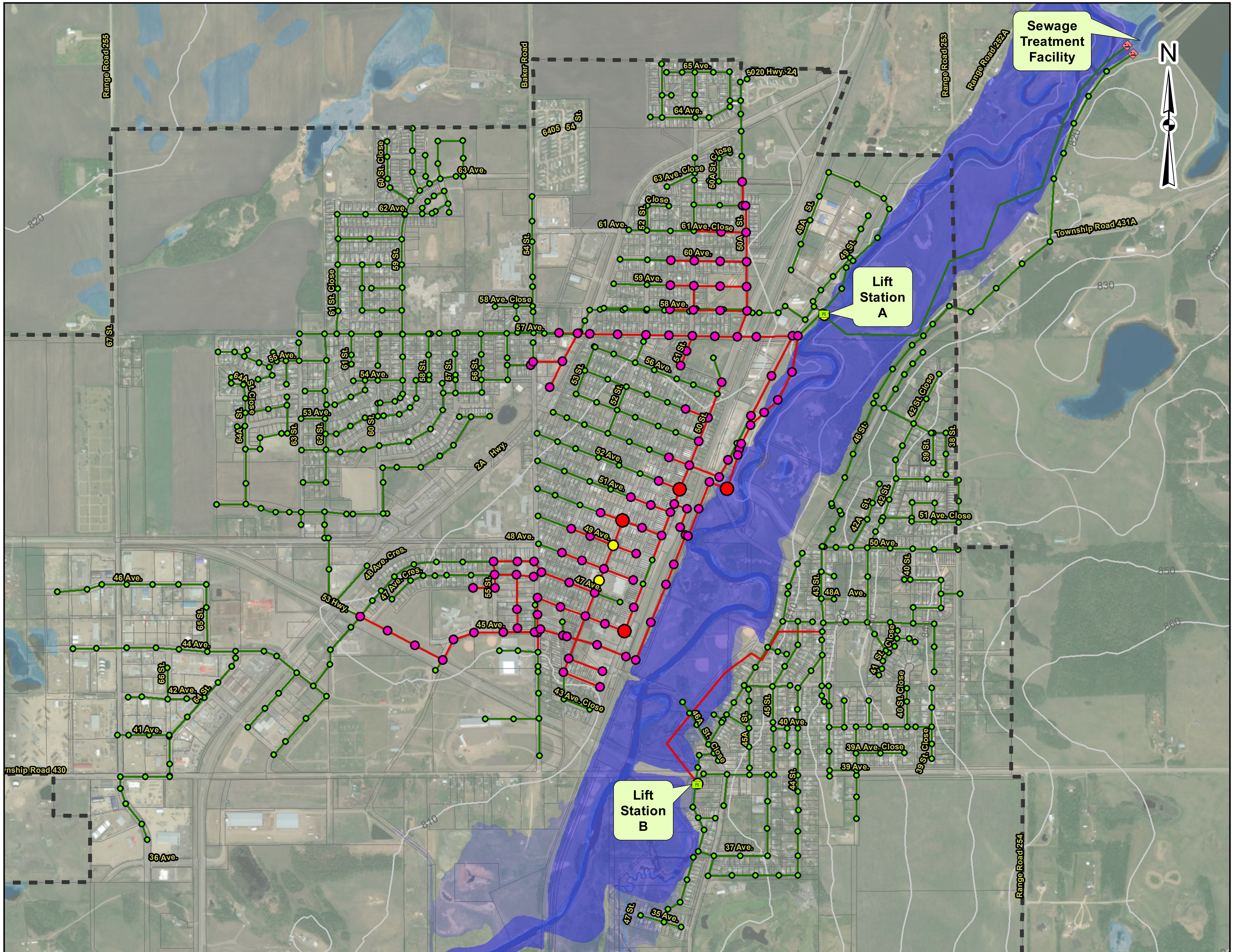
Project No.	Date
2131-00247-14	Mar 28, 2018

Existing System: Capacity Asssessment (current development)

Figure C4

Document Path: C:\Users\hshin\Downloads\ArcGIS\Ponoka\2.4.5 Figures\Sanitary\Figure C4 - Existing System - Capacity Asssessment (current development).mxd

Author: hshin



Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Existing Lift Stations
- Existing Outfalls

HGL

- HGL < Crown
- Crown < HGL < 0.3 m from Ground
- HGL > 0.3 m from Ground
- HGL > Ground

Conduits

- Surcharged
- No Surcharged

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

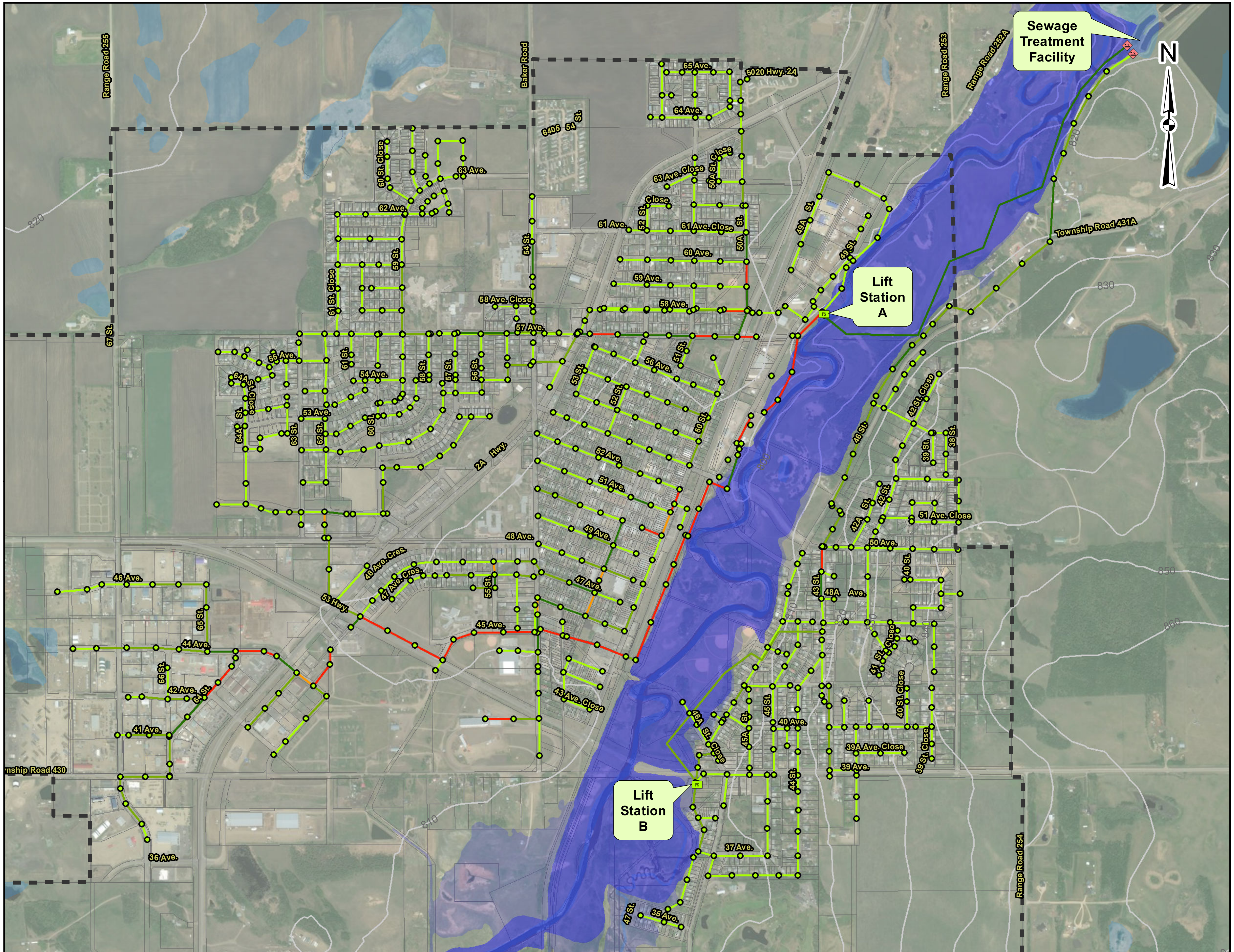
Project No.	Date
2131-00247-14	Mar 28, 2018

Existing System: HGL Assessment (current development)

Figure C5

Document Path: C:\Users\hshin\Downloads\ArcGIS\Ponoka\2.4.5 Figures\Sanitary\Figure C5 - Existing System - HGL Assessment (current development).mxd

Author: hshin



Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Existing Lift Stations
- Existing Outfalls
- Junctions

Q_5 / Q_{cap}(%)

- 0 - 30
- 30 - 60
- 60 - 90
- 90 - 100
- > 100

McElhanney

0 160 320 640 960 (m)

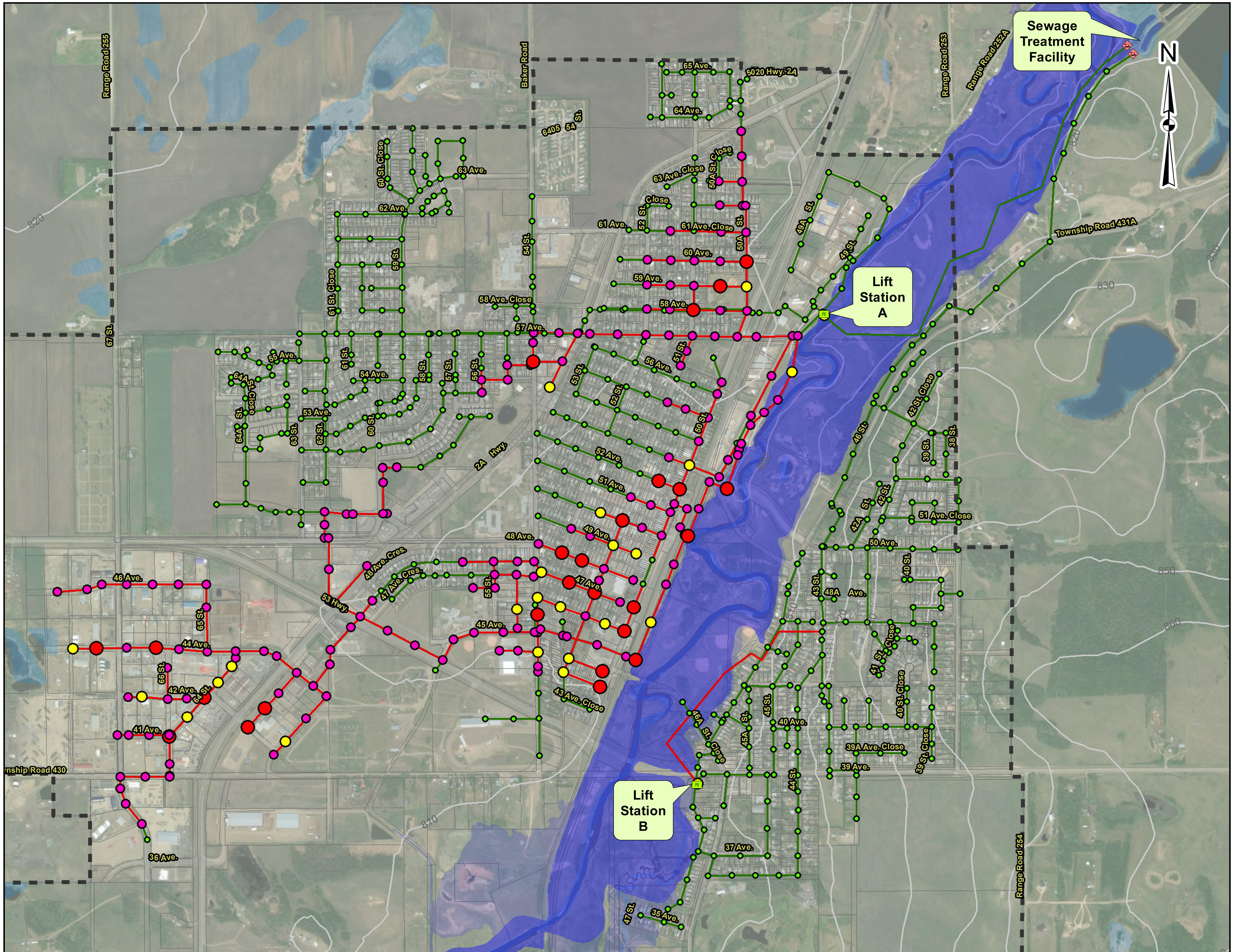
1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 28, 2018

Existing System: Capacity Asssessment (full development)

Figure C6



Master Servicing Study

Ponoka

Legend

Town Boundary
Floodway
Flood Fringe
Existing Lift Stations
Existing Outfalls

HGL

HGL < Crown
Crown < HGL < 0.3 m from Ground
HGL > 0.3 m from Ground
HGL > Ground

Conduits

Surcharged
No Surcharged

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 28, 2018

Existing System: HGL Assessment (full development)

Figure C7

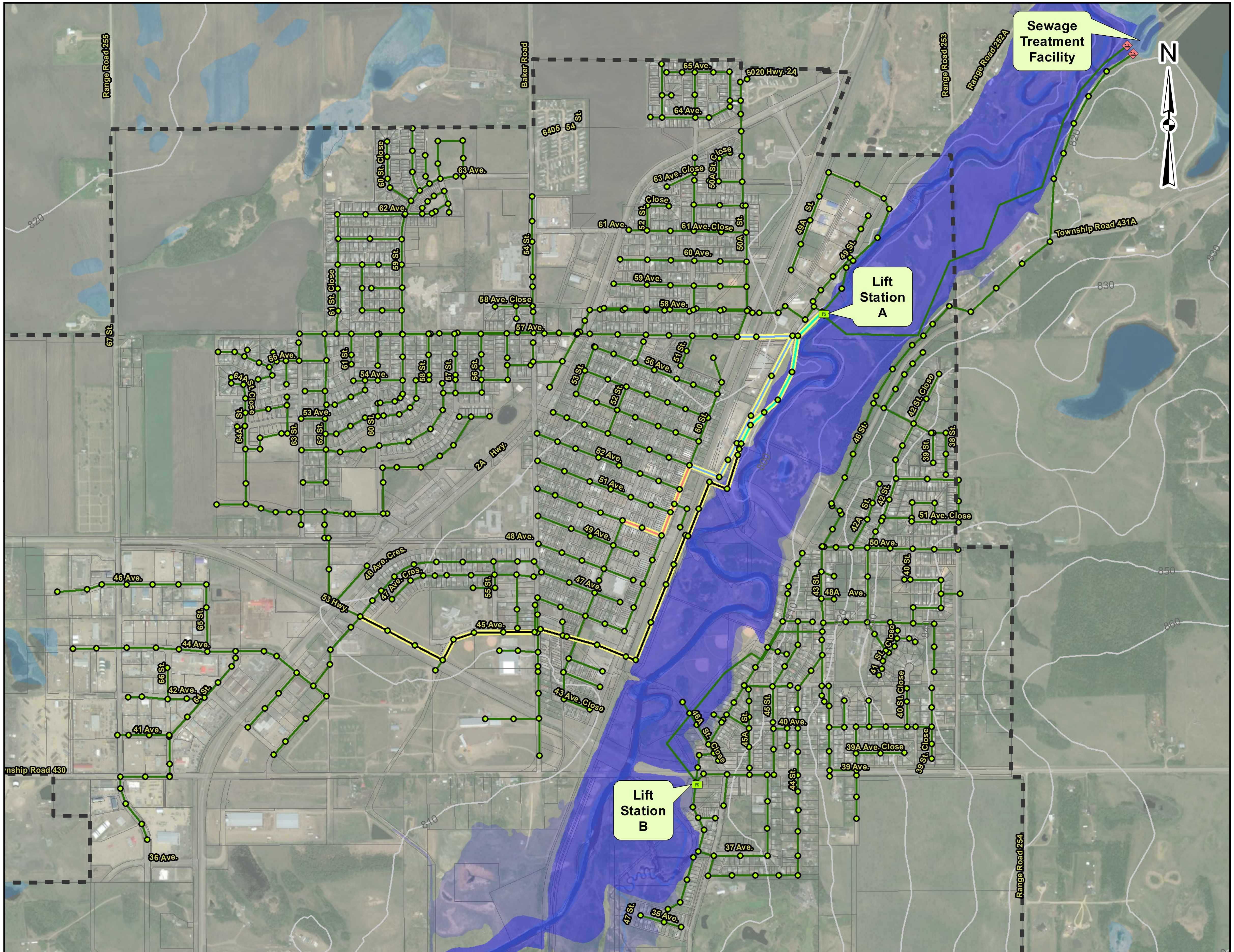
Document Path: C:\Users\hshin\Downloads\ArcGIS\Ponoka\2.4.5 Figures\Sanitary\Figure C7 - Existing System - HGL Assessment (full development).mxd

Author: hshin

C.4.3 Upgrades to Existing Sanitary System

In locations where the existing system does not have adequate capacity, pipes are recommended to be upsized so that the HGL falls within the pipe under full-development conditions. *Figure C-8* display the locations of the recommended upgrades.

However, the existing sanitary system is required to have capacity to convey not only current PWWF but also increased PWWF due to the anticipated future development. *Section C-5* presents the recommended upgrades to service both existing and future sanitary flows.



Master Servicing Study

Ponoka

Legend

Town Boundary

Floodway

Flood Fringe

Existing Lift Stations

Existing Outfalls

Proposed Junctions

Proposed Sewer Upgrades (mmØ)

300

375

525

600

750

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 28, 2018

Proposed System Upgrades

Figure C8

C.5. Future Sanitary System

The proposed sanitary sewer collection system upgrades and expansions were laid out taking into consideration the future land use, the existing and proposed road layouts, the existing sanitary sewer piping, and the natural topography / land contours. The proposed upgrades and expansions of the sanitary sewer collection system are shown on *Figure C-9.*

The design and the delineation of catchment boundaries are preliminary and are subject to detailed engineering design. All designs and locations must be approved by the Engineering Department. Construction standards shall be in accordance with current Town standards. The scope of this study is limited to the broad servicing concepts. The detailed design of the sanitary sewers within the Town of Ponoka boundaries should follow the servicing concepts and catchments of this study, but may vary based on actual development and new information as it becomes available. Easements and rights-of-way have not been identified within this report.

C.5.1 Proposed Sanitary Collection System Capacity Analysis

Upgrades to Existing Infrastructure

As per *Section C.4*, under full development conditions, surcharging / flooding was evident in the gravity main along 57 Avenue, and in the gravity pipe originating in the southwest industrial park terminating at Lift Station A. Limited constrictions were also observed in the southeast area, upstream of the gravity main discharging into the wastewater treatment plant. Lift Station A was also undersized under full development conditions. Proposed upgrades will accommodate future development and will incorporate full development of the existing land use.

As per *Figure C-9*, most of the upgrades to existing infrastructure relate to sewer pipe connecting to Lift Station A to the south. Detailed information can be found in *Section C.6.* This includes:

- A 686 m run of 375 mm pipe along 57 Avenue (UE1);
- A 731 m run of pipe along 49 Street, 53 Avenue, 50 Street, and 50 Ave, with 457 m of 300 mm pipe and 274 m of 375 mm pipe (UE2);
- A 4670 m run of pipe along the west side of Battle River, 45th Avenue, and 53rd Highway towards the southwest industrial park area, with 373m of 250 mm pipe, 1124 m of 600 mm pipe, 337 m of 675 mm pipe, 2213 m of 750 mm pipe, and 624 m of 900 mm pipe (UE3); and
- A 645 m run of pipe along 42 Street, Highway 53 and 43 Street, with 315 m of 250mm pipe and 330 m of 300mm pipe (UE4).
- A 580 m run of 300mm pipe along 46 Avenue, 65 Street and 44 Avenue (UE5).

Lift Station A would also require upgrades to accommodate the increased flows from new development.

Additionally, as a standard course of action, any storm water infrastructure connected to the sanitary sewer system should be disconnected.

Proposed Infrastructure to Service Future Growth

As discussed in *Section A-5*, the Town of Ponoka identified areas where future development is expected to take place. Sanitary sewer infrastructure will be required to service these areas, and therefore planning is required to confirm the existing system can fully support the new development. Additionally, planning will be required to confirm the future sanitary sewer system infrastructure has suitable tie-in points.

Short-Term (5-year) Upgrades

Identified upgrades to the existing system are recommended before construction of additional development. As discussed, model results show that at full development of the existing land use, and future growth areas developed, the existing system is expected to experience flooding. Once identified upgrades are complete, existing infrastructure will be sufficient to accommodate up to 25-year development. Once complete, installation of sanitary sewer infrastructure for future development can proceed.

Connection points and pipe sizes have been shown for servicing future development, as per *Figure C-9*. Gravity mains, and installation of lift stations and corresponding force mains, must be constructed to service future development and connected to the existing sanitary sewer collection system.

Intermediate-Term (10-Year) Upgrades

In general, 5-year development identified by the Town of Ponoka reside at the furthest extents of development, past the 10 and 25-year development zones, with the exception of the zone bounded by Range Road 260 and Highway 2 to the northwest. Therefore, servicing for 10-year development will be accomplished in large part by servicing for 5-year development.

Several 10-year development areas have also been identified adjacent to current development. Suitable connection points have been identified on *Figure C-9*.

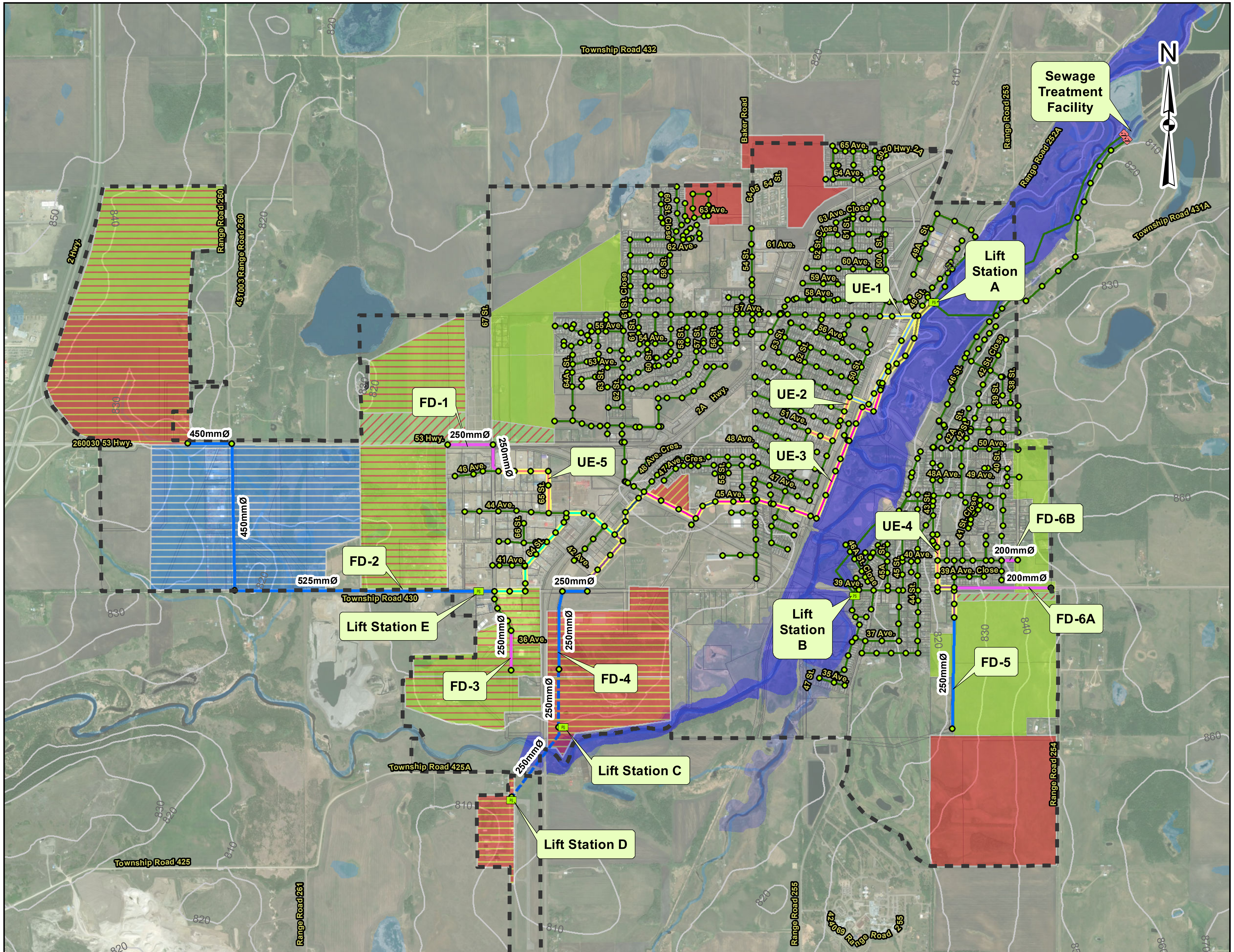
Long-Term (25-Year) Upgrades

Similar to 10-year development, servicing for 25-year will be accomplished in large part by servicing for 5-year development.

Staging

Table C-7: Summary for Staging of Proposed Upgrades and Servicing for New Development

Development Upgrades	
5 Year Development	
Upgrades to Existing System	Information
Lift Station A Upgrades	Pump Upgrade
Pipe Conduit UE-1	686m
Pipe Conduit UE-2	731m
Pipe Conduit UE-3	4670m
Pipe Conduit UE-4	645m
Pipe Conduit UE-5	580m
Servicing for Future Development	Lift Stations C,D,E
Pipe Conduit FD-2	2808m
Pipe Conduit FD-4	1627m
Pipe Conduit FD-5	696m
10 Year Development	
Pipe Conduit FD-1	464m
Pipe Conduit FD-3	246m
Pipe Conduit FD-6A	604m
Pipe Conduit FD-6B	101m
25 Year Development	
Accomplished by servicing of 5-year development – LS A upgrades, Pipe Conduit FD-2	



Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Existing Lift Stations
- Existing Outfalls
- Junctions
- Conduits

Proposed Sewer Upgrades (mmØ)

- 250
- 300
- 375
- 600
- 675
- 750
- 900

Future Infrastructures

- Lift Station 5-Years
- Force Mains 5-Years
- Sewers 5-Years
- Sewers 10-Years

Future Land Use

- 5 Years - Commercial
- 5 Years - Industrial
- 5 years - Residential
- 10 Years - Commercial
- 10 Years - Industrial
- 10 Years - Residential
- 25 Years - Industrial

McElhanney

0 255 510 1,020 1,530 (m)

1:24,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 28, 2018

Future Development

Figure C9

C.6. Costing

The costing completed is based on previous projects completed in the area, budget pricing provided by a contractor and the Price Averages Reports for the City of Calgary. *Table C-8* displays the preliminary costing for the recommended upgrades, and *Table C-9* provides the preliminary costing for the future water system. A full breakdown of the costs can be found in *Appendix C-4*.

Table C-8 – Preliminary Costing for Upgrades to Existing Sanitary Sewer System

Item	Proposed Work	Preliminary Project total Estimate
LS A	Upgrading pumps for Lift Station A to accommodate increased loading	**$700,000**
UE-1	375mm Dia, 686m Length Sanitary Sewer Pipe	**$866,000**
UE-2	300mm Dia, 457m Length Sanitary Sewer Pipe 375mm Dia, 274m Length Sanitary Sewer Pipe	**$875,000**
UE-3	250mm Dia, 373m Length Sanitary Sewer Pipe 675mm Dia, 337m Length Sanitary Sewer Pipe 750mm Dia, 2,213m Length Sanitary Sewer Pipe 900mm Dia, 624m Length Sanitary Sewer Pipe	**$6,117,000**
UE-4	250mm Dia, 315m Length Sanitary Sewer Pipe 300mm Dia, 330m Length Sanitary Sewer Pipe	**$726,000**
UE-5	250mm Dia, 580m Length Sanitary Sewer Pipe	**$693,000**

Table C-9 – Preliminary Costing for Future Servicing

Item	Proposed Work	Preliminary Project total Estimate
	5-YEAR	
LS C	New lift station to service south development near airport	**$1,050,000**
LS D	New lift station to service south development near airport	**$1,050,000**
LS E	New lift station to service industrial development west of the Town	**$1,050,000**
FD-1	200mm Dia, 464m Length Sanitary Sewer Pipe	**$254,000**
FD-2	450mm Dia, 1189m Length Sanitary Sewer Pipe 525mm Dia, 1619m Length Sanitary Sewer Pipe	**$3,344,000**
FD-3	250mm Dia, 246m Length Sanitary Sewer Pipe	**$165,000**
	10-YEAR	
FD-4	250mm Dia, 732m Length Sanitary Sewer Pipe 300mm Dia, 895m Length Sanitary Sewer Pipe	**$1,034,000**
FD-5	250mm Dia, 696m Length Sanitary Sewer Pipe	**$459,000**
FD-6A	200mm Dia, 604m Length Sanitary Sewer Pipe	**$319,000**
FD-6B	200mm Dia, 101m Length Sanitary Sewer Pipe	**$57,000**
	25-YEAR	
	Accomplished by servicing of 5-year development – LS A upgrades, Pipe Conduit FD-2	

D. Stormwater Master Plan

This section of the Infrastructure Master Plan presents the Town of Ponoka Stormwater Master Plan. The activities undertaken as part of the Stormwater Master Plan include:

1. A review of all completed stormwater studies and background information;
2. Development of an inventory of the Town's existing stormwater management network and facilities;
3. Development of a hydrologic/hydraulic model to analyse the existing system;
4. Use of the hydrologic/hydraulic model to identify problem areas within the Town's stormwater network;
5. Identify proposed upgrades for the existing drainage system;
6. Complete a stormwater servicing strategy for the future proposed development areas; and
7. Prepare cost estimates for the various phased development stages.

As part of the analysis McElhanney reviewed all the data available on the existing infrastructure including, the stormwater conveyance systems, ponds and outfalls. McElhanney conducted a field review of the outfall structures as part of the process, the results of the field review can be found in *Appendix D-1*. This report identifies capacity limitations in the existing system and outlines upgrade options and proposed stormwater systems needed to allow for future expansion throughout the Town. The master plan presents the analysis, results, conclusions and recommendations in a comprehensive report.

D.1. Introduction and Background

D.1.1 Background

Background information for this study has been collected from various completed studies (see *Section D.1.2*), GIS data, previous completed reports, as-built drawings, communication with the Town and field notes.

The study area covers the Town boundary including the areas annexed from the County of Ponoka in 2011. The Town is located along the east and west banks of the Battle River within the Battle River Valley. The Town is located within the Calgary- Edmonton Corridor adjacent to Highway 2 and directly on Highway 2A and Highway 53. The Battle River is the dominant hydrological feature within the Town, flowing through the Town from southwest to northeast. The river and drainage channels to the Battle River provides the main drainage outlet for the Town's stormwater runoff.

The Town receives an average annual precipitation of 431 mm of rain. The heaviest rainfall historically has been recorded from May through August, with July being the wettest month of the year. Most summer storms are characterized by high intensities and short duration leading to large quantities of runoff being generated over the urbanized landscape. The relatively flat topography of the town area has resulted in very flat grades for the storm sewer system. This coupled with the high intensity of summer storms continues to generate significant flooding problems across the Town during major rainfall events.

The western part of the Town (west of 67 Street) is currently largely undeveloped with significant wetlands and a permanent water body (*Figure D-1*). Most of the offsite catchment runoff is intercepted via the various wetlands and Lake 10. The flow then slowly drains through several channels south towards the Battle River. At present, the western part of the Town has experienced little development. The Municipal Development Plan (MDP) indicates that these wetlands need to be left in their natural state, therefore, the proposed stormwater infrastructure will not drain towards this existing natural system.

The current developed part of the Town, located along the west and east banks of the Battle River drain directly towards the Battle River via the existing conveyance system. The pipe system age ranges from 1961 to current year with some of the pipes age is still unknown. Various types of materials are found throughout the Town with concrete pipes being the dominant type. The structural condition of the pipes and outfalls are not known.

Very few ponds are located within the developed portion of the Town. Therefore, large event flows are not detained before draining towards the River through the minor and major systems. There are currently only four stormwater ponds (dry ponds) in the old part of the Town. As part of the plan proposed in this Stormwater Master Plan, new stormwater management facilities are proposed for the new developments to control the release rate and water quality to the receiving waterbody.

Previous studies including the Review of the Town of Ponoka Master Servicing Study 2013 Update (McElhanney, 2016) and discussion with the Town of Ponoka indicated regular localized flooding in a number of locations throughout the Town. With the majority of regular flooding concerns occurring in the downtown area.

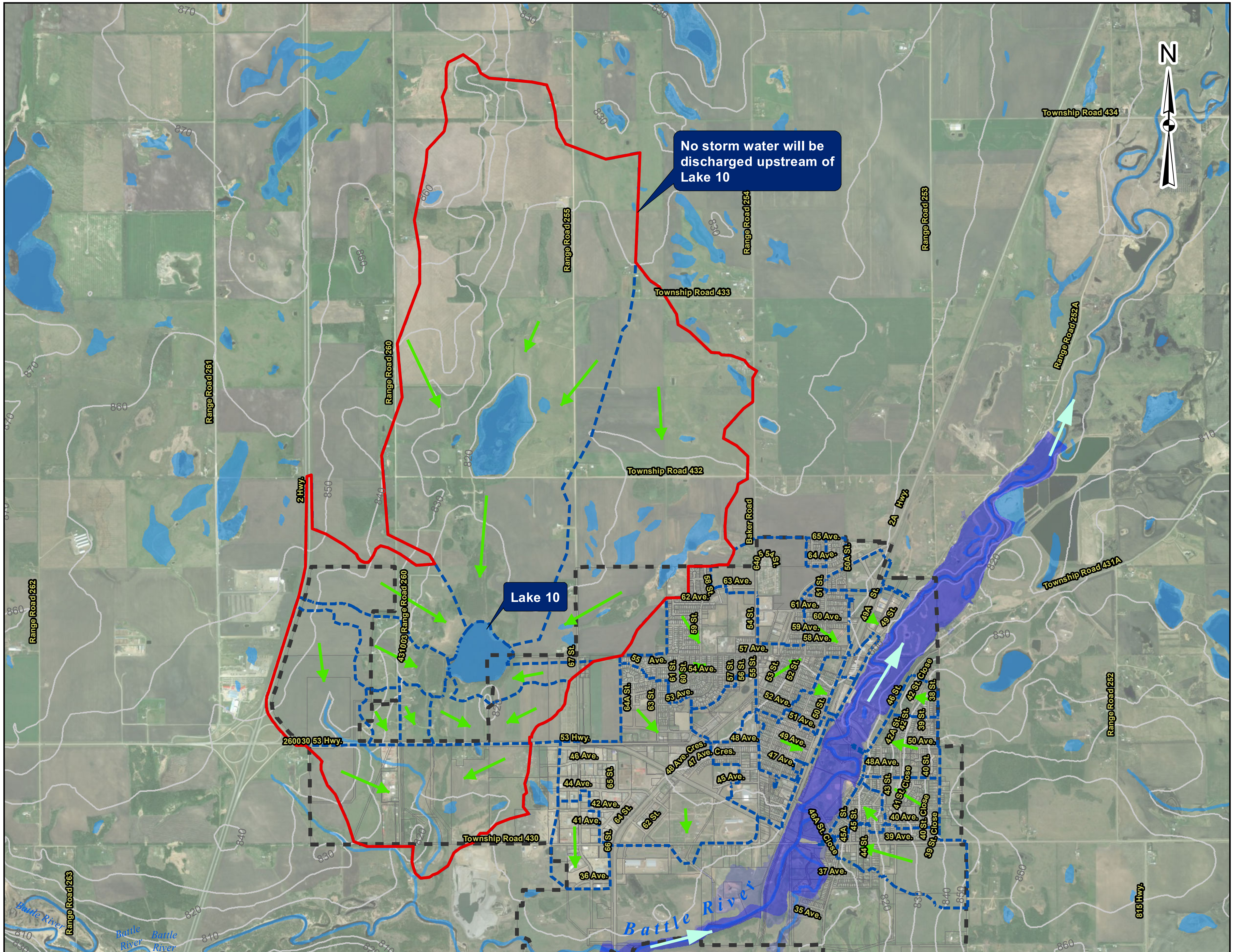
As outlined by Alberta Environment and Parks (2013) for new developments, there is an emphasis on controlling runoff rates and improving the quality of the water discharged to receiving bodies. For this master plan, as advised by the Town, the Alberta Environment Stormwater Management Guidelines (1999, 2013) and the City of Red Deer Engineering Services Design Guidelines (Section 10, 2016), are used to develop proposed design criteria for the proposed future developments. The Regional Flood Frequency analysis as well as the computer modelling performed for the northwestern part of the Town, completed in the Town of Ponoka Master Servicing Study 2013 Update have determined that the pre-development runoff rate for the 100-year event is 2.5 L/s/ha. Therefore, the allowable storm water release rate for the 100-year event will be held to approximately 2.5 L/s/ha. Any future development within the Town, will require the construction of Storm Water Management Facilities or use of best management practices to restrict the flow rate to the allowable pre-development release rate as well as for improving the water quality to targets outlined by Alberta Environment and Parks (85% removal or particles 75 µm and larger).

The Flood Hazard Map published by Alberta Environment and Parks (last updated February 2016) is referenced for the 100 Year floodway and flood fringe alignments along the developed Town site. The floodway information for the west side of the Town (west of Highway 2A) is not available from Alberta Environment and Parks and therefore is not included in this master plan.

The Town of Ponoka MDP is the Town's primary land use policy statement and is used in this analysis to guide future growth and development projections. Included in the 2013 MDP update are the lands annexed from Ponoka County by the Town of Ponoka in 2011. These lands require preplanning of the stormwater management strategy. The Town of Ponoka Growth Study report (2016) indicates that strategic long-term planning considers a timeframe of 30 to 50 years. However, as standard for Infrastructure Master Plans the time frame ranges from 5 to 25 years as per discussion with the Town.

The 2013 Master Servicing Study Update (Tagish) considered the Hudson's Green area to be fully developed in the future. However, due to environmental concerns following discussions with the Town, the full area will not be used for future development, only the southeastern portion of the Hudson Green development is included in the future growth area.

There is no Town wide geotechnical study available to refer for this Master Plan. Soil textures of the northwestern part of the Town are reported to be well-drained sandy loam to loam. Lands immediately adjacent to the River are underlain with gravels as evidenced by the current and past gravel operations (Tagish 2013). For this analysis, the soil throughout the Town is assumed to be sandy loam.



Master Servicing Study

Ponoka

Legend

- Town Boundary (2011 Annexation)
- Floodway
- Flood Fringe
- Major Catchments
- Flood Direction

McElhanney

0 370 740 1,480 2,220 (m)

1:35,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 26, 2018

Stormwater Master Plan: Existing Major Drainage Basins

Figure D1

Document Path: L:\Proj\Projects\2131 - Edmonton\2131-00247-00 Engineering Services Town of Ponoka\2131-00247-14 Master Servicing Study Re-Write\2.0 Documents\2.4 Reports\2.4.5 Figures\Storm\Figure D1 - Existing Major Drainage Basins.mxd Author: hshin

D.1.2 Review of Previous Studies

McElhanney reviewed the following background information relevant to the stormwater planning undertaken as part of this study:

- Town of Ponoka Master Servicing Study (Tagish Engineering, 2005)
- Town of Ponoka Master Servicing Study Update (Tagish Engineering, 2013)
- North West Stormwater Management Plan (Tagish Engineering Ltd., 2009)
- Design Guidelines 2016 Edition, The City of Red Deer Engineering Services (2016)
- Town of Ponoka Master Servicing Study 2013 Update Review (McElhanney, 2016)
- Hudson's Green Area Structure Plan (Tagish Engineering Ltd., 2009)
- Town of Ponoka Municipal Development Plan (Tagish Engineering Ltd., 2009)
- Town of Ponoka Municipal Development Plan (2013)
- Alberta Environment and Sustainable Resources - Approved Water Management Plan for the Battle River
- Caledera Area Structure Plan, Stantec (2009)
- Town of Ponoka Growth Study,
- Town of Ponoka, Underground Utilities (2010) and Town of Ponoka, Underground Utilities, Pre-2014 Update (2014)
- 47 Avenue Storm Upgrades (McElhanney,2016)
- Southwest Industrial Stormwater Management Plan (2005)
- Stormwater Management Plan Report 60 Street Development Town of Ponoka, Alberta (McElhanney, 2016)

Various maps, GIS databases, and other data sources provided by the Town have been used for the development of base information for this study. The following databases are used for the development of this master plan:

- LiDAR data
- Roads
- Rivers and water bodies
- Subwatershed boundaries
- Storm sewers and manhole locations, types, dimensions, ages, inverts
- Existing stormwater ponds
- Town growth management strategy study

D.1.3 Master Servicing Plan Objectives

The objective of this study is to develop a Stormwater Master Plan to guide the management of the Town's stormwater drainage system. The Stormwater Master Plan will evaluate the existing and future growth areas drainage system. As a result of the review McElhanney existing system upgrades and future servicing strategies are proposed.

For the existing stormwater system, the study objectives include taking and inventory of the existing system, analysing (modelling) the system and proposing potential upgrading options. The existing stormwater system is composed of both minor and major systems as well as four existing stormwater management ponds.

For the future growth areas, the proposed stormwater management system (conveyance, detention storage, outfalls etc.) are designed by limiting the off-site release rate to the 2.5 L/s/ha. Modelling of the stormwater infrastructure follows base mapping, existing infrastructure information provided by the Town, future development plans and site information collected through field reviews.

D.2. Methodology

Runoff within the Town is conveyed using a dual drainage minor and major system. The minor system consists of catchbasins (inlets and leads) the underground pipe system and manholes and junctions. The major system is designed to convey overland flows and includes curb and gutter on the roads, drainage ditches and storm water management facilities (SWMF).

D.2.1 Design Criteria

The drainage analysis was completed in order to develop recommendations for the development of a stormwater drainage system with the ability to effectively and efficiently drain runoff within the Town boundary. As discussed in *Section D1.1*, the City of Red Deer Engineering Services Design Guidelines (Section 10, 2016) and Alberta Environment and Stormwater Management Guidelines (1999) were the main sources of design criteria for the assignment. Supplementary design criteria were provided through consultations with Town staff.

Therefore, based on the available design criteria the drainage analysis was conducted in a manner to provide a design where:

- The proposed minor system has adequate capacity to convey the runoff from the 1:5-year return period storm event, and
- The proposed major system has adequate capacity to safely convey runoff during the 1:100 return period storm.

D.2.2 Service Levels

Single event simulation is used to evaluate the ability of the drainage system to meet all required design criteria and targets. The minor system is analysed based on the ability to convey the 1:5-year 1 hour Chicago design storm event without any surcharging, as outlined in the City of Red Deer Engineering Services Design Guidelines (Section 10, 2016). The minor system was also analysed using the single event 1:100-year 1 hour Chicago design storm to determine locations with excessive surcharging/flooding. The major flow routing system was not modeled using computational modelling.

The verification and sizing of SWMF is carried out using the single event simulation, analysing the ability to detain the 1:100 year 24 hour Chicago design storm.

D.2.3 Hydrologic/Hydraulic Modelling

Single event computational modelling was undertaken to evaluate the existing and proposed drainage systems under peak discharge conditions. The hydrologic/hydraulic model was developed in PCSWMM version 7.0. PCSWMM version 7.0 is an adaptation and enhancement of the well known an widely used United States Environmental Protection Agencies (USEPA) Stormwater Management Model (SWMM) version 5.1. PCSWMM was developed by Computational Hydraulics International (CHI) as a combination hydrology-hydraulic model. The hydrology component performs the rainfall to runoff conversion by applying a user selected loss method which takes into account both pervious and impervious area. A runoff hydrograph is then generated for each of the specified catchments based on the catchments characteristic width and roughness. The hydrograph is then routed to a junction. From there, the hydraulic portion of the model routes the flow through a series of conduits (ditches, storm sewers, culvert, etc.) and storage elements using a routing methodology such as the Dynamic Wave equation used in this analysis. The Dynamic Wave methodology was selected for this analysis as it has the ability to account for backwater effects. *Appendix D-2* provides a summary of the input parameters and their associated assumptions. *Table D-1* outlines the modelling scenarios employed for this assignment.

Table D-1: Model Scenarios

Scenario Number	Development Condition	Purpose
1	Existing Minor System	Analyze the performance of the existing minor system during the 5-year and 100-year return period storm event.
2	Proposed Minor System	Analyze the performance of the proposed minor system upgrades and extension during the 5-year and 100-year return period storm event.
3	5-year Development	Sizing of the proposed SWMF and trunk sewers for the proposed 5 year developments.
4	10-year Development	Sizing of the proposed SWMF and trunk sewers for the proposed 10 year developments.
5	25-year Development	Sizing of the proposed SWMF and trunk sewers for the proposed 25 year developments.

Hydrologic modelling of catchment areas requires several inputs to simulate the rainfall to-runoff process. *Table D-2* shows the global input parameters required for the hydrologic/hydraulic simulation of the catchment areas and routing elements. Depression storages are based on typical values used for similar land uses and soils types. Infiltration losses are estimated using the Green Ampt Method; these values are based on sandy loam, the soil characteristics outlined the Town of Ponoka Master Servicing Study (2013). Percent impervious values were determined based on a combination of the City of Red Deer Engineering Services Design

Guidelines (Section 10, 2016) and Alberta Environment and Stormwater Management Guidelines (1999). Percent impervious values were modified to better suit the Town of Ponoka based on a review of the aerial photo. The percent impervious for the residential properties is reduced to 25%, as many of the residential properties contain houses that do not take up a large footprint of the property as is common with larger urban centres and newer builds. Many of the industrial properties within the Town are not fully built out and contain large green spaces/graveled areas, therefore, the value of 80% used may be considered high. However, the value of 80% was maintained to develop conservative outflows. Based on a review of typical residential, commercial and industrial properties a percent impervious disconnect of 25% was applied to all properties.

Table D-2: Modelling Input Parameters

Parameter	Value
Impervious Manning's n	0.013
Pervious Manning's n	0.25
Impervious Depression Storage (mm)	2.5
Pervious Depression Storage (mm)	7.5
Impervious Disconnect	25%
Infiltration loss Method	Green-Ampt
Suction head (mm)	110.1
Conductivity (mm/hr)	21.8
Initial Deficit (frac.)	0.246
Percent Impervious	Road Right of Way: 70% Residential Properties: 25% Commercial Properties: 80% Industrial: 80% Institutional: 50% Parks: 15% Undeveloped: 2%
Conduit Manning's n	Concrete: 0.013 PVC: 0.013 CMP: 0.025 Ditches/Swales: 0.025 Unknown: 0.013

Hydraulic losses in the storm sewers at manhole locations were based on losses due to bends. The loss coefficients were selected based on the values found in *Table D-3.*

Table D-3: Manhole Loss Coefficient Due to Bends (Based on Figure 5-9 in the City of Calgary Stormwater Management Design Guidelines, 2011)

Angle	Loss Coefficient
0	0.05
20	0.15
40	0.35
60	0.65
90	1.6

D.2.4 Design Storms

As per the City of Red Deer Engineering Services Design Guidelines (Section 10, pg. 6, 2016) the Chicago synthetic design storm is used to analyse the stormwater infrastructure. The minor system is analysed using a single event 1:5-year 1-hour Chicago synthetic design storm (*Table D-4, Figure D-2*) and a 1:100-year 1-hour Chicago synthetic design storm (*Table D-4, Figure D-2*). SWMFs are analysed using a single event 1:100-year 24-hour Chicago Synthetic design storm (*Table D-4, Figure D-3*).

Table D-4: Parameters for 1:5 year and 1:100 year Storm Event (Values Taken form the City of Red Deer Engineering Services Design Guidelines [Section 10, 2016])

Parameter	Value		
Return Period	5	100	100
Duration	1	1	24
a	324.72	620.99	620.99
b	0.007	0.002	0.002
c	0.6764	0.6969	0.6969
Peaking Factor	0.3	0.3	0.3
Total Rainfall (mm)	20.36	35.80	93.81

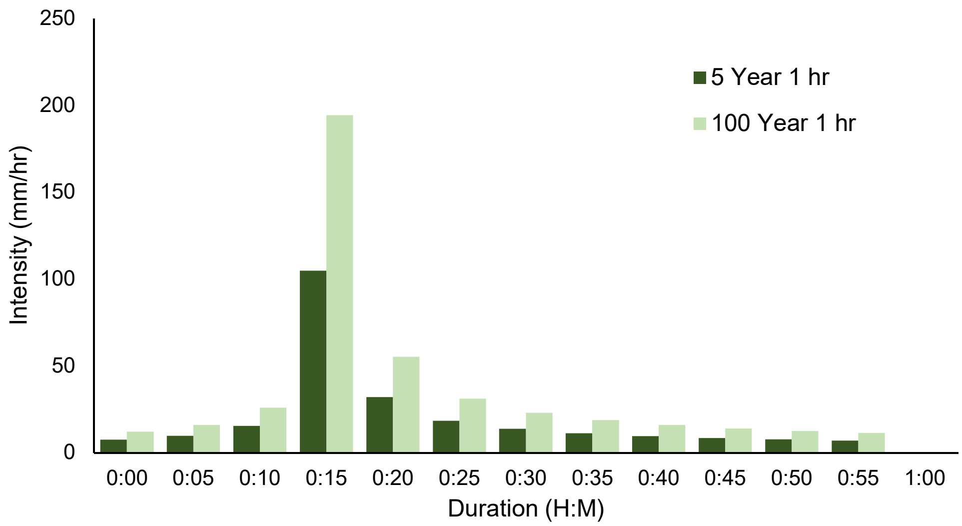


Figure D-2: City of Red Deer 5 & 100 Yr 1 hr Chicago Design Storm

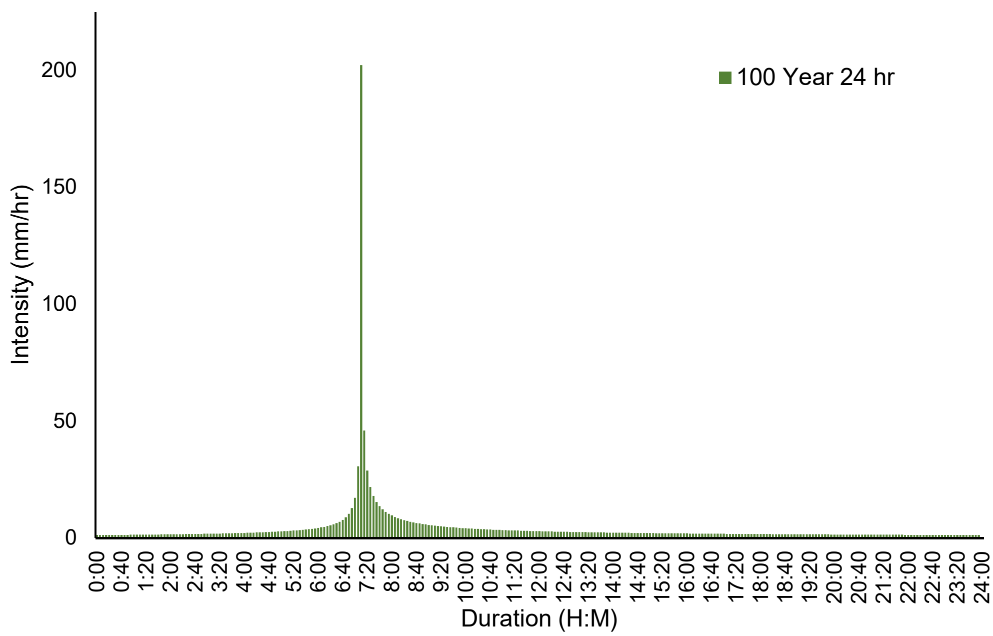


Figure D-3: City of Red Deer 100 Year 24 hr Chicago Design Storm

D.3. Existing Stormwater Collection System

The existing stormwater system for the Town consists of a major and minor system. The minor system consists of catchbasins (inlets and leads) the underground gravity pipe system and manholes. The major system is used to convey larger overland flows and consists of curb and gutter, drainage ditches and stormwater storage elements. There is only one type of storage infrastructure currently located within the Town, dry pond facilities. Runoff within the Town is mainly conveyed overland towards the Battle River. Overland flow is also directed towards inlets into the minor system, drainage ditches or to low points located within the Town. Catchbasins are used to collect the runoff into the minor system. The study area also contains several areas where overland flow is unable to reach the minor system and pools in low depression throughout the Town (*Figure D-5*).

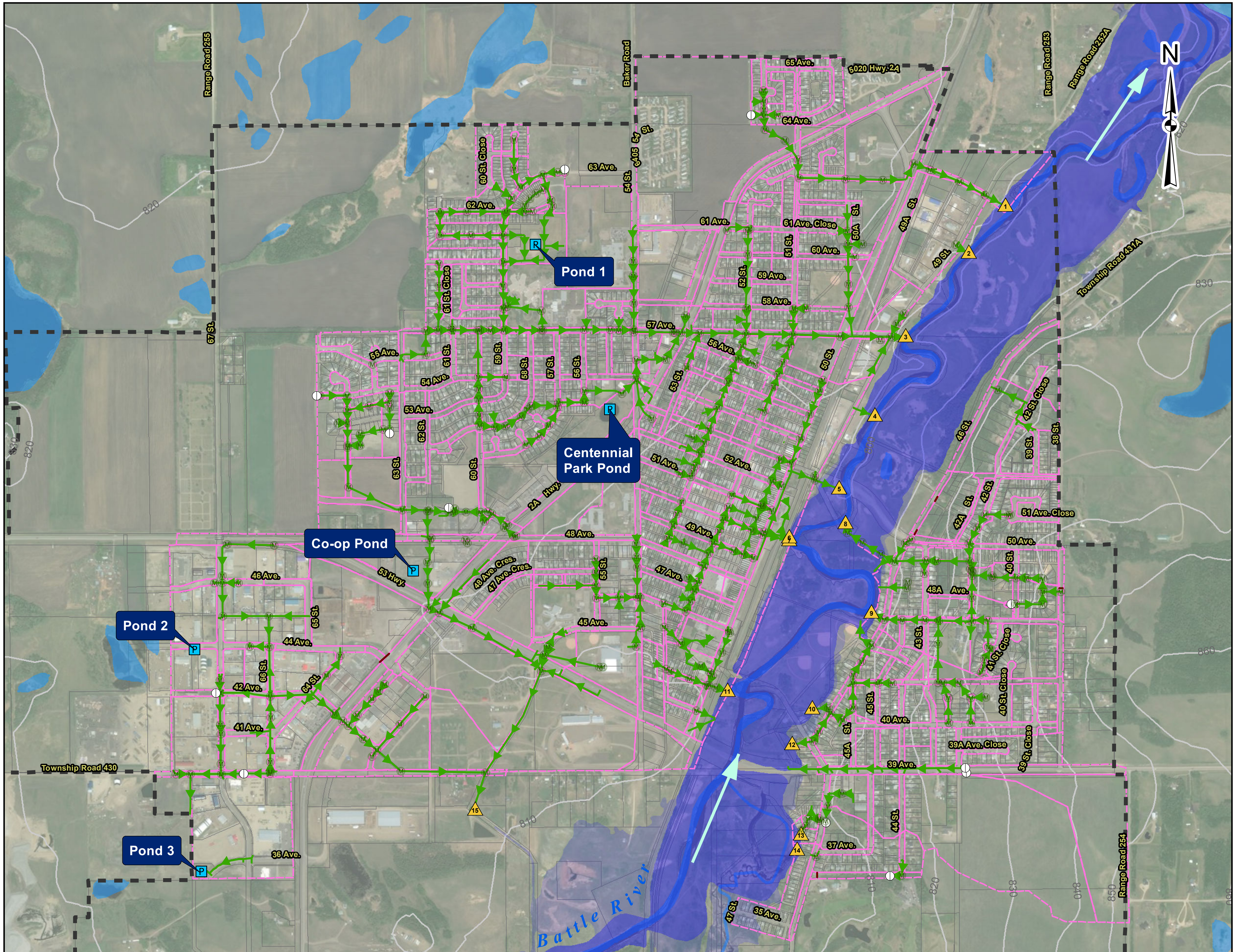
As shown in *Figure D-4*, the existing drainage infrastructure within the Town consists of a network of storm sewers that service the majority of the study area. Several drainage channels also convey overland flow from undeveloped areas directly to the Battle River. Highway 2A and Highway 53 have large wide ditches which store large quantities of runoff and do not drain directly into the Town's stormwater system. The storm sewers and ditches collect and convey runoff to 18 outfalls along the Battle River.

Figure D-5 displays the overland flow directions throughout the Town. *Figure D-5* also displays the localized low points located throughout the Town. The low points may cause localized flooding during rainfall events. Runoff from the minor system is eventually conveyed to the Battle River. Designed major flow paths are generally missing throughout the older parts of the Town, and runoff flows overland uncontrolled. Most of the developed newer areas and downtown area contains curb and gutter drainage with collection to storm sewers.

D.3.1 Existing Overland Drainage Patterns

As shown in *Figure D-5* the Towns runoff patterns can be broken up based on the outfall the minor system runoff is conveyed to. The Towns general overland runoff patterns for the various neighbourhoods can be described as follows:

1. Areas west of the Battle River are generally flat in nature, with mild slopes. This reduces the ease at which runoff flow overland, which can cause substantial pooling.
2. Runoff in the north part of the Town, north of 57 Avenue and west of the Battle River flows southeast towards the 57 Avenue storm system and the Battle River. Overland runoff north of Highway 2A between 64 Avenue and 65 Avenue and the large undeveloped area between 54 Street and Highway 2A is captured by the Highway 2A roadside ditches.
3. The terrain of the downtown core is generally undulating in nature creating a number of localized low points. A gentle ridge runs along the north end of the downtown core along 52 Street which splits the flow east and west.
4. The residential areas west of Highway 2A is divided by a gentle ridge that runs from 57 Avenue and 57 Street to 54 Avenue and 63 Street. Runoff north of the ridge flows north towards 57 Avenue and runoff south of the ridge flows south. Runoff east of 60 Street flows east towards Centennial Park and runoff west of 60 Street flows south towards 48 Avenue. There are a number of localized low points located within the neighbourhood.
5. The South industrial area and Stampede Grounds are flat in nature. The industrial lands are undulating and poorly graded in several areas and contain minimal overland flow routes for runoff. Runoff typically pools along the roadways as flow cannot reach inlets into the minor system
6. Flow east of the Battle River generally flows west towards the Battle River. Steeper slopes are experienced on the east side of the Battle River.



Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Minor Catchments
- Plug
- Manhole
- OutFall
- Ponds
- Culverts
- Storm Sewer Pipes

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 26, 2018

Stormwater Master Plan: Existing Minor System

Figure D4

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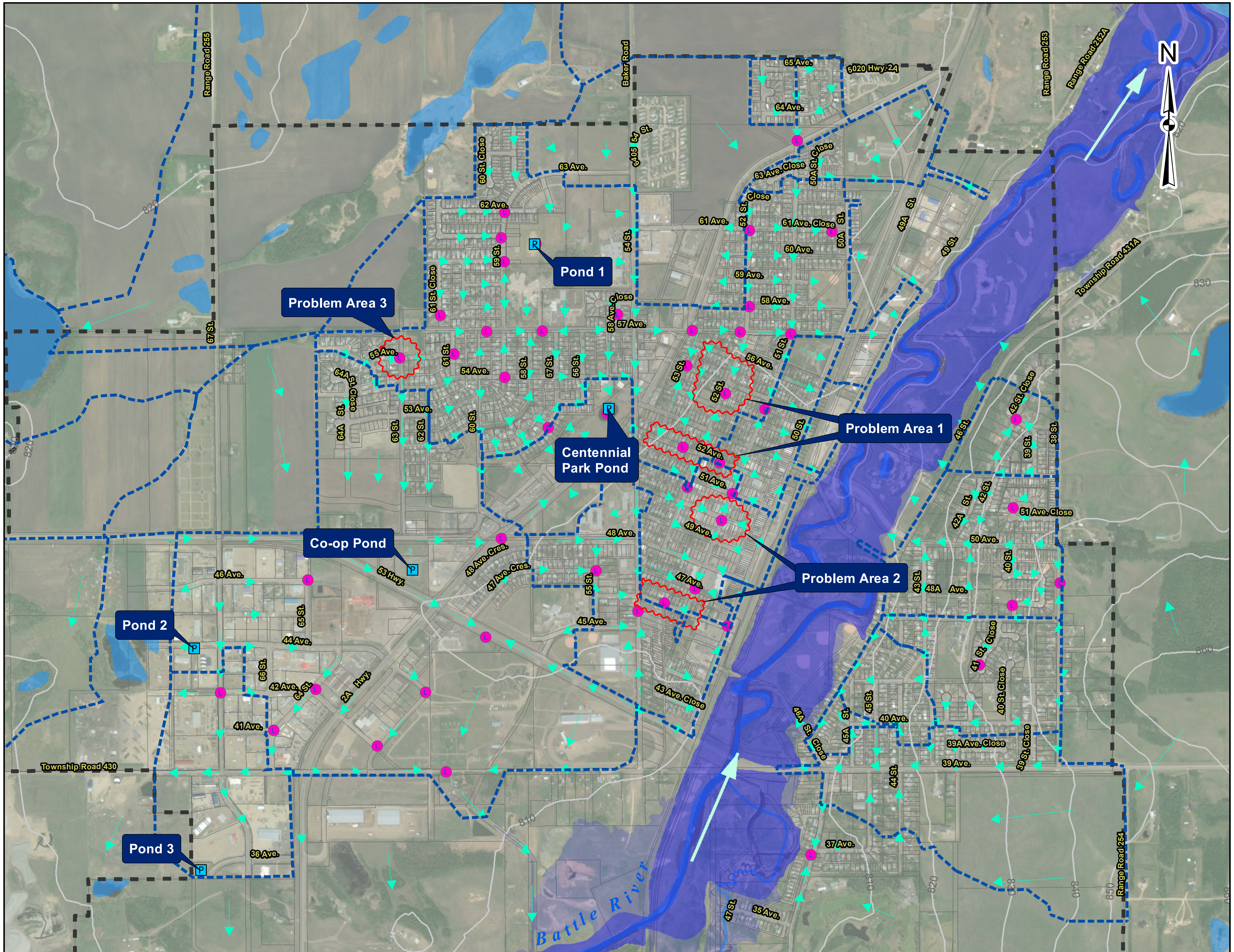
Author: hshin



Master Servicing Study

Ponoka

Legend

- Town Boundary
- Major Catchments
- Floodway
- Flood Fringe
- Ponds
- Low Point
- Overland Flow

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 26, 2018

Stormwater Master Plan: Existing Major System

Figure D5

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D.3.2 Storm Sewers, Ditches, and Culverts

The storm sewers in the Town range in size from 200 mm ϕ to 1800 mm ϕ. Throughout the downtown core storm sewers typically range in size from 200 mm ϕ to 300 mm ϕ. *Table D-5* provides a summary of the active pipes in the Town, according to the GIS data provided. *Figure D-6 and D-7* illustrates graphically the pipe material and installation dates. As displayed, the majority of drainage network is comprised of concrete pipes. A large number of the pipes are comprised of unknown material. A vast majority of pipes have an unknown installation date.

Table D-5: Summary of Active Pipes

Material	Smallest Size (mm)	Largest size (mm)	Pipe lengths (m)							
			Installation Date							Total
			Unknown	1960-1970	1970-1980	1980-1990	1990-2000	2000-2010	2010-2017	
Concrete	200	1825	12,336	2,153	1,250	2,922		42	125	**18,824**
PVC	200	630	2,754					745	14	**3,512**
Asbestos C.	250	250	65							**65**
CMP	200	1200	2,178	17						**2186**
CT	200	200	926							**926**
Perforated CI	200	200	344							**344**
Ultra-Rib	375	375	12							**12**
VCT	200	300	185							**185**
Unknown	Unknown	Unknown	12,982							**12,982**
TOTAL										

Approximately 172 ha of the town, including approximately 21 ha of the downtown core drain to the storm sewer which runs east along 57 Avenue from 63 Street to the outfall into the Battle River on 57 Avenue. The 57 Avenue storm sewer has been identified as a key storm sewer line servicing the Town. The 57 Avenue storm sewer is comprised of concrete and Corrugated Metal Pipe (CMP) and was installed between 1960 and 1970. This vital storm sewer may be reaching the end of its design life. The storm sewer is recommended to be analysed and reviewed in more detail, including CCTV inspection.

A field review of the outfalls was conducted to determine the conditions of the outfall structures. The results of the review can be found in *Appendix D-1*. Among the 17 outfalls of the Town's existing minor stormwater system, seven of the outfalls could not be located during the site visit due to heavy vegetation, this included outfall 2, 6, 7, 13, 15, 17 and 18. During the site inspection it was noted that a number of the outfalls had heavy debris and vegetation. This can result in restrictions at the outlet causing water to backup in the pipe system, reducing the overall capacity of the network.

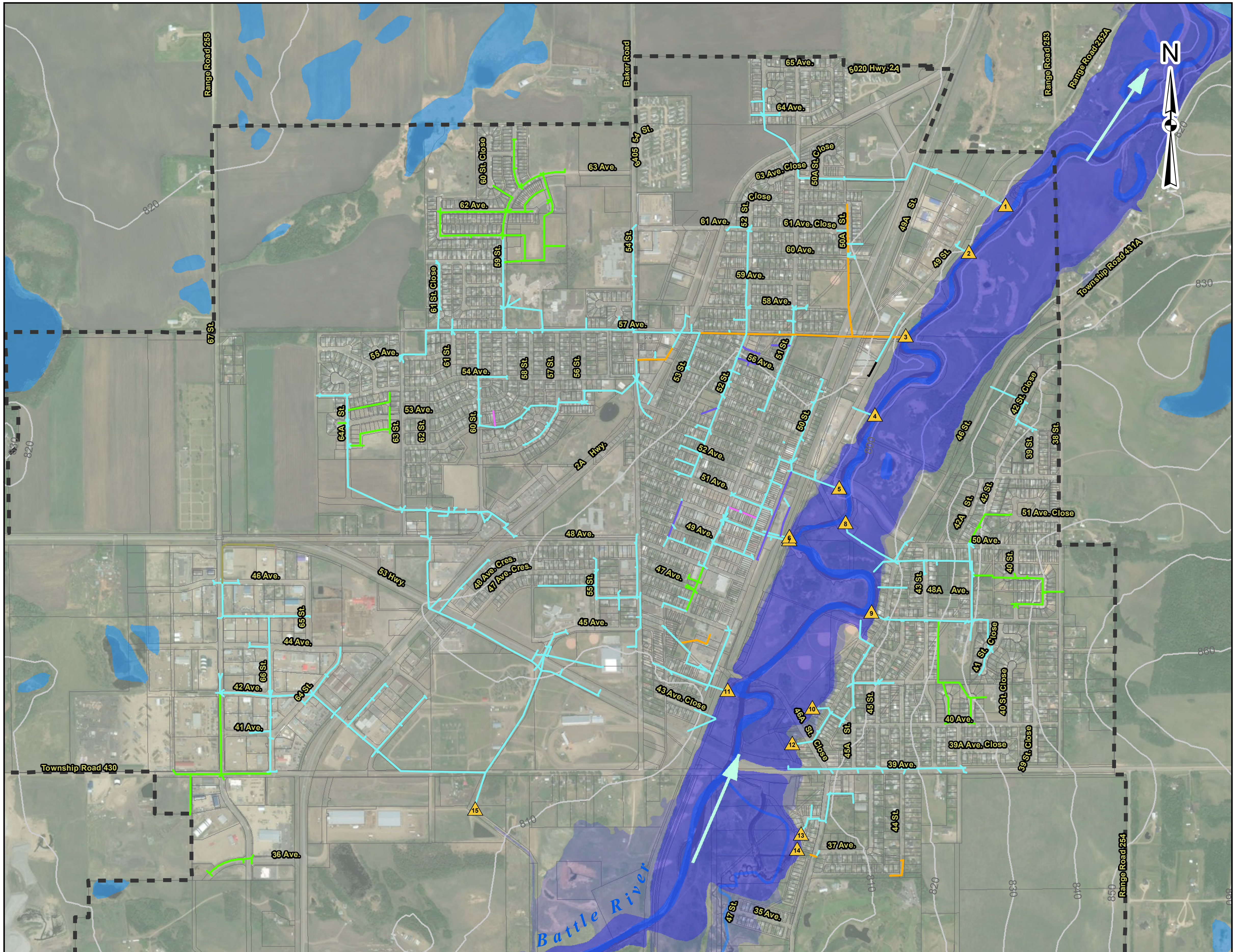
A number of the stormwater manholes, ditches, pipes and outfalls were missing attribute values. Due to unknown information on the storm network components several assumptions were required. The following assumptions were made in the modelling of the storm network.

1. If manhole rim elevations were unknown they were generated from the LiDAR surface provided by the Town.
2. If pipe inlet invert or outlet inverts was unknown, values were assumed which generated a pipe slope equal to that of the upstream or downstream pipes.
3. If manhole inverts were unknown they were assumed to match the lowest invert of a connected pipe.

4. If a pipe size was unknown it was assumed to match the size of the upstream pipe.
5. If pipe material was unknown it was assumed to be concrete.
6. Pond sizes were measured off of the areal photo provided by the Town.
7. Ditches were assumed to be trapezoidal shape with 1 m bottom width, 0.5 m depth and 3:1 side slopes.
8. Outfall invert elevations were generated based on the LiDAR data provided by the Town.

Master Servicing Study

Ponoka



Legend

- Town Boundary
- Floodway
- Flood Fringe
- OutFall

Pipe Material

- AC
- CMP
- CONC
- CT
- PVC
- Perforated CI
- VTC

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 26, 2018

Stormwater Master Plan: Existing Pipe Material

Figure D6

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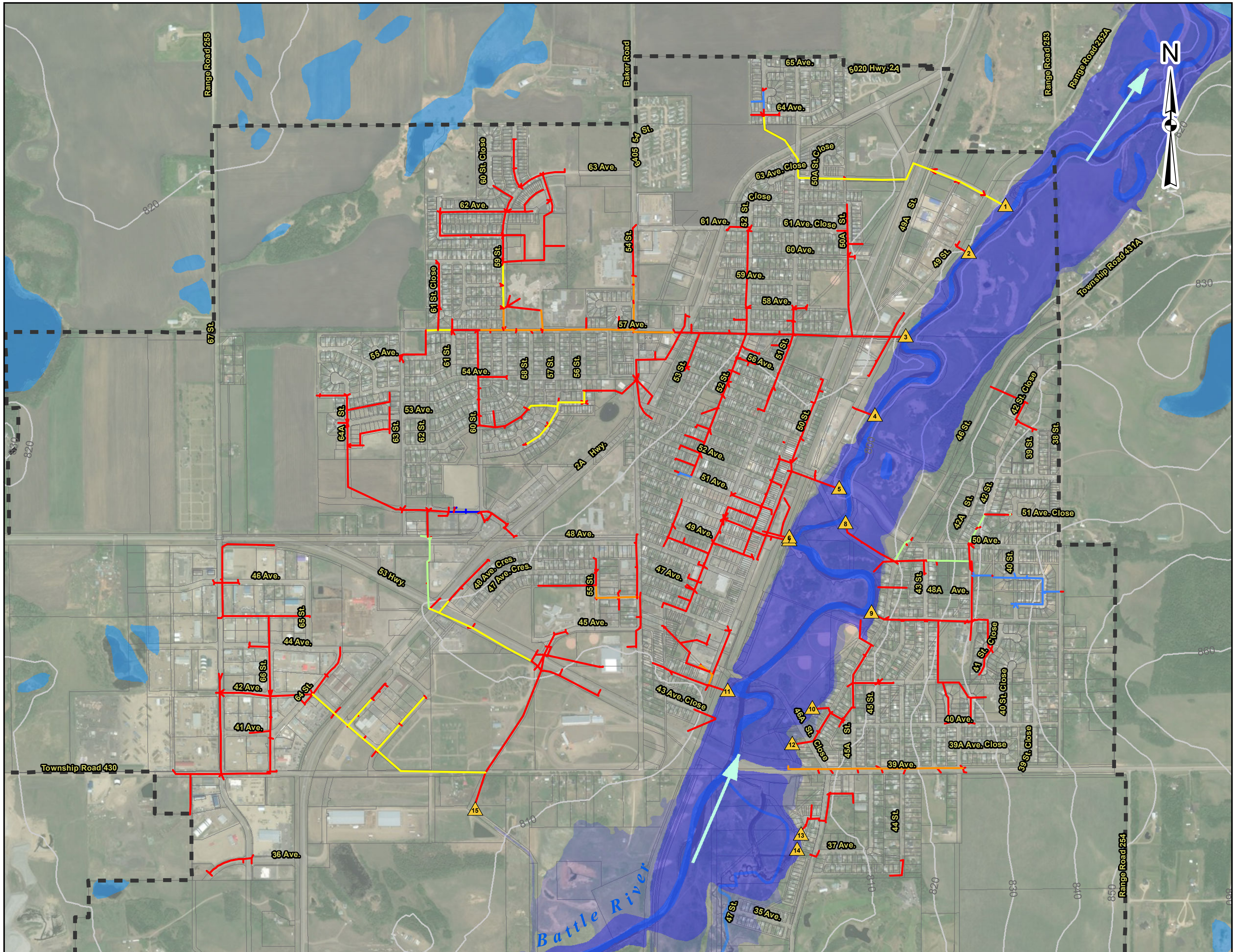

Master Servicing Study

Ponoka

Legend

Town Boundary
Floodway
Flood Fringe
OutFall

Age of Infrastructure

Unknown
1961 - 1970
1971 - 1980
1981 - 1990
2001 - 2010
2011 - 2017

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 26, 2018

Stormwater Master Plan: Age of Minor System

Figure D7

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D.3.3 Ponds, Battle River, and Lake 10

The Battle River is the predominant hydrological feature within the Town. The River flows from the southwest to the northeast. As shown in *Figure D-4* runoff from the Town eventually drains towards the Battle River. The floodway and flood fringe for the Battle River was obtained from Alberta Environment and Parks as part of the Alberta Flood Hazard mapping program. The floodway and flood fringe for the Battle River through the Town is contained within the River valley.

According to the Town of Ponoka's GIS data provided there are four dry detention ponds located within the Town. The location of each of the dry ponds can be found in *Figure D-4*. Each of the dry ponds can be described as follows:

1. Pond 1 collects surface runoff from a residential subdivision located in the northwest corner of the Town. The dry pond is located within a park and contains two playing fields. The pond outlets to six catchbasins located within the dry pond. Flow from the minor system may also surcharge into the dry pond during large storm events. McElhanney was unable to obtain the as-built drawings or report on the dry pond and was therefore, unable to complete a full assessment.
2. Pond 2 collects surface runoff from a part of the southwest industrial area, in particular from lots located on 44 Ave. McElhanney was unable to obtain the as-built drawings or report on the dry pond and was therefore, unable to complete a full assessment.
3. Pond 3 collects surface runoff form a part of the southwest industrial area. The pond outlets to a ditch which flows south towards the Battle River. McElhanney was unable to obtain the as-built drawings or report on the dry pond and was therefore, unable to complete a full assessment.
4. The CO-OP pond collects runoff from a commercial, residential and CO-OP industrial area located immediately north of 48 Avenue between 67 Street and Highway 2A. The pond also collects surface runoff from the two industrial parcels adjacent to the pond site. Information on the pond was obtained from the Stormwater Management Plan Report 60 Street Development Town of Ponoka, Alberta (2016).

The Centennial Park pond is a recreational pond which captures surface runoff from Centennial Park, a number of residential properties backing onto Centennial Park (on the west end of the park) and a portion of Highway 2A. There are two swales directed surface runoff into the pond along the south and west edges of the pond. In discussion with Town staff it was determined that the pond is equipped with a 300 mm ϕ concrete outlet pipe at the north side of the pond that is set at the HWL of the pond. The pipe discharges to a manhole connected to the Town's minor system. The pipe allows overflow when the water level reaches the HWL of the pond, preventing pond overflow. In addition, the town identified a manhole located on the south side of the pond that holds a pump. The manhole fills with water and Town staff are required to manually connect the pump to discharge the water upstream.

Lake 10 is one of the major features in the Town (*Figure D-1*). This crown water body has a static water level of 810.1 m and a lake surface area of 22.6 ha. A major catchment from north of the Town and the Town boundary comprises the catchment area to Lake 10. A 40 ha marshland exists to the west, north, and east sides of the Lake. The lake outlets south towards the Battle River in a defined outlet channel. The Land Management Department (Public Lands) of Alberta Sustainable Resources Development have confirmed they will claim the Crown boundary of Lake No. 10 to an elevation of 810.4m. Therefore, no development can be conducted in this area.

D.3.4 Hydraulic Analysis of Existing Storm Drainage System

Computational modelling was undertaken to simulate the rainfall-to-runoff process and determine the peak flows from the sub-catchments during the design storm events. A modelling scenario was developed in PCSWMM to determine if the existing minor system has adequate capacity to convey the 5-year flows (Scenario 1 in *Table D-1*). As discussed in *Section D.2.4* the existing minor system was assessed using the City of Red Deer 5 year 1 hour Chicago design storm. The design criteria used for the analysis was taken from the City of Red Deer Engineering Services Design Guidelines (Section 10, 2016) and Alberta Environment and Stormwater Management Guidelines (1999). The minor system is analysed based on the ability to convey the 1:5-year design storm event without any surcharging.

Since the analysis was completed with 5-year runoff the Battle River level was assumed to be within the banks and therefore not have an impact on the outfall structures. All outfall structures were modeled during the 5-year analysis as free flowing. During larger regional rainfall events or rain on snow events the water level of the Battle River may rise and cause a rise in the outlet hydraulic grade line (HGL), effecting the outflow from the minor system. The outfalls were also modeled assuming no debris or blockages existed.

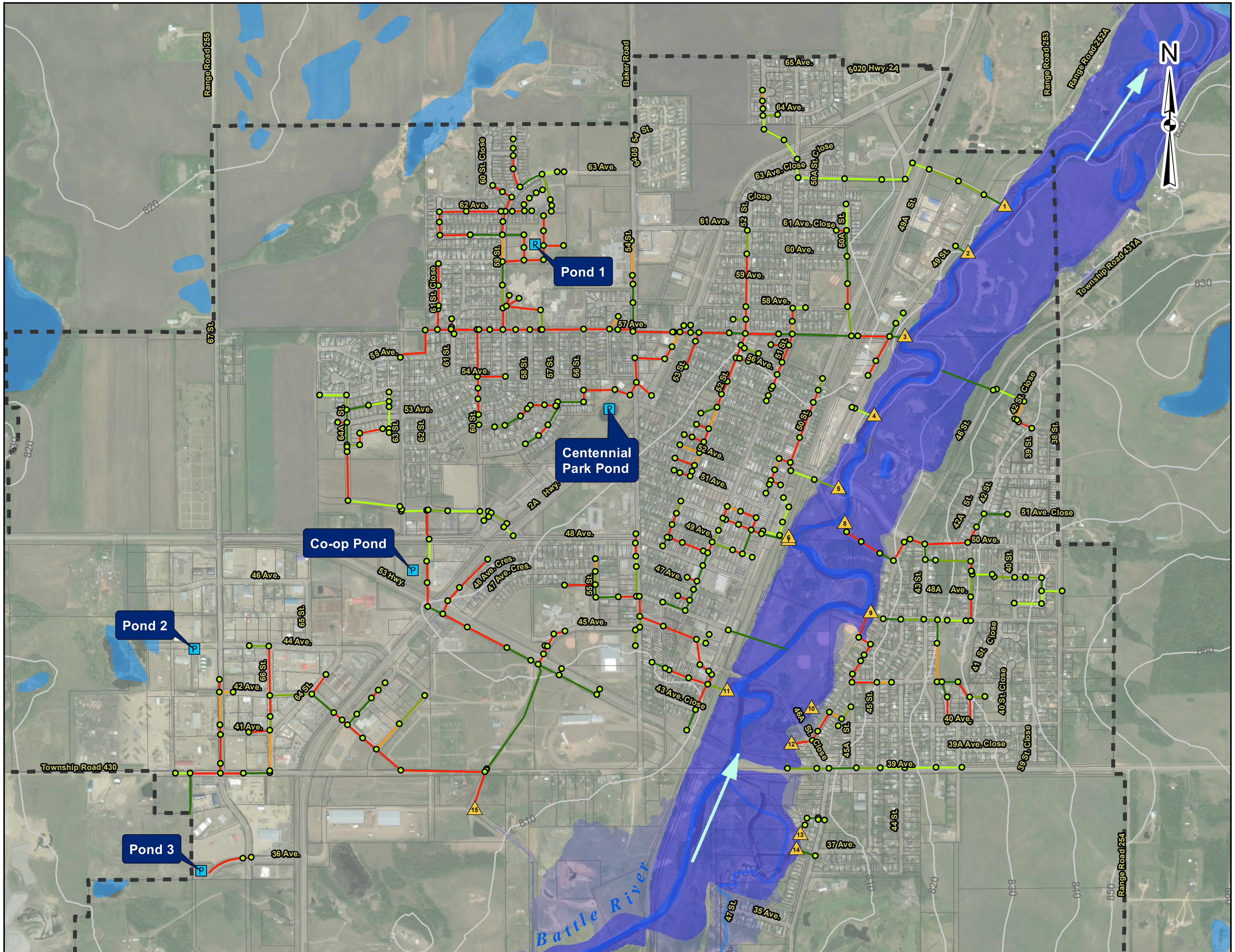
Capacity Analysis

The modelling revealed that during the 5-year 1-hour event, the peak runoff exceeds the capacity of a large number of the Towns storm sewers. The capacity of the minor system during the 5-year design storm is depicted in *Figure D-8*, with colour classification illustrating the ratios of peak flow to pipe capacity during the 5-year design storm event.

The undersized storm sewers include the large majority of storm sewers located within the downtown core and western residential neighbourhoods. The undersized sewers also include the main sewer located along 57 Ave which conveys 172 ha of the Towns runoff to the Battle River. The modelling revealed that the reduced capacity of these pipe segments cause water to surcharge and backup during the 5-year 1-hour storm event. *Figure D-9* shows the locations where surcharge conditions are expected. The increased HGL affects not only the undersized pipes but also upstream segments. These pipes may have capacity to convey the peak runoff, but due to backwater effects, surcharging also occurs.

The colour classification used in *Figure D-9* depicts the manholes where the HGL is below the crown of the connecting pipes (green-coloured), those where the HGL is above the crown but 0.3m below the ground surface (pink-coloured), those where the HGL is above a 0.3m depth from the surface but still under the surface (yellow-coloured), and locations where flooding occurs (red-coloured).The analysis reveals substantial flood within the downtown core, in particular along 52 Street, 51 Street, 50 Street, 54 Street, and 43 Avenue (these were areas also identified by the Town). Substantial flooding also occurs within the western residential neighbourhood south of 57 Avenue between Highway 2A and 63 Street. Several storm sewers east of the Battle River also experience some flooding issues. The SW industrial area also experiences extensive flooding during the 5 year event. The 57 Avenue storm sewer also experiences considerable flooding between 58 Street and 63 Street. This loss of water during the simulation as a result of the flooding can cause a loss of water in the downstream system and therefore, an under-estimation of potential flows in the downtown system. Therefore, as the under-capacity pipes are upsized, additional flow will be added to the downstream system which may cause these pipes to be under capacity.

It is important to note that the modelling of the minor system assumed that the overland flow is able to reach inlets into the minor system and that the inlet capacity is not a limiting factor. This is usually not the case; however, the purpose of this analysis is to assess the ability of the minor system to convey the 5-year design flows and not the ability of the inlets to capture the runoff. A review of the catchbasin locations found in the GIS data provided by the Town indicate that in several neighbourhood's runoff needs to travel long distances (greater than 150 m) before reaching an inlet. Therefore, the modelling may be overestimating the capture rate of the minor system.



Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Junctions
- OutFall
- Ponds

Q_5/Q_{cap}(%)

- 0 - 30
- 30 - 60
- 60 - 90
- 90 - 100
- > 100

McElhanney

0 160 320 640 960 (m)

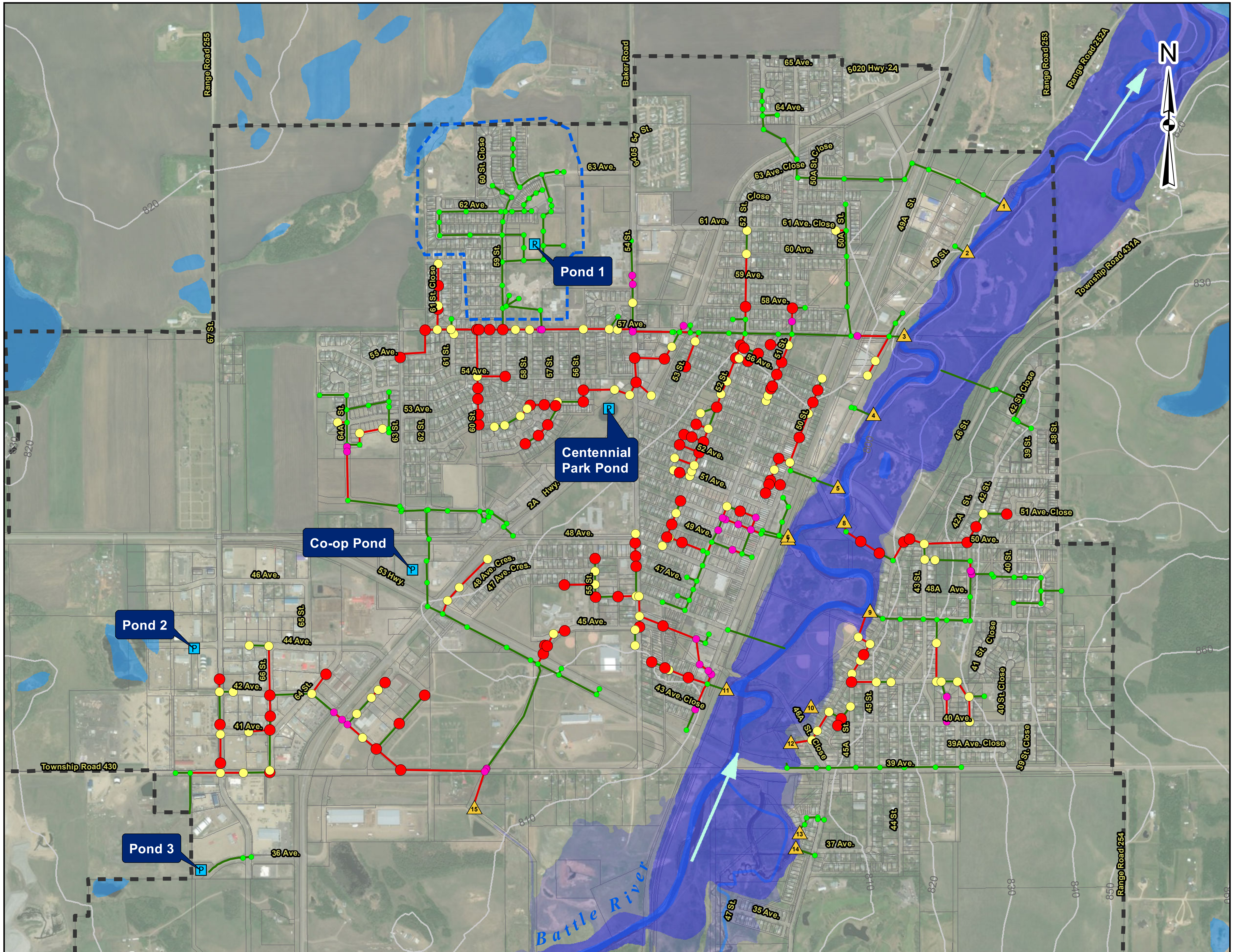
1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 26, 2018

Stormwater Master Plan: Existing Minor System Capacity Assessment

Figure D8



Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- OutFall
- Ponds

HGL at Manhole

- HGL < Crown
- Crown < HGL < 0.3 m from Ground
- HGL > 0.3 m from Ground
- HGL > Ground

Conduits

- Surcharged
- Not Surcharged

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 26, 2018

Stormwater Master Plan: Existing Minor System HGL Assessment

Figure D9

D.4. Evaluation Strategies

D.4.1 Objectives

As discussed in *Section D.2.3* the pipe system was analysed using PCSWMM on the ability to accommodate the 5-year design flows in pipe. As shown in *Figures D-8 and D-9*, there are several locations where the existing system does not have the capacity to convey the 5-year design flows and as a result the HGL rises above the crown of the pipe. In locations where the existing system does not have the capacity, pipes have been recommended to be upsized so that the HGL falls within the pipe as per the City of Red Deer Engineering Services Design Guidelines (Section 10, 2016).

D.4.2 Evaluation Criteria

Storm sewer upgrades have been prioritized as either high, medium or low priority based on the existing system HGL analysis and the proximity of the flooding locations to residences or business. The priorities were based on the following descriptions:

- High priority was given to locations where the HGL was currently above the ground surface under the 5-year design storm causing frequent flooding/ponding. High priority at these flooding/ponding locations was given if the flooding/ponding occurred in close proximity to residences or buildings. The high priority proposed upgrades should be addressed within the 5 or 10-year development plan.
- Medium priority was given to given to locations where the HGL was currently within 0.3 m of the ground surface under the 5-year design storm. The elevated HGL has a negative effect on the upstream storm system. An elevated HGL also may cause service connections to backup. The medium priority proposed upgrades should be addressed within the 25-year development plans.
- Low priority was given to locations where the HGL was above the crown of pipe but still well below the ground (greater than 0.3 m from ground). In these locations, the system fails under the design criteria of containing the 5-year design storm within the pipe, however, the impact of the elevated HGL is not significant. These upgrades may not be necessary given budget constraints.

Prior to the removal/abandonment of a storm sewer CCTV inspection should be conducted to identify the locations of service connections joined to the pipe systems.

D.5. Proposed Stormwater Servicing Strategy

D.5.1 Opportunities and Constraints

A number of alternatives exist to eliminate ponding/flooding and reduce the HGL within the minor system other than increasing the pipe sizes as identified in this report. These alternatives include introducing storage elements where possible. Some examples of alternative methods that could be employed include:

- Oversized pipes;
- Underground storage tanks;
- Introducing Inlet Control Devices at strategic location to create surface traplows;
- Rain gardens;
- Combination soil/water underground storage tanks (i.e. Silva Cells);
- Etc.

In addition, introducing a new storm sewer to a new outfall structure into the Battle River is also an alternative to upgrading existing pipe sizes.

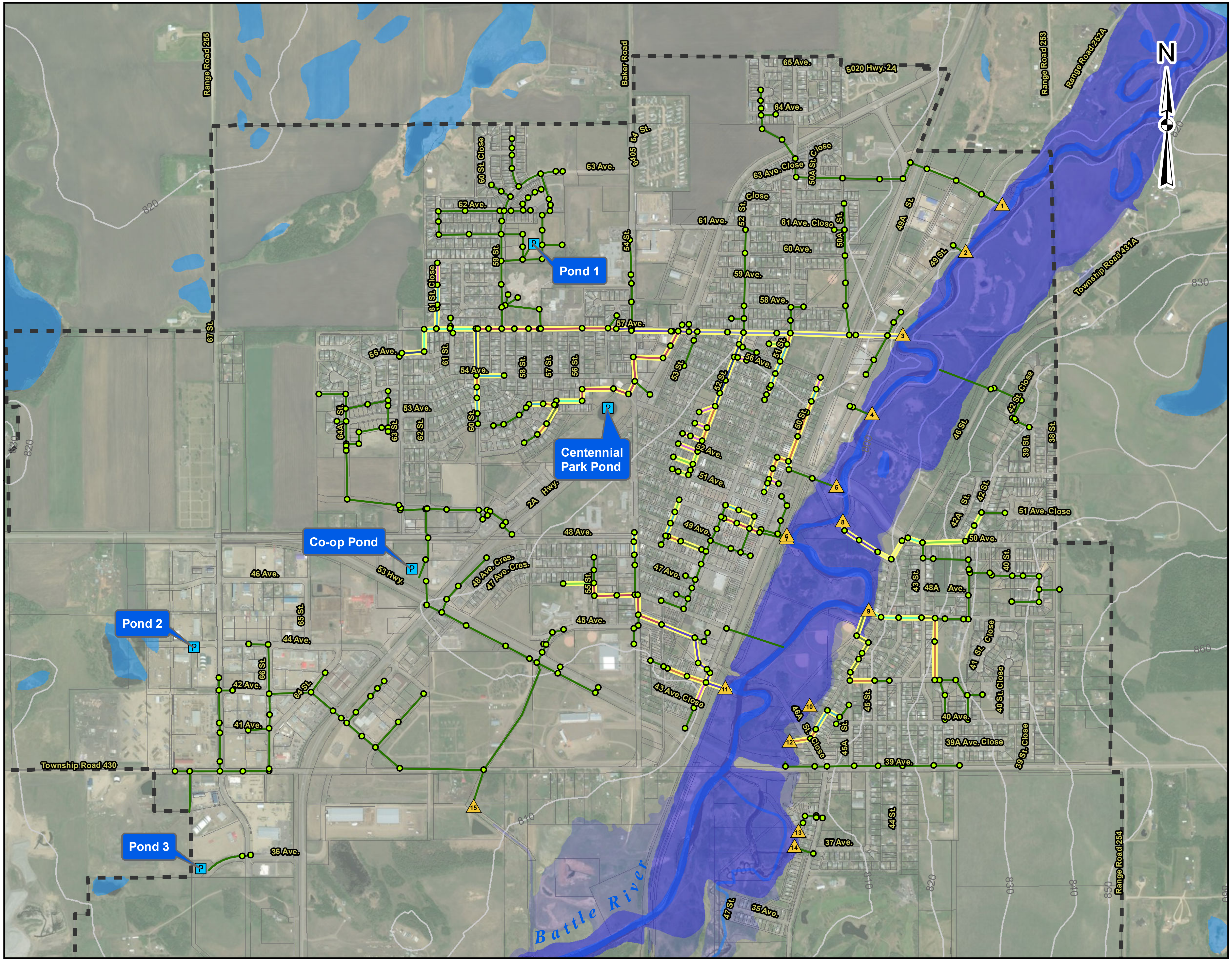
Due to the lack of design information on the functioning of dry ponds within the Town, several systems could not be fully analysed. The residential neighbourhood located north of 57 Avenue between 58 Street and 61 Street could not be fully analysed.

It is also important to note that the recommendations provided are based on the capacity analysis. The condition of the storm sewer is not considered during this analysis. A number of pipes may be reaching the end of there design life. In addition, installation practices or pipe materials may have resulted in advanced degradation of the pipe network. CCTV may reveal that pipes not recommended to be replaced due to capacity issues may require replacing due to poor quality of the pipe.

D.5.2 Upgrades to Existing Stormwater Drainage System

Figures D-10 to D-12 display the locations of proposed upgrades for high, medium and low priority, respectively. The 57 Avenue storm sewer should be upgraded prior to any connecting systems to guarantee that the 57 Avenue storm sewer has the capacity to handle additional flows that may result from upgrading connecting systems. Upgrades within the downtown core involve upgrading the existing 200 mm ϕ and 250 mm ϕ pipes. *Appendix D-4* displays the characteristics of the recommended pipe upgrades.

Author: hshin
Document Path: L:\Proj\Projects\2131 - Edmonton\2131-00247-00 Engineering Services Town of Ponoka\2131-00247-14 Master Servicing Study Re-Write\2.0 Documents\2.4.5 Figures\Storm\Figure D10 - High Priority Minor System Upgrades.mxd



Master Servicing Study

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Proposed Junctions
- OutFall
- Ponds

Proposed Storm (mmØ)

- 300
- 375
- 450
- 525
- 600
- 675
- 750
- 900
- 1050
- 1200
- 1500

McElhanney

0 160 320 640 960 (m)

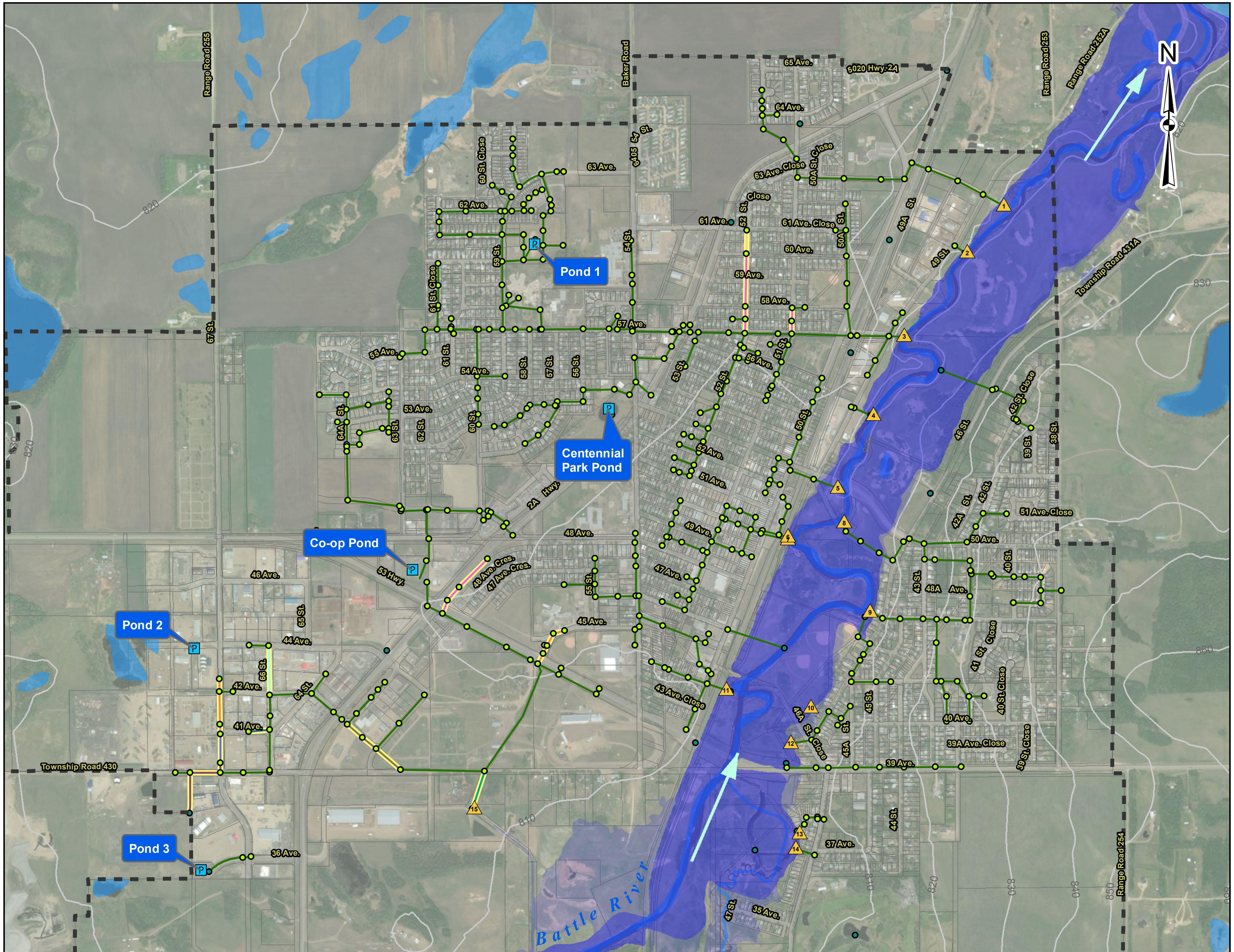
1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 26, 2018

Stormwater Master Plan: High Priority Minor System Upgrades

Figure D10



Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Proposed Junctions
- OutFall
- Ponds

Proposed Storm (mmØ)

- 300
- 450
- 525
- 600
- 675
- 750
- 900
- 1200
- 1350

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
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Stormwater Master Plan: Medium Priority Minor System Upgrades

Figure D11

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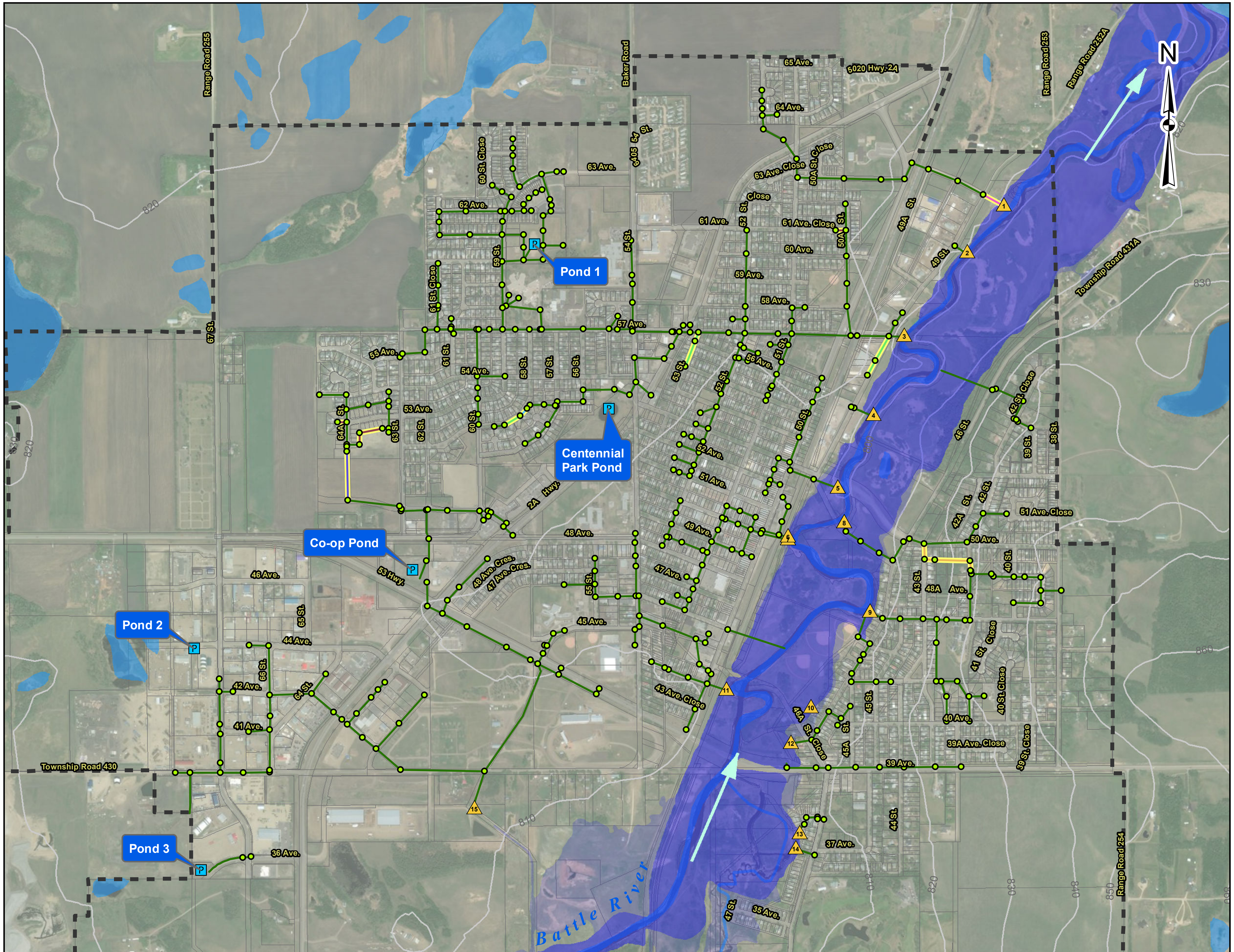

Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Proposed Junctions
- OutFall
- Ponds

Proposed Storm (mmØ)

- 300
- 375
- 450
- 675
- 750
- 1350

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 26, 2018

Stormwater Master Plan: Low Priority Minor System Upgrades

Figure D12

The Town noted several areas where ponding/flooding is frequently observed. The following are the trouble areas identified by the Town.

1. Frequent ponding noted along 52 Avenue between 52 Street and 53 Street.
2. Frequent ponding at 52 Street and 46 Avenue, 54 Street and 46 Avenue and at 51 Street and 50 Avenue.
3. Frequent ponding noted at 63 Street and 55 Avenue.

These areas are each located at low points where runoff collects. It is important to maintain the catchbasins at these locations to confirm that they are not clogged with debris. Each of these areas are explored in deeper detail below.

Trouble Area 1

The storm sewer collecting runoff from 52 Avenue between 52 Street and 53 Street conveys flows east into the 52 Street storm sewer which flows north eventually joining into the 57 Avenue storm sewer at the intersection of 52 Street and 57 Avenue. The storm sewer is currently a 250 mm ϕ feeding into a 250 mm ϕ concrete storm sewer along 52 Street. As shown in *Figure D-5* there is a low point midway between 52 Street and 53 Street. As identified in *Figure D-8* the 52 Street storm sewer does not have the capacity to properly convey the 5-year design flow. As a result, the HGL rises above ground. Since the 52 Avenue storm sewer is connected and the ground elevation is lower than the connecting roadway the HGL rises above the ground level along 52 Avenue first causing ponding at this location first. *Figure D-13* displays the HGL of the 52 Avenue and 52 Street storm sewer under the 5-year design flow for existing conditions. *Figure D-14* displays the recommended upgrades for the area to reduce the potential for frequent ponding. Additional twin catchbasins are also recommended at the low point to confirm that all the collected runoff can enter the minor system

It is important to note that the 57 Avenue storm sewer downstream of 52 Street should be upgraded prior to upgrades along 52 Street to ensure that the 57 Avenue storm sewer has the capacity to handle any additional flows.

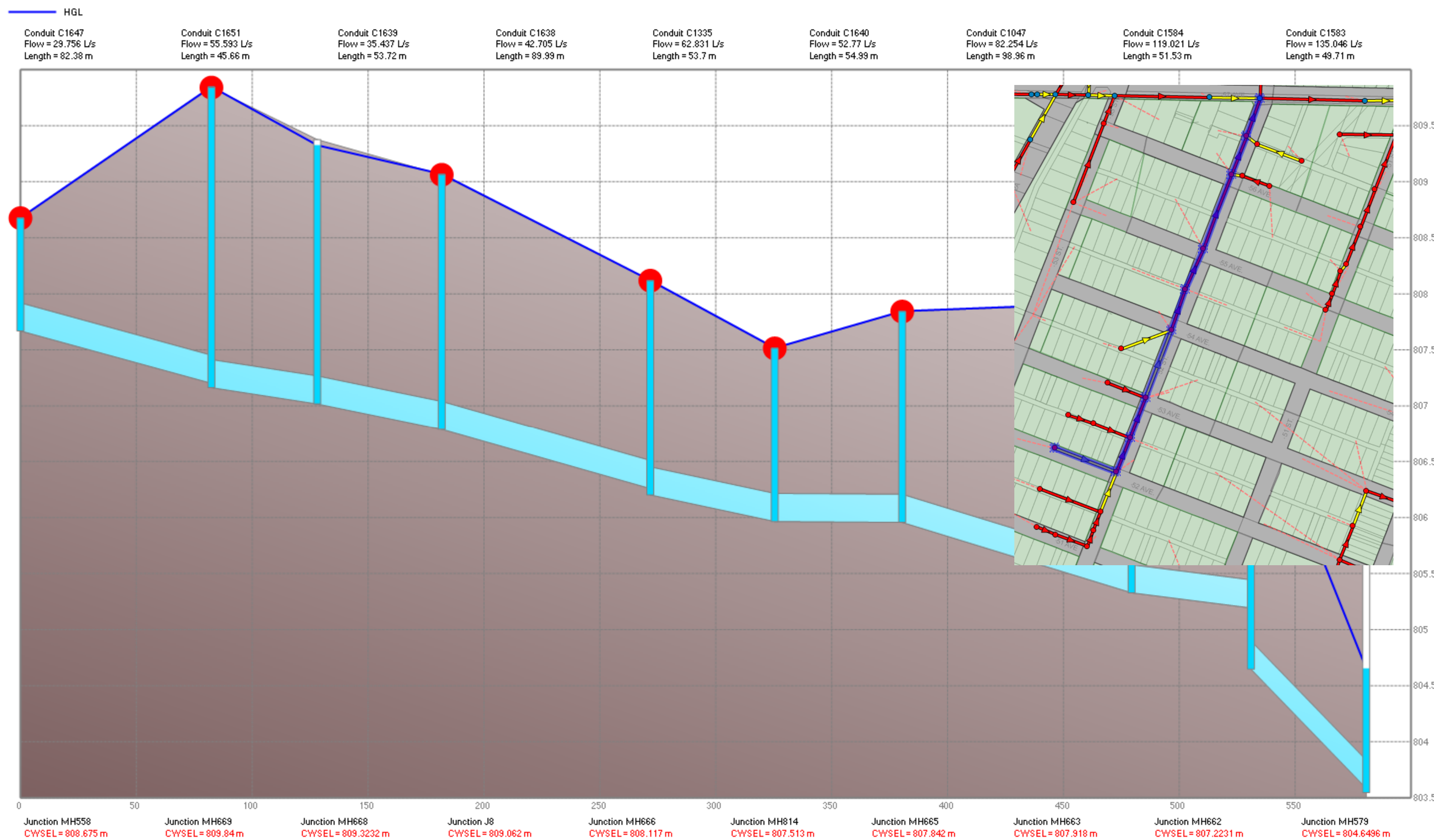

Figure D-13: Trouble Area 1 HGL Plot

Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Proposed Junctions
- Proposed Outfalls

Proposed Storm (mmØ)

- 300
- 375
- 450
- 525
- 675
- 750
- 900
- 1200
- 1500

McElhanney

0 30 60 120 180 (m)

1:3,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 29, 2018

Proposed Minor System Upgrades: Trouble Area 1

Figure D 14

Document Path: C:\Users\jmckee\Desktop\Figure D10 - Proposed Minor System Upgrades - Trouble Area 1.mxd

Author: jmckee

Trouble Area 2

Trouble area two, *Figure D-16*, contains a number of flooding/ponding locations within the same downtown storm network along 52 and 51 St between 46 Ave and 60 Ave. As noted in *Figure D-5* there are a number of low points along 51 St between 46 Ave and 60 Ave. The storm sewer along 51 St has a shallow slope, ranging from 0.3% to 0.8% at the intersection with 60 Ave. The storm sewer along 51 St was upsized in 2016 between 46 Ave and 48 Ave. Based on the PCSWMM model results the upsized storm sewer has the capacity to convey the 5-year design storm within the pipe. The HGL plot is shown in *Figure D-15*. The issue at these specific locations may be attributed to the number and location of the inlets into the minor system. Twin catchbasins are recommended at each of the low points to enable runoff to be captured and conveyed within the minor system.

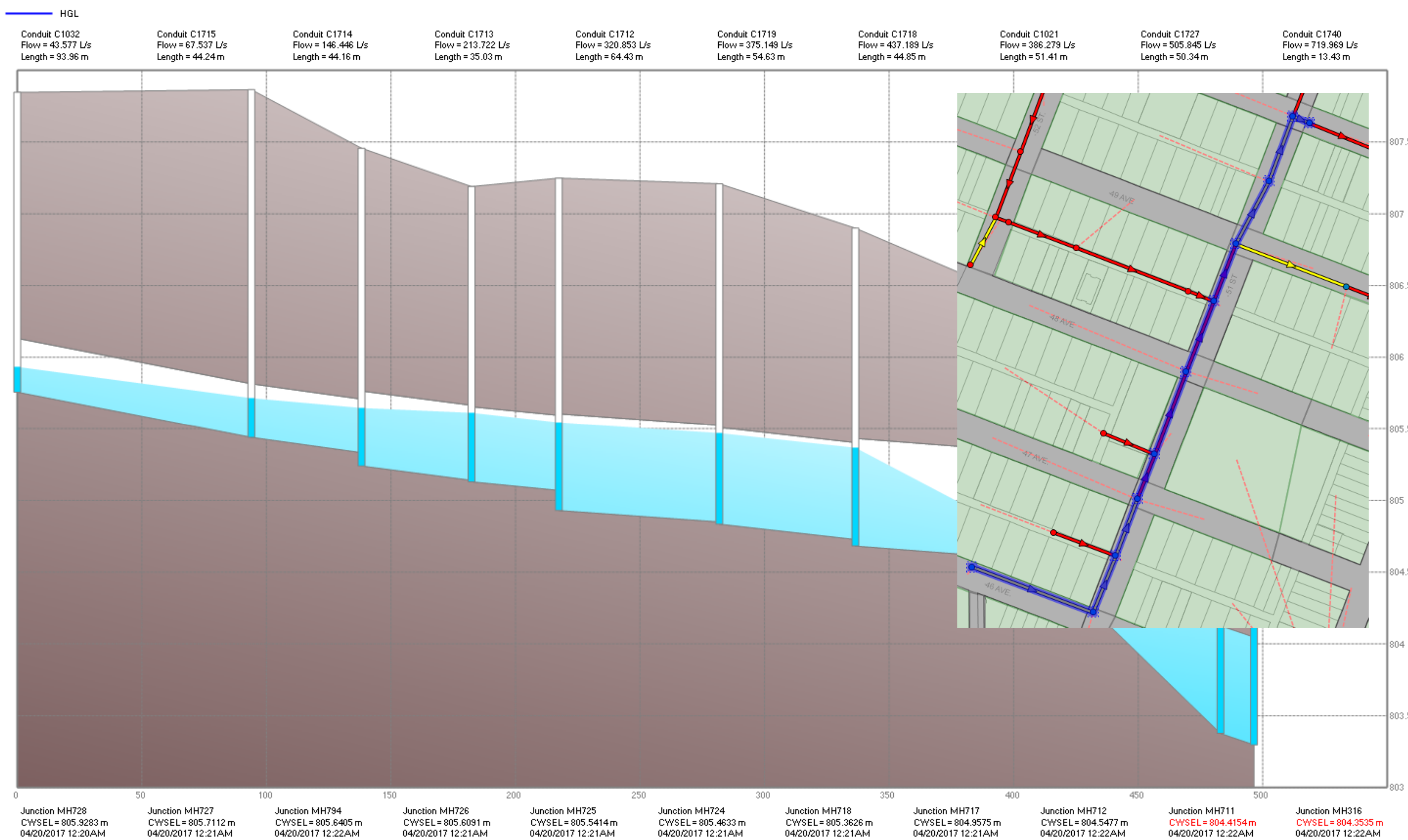

Figure D-15: Trouble Area 2 HGL Plot

Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Proposed Junctions
- Proposed Outfalls

Proposed Storm (mmØ)

- 300
- 375
- 450
- 525
- 600
- 750
- 900
- 1200

McElhanney

0 30 60 120 180 (m)

1:3,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 29. 2018

Proposed Minor System Upgrades: Trouble Area 1

Figure D16

Document Path: C:\Users\jmckee\Desktop\Figure D11 - Proposed Minor System Upgrades - Trouble Area 2.mxd Author: jmckee

Trouble Area 3

Trouble area three is located at the intersection of 63 St and 55 Ave, shown in *Figure D-18*. The storm sewer collecting runoff from 55 Ave at the intersection with 63 St conveys flows east and then north to the 57 Ave storm sewer. The storm sewer is currently a 300 mm ϕ feeding into a 450 mm ϕ concrete storm sewer along 55 Ave. As shown in *Figure D-5* there is a low point at the intersection of 55 Ave and 63 St which collects runoff from the residential neighbourhood to the west. As identified in *Figure D-8* the 57 Ave storm sewer does not have the capacity to properly convey the 5-year design flow. As a result, the HGL rises above ground. Since the 57 Ave storm sewer is connected and the ground elevation at the intersection of 63 St and 55 Ave is lower than 57 Ave the HGL rises above the ground level along 55 Ave first causing water and ponding at this location first. *Figure D-18* displays the recommended upgrades for the area to reduce the potential for frequent ponding. Additional twin catchbasins are also recommended at the low point to confirm that all the collected runoff can enter the minor system

It is important to note that the 57 Ave storm sewer downstream of 61 St should be upgraded prior to upgrades along 55 Ave to ensure that the 57 Ave storm sewer has the capacity to handle any additional flows.

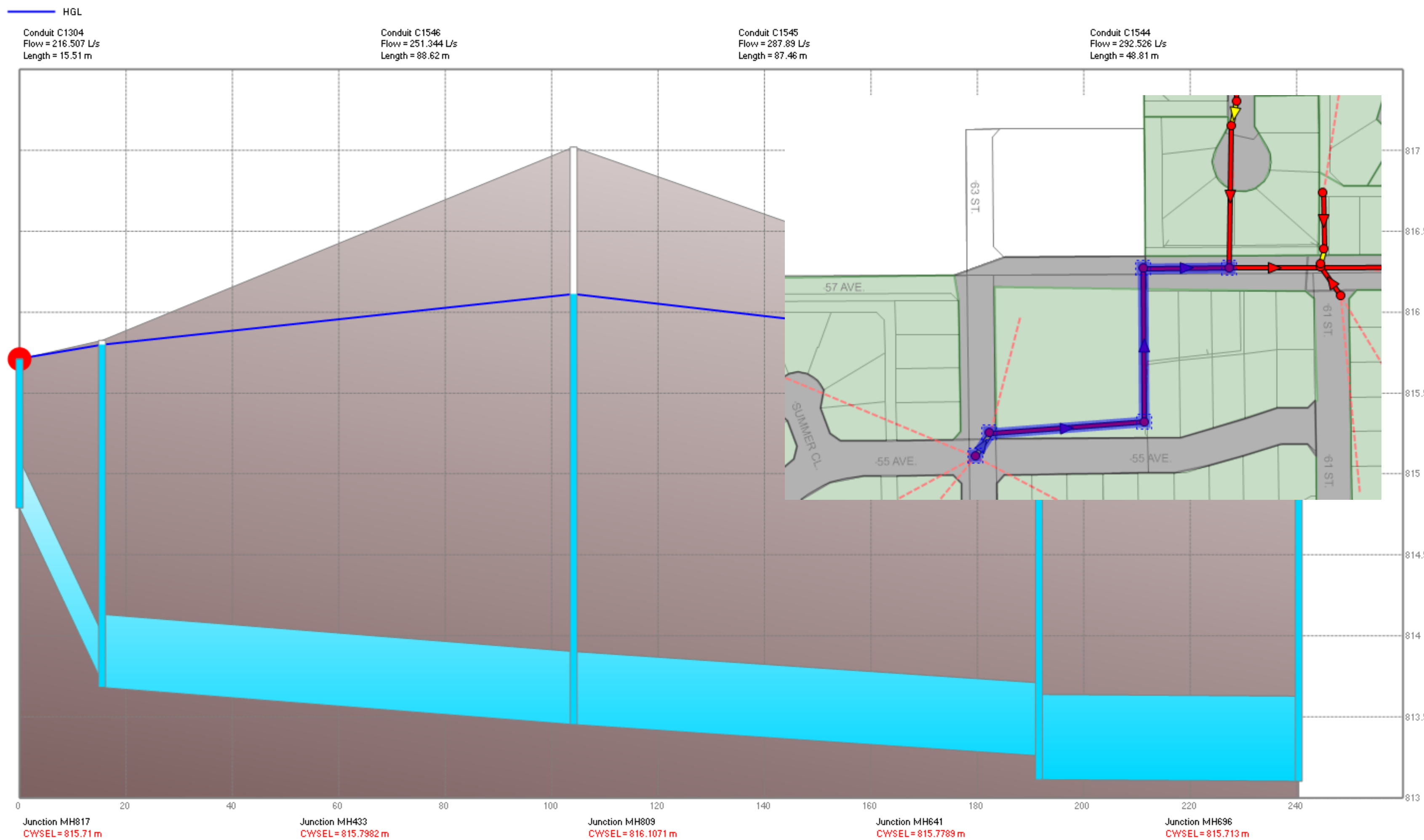

Figure D-17: Trouble Area 3 HGL Plot

Master Servicing Study

Ponoka

Legend

Town Boundary

Proposed Junctions

Proposed Storm (mmØ)

- 300
- 450
- 525
- 675
- 750
- 900

McElhanney

0 30 60 120 180 (m)

1:3,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 29, 2018

Proposed Minor System Upgrades: Trouble Area 1

Figure D18

Document Path: C:\Users\jmckee\Desktop\Figure D11 - Proposed Minor System Upgrades - Trouble Area 3.mxd Author: jmckee

D.5.3 Phasing and Implementation

Phasing for the upgrades to the existing system should be completed from high priority locations to low priority locations. Projects should be set up so that the downstream upgrades are completed first. Projects can be aligned with other infrastructure projects in the area, such as roadway resurfacing work, sanitary upgrades, water upgrades etc. As noted above 57 Avenue storm sewer collects runoff from 172 ha of the Town and should be completed prior to connecting storm sewers.

D.6. Future Developments Stormwater Servicing Strategy

The Town of Ponoka has approximately 670 ha of undeveloped land scheduled to be developed as part of the MDP. At present this development area is located at the edges of Town, along with several undeveloped parcels within the Town. To develop this land a stormwater servicing strategy is required to confirm that the lands are developed sustainably and runoff is drained effectively and efficiently. The proposed developments will substantially increase impervious areas by introducing paved surfaces and buildings. This increase in imperviousness will cause runoff rates and volumes to increase, this increase must be mitigated to prevent flooding and damage of downstream property, infrastructure and natural systems. Based on Alberta Environment and Parks guidelines, post-development flows should be limited to pre-development rates. As noted in *Section D.1.1* to prevent damage to downstream systems a release rate of 2.50 L/s/ha was proposed to match pre-development flow rates. Three types of developments have been proposed; industrial, commercial and residential. The proposed developments can be found in *Figure D-19*. Development horizons of 5, 10 and 25 years is used for the phasing. The horizons and phasing for the developments was provided by the Town.

The pond and future storm sewer systems for the future developments are designed based on the following criteria:

1. Ponds are sized using the 1:100 year 24 hr Chicago design storm.
2. Major sewers conveying development runoff to the pond facilities have been design using the 1:100 year 24 hour Chicago Design Storm.
3. Ponds are located to act as regional ponds.
4. Ponds are located at low points within the developments.
5. Permanent pool depths of 2 m are assumed for wet ponds for water quality.

The future stormwater system designs can be found in *Figure D-19*. Ponds should be designed so that they can expand to accommodate the future developments that will be contributing runoff.

D.6.1 Short Term (5 Year) Developments

The Town is proposing 234 ha of development within the 5 year horizon. This includes 4 ha of commercial developments, 138 ha of industrial developments and 92 ha of residential developments.

As shown in *Figure D-19* there are three residential developments, two of them are located in the north end of Town which will drain to a regional pond (Pond 2) at the intersection of 51 Street and Highway 2A. The pond will discharge into an existing storm sewer and then into the Battle River at and existing outfall. A storm sewer will connect the two developments and be designed to convey the 100-year runoff. An additional residential development is purposed in the southeast section of Town. This development will drain north to a regional pond (Pond 8) located at the intersection of 42 Street and 39 Avenue. This pond will also accommodate the future runoff from the proposed 10 year commercial and residential developments in the area. The pond will discharge to an existing storm sewer along 39 Avenue and drain to an existing outfall into the Battle River. Two commercial developments are proposed within the Town, one at the intersection of Highway 53 and 45 Avenue Crescent and one at the intersection of 54 Street and 58 Avenue. Two dry ponds are proposed to service these developments, Pond 4 and Pond 3, respectively. The two future commercial developments will drain into the existing storm sewer system. Three industrial developments are proposed for the 5-year development horizon. The future airport expansion will drain to a dry pond (Airport Expansion Pond) located along the north end of the site. The pond will discharge to a ditch and then into a new outfall into the Battle River. The industrial expansion at the Highway 2 and Highway 53 interchange will drain south to a proposed pond (Pond 7) located along Highway 53. Pond 7 will also accommodate future industrial developments along Highway 2. The pond will outfall into channel located along Highway 53 and flow south to the Battle River through a new outfall. The third proposed five year industrial development will occur immediately south of the Stampede Grounds. The development will drain to a pond (Pond 5) located at the southwest end of the development. Pond 5 will also accommodate future industrial developments located south of the Town. The pond will discharge to a new outfall into the Battle River.

Table D-6 displays the characteristics of the proposed ponds under the 5-year development horizons. It is important to note that the pond characteristics shown in *Table D-6* reflect the accommodation of future 10 and 25 year developments.

Table D-6: 5 Year Development Pond Characteristics

Design Data for Future Development Ponds							
Attribute	**Pond 2**	**Pond 3**	**Pond 4**	**Pond 5**	**Pond 7**	**Pond 8**	**Airport Expansion**
Contributing Drainage Area	29.63 ha	2.60 ha	2.78 ha	164.89 ha	124.75 ha	138.01 ha	11.15 ha
Bottom Elevation	806.26 m	811.07 m	806.7 m	802.65 m	809.79 m	822.16 m	803.5 m
Maximum Depth Below NWL	2 m	NA	NA	2 m	2 m	2 m	NA
NWL Elevation	810.26 m	NA	NA	804.65 m	811.79 m	824.116 m	NA
Area at NWL	3,315 m^2	NA	NA	28,025 m^2	24,025 m^2	16,900 m^2	NA
Dead Storage Volume below NWL	4,521 m^3	NA	NA	68,525 m^3	42,125 m^3	28.875 m^3	NA
Maximum Pond Storage	13816 m^3	2,189 m^3	1,399 m^3	152,625 m^3	96,650 m^3	68,150 m^3	6,870 m3
Maximum Storage Depth	4 m	1.5 m	1.5 m	4 m	4 m	4 m	2 m
Maximum Storage Elevation	812.26 m	812.57 m	808.20 m	806.65 m	813.79 m	826.116 m	805.00 m
Calculated 1:100 Year Active Storage Required	8,647 m^3	1,288 m^3	1,390 m^3	72,521 m^3	46,889 m^3	33,854 m^3	5,402 m^3
Calculated 1:100 Year Total Storage Required	13,168 m^3	1,288 m^3	1,390 m^3	141,046 m^3	89,014 m^3	62,729 m^3	5,402 m^3
Calculated 1:100 Year Storage Depth (m)	3.89 m	1.46 m	1.49 m	3.75 m	3.75 m	3.76 m	1.23 m
Calculated 1:100 Year Peak Discharge	74 L/s	6.5 L/s	6.80 L/s	360 L/s	270 L/s	275 L/s	25 L/s
Calculated 1:100 Year Water Surface Elevation	810.15 m	812.53 m	808.19 m	806.4 m	813.53 m	825.87 m	804 73 m
Calculated 1:100 Year Drawdown	4.5 days	4.75 days	4.93 days	6.2 days	5.5 days	11.1 days	7 days
Freeboard	0.3 m	0.3 m	0.3 m	0.3 m	0.3 m	0.3 m	0.3 m

D.6.2 Intermediate Term (10 Year) Developments

The Town is proposing 436 ha of development within the 10-year horizon. This will include 21 ha of commercial development, 232 ha of residential development and 184 ha of industrial development. As shown in *Figure D19* the majority of the 10 year developments will drain to regional ponds established during the 5 year development phase. These ponds can be extended to their full volumes outlined in *Table D-7*. There will be one additional pond (Pond 9) constructed to attenuate the flows from a commercial and residential development located north of Highway 53 between Lake 10 and 64 St.

Table D-7: 10 year Pond Characteristics

Design Data for Future Development Ponds	
Attribute	**Pond 9**
Contributing Drainage Area	97.33 ha
Bottom Elevation	807.06 m
Maximum Depth Below NWL	2 m
NWL Elevation	809.06 m
Area at NWL	15,625 m^2
Dead Storage Volume below NWL	26,525 m^3
Maximum Pond Storage	63,050 m3
Maximum Storage Depth	4 m
Maximum Storage Elevation	811.06 m
Calculated 1:100 Year Active Storage Required	32,390 m^3
Calculated 1:100 Year Total Storage Required	58,915 m^3
Calculated 1:100 Year Storage Depth (m)	3.80 m
Calculated 1:100 Year Peak Discharge	198 L/s
Calculated 1:100 Year Water Surface Elevation	810.86 m
Calculated 1:100 Year Drawdown	4.5 days
Freeboard	0.3 m

D.6.3 Long Term (25 Year) Developments

There is only one industrial development planned for the 25 year horizon. The industrial development will total approximately 112 ha and will be located south of Highway 53 between Highway 2 and Range Road 261. The runoff will be conveyed to Pond 6. The ponds characteristics are outlined in *Table D-8*.

Table D-8: 25 year Pond Characteristics

Design Data for Future Development Ponds	
Attribute	**Pond 6**
Contributing Drainage Area	112.93 ha
Bottom Elevation	804.9 m
Maximum Depth Below NWL	2 m
NWL Elevation	806.9 m
Area at NWL	19,600 m^2
Dead Storage Volume below NWL	33,875 m^3
Maximum Pond Storage	78,950 m^3
Maximum Storage Depth	4 m
Maximum Storage Elevation	808.3 m
Calculated 1:100 Year Active Storage Required *	41,187 m^3
Calculated 1:100 Year Total Storage Required *	75,065 m^3
Calculated 1:100 Year Storage Depth (m)	3.85 m
Calculated 1:100 Year Peak Discharge	270 L/s
Calculated 1:100 Year Water Surface Elevation	808.75 m
Calculated 1:100 Year Drawdown	4.7 days
Freeboard	0.3 m

Author: hshin

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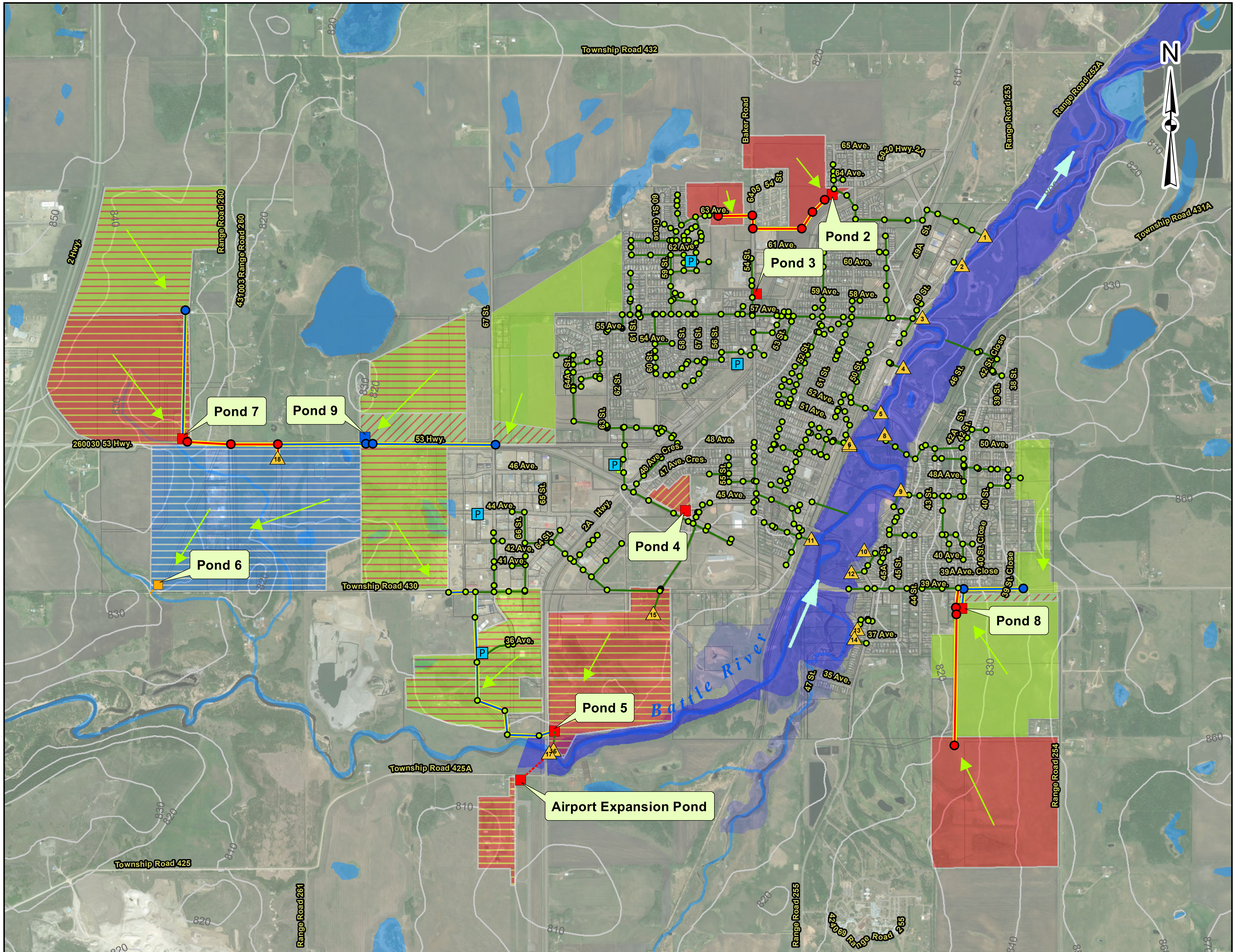


Master Servicing Study

Ponoka

Legend

- Floodway
- Flood Fringe
- Junctions
- Storages
- OutFall
- Ponds
- Conduits
- Orifices
- Overland Flow

Future Land Use

- 5 Years - Commercial
- 5 Years - Industrial
- 5 years - Residential
- 10 Years - Commercial
- 10 Years - Industrial
- 10 Years - Residential
- 25 Years - Industrial

5-Years Development

- Junctions
- Storages
- Conduits
- Orifices

10-Years Development

- Junctions
- Storages
- Conduits
- Orifices

25-Years Development

- Storages
- Orifices

McElhanney

0 255 510 1,020 1,530 (m)

1:24,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 26, 2018

Stormwater Master Plan: Future Developments Storm Network

Figure D19

D.7. Costing

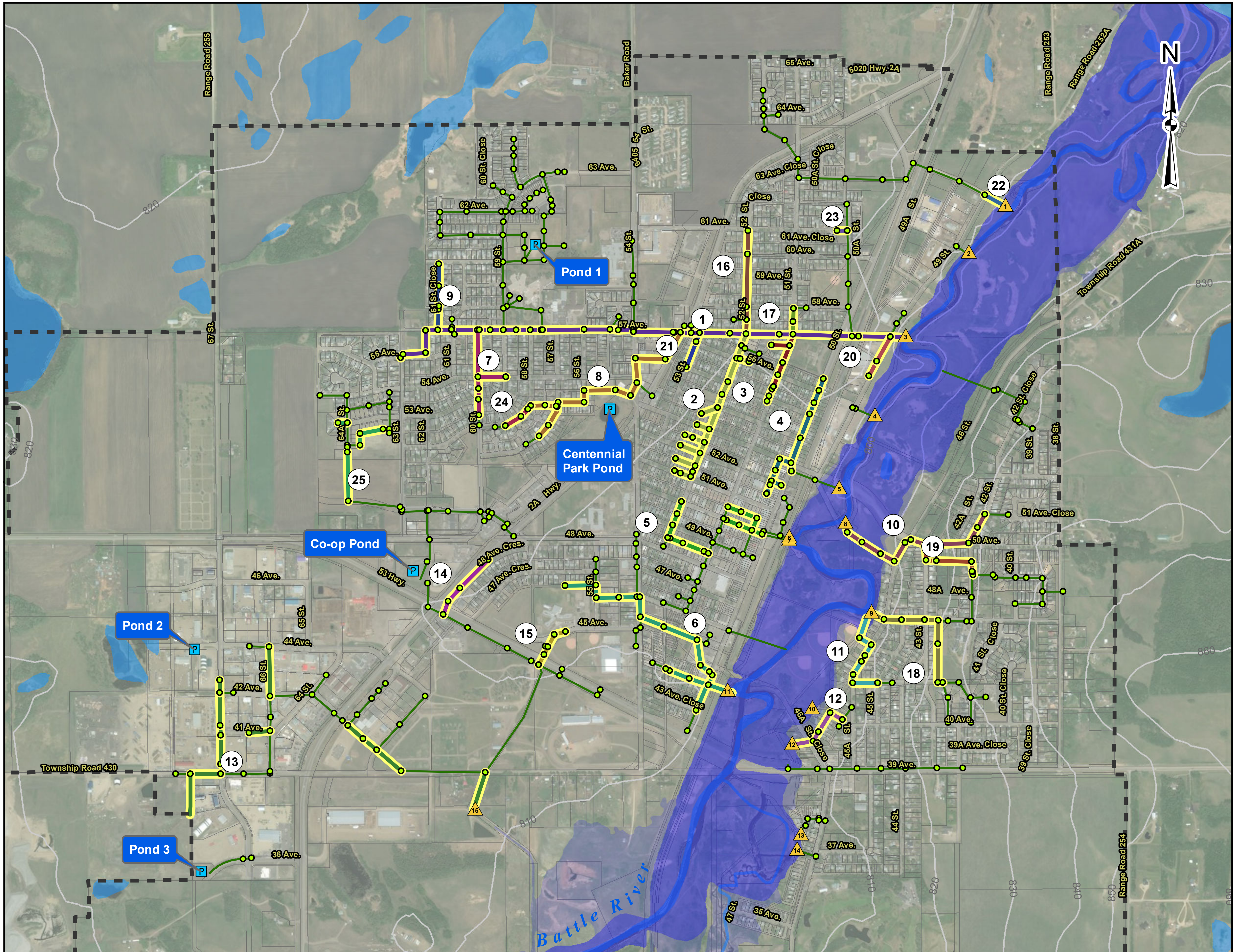
D.7.1 Existing System Upgrades

The costing completed is based on previous projects completed in the area (including 47 Ave storm upgrades project), budget pricing provided by a contractor and the Price Averages Reports for the City of Calgary. *Table D-9* displays the preliminary costing for the recommended upgrades. These costing groups can be found in *Figure D-20*. A full breakdown of the costs can be found in *Appendix D-5*.

Table D-9: Preliminary Costing for Proposed Upgrades

Preliminary Costing Group	Proposed Upgrades	Preliminary Project total Estimate	Priority
1	16 m of 300 mm Φ Storm 89 m of 675 mm Φ Storm 290 m of 750 mm Φ Storm 549 m of 900 mm Φ Storm 326 m of 1200 mm Φ Storm 802 m of 1500 mm Φ Storm	**$6,336,000**	High
2	397 m of 300 mm Φ Storm 180 m of 375 mm Φ Storm 189 m of 525 mm Φ Storm 309 m of 675 mm Φ Storm	**$2,050,000**	High
3	63 m of 300 mm Φ Storm 70 m of 375 mm Φ Storm 172 m of 450 mm Φ Storm 46 m of 525 mm Φ Storm	**$639,000**	High
4	90 m of 300 mm Φ Storm 105 m of 450 mm Φ Storm 389 m of 525 mm Φ Storm 32 m of 750 mm Φ Storm	**$1,202,000**	High
5	51 m of 375 mm Φ Storm 163 m of 450 mm Φ Storm 53 m of 525 mm Φ Storm 225 m of 600 mm Φ Storm 150 m of 900 mm Φ Storm	**$1,386,000**	High
6	111 m of 300 mm Φ Storm 121 m of 375 mm Φ Storm 105 m of 450 mm Φ Storm 161 m of 525 mm Φ Storm 398 m of 900 mm Φ Storm 298 m of 1200 mm Φ Storm	**$2,645,000**	High
7	210 m of 450 mm Φ Storm 44 m of 525 mm Φ Storm 183 m of 675 mm Φ Storm	**$810,000**	High
8	56 m of 450 mm Φ Storm 103 m of 525 mm Φ Storm 99 m of 600 mm Φ Storm 103 m of 750 mm Φ Storm 616 m of 900 mm Φ Storm	**$2,119,000**	High
9	87 m of 300 mm Φ Storm 157 m of 450 mm Φ Storm	**$441,000**	High
10	297 m of 375 mm Φ Storm 61 m of 750 mm Φ Storm 171 m of 1050 mm Φ Storm 190 m of 1200 mm Φ Storm	**$1,619,000**	High

Preliminary Costing Group	Proposed Upgrades	Preliminary Project total Estimate	Priority
11	97 m of 525 mm Φ Storm 303 m of 600 mm Φ Storm	**$788,000**	High
12	143 m of 450 mm Φ Storm 125 m of 525 mm Φ Storm	**$475,000**	High
18	262 m of 525 mm Φ Storm 52 m of 600 mm Φ Storm	**$929,000**	High
13	82 m of 525 mm Φ Storm 215 m of 600 mm Φ Storm 192 m of 675 mm Φ Storm 114 m of 750 mm Φ Storm 315 m of 900 mm Φ Storm 272 m of 1200 mm Φ Storm 154 m of 1350 mm Φ Storm	**$3,201,000**	Medium
14	280 m of 450 mm Φ Storm	**$450,000**	Medium
15	176 m of 600 mm Φ Storm	**$377,000**	Medium
16	90 m of 300 mm Φ Storm 311 m of 450 mm Φ Storm	**$617,000**	Medium
17	101 m of 450 mm Φ Storm	**$189,000**	Medium
19	293 m of 750 mm Φ Storm	**$610,000**	Low
20	174 m of 375 mm Φ Storm	**$264,000**	Low
21	142 m of 375 mm Φ Storm	**$226,000**	Low
22	91 m of 1350 mm Φ Storm	**$297,000**	Low
23	40 m of 300 mm Φ Storm	**$72,000**	Low
24	69 m of 375 mm Φ Storm 57 m of 450 mm Φ Storm	**$270,000**	Low
25	174 m of 300 mm Φ Storm 190 m of 600 mm Φ Storm	**$677,000**	Low



Master Servicing Study

Ponoka

Legend

- Town Boundary
- Floodway
- Flood Fringe
- Proposed Junctions
- OutFall
- Ponds

Preliminary Costing Groups

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25

McElhanney

0 160 320 640 960 (m)

1:15,000

Coordinate System: NAD 1983 CSRS 3TM 114

Project No.	Date
2131-00247-14	Mar 26, 2018

Stormwater Master Plan: Preliminary Costing Groups

Figure D20

D.7.2 Future Development Ponds

The costs for the future development ponds were developed based on Unit Price Averages Reports for the City of Calgary and previous projects completed in the area. It is important to note that these costs are for the full buildout of the pond. These costs can be delayed if the pond is expanded as buildout continues over the 25 year horizon. *Table D-10* displays the costs for the ponds required for the future developments.

Table D-10: Future Development Pond Costing

Pond	Total Storage Volume (m^3)	Area (m^2)	Stripping Costs	Excavation Costs	Landscaping	Outlet Control Structure	Contingency (40%)	Total Cost
2	13,168	6,105	$12,210	$167,892	$309,218	$50,000	$215,728	$755,048
3	1,288	1,429	$2,858	$16,422	$72,378	$50,000	$56,663	$198,322
4	1390	1450	$2,900	$17,722	$73,442	$50,000	$57,626	$201,691
5	141,046	46,225	$92,450	$1,798,336	$2,341,296	$50,000	$1,712,833	$5,994,915
6	78,950	25,600	$51,200	$1,006,612	$1,296,640	$50,000	$961,781	$3,366,233
7	96,650	30,625	$61,250	$1,232,287	$1,551,156	$50,000	$1,157,877	$4,052,571
8	62,729	22,500	$45,000	$799,794	$1,139,625	$50,000	$813,767	$2,848,187
9	63,050	21,025	$42,050	$803,887	$1,064,916	$50,000	$784,341	$2,745,195
Airport Extension	5,402	5,625	$11,250	$68,875	$284,906	$50,000	$166,012	$581,044

E. Wastewater Treatment Facility Review

E.1. Summary

As part of the Master Servicing Study, McElhanney completed a desktop study of the Town's Wastewater Treatment Facility (WWTF). The WWTF has not been included in the previous sections for report clarity. To complete the study McElhanney reviewed the 2013 Town of Ponoka Master Servicing Study Update completed by Tagish Engineering and contacted the Town of Ponoka's operating staff to assist in evaluating the Town of Ponoka's WWTF. McElhanney's review was intended to provide an assessment of the treatment plant in response to increased flow from future population growth.

The WWTF, operating under the current permit, must treat all incoming flows and store the treated effluent. Twice per year, for a period not to exceed three (3) weeks, all treated volume is discharged into the Battle River. Continuous discharge from the facility is not allowed. Prior to discharge, the water quality of the stored effluent is measured for permit compliance of Carbonaceous Biochemical Oxygen Demand (CBOD). Ponoka also verifies fish toxicity with a Choke Test, completed by an external lab. The Choke Test involves a standard procedure to verify that a limited amount of fish fry will perish within the effluent (also referred to as an LC50 test) This is a traditional experiment where fish are exposed to a series of concentrations for a set period of time. The concentrations of the treated effluent that kills 50% of the fish during the observation period is the LC50 value. Ponoka aims for 100% survival, but we understand that LC50 levels have fallen below 50% where discharge is not permitted.

The LC50 testing requirement is not included within the Town's current permit but was mandated after the Town had a fish kill with discharge into the Battle River several years earlier. This has become a standard operating procedure for the community to provide proper environmental stewardship. However, the current arrangement of the WWTF is not optimal for unionized ammonia and associated fish toxicity. It is important to note that in 2020 new harmonized Federal standards will be introduced that include ammonia levels. *Table E-1* provides standards that will be added to the Town's current permit of 25 gm/l for CBOD.

Table E-1 – Federal Compliance Targets

Item	Target
Authorized ADWF (m^3/day)	From existing permit
Design peak flow for hydraulic components	2 times ADWF
CBOD (mg/L)	$\leq$ 25
TSS (mg/L)	$\leq$ 25
Total Phosphorus (mg-P/L)	Provincial mandate
Orthophosphate (mg-P/L)	Provincial mandate
Fecal Coliform (CFU/100 mL)	< 200
Turbidity (NTU)	n/a
Un-ionised ammonia (mg/L)	< 1.25
Redundancy	Multiple units for all processes

It should be noted that the levels for unionized ammonia found in the effluent from the Town's WWTP are higher than the 25 mg/L required to pass the LC50 toxicity test.

McElhanney determined that the current WWTF operation provides marginal storage for the existing permit with higher flow. It is recommended that the Town plan for upgrades to the WWTP to meet the new harmonized standards. More specifically, the WWTF configuration is challenged in meeting ammonia and coliform levels. McElhanney will prepare a separate technical memorandum to initiate discussion and establish an end deliverable for WWTF assessment within the scope of the overall report. Based on the desktop review McElhanney has concluded that the issues within the WWTP go beyond flow limitations and the additional Technical Memorandum will highlight potential concerns that a detailed investigation should include. Plant compliance is somewhat complex and requires a better understanding of actual data to confirm how the facility is operating in comparison to the current permit and future federal regulations.

E.2. Introduction

The review of the Town's WWTF was intended to provide an assessment in response to increased flow due to population growth. The assessment of the WWTF will require a more comprehensive review to update the Master Servicing Report and to define how the current infrastructure will service future growth.

McElhanney reviewed the 2013 Town of Ponoka Master Servicing Study Update completed by Tagish Engineering and contacted the Town's operating staff to assist in evaluating the WWTF. The WWTF has had several upgrades and limited operating information was available to determine current lagoon system performance. To gain further insight, the Town's operation staff were contacted to provide anecdotal discussion of plant operation and monitoring requirements.

This Technical Memorandum provides a high-level review of the facility and some recommendations for maintaining and upgrading the existing infrastructure. The review includes an examination of the mandated level of treatment to meet permit requirements, discussion on challenges to meet permit requirements and considers discussion on some potential future regulatory changes that may affect plant needs.

E.3. Existing System

The WWTF covers approximately 70 ha (175 acres) and has a combination of facultative and aerated lagoons with semi-annual storage. The WWTF provides a biological process to reduce the incoming Carbonaceous Biochemical Oxygen Demand (CBOD) and Total Suspended Solids (TSS) for the safe discharge of water into the Battle River.

E.3.1 Anaerobic Cells

The current system includes four anaerobic cells for primary solids settling. The cells are fed by the incoming forcemain and gravity main. These systems are not included in this review but are included within other sections of the Ponoka Master Servicing Report.

The anaerobic cells provide low velocity to permit settling of larger / heavier solids. The anaerobic cells are highlighted in yellow on *Figure E-1*.

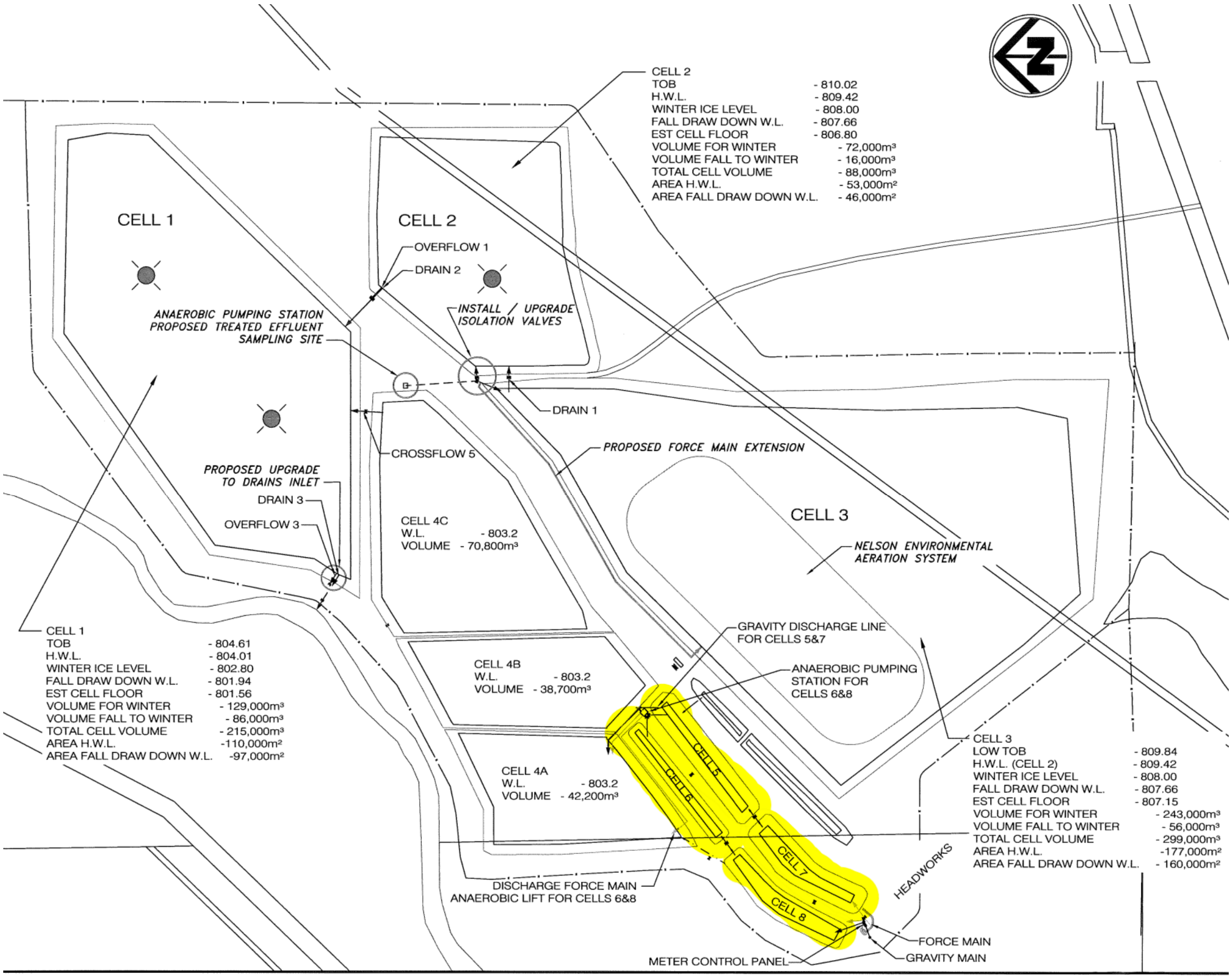


Figure E-1: Anaerobic Cells (Taken from the Town of Ponoka Master Servicing Study Update [Tagish, 2013])

The subsequent cells provide the majority of the soluble CBOD and TSS removal. The WWTF has no influent screening, so the anaerobic cells provide settling of both organic and inorganic matter. The anaerobic cells are periodically drained to drying beds to reduce deposition.

The purpose of the lagoons is to remove solids to prevent deposition in the biological lagoons. The anaerobic cells are the major source of plant odour.

The operations staff confirmed that the beds are fully dredged by an outside contractor every five (5) years. The Town previously dredged the anaerobic lagoons every 10 years, however, upon recommendation from the contractor a 5-year program to keep up with settled solids was adopted. The Town staff also remove solids and pump influent into drying beds in the two cells located east of the four (4) anaerobic cells. *Table E-2* illustrates the anaerobic pond operating water levels and capacities.

Table E-2 – Anaerobic Pond Operating Data Phase 3 (from Tagish 2013 report)

Cell #	8	7	6	5
Bottom Cell Elev. (m)	798.88	798.88	798.88	798.88
HWL Elev. (m)	802.60	804.20	802.50	804.10
Top of Berm Elev. (m)	804.80	804.80	804.80	804.80
Operating Volume (m3)	8,260	15,103	5,500	13,789
Storage -Current (days)	0.6	1.1	0.4	1.0
Storage – 5 yr. (days)	0.4	0.8	0.3	0.7
Storage – 10 yr. (days)	0.3	0.5	0.2	0.5
Storage – 25 yr. (days)	0.3	0.5	0.2	0.4

As depicted in *Table E-2*, the total storage volume ranges from three (3) days total storage to 1.3 days for the 25-year projected flows. There are no stipulated volumes for the anaerobic tanks within the current permit.

E.3.2 Aerated Lagoon System

In 2001, the Town upgraded Cell 4 with a Nelson Environmental (now Nexom) fine bubble aeration system. This system upgrade converted the facultative lagoon to an aerated lagoon. Facultative lagoons rely on natural aeration. By adding more aeration and mixing, the upgrade was completed to improve Carbonaceous Biochemical Oxygen Demand (CBOD) removal. The yellow highlight in *Figure E-2* indicates the modified cells providing aerobic treatment:

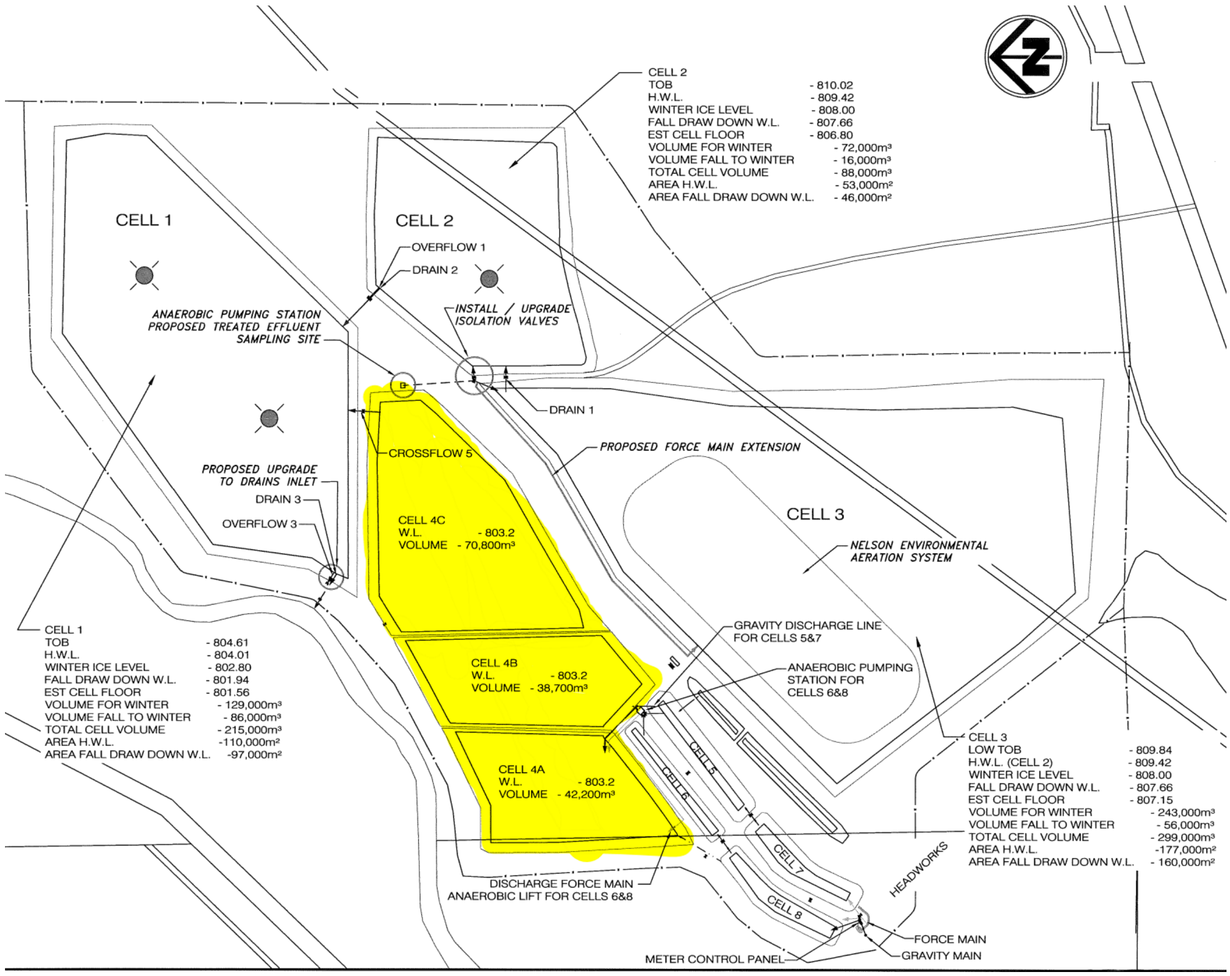


Figure E-2 – *Aerobic Cells (Taken from the Town of Ponoka Master Servicing Study Update [Tagish, 2013])*

The upgrade to the facility included partitioning existing lagoon Cell 4 into three cells (4A, 4B, and 4C) to minimize short circuiting and improve lagoon performance. The three-cell upgrade provides operation in series that should improve lagoon performance. Effluent from the upgraded cells should, based on design criteria, meet the 25 mg/l CBOD target, based on the monthly arithmetic mean of weekly CBOD samples. Note that this is the current Alberta design standard for aerated lagoons as shown in *Table E-3*. The system, in theory, could have been designed for a continuous discharge. However, the Town operates on license with two annual discharges of treated effluent per year between May and October as per the original permit. The aerated system discharges into the storage cells and the intent is that 30 days of storage is required after Cell 4 discharges.

Table E-3 - Aerobic System Data – From Phase 3 Upgrade (from Tagish 2013 Report)

Cell #	4A	4B	4C
Bottom Cell Elev. (m)	801.40	801.40	801.40
HWL Elev. (m)	803.20	803.20	803.20
Top of Berm Elev. (m)	805.00	805.00	805.00
Operating Water Level (m)	804.00	804.00	804.00
Water Surface Area (m^2)	28,142	23,905	43,073
Operating Volume (m^3)	63,941	57,405	104,493
Total Storage (m^3)		225,800	
Average Day Storage Existing Flow		16 days	
Average Day Storage 5-yr Flow		12 days	
Average Day Storage 10-yr		8 days	
Average Day Storage 25-yr		7 days	

The previous operating depth of the cells was 0.8 m; the cross berms were raised to a maximum water depth of 1.8 m. Added depth provides more efficient oxygen transfer with the fine bubble diffusion system.

The upgraded lagoon includes a 60 HP blower running continuously, with a standby unit. The blower delivers pressurized air to diffuser tubes lying at the cell bottoms. It is important to note that this is an early design by Nexom. A surface header runs from the blower house to the cells. A header with valve isolation connections feeds the diffusers connected to each lateral. These lateral pipes are weighted with stainless steel cables to sink the pipes. The air infusion pipes lay on the bottom of the pond and disperse air into the liquid.

Nexom updated this design to a floating system with aeration diffuser tubes suspended off surface rather than lying at the cell bottom.

According to the 2013 Master Servicing Study Update, the existing aeration system design was based on handling a design population of 10,000, which is projected to be close to the 25-year growth within this current study.

The 2013 Master Servicing Study Update report and discussion with the Town's operations staff identified additional changes to the cells including:

- Venturi aeration system on the pump outlet to provide more aeration to Cell 4.
- Ammonia treatment upgrade utilizing solar aeration (Solar Bees) installed in Cells 1 and 2, in 2013.
- Additional fine bubble Air Diffusion System similar to Cell 4 installed in Cell 3 to increase biological treatment.

These modifications appear to be addressing both BOD and ammonia treatment. Full assessment of the WWTF performance is beyond the scope of this review. However, according to initial discussion with operations staff, the upgrades to the WWTF have not fully met the intended performance. Some issues stated include:

- High CBOD with recent data showing an influent CBOD of 151 mg/l and effluent from cell 4 at 87.2 mg/l. Note the effluent target as stated before is 25 mg/l and the high CBOD is a concern.
- Access to the diffusers is challenging and presents an unsafe access with poor footing on berms. Sections requiring service have been turned off pending supplier service professionals to remediate the system.

- Adding aeration into storage ponds has improved performance, BOD in storage for the same period was 11.9 mg/l – meeting effluent quality for discharge. However, the intent of the storage ponds is to allow settlement of solids prior to discharge.

The current system appears to have CBOD reduction occurring after the aerated system. From a discharge standpoint, the operation staff have always been able to discharge. However, toxicity and CBOD have been close to or over permit limits, which has caused delays in discharge. This results in added height within the storage cells, meeting the limits of storage for the WWTF.

E.3.3 Storage Ponds

The three storage ponds at the WWTF are Cells 1, 2, and 3 as illustrated in *Figure E-3*.

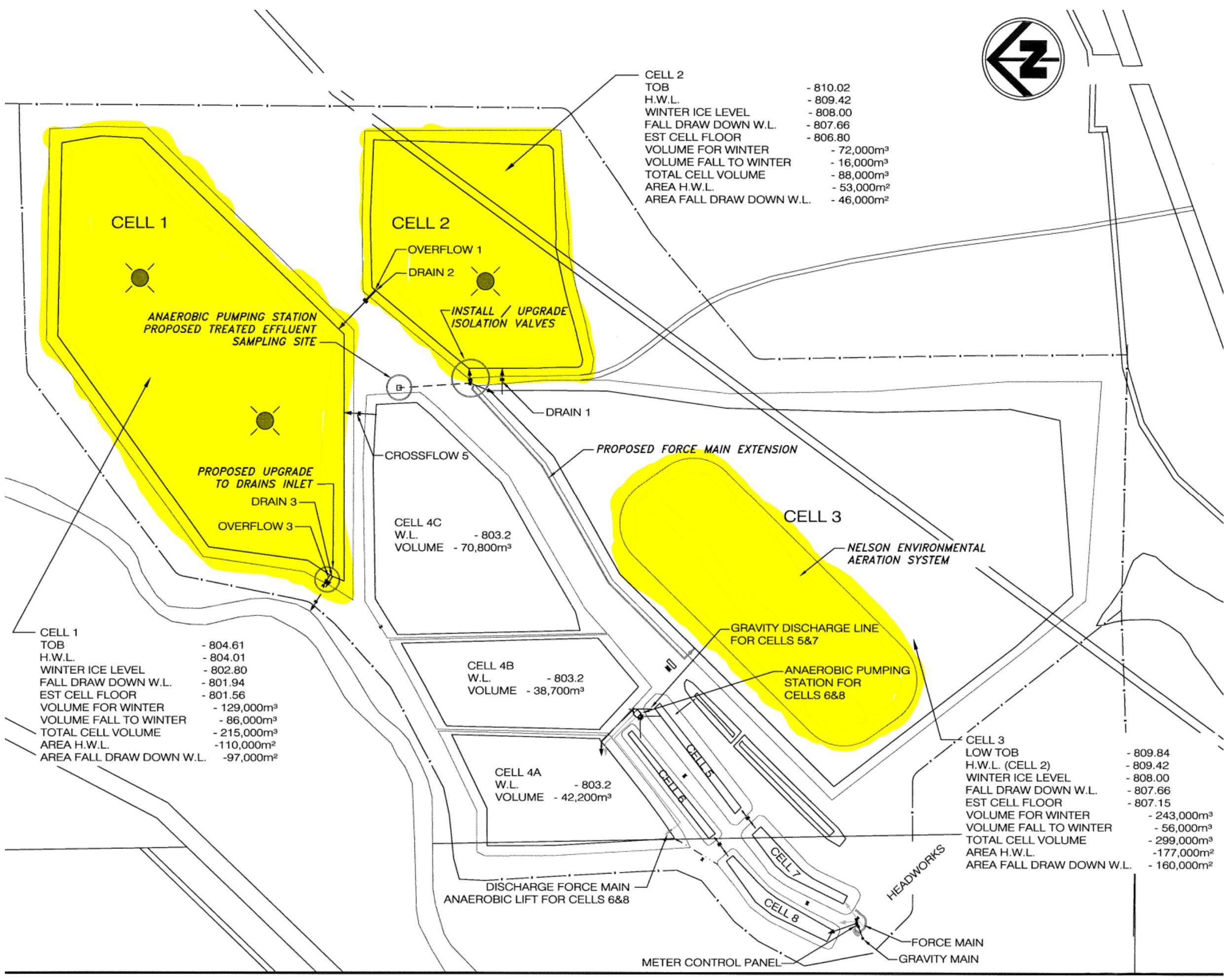


Figure E-3 – *Storage Cells (Taken from the Town of Ponoka Master Servicing Study Update [Tagish, 2013])*

As shown in the 2013 Master Servicing Update report, provides storage volumes (*Table E-4*). The Town's license allows discharge twice annually between May and October. The controlling factor of the storage ponds is having sufficient storage to handle the winter flows.

The following data was collected for the aerobic pond operating water levels, surface areas, and volumes as per the 2012 construction completion, identified in the 2013 study as Phase 2. The report notes that existing storage capacity of all storage ponds is not fully available as they can only be drawn down to within 0.40m of bottom elevation. Therefore, the total volume of 802,000 m³ was estimated at 675,000 m³ of active storage

Table E-4 – Storage Cell Data (from Tagish 2013 Report)

Cell #	3	2	1	Total
Description	Storage	Storage	Storage	
Bottom Cell Elev. (m)	807.40	807.60	802.00	
HWL Elev. (m)	809.93	809.63	804.45	
Top of Berm Elev. (m)	810.60	810.60	805.10	
Operating Water Level (m)	809.93	809.63	804.45	
Total Volume (m²)	417,777	124,333	260,031	802,141
Total Estimated Operating Volume (m²)	351,000	105,000	219,000	675,000
Hydraulic Storage:				
Current Total / Operating (days)	29 / 25	9 / 7	18 / 15	56 / 47
5-year Growth (days)	23 / 19	7 / 6	14 / 12	43 / 36
10-Year growth (days)	15 / 13	4 / 4	9 / 8	29 / 24
25-year Growth (days)	13 / 11	4 / 3	8 / 7	25/ 21

The numbers in *Table E-4* above differ from the values on *Figure E-3*. The report figures were used to determine storage capacity and the plan was considered obsolete.

In compliance with the permit, eight (8) months of storage is needed for the 35-week long winter period from November 1 to June 30 or a total of 240 days. Summer storage is needed for the 17 weeks between July and the end of October is 125 days. Neither of these criteria are being met.

The 2013 Master Servicing Study Update report assumed an average summer flow rate of 3,300 m³/day for a total storage of 400,000 m³, which is being met. The report also noted winter storage was meeting a service population of only 7,000 people and recommended short- to mid-term additional storage of at least 350,000 m³ be achieved through either construction on Town-owned property south of the Cell 2 storage or by raising Cell 3 to 3.3 m depth.

The challenge identified through discussions with operation staff is that toxicity tests have been marginal, resulting in delays discharging stored treated effluent. This results in high storage levels. Operation staff have confirmed that with higher water levels the berms are vulnerable. Windstorms with high volume are also a concern. Failure of the berms would result in discharge onto private property.

E.4. Current Permit

Table E-5 provides the current guidelines published within the Alberta Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems - Part 3 (2013):

Table E-5 – Best Practical Technology Standards For Municipalities Population under 20,000

Type	Parameter	Standard	Sample	Comments
Aerated lagoons	CBOD	25 mg/L	Grab	Monthly average of weekly samples
Wastewater lagoons 2 or 4 anaerobic cells (2-day retention time in each cell) 1 facultative cell (2-month retention time) 1 storage cell (12-month retention time)	None defined	None defined	None defined	Lagoons built to the specified design configuration and drained once a year between late spring and fall do not have a specified effluent quality standard. Early spring discharges may be allowed under exceptional circumstances to comply with any local conditions. Discharge period should not exceed three weeks unless local conditions preclude this rate of discharge.

The Town's current license follows the wastewater lagoon type of plant permit which allows for discharge of treated and stored effluent into the Battle River twice per year between May and October, over a maximum period of three weeks. Our understanding of the upgrades is that aeration systems were added to improve reaction kinetics and improve CBOD removal. As in *Table E-5,* CBOD is not regulated for lagoons. The standards require that lagoons only discharge twice, and operation staff verify treatment before discharge is allowed.

The fine bubble system was provided to deliver more air and mixing to speed digestion to a point where nutrients are digested, meeting the 25 mg/l CBOD target defined within aerated lagoon standards. A continuous discharge to the Battle River, as allowed for aerated lagoons in *Table E-5*, would lessen volume limits identified in previous sections.

The CBOD standard is the same listed within the Federal Wastewater Systems Effluent Regulations (WSER) announced on July 18, 2012. *Table E-6* provides the complete target for discharge into a receiving environment with greater than 40-to-1 dilution.

Table E-6 – Federal Compliance Targets

Item	Target
Authorized ADWF (m3/day)	From existing permit
Design peak flow for hydraulic components	2 times ADWF
BOD (mg/L)	< 25
TSS (mg/L)	< 25
Total Phosphorus (mg-P/L)	Provincial mandate
Orthophosphate (mg-P/L)	Provincial mandate
Fecal Coliform (CFU/100 mL)	< 200
Turbidity (NTU)	n/a
Un-ionised ammonia (mg/L)	< 1.25
LC50 toxicity test	pass
Redundancy	Multiple units for all processes

Table E-6 provides the new national standard for all of Canada's municipal wastewater treatment systems. Of importance to the Town is that the TSS levels will be set at 25 mg/l and ammonia will be regulated to 1.25 mg/l of ionized ammonia. If CBOD is high, TSS is likely high as well. The current discharge is not disinfected, thus chemical or UV radiation is likely required. Systems in place may need some additional units in order to meet the redundancy requirements.

According to the Federation of Canadian Municipalities (2017)[1]:

> *Over the next three decades, the regulations will require communities to upgrade about one out of every four wastewater treatment systems across the country. Based on conservative estimates, future capital expenditures alone will be in excess of $18 billion dollars. Municipalities will also face significant additional costs in terms of up-front assessment and planning, as well as operating expenses. These costs will force municipalities to defer other local infrastructure priorities that are critical to sustained economic growth and job creation, and could significantly increase property taxes for hundreds of thousands of families and small businesses.*

Based on this the upgrade work should be considered with the assistance of grant funding.

E.5. Previous Report Recommendations

E.5.1 Short Term

The following recommendations for a 1- to 5-year period appear to have been completed and integrated:

- Extend the aerated cell lift station force main to the SW corner of Cell 3; "Proposed Force Main Extension".
- Upgrade the outlet structure to the Battle River to accommodate discharge of surface water rather than from the bottom of the pond, during discharge.
- Install a Miltronics Level Controller and "Treated Effluent Sampling Station" in the aerated cell lift station.

E.5.2 Intermediate Term and Long Term

The 2013 Master Servicing Study Update report provided Intermediate Term (6 to 10 year) upgrade recommendations to meet development growth.

- Upgrade Cell 4 Header System to accommodate final increase in water levels for increased flows from population growth.
- Develop a new storage cell to accommodate increased flows and winter needs.

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[1] [1] 2017, May 10, Federal Wastewater Systems Effluent Regulations, *Federation of Canadian Municipalities* (Retrieved from https://fcm.ca/home/issues/clean-water-/federal-wastewater-systems-effluent-regulations.htm)

Long Term (11 to 20 year) upgrades were recommended in the 2013 Master Servicing Study Update to service ultimate infrastructure needs, these included:

- Developing an additional storage ponds to meet winter storage needs.

These upgrades do not appear to be complete and study elements included in the previous sections would suggest both recommendations be included.

E.6. Current Operational Considerations

The following provides considerations that will affect long term operation of the WWTF for current and future population and regulations.

E.6.1 CBOD and LC50

As stated in previous sections, the WWTF, operating under the current permit, must treat all incoming flows and then store the treated effluent. Twice per year, during a period not to exceed three (3) weeks, all treated volume is discharged into the Battle River. Continuous discharge is not allowed. Prior to discharge, the stored volume water quality is measured for permit compliance of CBOD. Ponoka also verifies fish toxicity with a Choke Test (LC50) as done by an outside lab.

This LC50 testing is not included within the current permit but has been mandated after Ponoka had a fish kill with discharge into the Battle River several years earlier. This has become a standard operating procedure for your community to provide proper environmental stewardship.

However, the WWTF within the current arrangement, is not optimal for un-ionized ammonia and associated fish toxicity. It is important to note that in 2020 new harmonized Federal standards will be introduced that includes ammonia levels. *Table E-6* provides all standards that will be added to your current permit of 25 gm/l for CBOD. It should be noted that the levels for unionized ammonia are higher than required to pass the LC50 toxicity test.

The community should consider non-mechanical fixed film treatment such as wetland discharge, reed beds, Nexom SAGR system can provide ammonia removal. Mechanical treatment can also provide an upgrade option for augmenting the lagoon system for current and long-term operation.

E.6.2 Storage

Our findings show that the current WWTF cells provide marginal storage under the existing permit. This was also identified in the 2013 Master Servicing Study Update.

E.6.3 Solids Separation

The limited data reviewed in this study indicates insufficient CBOD removal from the aerated lagoon cells. There is also no screening of influent. All solids are deposited in 4 lagoons. Some consideration should be made to screen the incoming sewage for solids separation then perhaps utilize the anaerobic cells for aerobic treatment. No data was captured but this system should reduce incoming BOD by 10 – 25%. Subsequent lagoon performance should be improved. This may provide a reduction of plant odours and provide a payback on the sludge bed operation and dredging contract currently required.

E.6.4 Alternate Discharge

The Town may investigate an alternate discharge. This could include irrigation for agriculture or habitat restoration. An example is in the City of Cranbrook BC, where the community worked with Ducks Unlimited to create a wetland enhanced with continual recharge from the wastewater treatment plant. Industry may also have need of water. The community was contacted regarding the supply of frac. water. This is being done in the City of Dawson Creek BC. Another example is the City of Edmonton AB where the WWTF directs treated wastewater to the Suncor refinery.

The key need for the WWTF – for current and future needs – is more storage. The Town should investigate establishment of an alternate discharge where some or all water can be treated for new discharge needs. This would limit the volume shortfall – especially in the winter. The upgrade can also be cost effective depending on the water demand and on industry taking on some of the capital and operating costs.

E.6.5 Permit Change

With the upcoming change in regulations, the community can consider updating their permit to convert from full storage to complete or limited discharge into the Battle River. This would require investigation of the outfall design to confirm freezing will not restrict discharge. An environmental assessment is also necessary.

The reduction in cost to reach the 8-month storage needs should be compared to a treatment plant upgrade for continuous discharge. The increase on storage volume may prove to be costly. In addition, increased shortage can present issues with algae growth. Lagoon storage can see a decline of effluent quality in storage as nutrients including phosphorus and ammonia create a favorable environment for algae. The current aeration limits algae formation – but at a cost. The cost is reduced with solar power aerators, but operation and maintenance are still a consideration.

Longer term plan should investigate options for treating to a higher level for a cost-effective solution.

E.6.6 Berm Conditions

The treatment process relies on the integrity of berms to retain water for the biological treatment of the influent. The 2013 Master Servicing Study Update report indicates that flood proofing of berms against the Battle River was carried out from 2005 to 2012. A study of the berms should be completed to confirm integrity of berms to flooding and integrity of berms with higher storage levels.

E.7. Conclusion

The Town is facing current challenges in meeting effluent quality and have needed capital upgrades to add treated water storage. The Town does however have options that can be developed to meet these challenges. The issues go beyond the scope of this study. This memo is intended to highlight concerns and provide some recommendations for further investigation. The WWTF compliance is somewhat complex and requires a better understanding of plant data to confirm how it is operating in comparison to the current permit. The review should also include compliance to future federal regulations.

Appendix A-1: Technical Memorandums

M E M O R A N D U M

McElhanney Consulting Services Ltd.
14904 – 121A Avenue
Edmonton, AB T5V 1A3
Tel: 780 809 3200
www.mcelhanney.com

Town of Ponoka	Master Servicing Study Re-Write Additional Information & Design Criteria Technical Memorandum #1
Date:	**March 7, 2017**
Our Reference:	**2131-00247-14**

To: **Dave McPhee, Director of Operations & Property Services**
Town of Ponoka
5102 – 48 Avenue
Ponoka, AB, T4J 1P7

After further review of the available documents provided by the Town, MCSL has summarized what additional information is required to fulfill the requirements of the Master Servicing Study Re-Write. Please see below for our proposed design criteria and questions/inquiries required to proceed with this project:

1.0 GENERAL INQUIRIES

See below for inquiries relative to the Water, Sanitary and Storm Sewer systems. Please respond accordingly.

- The 2013 Master servicing study shows a figure with the future land use plan. We don't have that information as shapefiles. Is there any updated land use plan that we should be using for this project?
- We have shapefiles, DWG files and PDF files that show the existing water, sanitary and stormwater networks. Can the Town provide input on the latest/update-to-date data sets for Sanitary/Storm/Water? Our most recent PDF for data is the Town of Ponoka, Underground Utilities, Pre-2014 Update.
- Are Shapefiles for the catchments available for the sanitary, water, storm sewer analysis previously completed?
- The contours data (LiDAR) seems to be incomplete, please confirm. See further details in Section 2.1 for specifics.
- Does the Town have a Design Criteria Manual or Subdivision Servicing Bylaw? If not, do we adopt criteria from City of Red Deer, City of Edmonton, City of Calgary, Alberta Environment, etc.? Please review and confirm the attached design criteria summary sheets.

2.0 WATER SYSTEM

See below for inquiries relative to the Water System. Please respond accordingly.

- How were the demands in the existing model calculated? (residential, industrial, commercial). Table 3.2 from the Master Servicing Study shows equivalent populations for the industrial and commercial areas, but it is not clear how they were estimated.
- Please provide pump curves or any other related information available (specifications, etc.).

2.1 WATER SYSTEM DESIGN CRITERIA

See below for our proposed Water System Design Criteria. Please confirm and/or respond accordingly.

Parameter	Design Criteria	Source
Fire suppression demand	4,500 liters per minute for two hours	Town of Ponoka – Master Servicing Study 2013 Update
Total water storage	3 days of average day demand	Requirement from NRDWSC (Regional System)
Total water storage	S = A + B + (the greater of C or D)[i]	Alberta Environment and Sustainable Resource Development - Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Analysis Part 2
Average Day Demand (ADD)	315 L/day/capita[ii]	Town of Ponoka – Master Servicing Study 2013 Update / Metered Water Consumption for 2012
Maximum Day Demand (MDD)	1.8 x ADD (567 L/day/capita)[iii]	Town of Ponoka – Master Servicing Study 2013 Update
Peak Hour Demand (PHD)	4.6 X ADD (1,449 L/day/capita)[iv]	WaterCAD model prepared for Master Servicing Study 2013 Update
Non-residential demands (industrial, commercial, institutional)		
Minimum distribution pressure during PHD	300 KPa (44 psi)	Red Deer Design Guidelines 2016
Minimum distribution pressure during MDD plus fire flow condition	20 psi[v]	Town of Ponoka – Master Servicing Study 2013 Update
Maximum distribution pressure	550 KPa (80 psi)	Alberta Environment and Sustainable Resource Development - Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Analysis Part 2
Water velocity during PHD	1.5 m/s	Red Deer Design Guidelines 2016
Water velocity during MDD plus fire flow condition	2.5 m/s	Red Deer Design Guidelines 2016

[i] S = Total storage requirement; A = Fire storage; B = Equalization storage (25% of MDD); C = Emergency storage (15% of ADD); D = Disinfection contact time
[ii] Red Deer Design Guidelines 2016: 375 L/day/capita
[iii] Red Deer Design Guidelines 2016: 600 L/day/capita
[iv] Red Deer Design Guidelines 2016: 1200 L/day/capita
[v] Red Deer Design Guidelines 2016: 150 KPa (22 psi)

3.0 SANITARY SEWER SYSTEM

See below for inquiries relative to the Sanitary Sewer System. Please respond accordingly.

Please provide the following:

- Pump curves of the lift station.
- Storage capacity of the wet wells in the lift station.
- Shapefiles (preferably) for the existing forcemains. The as-built information does not provide information about the forcemains (size, elevations, material).
- Information about the capacity of the different ponds in the WWTF (as-built drawings, storage-area curves, etc.).
- Maximum allowable release rate to the Battle River during allowable discharge period.

3.1 SANITARY SEWER SYSTEM DESIGN CRITERIA

See below for our proposed Sanitary Sewer System Design Criteria. Please confirm and/or respond accordingly.

Parameter	Design Criteria	Source
Residential average daily dry weather flow (ADWF)	320 L/day/person	1. Town of Ponoka – Master Servicing Study 2013 Update 2. Red Deer Design Guidelines 2016
Population (P)	45 people per hectare	Red Deer Design Guidelines 2016
Harmon's Peaking Factor (Pf)	$1 + \frac{14}{4 + \sqrt{P}}$	Red Deer Design Guidelines 2016
Residential peak dry weather flow (PDWF)	$\frac{\text{ADWF x P}^{\text{i}}\text{ x Pf}}{86.4}$	Red Deer Design Guidelines 2016
Non-residential average daily dry weather flow (ADWF)	0.15 L/s/ha	1. Town of Ponoka – Master Servicing Study 2013 Update 2. Red Deer Design Guidelines 2016
Non-residential peaking factor (Pf)	$10*(ADWF^{-0.45})$ [ii]	Red Deer Design Guidelines 2016
Non-residential peak dry weather flow (PDWF)	Pf*ADWF	Red Deer Design Guidelines 2016
Inflow & Infiltration	0.20 L/sec/ha	1. Town of Ponoka – Master Servicing Study 2013 Update 2. Red Deer Design Guidelines 2016
Discharge from WWTF to Battle River	2 times per year, between May and October. Maximum discharge period: 3 weeks (per discharge)	Town of Ponoka – Master Servicing Study 2013 Update

[i] Population in thousands
[ii] Not less than 2.5 or greater than 25

4.0 STORM SEWER SYSTEM

1. LiDAR Data
   - Attachment 1 presents the LiDAR data available for the study. The recent LiDAR data received covers most of the Town (except at the area south part of the airport). The green line presents the boundary of another set of LiDAR data previously received.
   - Comparison of the profile across the two LiDAR surfaces are within 10 cm to 30 cm variation of each other
   - We will investigate if there is additional data requirement

2. Storm Sewer Data - Reviewed the “Town of Ponoka, Underground Utilities (Nov 17, 2010)”, “Town of Ponoka, Underground Utilities, Pre-2014 Update (July 9, 2014)” and the shape files provided. The storm sewer files are missing some information as shown in Attachment 2. The missing information which are required for our modelling are as follows:
   - Red hatch areas (Missing Network Info) – random catchbasins and storm sewers are located in these areas without being connected to an outfall or a sewer system discharging to an outfall.
   - Green Highlighted Line (Missing Size) – Storm sewer size (diameter) is missing in the highlighted storm sewers but inverts are provided.

3. Flood Map of Battle River – Two data sets listed below are available for the study.
   - The Flood Hazard Map by AEP as shown in Attachment 3 (last updated Feb, 2016). The information is not available for all the study area. We have requested and obtained the shape file of the flood map which also includes flood elevations as shown in the attachment. This updated data will be used for the available area.
   - Attachment 4 presents (Figure 11 Open Space and Trail System). In this figure, the 1:100 Year flood extent for the whole town is presented. As shown in this attachment, the flood map covers the entire town. The 2010 Town of Ponoka Growth Study 2009-2059 also used the same flood boundary as shown in Attachment 5.
   - Can the Town provide us with the flood study shown in Attachment 4 and 5?

4. Ponoka Growth Study - Attachment 5 presents the “Proposed Growth Area by Use” in the 2010 Town of Ponoka Growth Study 2009-2059.
   - Is there an updated Future Growth Development plan to be used for this study?
   - Is there a change in the proposed growth areas?

5. Future Growth Development - Attachment 6 presents the Tagish Future Growth Development in various probability.
   - Is there a change in the existing development area, shaded in grey?
   - Are any of the brown or yellow shaded “First or Second Probability” proposed growth development areas already developed?

6. Clarification is required on:
   - Caldera Development is shown only in SE 32 in Attach 5 while Attach 6 shows the development in SE 32 and NE 32. Which area shall we use?
   - Forman Industrial Park – is the extent of the industrial park as shown in Attachment 5?
   - Ponoka Airport – development area is shown outside of the Town of Ponoka boundary.
   - Downtown Area – where are the locations of development areas in downtown?
   - Any future development area not shown here?

4.1 STORM SEWER SYSTEM DESIGN CRITERIA AND METHODOLOGY

This section summarizes the methodology used to complete the drainage analysis for the Town of Ponoka Master Servicing Study.

This analysis examines both existing stormwater infrastructure and proposed stormwater infrastructure within the Town of Ponoka. The drainage analysis is conducted in a manner to ensure that the discharge of stormwater from future developments within the Town of Ponoka meets:

- Quality control targets; and
- Release rate targets.

Methodology

Best Management Practices

Development can substantially increase impervious areas by introducing paved surfaces and buildings. This increase in imperviousness will cause runoff rates and volumes to increase, this increase must be mitigated to prevent flooding and damage to downstream property, infrastructure and natural systems. In order to mitigate damage as a result of increased runoff, flows from future developments will be held to pre-development runoff rates. As per the Town of Ponoka Master Servicing Study 2013 Update (Tagish 2013) the pre-development unit area release rate (UARR) for the area is 2.5 L/s/ha. Therefore, future drainage systems will capture and control runoff from developments within the Town of Ponoka to 2.5 L/s/ha. Stormwater Management Facilities (SWMF) will be the principle means of achieving the release rate targets identified. Detention storage is the most common method used for stormwater flow attenuation.

To improve stormwater runoff quality and reduce the potential impact on the receiving waters, flows will be required to meet water quality targets as set out by Alberta Environment and Parks. These targets require that at least 85% of total suspended solids (TSS) from stormwater runoff be removed for particle sizes greater than or equal to 75 microns.

To meet water quality targets for future developments, best management practices will be employed. Best management practices include:

- Wet Ponds;
- Oil Grit Separators;
- Etc.

Runoff Simulation

Two approaches are used to evaluate the drainage design in meeting all required design criteria and targets:

- Single event simulation; and
- Continuous simulation.

The verification and sizing of the SWMFs is carried out using both the single event simulation and continuous simulation, with the greater volume of the two simulations taking priority. Frequency analysis is run on the yearly maximums of the continuous simulation to determine the 1:100-year volume. The continuous data is compiled from Environment Canada for the City of Red Deer over the past 25 years.

Runoff is conveyed to the SWMFs using a dual drainage minor and major system. The minor system consists of catchbasins (inlets and leads) the underground pipe system and manholes and junctions. The major system is designed to convey overland flows and includes curb and gutter on the roads, drainage ditches and storm water management ponds.

Single Event Simulation

Computer Model

Computational modeling is used to verify the performance of the proposed drainage designs in meeting the targets outlined in the City of Red Deer Engineering Services Section 10 Stormwater Management Design (2016) and the Alberta Environment and Parks Stormwater Management Guidelines (1999). The following models are used in the analysis:

- PCSWMM Version 6.3 (for both single event and continuous simulation)
- HYFRAN
- City of Calgary Frequency Analysis Spreadsheet

Model Development

As per the City of Red Deer Engineering Standards Section 10 Stormwater Management Design (pg. 6, 2016) the Chicago synthetic design storm is used to analyse the stormwater infrastructure. The minor system is analysed using a single event 1:5-year 4-hour Chicago synthetic design storm (**Table 1**) and the major system is analysed using a single event 1:100-year 24-hour Chicago Synthetic design storm (**Table 2**).

Table 1: Parameters for 1:5 year 24 hour event (Values Taken form the City of Red Deer Engineering Standards Section 10 Stormwater Management Design [pg. 2, 2016])

Parameter	Value
Return Period	5
Duration (hrs)	4
a	376.86
b	0.09
c	0.6974
Time to peak (hrs)	0.3

Table 2: Parameters for 1:100 year 24 hr Event (Values Taken form the City of Red Deer Engineering Standards Section 10 Stormwater Management Design [pg. 2, 2016])

Parameter	Value
Return Period	100
Duration (hrs)	24
a	751.03
b	0.09
c	0.7240
Time to peak (hrs)	0.3

Hydrologic and hydraulic modeling of the catchment requires several parameters to be specified. **Table 3 and Table 4** lists the inputs for the PCSWMM model as obtained from the City of Red Deer Engineering Services Section 10 Stormwater Management Design (2016) and the Alberta Environment and Parks Stormwater Management Guidelines (1999).

Table 3: PCSWMM Subcatchment Parameter Inputs

Parameter	Design Guideline	Value and Assumptions Associated	
Catchment Areas	NA	Catchments were delineated based on 2015 LiDAR data provided by the Town of Ponoka.	
Width	SWMM Reference Manual Volume 1 – Hydrology (USEPA, 2016)	The average maximum length of overland flow divided by the area.	
Slope	NA	Catchment slopes are based on the 2015 LiDAR data provided by the Town of Ponoka. The slopes are calculated in Civil 3D using the generated LiDAR surface.	
Percent Impervious	Alberta Environment and Parks Stormwater Management Guidelines (pg. 4-16, 1999)	• Business: 70 – 95% • Residential: 50 – 70% • Industrial: 80 – 90% • Parks: 7% • Playgrounds: 13% • Schools: 50%	• Railway Yard Areas: 40% • Asphalt: 100% • Gravel: 13% • Roofs: 90% • Lawns: 0%
Manning's n	City of Red Deer Engineering Services Section 10 Stormwater Management Design (pg. 10, 2016)	• Impervious: 0.013 • Pervious: 0.25	
Green-Ampt Parameters	As per the Town of Ponoka Master Servicing Study 2013 Update (Tagish 2013)	Soil conditions are Sandy Loam, values form Handbook of Hydrology (1993). • Infiltration Rate: 21.8 mm/hr • Suction Head: 110.1 mm • Initial Deficit: 0.246	
Depression Storage	City of Red Deer Engineering Services Section 10 Stormwater Management Design (pg. 10, 2016)	Soil conditions are Sandy Loam; values form Modern Sewer Design (1980). • Impervious: 2.5 mm • Pervious: 7.5 mm	

Table 4: PCSWMM Conduit Parameter Inputs

Parameter	Design Guideline	Value and Assumptions Associated
Manning's n	City of Red Deer Engineering Services Section 10 Stormwater Management Design (pg. 10, 2016)	• Concrete: 0.013 • PVC: 0.013 • CSP: 0.025
Manhole loss coefficient	City of Red Deer Engineering Services Section 10 Stormwater Management Design (pg. 10, 2016)	• Values based on Modern Sewer Design (1980). • Pipe losses were based on bend losses and lateral inflow losses and Junctions.

5.0 CONCLUSION

We request that the Town review this memorandum, respond to our inquires and confirm the proposed design criteria.

If you have questions or concerns, with regards to the information provided, please do not hesitate to contact the undersigned at 780.809.3290 or at clongoz@mcelhanney.com.

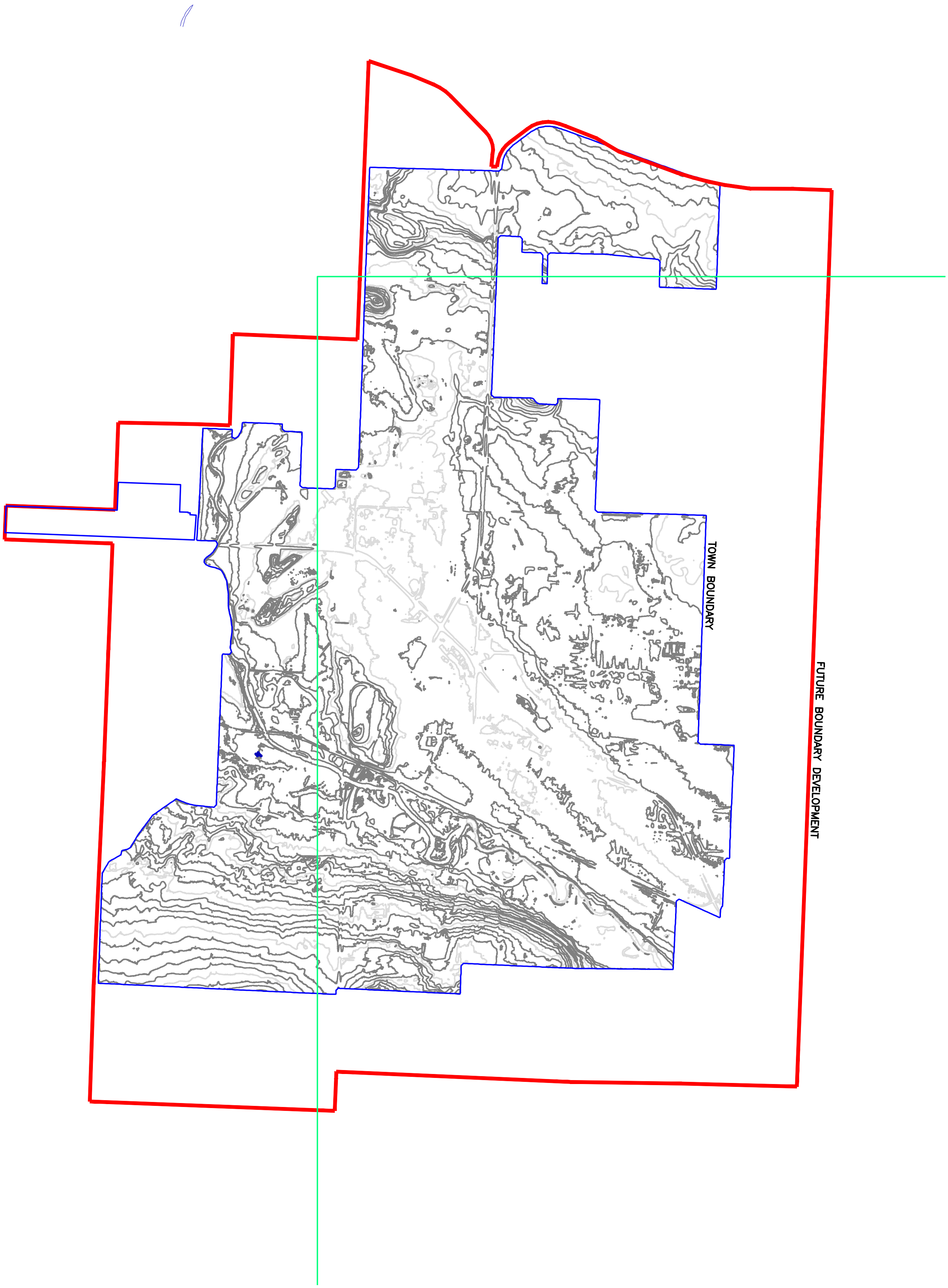
Yours truly,

Chris Longoz, P.L.(Eng.)

cc: Justin Caslor, CET, Engineering Technician, Town of Ponoka
Haimanot Yadete, P.Eng., MCSL
Nav, Sandu, P.Eng., MCSL

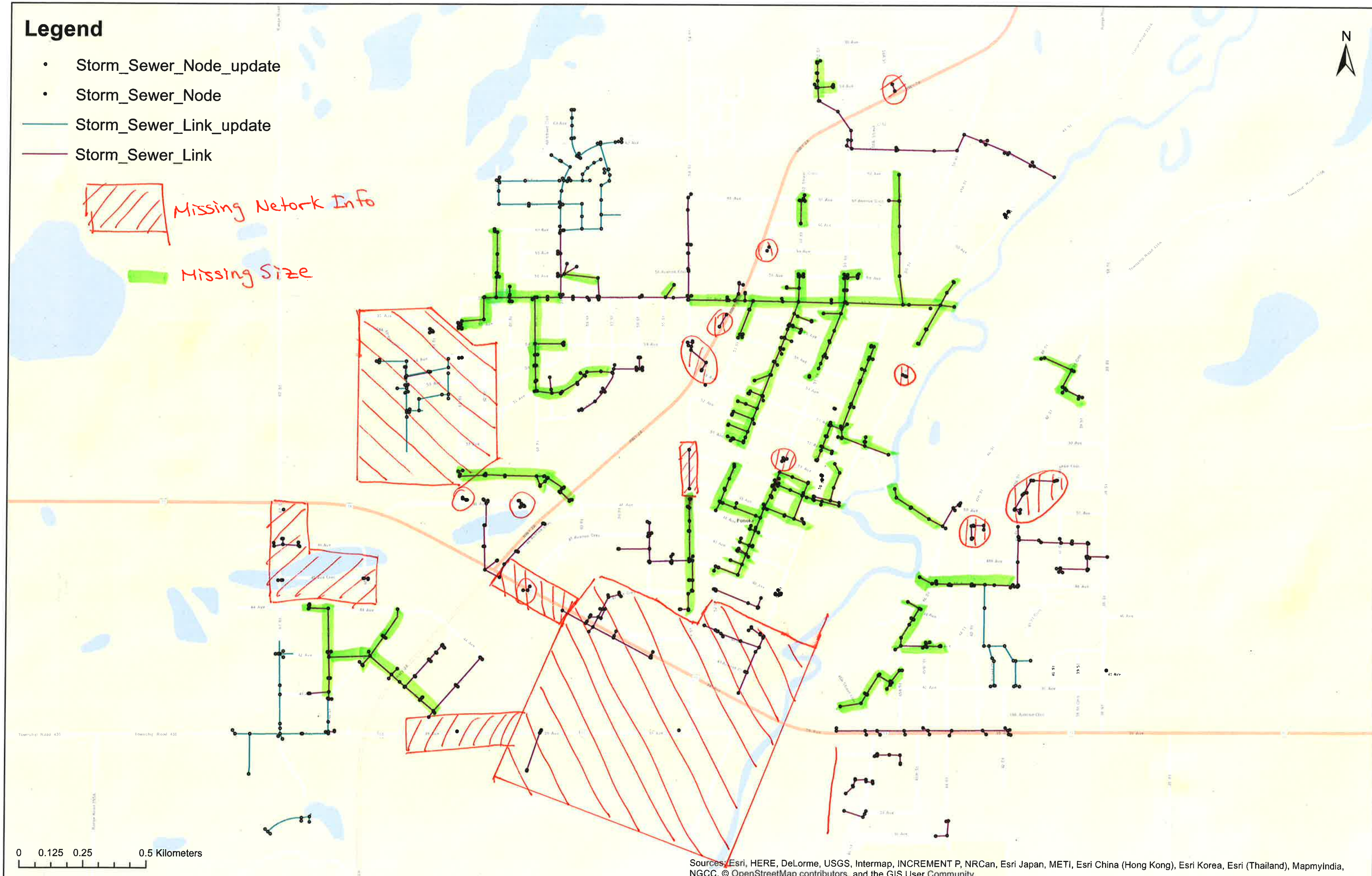
ATTACHMENT 1

LiDAR


TOWN BOUNDARY
FUTURE BOUNDARY DEVELOPMENT

ATTACHEMENT 2

MISSING STORM INFORMATION



Legend
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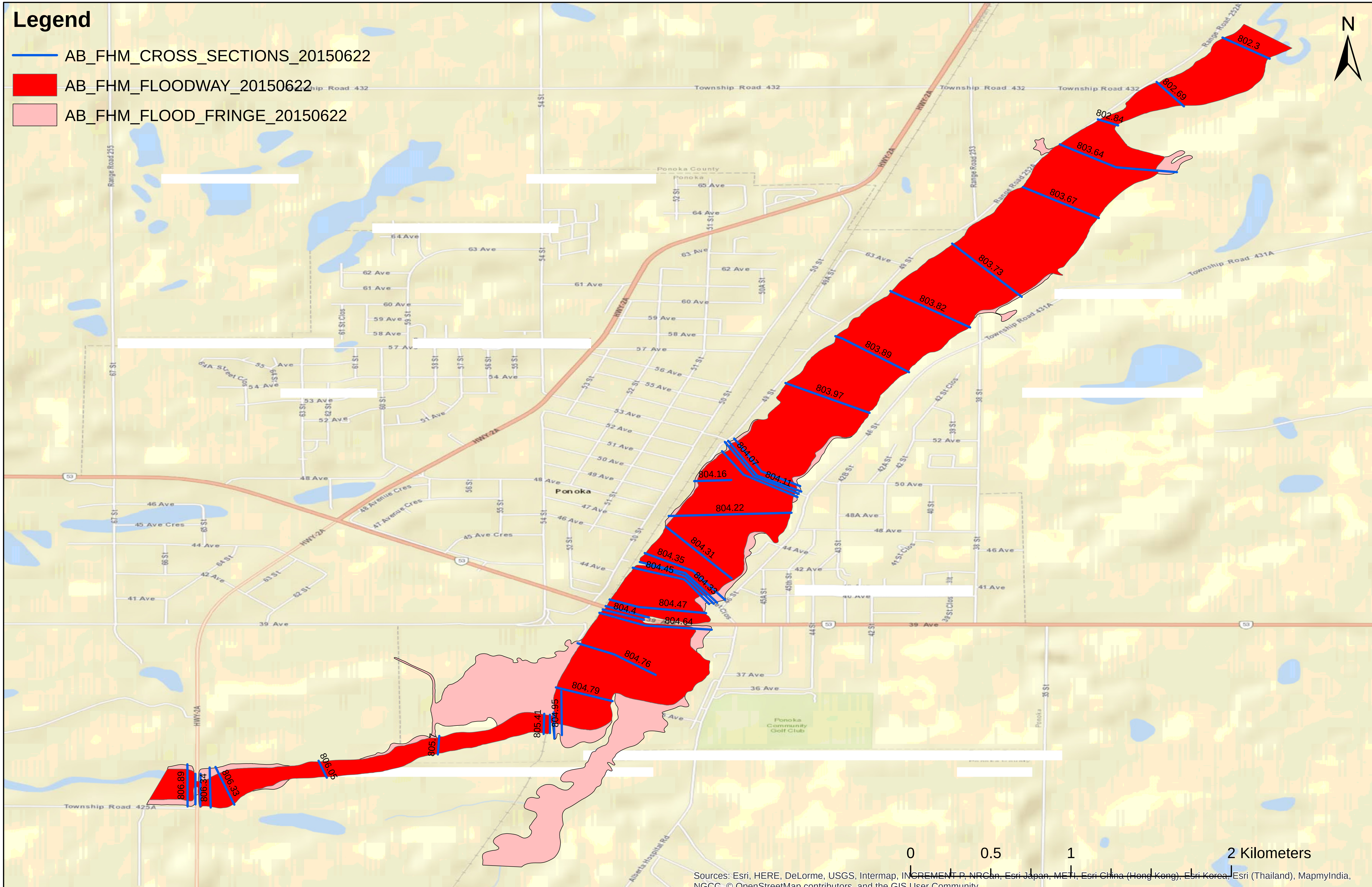
Storm_Sewer_Node
Storm_Sewer_Link_update
Storm_Sewer_Link
Missing Netork Info
Missing Size
N
0 0.125 0.25 0.5 Kilometers
Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

ATTACHMENT 3

AEP FLOOD HAZARD MAP


Legend
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AB_FHM_FLOODWAY_20150622
AB_FHM_FLOOD_FRINGE_20150622
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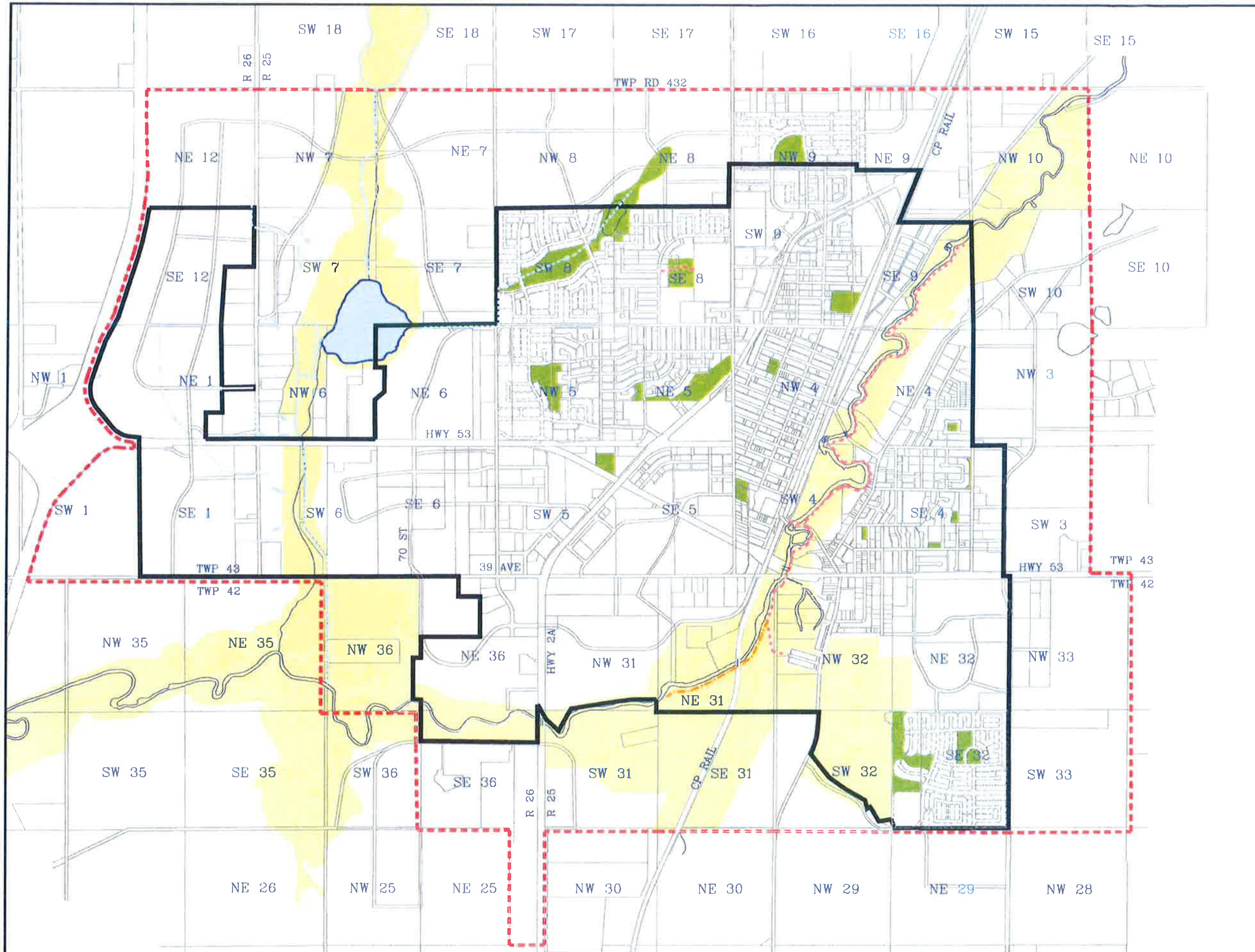
803.64
803.67
803.73
803.82
803.89
803.97
804.07
804.11
804.16
804.22
804.31
804.35
804.45
804.47
804.4
804.64
804.76
804.79
804.95
805.41
805.7
806.05
806.33
806.34
806.89
Ponoka
0 0.5 1 2 Kilometers
Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

ATTACHMENT 4

OPEN SPACE AND TRAIL SYSTEM



Client

Consultant

TAGISH ENGINEERING LTD.
Consulting Engineers
64, 5550 - 45 Street, RED DEER, AB T4N 1L1
Phone (403) 346 - 7710 Fax (403) 341 - 4909
E-mail admin@tagish-engineering.com

Project

MASTER SERVICING STUDY

Legend

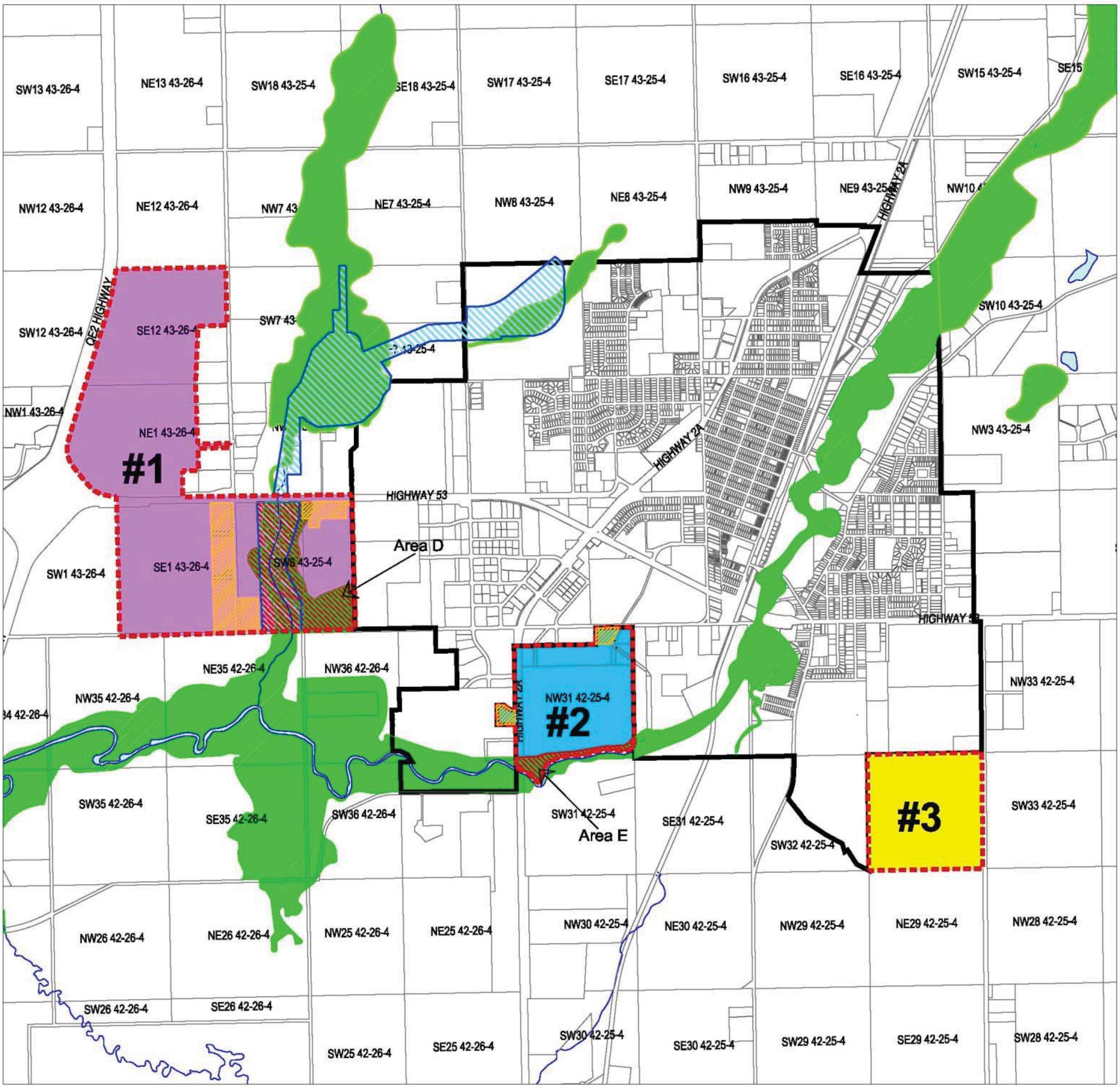
- OPEN SPACE
- FLOOD PLAIN (1:100 YEAR)
- EXISTING TRAILS
- PROPOSED TRAILS BOUNDARY
- 2011 ANNEXATION BOUNDARY
- FUTURE SERVICING AREAS ASSESSED
- DRAINAGE CHANNEL

DATE: MAY15, 2013

OPEN SPACE AND TRAIL SYSTEM	Project No. TP71
	FIG. 11
Design by:	Approved by:

ATTACHMENT 5

PROPOSED GROWTH AREA BY USE



Legend

- Town of Ponoka Boundary
- Proposed Growth Area # 1 (Commercial Business Uses)
- Proposed Growth Area # 2 (Future Institutional and Mixed Uses - Regional Ag Event Centre and Potential Stampede Association Facility Expansion)
- Proposed Growth Area # 3 (Residential Uses - Caledera Area Structure Plan)
- Areas undevelopable due to flood risk and drainage corridor constraints
  Area D = 35.55 ha (87.86 ac), Area E = 4.78 ha (11.82 ac)
- Lands with Existing Development in Growth Area # 1
  SE1 43-26-4 = 13.60 ha (33.62 ac), SW6 43-25-4 = 7.16 ha (17.70 ac)
  Lands with Existing Development in Growth Area # 2
  NW31 42-25-4 = 3.06 ha (7.60 ac)

Figure 17
Proposed Growth Area By Use

Town of Ponoka
Growth Study

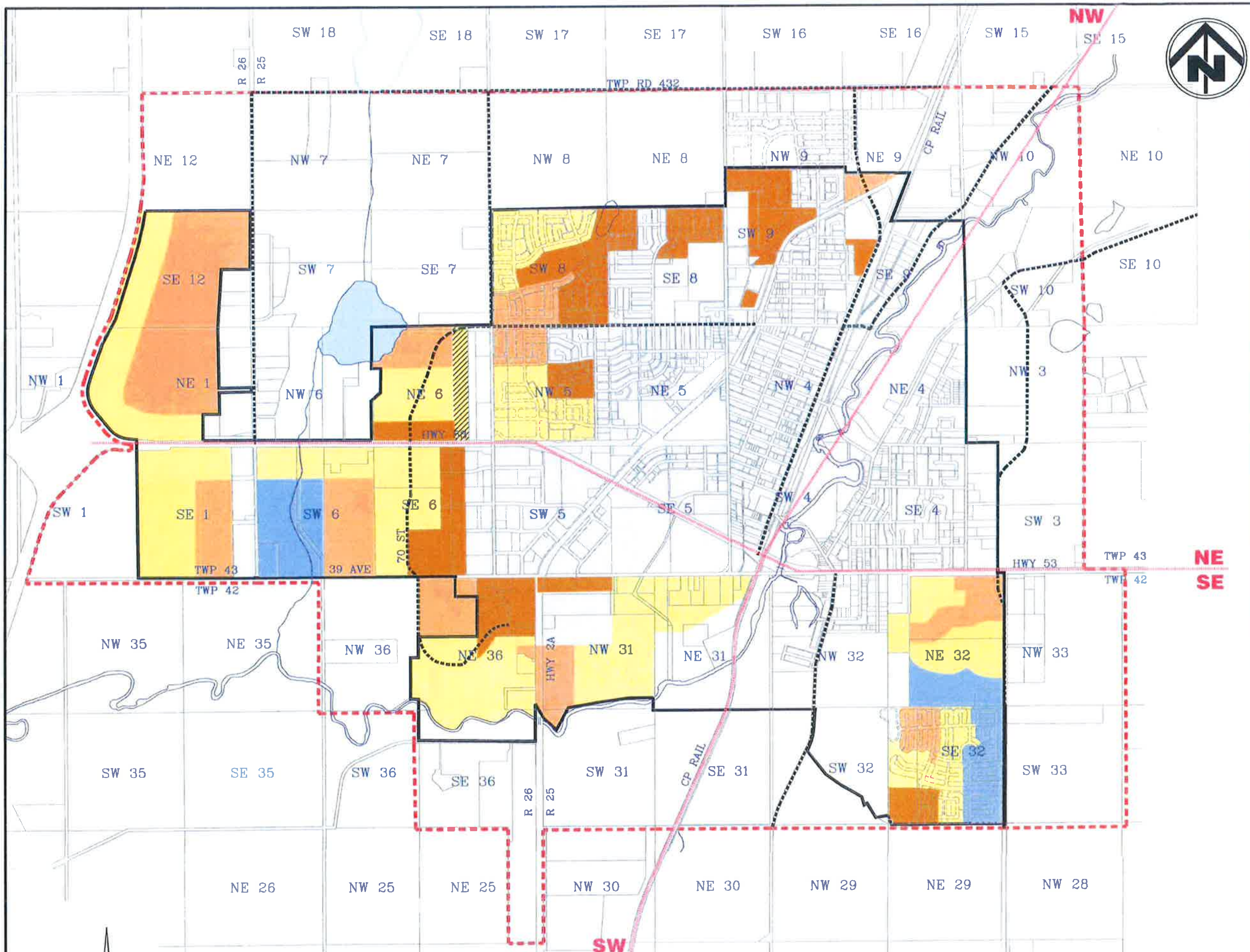
0 375 750 1500m

N

ARMIN A. PREIKSAITIS & ASSOCIATES LTD.

ATTACHMENT 6

FUTURE GROWTH DEVELOPMENT



Client

Ponoka

Consultant

TAGISH ENGINEERING LTD.
Consulting Engineers
G4, 5550 - 45 Street, RED DEER, AB T4N 1L1
Phone (403) 346 - 7710 Fax (403) 341 - 4909
E-mail admin@tagish-engineering.com

Project

MASTER SERVICING STUDY

Legend

- 2011 ANNEXATION BOUNDARY
- FUTURE SERVICING AREAS ASSESSED

ORDER OF DEVELOPMENT:

- FIRST PROBABILITY
- SECOND PROBABILITY
- THIRD PROBABILITY
- FOURTH PROBABILITY
- FIFTH AND BEYOND PROBABILITY
- EXISTING DEVELOPED AREAS
- FUTURE CEMETERY EXPANSION

DATE: MAY15, 2013

FUTURE GROWTH DEVELOPMENT	Project No. TP71	FIG. 3.2
	Design by:	Approved by:

M E M O R A N D U M

McElhanney Consulting Services Ltd.
14904 – 121A Avenue
Edmonton, AB T5V 1A3
Tel: 780 809 3200
www.mcelhanney.com

Town of Ponoka	Master Servicing Study Re-Write Additional Information & Design Criteria Technical Memorandum #2
Date:	May 4, 2017
Our Reference:	2131-00247-14

To: **Dave McPhee, Director of Operations & Property Services**
Town of Ponoka
5102 48th Ave
Ponoka, AB T4J 1P7

MCSL previously sent a technical memo to the Town detailing information required to complete the study. The Town is still in the process of compiling all the information requested, though sufficient information has been provided to proceed with parts of the study.

The following is a summary of the critical information required to proceed further at this time.

1.0 GROWTH STUDY

- As per the e-mail from Chris dated April 26, 2017, the Growth Study forecasts 30, 40 and 50 years for land development. For the Master Servicing Study it was agreed that we would look at 5, 10 and 25 years down the road. Can you provide some insight into what the Town's vision is for development for 5, 10 and 25 years? We are currently working on existing conditions but the modeling for expansion will be next on our to do list.

2.0 WATER SYSTEM

- Please provide pump curves / pump models / number of pumps for pump houses or any other related information available (specifications, etc.).

3.0 SANITARY SEWER SYSTEM

- Pump curves / pump models / number of pumps for lift stations.
- Any available flow metering data.
- Missing inverts as previously discussed (attached).

4.0 STORM SEWER SYSTEM

- There is a pond along Hwy 2A to the west, south of 54th Street (adjacent to Trinity Evangelical Lutheran Church). There is no outlet shown in the map book; is there any outlet information available?

5.0 CONCLUSION

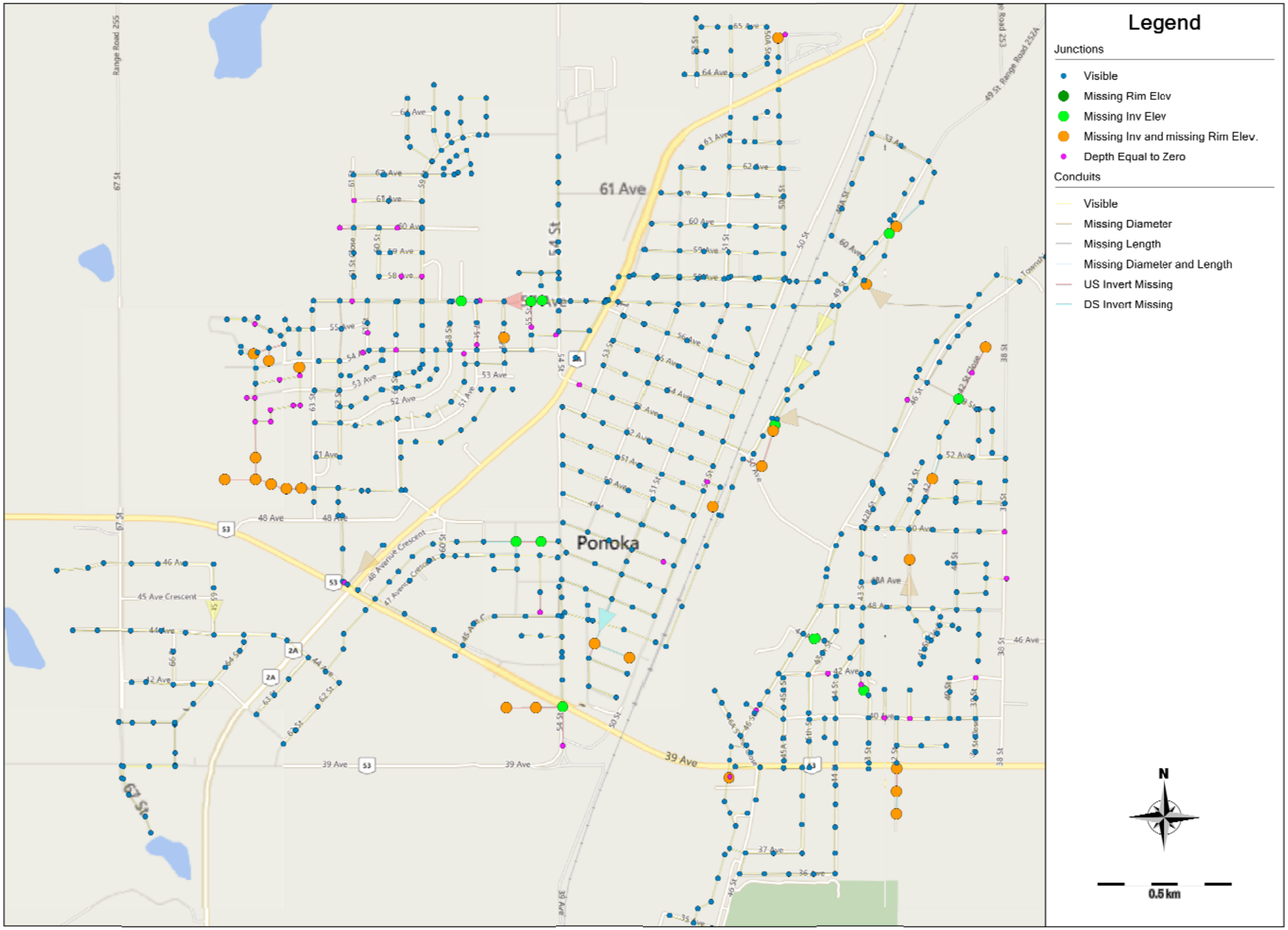
We request that the Town review this memorandum and respond to our inquires.

If you have questions or concerns, with regards to the information provided, please do not hesitate to contact the undersigned at 780.809.3290 or at clongoz@mcelhanney.com.

Yours truly,

Chris Longoz, P.L.(Eng.)

cc: Justin Caslor, CET, Engineering Technician, Town of Ponoka
Haimanot Yadete, P.Eng., MCSL
Nav Sandu, P.Eng., MCSL
Jack McKee, EIT, MCSL
Daniel Archila, EIT, MCSL
Jeff Amundson, P.Eng., MCSL


Legend
Junctions
Visible
Missing Rim Elev
Missing Inv Elev
Missing Inv and missing Rim Elev.
Depth Equal to Zero
Conduits
Visible
Missing Diameter
Missing Length
Missing Diameter and Length
US Invert Missing
DS Invert Missing
N
0.5 km
Ponoka
61 Ave
54 St
39 Ave
48 Ave
67 St
50 St

M E M O R A N D U M

McElhanney Consulting Services Ltd.
14904 – 121A Avenue
Edmonton, AB T5V 1A3
Tel: 780 809 3200
www.mcelhanney.com

Town of Ponoka	**Master Servicing Study Re-Write Summary of Outstanding & Received Information & Design Criteria (Rev 1) Technical Memorandum #3**
Date:	**July 12, 2017**
Our Reference:	**2131-00247-14**

To: **Dave McPhee, Director of Operations & Property Services**
Town of Ponoka
5102 48th Ave
Ponoka, AB T4J 1P7

MCSL previously sent two (2) technical memos to the Town detailing information required to complete the study. The Town is still in the process of compiling all the information requested, though sufficient information has been provided to proceed with parts of the study.

To simplify the information requests, this technical memo has been written to summarize outstanding information required, as well as information received to date. This technical memo is intended to supersede Technical Memorandum #1 and #2. In **Appendix D,** we have included details in chart form listing the documents we have received from the Town.

1.0 GROWTH STUDY

- As per the e-mail from Chris dated April 26, 2017, the Growth Study forecasts 30, 40 and 50 years for land development. For the Master Servicing Study, it was agreed that we would look at 5, 10 and 25 years down the road. Can you provide additional insight into what the Town's vision is for development for 5, 10 and 25 years? We note that we are specifically looking for boundaries showing where the expansion will take place, along with the anticipated land use. ***We propose holding a conference call to clarify our requirements once the Town has had an opportunity to review this request.***

2.0 WATER SYSTEM

- Please provide pump curves / pump models / number of pumps for pump houses or any other related information available (specifications, etc.).
- Confirm the configuration of the feeder main to the Lucas Reservoir from the Regional System.
  - The relevant sections of the map book with mark-ups have been attached in **Appendix A**, for reference.
  - Specifically, on GRID #: 48 it appears as though the feeder main connects to the 150 mm watermain. However, the 150 mm watermain is feeding several hydrants. There is also a 300 mm watermain running parallel to the 150 mm watermain, and the 300 mm watermain connects to other distribution mains at 54 Ave and 55 Ave. Please confirm that the 150 mm watermain is in fact the feeder main, and whether the hydrants are being fed from the 150 mm watermain.
  - Are there any record drawings available for the Regional System?

  - Is the valve at the intersection of 45 Ave / 65 Street normally closed?
  - There are no valves at the connections in 54 and 55 Avenues, so it appears the areas west of 63 Street are being serviced directly from the Regional System feeder main. Please confirm.
- We have not completed the model for existing conditions due to lack of calibration information. We will be unable to continue with the water modeling until we have information relating to calibration pressure and flow testing. We note that the Town has two options, either purchasing calibration equipment for themselves, which as previously indicated could be in the range of $10,000 based on preliminary review, or hiring an outside contractor to do the work, which will be in the range of $1,200. Please advise how the Town plans to proceed.
- We are intending to use the City of Red Deer design standards for assigning a water demand in the water model as opposed to basing it on overall flow data, as this is a common approach in this type of design. Please confirm this is acceptable to the Town.

3.0 SANITARY SEWER SYSTEM

- Is there any GIS data for the correct forcemain location and configuration, as shown in the Tagish report?
- What is the storage capacity of the wet wells?
- Lift station pump info:
  - Please confirm the number of pumps operating at each lift station.
  - At what water level do the pumps turn on?
  - At what water level do the pumps shut off?
  - What is the pump configuration, i.e. do they run in parallel, lead-lag, etc?
- What is the current capacity of the wastewater treatment plant?
- What is the maximum allowable release rate to the Battle River during the allowable discharge period?

4.0 STORM SEWER SYSTEM

- There is a concrete MH with a pump connection identified on the Centennial Pond aerial photo. The note states that, “MH will fill with water and operators need to manually connect pump to discharge it back upstream”. Is this an item that needs to be corrected, and should it be included in the MSS?
- Concerning Centennial Pond, is the overflow the only outlet into the minor system? If not, please specify the outfall location and provide an invert elevation if possible.
- A number of inverts and conduit sizes are missing, as per the attached map in **Appendix B**. For modelling purposes, the inverts and pipe sizes will be assumed; please confirm this is acceptable to the Town.

The attached figure in **Appendix C**, notes four (4) stormwater detention facilities (3 dry ponds and 1 constructed wetland). We have currently not included these detention facilities in our existing system model. To include the facilities in the modeling we would require the following information from the Town:

- Stage-storage or stage area curves;
- Outfall structure design and target release rate;
- Inflow structure design;
- Figure showing the contributing catchment area; and
- catchment characteristics (i.e was it designed for existing buildouts or designed for future developments as well)

5.0 CONCLUSION

We request that the Town review this memorandum and respond to our inquires.

If you have **questions or concerns**, with regards to the information provided, please do not hesitate to contact the undersigned at **780.809.3290** or at clongoz@mcelhanney.com. This information is important for the progress of the study.

Yours truly,

Chris Longoz, P.L.(Eng.)

cc: Justin Caslor, CET, Engineering Technician, Town of Ponoka
Haimanot Yadete, P.Eng., MCSL
Nav Sandu, P.Eng., MCSL
Jack McKee, EIT, MCSL
Daniel Archila, EIT, MCSL
Jeff Amundson, P.Eng., MCSL

APPENDIX A -

GRID
48, 54 & 67

CONFIRM WHICH PIPE CONNECTS TO FEEDER MAIN

GRID #: 48

Legend

Storm Sewer Feature
- Catch Basin
- Catch Basin Manhole
- Manhole

Storm Sewer Lines
- Storm Main
- CatchBasin Lead
- Storm Service

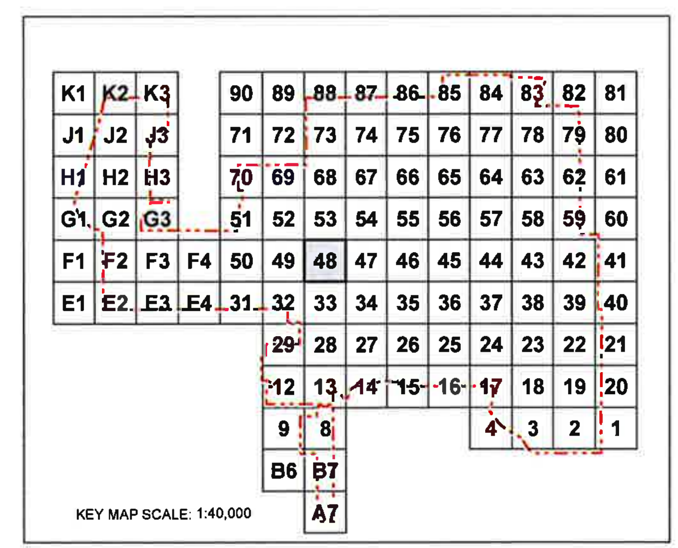
Sanitary Features
- Manhole

Sanitary Lines
- Gravity Main
- Service Connection

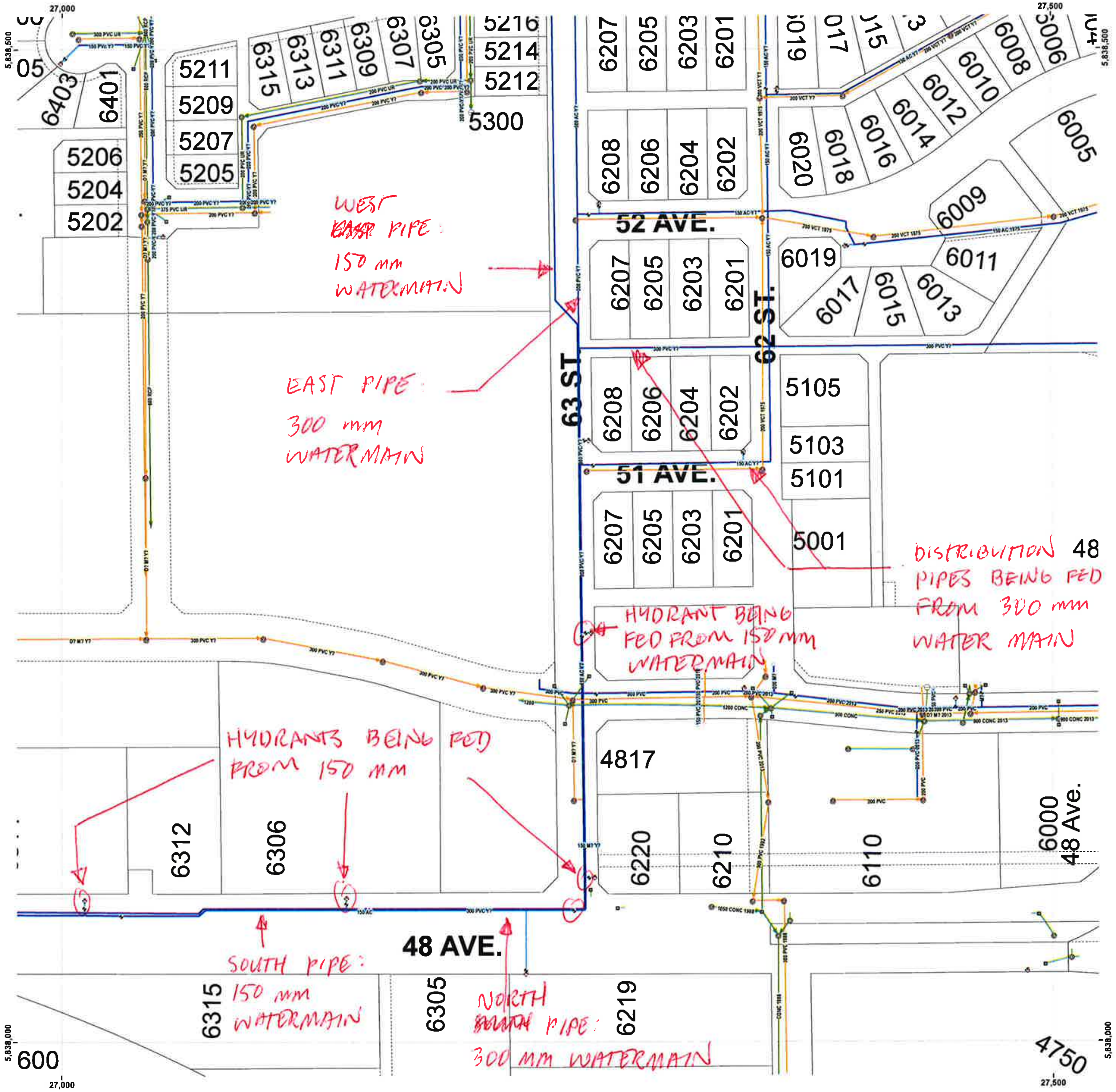
Water Feature
- Hydrant
- Plug
- Valve

Watermain
- Watermain
- Supply/Service Line
- Hydrant Lead
- Supply Main - Abandoned

SCALE: 1:1,000



GRID #: 54



Legend

Storm Sewer Feature
- Catch Basin
- Catch Basin Manhole
- Manhole
- Plug

Storm Sewer Lines
- Storm Main
- CatchBasin Lead
- Storm Service

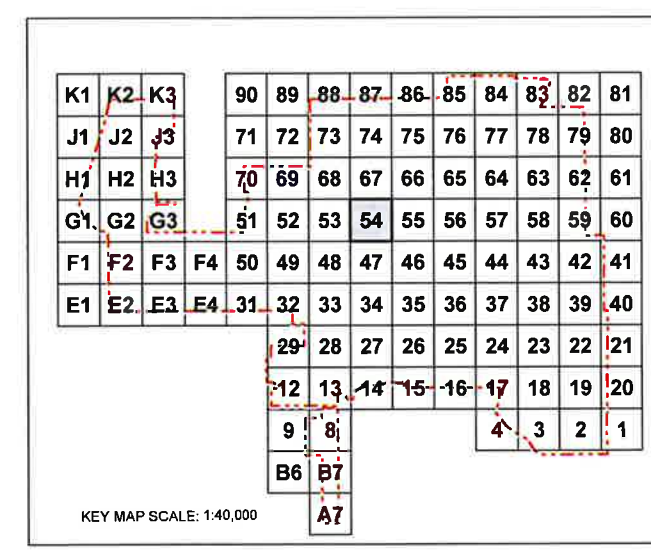
Sanitary Features
- Manhole
- Plug

Sanitary Lines
- Gravity Main
- Service Connection

Water Feature
- Hydant
- Plug
- Valve

Watermain
- Watermain
- Supply/Service Line
- Hydrant Lead

SCALE: 1:1,000



GRID #: 67

Legend

Storm Sewer Feature
- Catch Basin
- Catch Basin Manhole
- Manhole

Storm Sewer Lines
- Storm Main
- CatchBasin Lead
- Storm Service

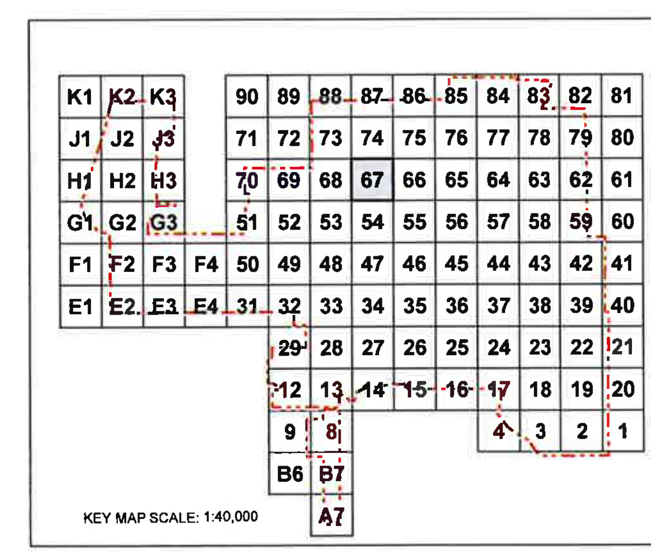
Sanitary Features
- Manhole

Sanitary Lines
- Gravity Main
- Service Connection

Water Feature
- Hydant
- Plug
- Reducer
- Valve

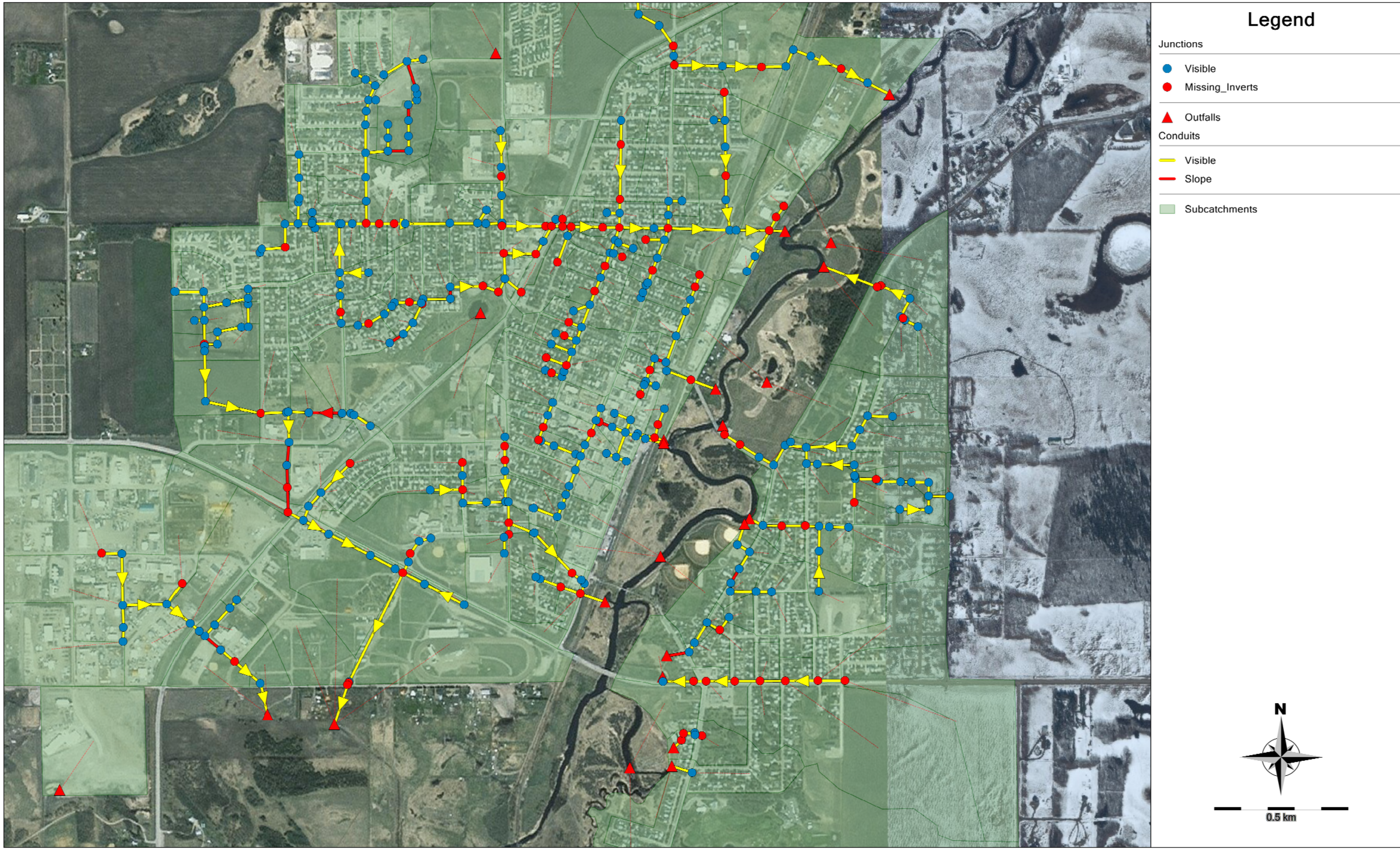
Watermain
- Watermain
- Supply/Service Line
- Hydrant Lead

SCALE: 1:1,000



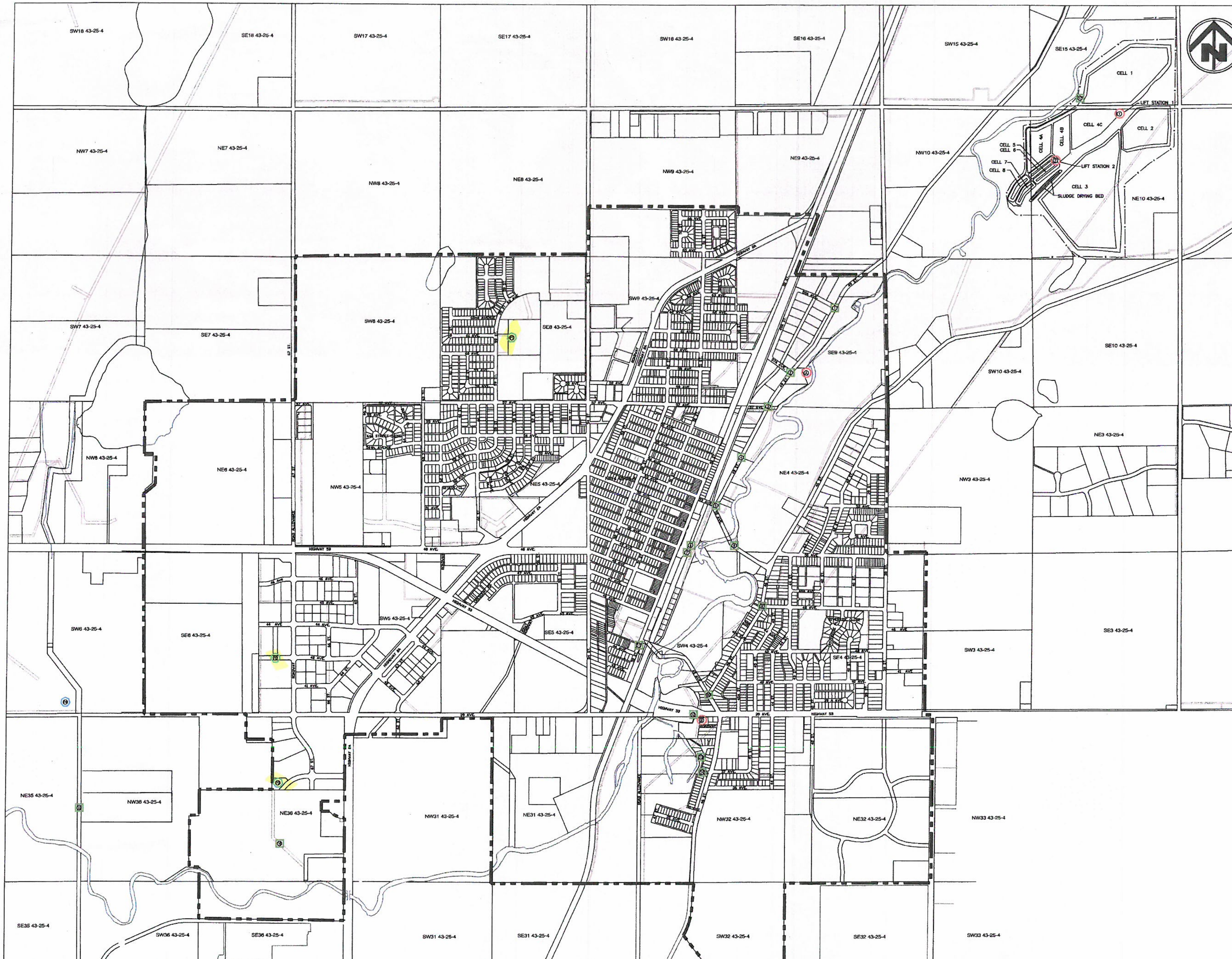
APPENDIX B -

Missing Storm Sewer Data


Legend
Junctions
Visible
Missing_Inverts
Outfalls
Conduits
Visible
Slope
Subcatchments
N
0.5 km

APPENDIX C -

Storm Water Detention Facilities



Client

TOWN of PONOKA
ENTERPRISE · PROGRESS · INTEGRITY

Consultant

TAGISH ENGINEERING LTD.
Consulting Engineers
G4, 5550 - 45 Street, RED DEER, AB T4N 1L1
Phone (403) 346-7710 Fax (403) 341-4909
E-mail admin@tagish-engineering.com

Project

APPROVAL RENEWAL FOR MUNICIPAL WASTEWATER STORM DRAINAGE SYSTEM

Legend

1) STORM SEWER OUTFALLS TO BATTLE RIVER

1. 48 INCH OUTFALL-58A AVE AND 49 ST
2. 15 INCH OUTFALL-60 AVE AND 49 ST
3. 48 INCH OUTFALL-57 AVE AND 49 ST
4. 15 INCH OUTFALL-56 AVE AND 49 ST
5. 30 INCH OUTFALL-53 AVE AND 49 ST
6. 15 INCH OUTFALL-50 AVE AND 49 ST
7. 36 INCH OUTFALL-50 AVE AND 49 ST
8. 40 INCH OUTFALL-50 AVE BY THE BRIDGE
9. 24 INCH OUTFALL-48 AVE AND 46 ST
10. 20 INCH OUTFALL-BETWEEN 39 AVE AND 46 ST
11. 36 INCH OUTFALL-50 ST AND 45 AVE
12. 42 INCH OUTFALL-HIGHWAY 53
13. 18 INCH OUTFALL-48 ST AND 38 AVE CLOSE
14. 12 INCH OUTFALL-46 ST AND 37 AVE
15. 48 INCH OUTFALL-COUNTY R/A
16. 12 INCH OUTFALL-DON KERNS
17. 18 INCH OUTFALL-WEST OF CELL 1 ON LAGOON

2) STORMWATER DETENTION PONDS

- P1 DRY STORM POND-EAST OF 59 ST AND 61 AVE
- P2 DRY STORM POND-SW INDUSTRIAL SUBDIVISION
- P3 DRY STORM POND-SW INDUSTRIAL SUBDIVISION
- P4 CONSTRUCTED WETLAND NORTH OF 39 AVE AND RR261

3) SANITARY LIFT STATIONS

- 1 LIFT STATION 1-EAST OF CELL 4C AND NW OF CELL 2
- 2 LIFT STATION 2-NE OF CELL 5 AND SW OF CELL 4B
- A LIFT STATION "A"-57A AVE BY THE BATTLE RIVER
- B LIFT STATION "B"-BY THE HIGHWAY 53

EXISTING TOWN BOUNDARY

EXISTING FENCE

NOTES:
- THIS DRAWING PRODUCED FROM SITE SURVEYS AND TOWN OF PONOKA BASE MAP. NO LIABILITY ACCEPTED FOR ERRORS OR OMISSIONS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING AND PROTECTING ALL UTILITIES PRIOR AND DURING ALL CONSTRUCTION

No.	Date	By	Eng.	Revisions
10				
9				
8				
7				
6				
5				
4				
3				
2				
1				
0				

Permit Stamp

Engineer's Stamp

Scale	1:9,000
Date	MAR09,2011
Dwg. File	TP42_DGN2_MAR2011.DWG
Drawn	AW
Designed	CDC
Checked	PBN
Approved	CS

Title

LOCATION PLAN

Project No.
TP42

Drawing No.
1 / 1

APPENDIX D -

Documents Received

Master Servicing Study Re-Write - Document Tracking Sheet

Documents Received Prior to Tech Memo Submittal

Document	Author	Description
GENERAL		
REPORTS		
2013 Master Servicing Study	Tagish	
Cemetary Master Plan (2015)	TOP (Justin Caslor)	Forest Home Cemetary (Hwy 53 & 67 St)
TOP 2013 Master Servicing Study Review	MCSL (EDM)	
Recreation & Culture Master Plan (2016 - 2036)	MCSL (CGY)	Background Analysis Planning Context Trends Parks, Rec & Culture Service Delivery Model Development Standards and Classification Needs Summary Recommendations
MAPS, IMAGES, DRAWINGS		
2009 AS Built dwg	Tagish	CAD Dwg
Orthophoto	TOP	tif of TOP
LiDAR	TOP	zip files
cadastral	TOP	CAD Dwg
2010-11-17 Town of Ponoka Underground Utilities	TOP	GIS
2014-07-09 Town of Ponoka Underground Utilities Pre 2014	TOP	GIS
Drawing Details combined	TOP	Design Guideline Details
TOP NOTES, CLARIFICATIONS		
Tech Memo 1 - answers 2017-04-18	TOP	Not complete
Tech Memo 2 - answers 2017-05-04	TOP	Not complete
map book combined	TOP	Includes partial requested missing san/wat/stm info requested by MCSL
water missing distribution	TOP	Includes partial requested missing wat/FM info requested by MCSL
rim_and_invert_info	TOP	Includes partial missing water info requested by MCSL
TRAFFIC		
TIA (JAN 2010)	Williams Engineering	Ag Event Centre & SW Industrial Park (NW 1/4 Sec 31-42-25-W4
Hwy 2A Functional Planning Study	CastleGlen Consultants	for AT & TOP
Hwy 53 Functional Planning Study Exec Summary	ISL	Not complete Package
GUIDELINES		
Red Deer Design Services	RD	Use for Master Servicing Study
GROWTH RATES		
Growth Study 2009-2059	Armin A. Preiksaitis & Ass.	
2013 MDP	TOP	
2013 MDP First Reading	TOP	
Growth Study 2009-2059	Armin A. Preiksaitis & Ass.	With Tim Schmidt (TOP) Sticky notes
25year_estimated_dev	TOP	25-yr development for Lucas Heights, Hudson Green
WATER		
waterbase	Tagish	CAD Dwg Model
2015 Annual Water Report	TOP	To AE & Parks (2016-01-28)
2016 Annual Water Report	TOP	To AE & Parks (2017-01-11)
2016 Ponoka Water Use	TOP	Town Owned Buidings
Missing Water Info from GIS	TOP	Includes partial requested missing wat info requested by MCSL
SEWER		

Infiltration & Inflow Study	Tagish	500 Site Inspections Smoke Testing Trunk Main Flow Meter Testing
2015 Annual Wastewater Report	TOP	To AE & Parks (2016-02-19)
2016 Annual Wastewater Report	TOP	To AE & Parks (2017-01-15)
2015 Facultative Storage Facility Cell #3 FM Extension	Allnorth	NE10 43-25-4 (2015 Facultative Lagoon Storage Facility - Cell #3 Force Main Extension)
Sewage Lagoon (Plan of Record, 2004)	Stantec	NE10 43-25-5
Annual Flow 2015 2016 m3	TOP	2015 & 2016 Annual WW Flows
BG100_2014_Cell 3 Forcemain Extension_Record Drawings	Allnorth	2015 Facultative Lagoon Storage Facility - Cell #3 Force Main Extension
Pumping Curve A Lift	Vaughan - pump manufacturer	Lift Station A - Pump Curve
Pumping Curves Lift Station B	Vaughan - pump manufacturer	Pump #1 and #2 Pump Curves
Pumping Hours A Lift 2015	TOP	2015 record of daily pumping hours
Pumping Hours A Lift 2016	TOP	2016 record of daily pumping hours
Pumping Hours B Lift 2015	TOP	2015 record of daily pumping hours
Pumping Hours B Lift 2016	TOP	2016 record of daily pumping hours
STORM		
NW SWMP (2009)	Tagish	SE 1/4 Sec 6-43-25 W4M (Future Industrial Development) SW 1/4 Sec 8-43-25-W4M (Future Residential Development)
Ponoka Golf Course SWMP (2012)	Tagish	
47 Ave STM Upgrades As-Builts	MCSL	47 Ave & 46 Ave to 51 Street
60 Street Development SWMP Report	MCSL (EDM/SURREY)	Phase 1 & 2 (N of 50 Ave & W of 60 St) Prop Pond N of Hwy 53 & W of Hwy 2A
2016-04-20_47 Ave Stm Upgrades	MCSL (EDM)	Design dwgs for 47 Ave stormwater infrastructure upgrade
Centennial Pond information	TOP	Centennial pond features
Stormwater_outfalls_detention ponds_locations	Tagish	Location plan for storm detention ponds and outfalls, sanitary LSs

Appendix B-1: Field Review

Site Review Summary

PROJECT NAME Master Servicing Study	PROJECT NUMBER 2131-00247-14
PROJECT LOCATION Ponoka, AB	
ATTENDING Jeff Amundson (MCSL), Todd Chahley (Foreman, Town of Ponoka)	
START DATE (MM/DD/YY) 08/04/2017	END DATE (MM/DD/YY) 08/04/2017
PURPOSE OF VISIT Site Visit	

SITE OBSERVATIONS

1. Riverside Booster Station & Riverside Reservoir

INFORMATION	COMMENTS
PUMP INFORMATION	
2 distribution pumps	
-lead-lag configuration	
-both pumps same model	
-VFD motors	
-pump information:	
-make: WEG	
-serial number: 1034067648	
-HP (kW): 15.0 (11.0)	
-RPM: 3525	
-Hz: 60	
1 auxiliary pump	
-fire pump -back-up during power outage -back-up for insufficient flow	
-diesel generator	
-pump information:	
-make: Optim ODP / Teco Westinghouse Motors (Canada) Inc.	
-serial number: PBP7164748006	
-HP (kW): 100 HP / 75 KW	
-RPM: 1780	
-Hz: VT 3-60, CP 60-90	
DISTRIBUTION INFORMATION	
-Riverside Reservoir fed by Regional Line	
-Riverside Booster Station fed by Riverside Reservoir	
-Riverside Booster Station connects to ToP distribution system	

RESERVOIR INFORMATION	
Riverside Reservoir	
-volume: 900 m3	
-level alarms -high-high level: 3.8 m -high level: 3.7 m -low level: 2.4 m -low-level: 1.4 m	-operators notified by automated call system at each level alarm -all reservoirs have equal alarm set-points

2. 39th Ave Pumphouse & 39th Ave Reservoir

INFORMATION	COMMENTS
PUMP INFORMATION	
3 distribution pumps	
-lead-lag configuration	
-all three (3) pumps same model	
-VFD motors	
-pump information:	
-make: Aurora Pump	
-Type: 411 BF	
-Size: 3X3X10B	
-GPM: 602	
-Head FT: 199	
-RPM: 3600	
1 auxiliary pump	
-fire pump -back-up during power outage -back-up for insufficient flow	
-diesel generator	
-pump information:	
-make: Aurora Pump	
-Type: 481 BF H	
-Size: 8X481X17B	
-GPM: 2500	
-Head FT: 208	
-RPM: 1750	
DISTRIBUTION INFORMATION	
-pumps from 39th Ave reservoir	

RESERVOIR INFORMATION	
39th Ave Reservoir	
-volume: 4600 m3	
-level alarms -high-high level: 3.8 m -high level: 3.7 m -low level: 2.4 m -low-low level: 1.4 m	
-reservoir fed by Regional Line	

3. Lucas Heights Pumphouse & Lucas Heights Reservoir

INFORMATION	COMMENTS
PUMP INFORMATION	
2 distribution pumps	
-lead-lag configuration	
-both pumps same model	
-VFD motors	
-pump information:	
-Serial Number: 84-30218	
-GPM: 723	
-TDH:	
-RPM: 1750	
-pump motor information:	
-make: GE Motors	
-Serial Number: AB659197	
-HP: 40	
-Hz: 3-60	
1 auxiliary pump	
-back-up during power outage -back-up for insufficient flow	
-diesel generator	
-pump motor information:	
-make: Cummins	
-Serial Number: 99486	
-Model: N-855-F	
-HP: 240	
-RPM: 2100	
1 fire pump	
-diesel generator	
-pump motor information:	

DISTRIBUTION INFORMATION	
-fed from Lucas Heights reservoir	
RESERVOIR INFORMATION	
Lucas Heights Reservoir	
-volume: 4600 m3	
-level alarms -high-high level: 3.8 m -high level: 3.7 m -low level: 2.4 m -low-low level: 1.4 m	
-reservoir fed by regional line	

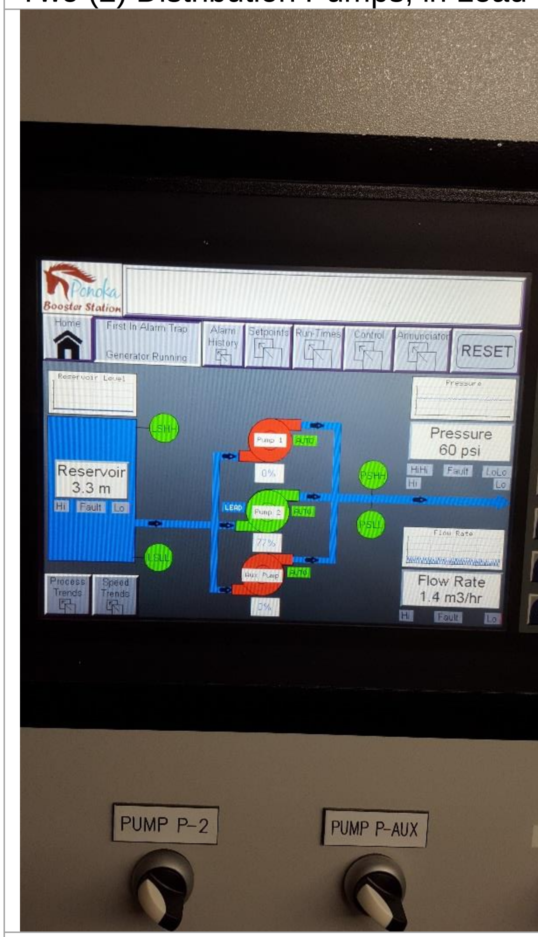
DISCUSSION/RECOMMENDATION

-Town of Ponoka to confirm whether reservoir maximum height is 3.3 m or 3.7 m.
-Town of Ponoka to confirm wet well volume information.
-Report updated to reflect new information provided by design engineer Bryan Gurnon.

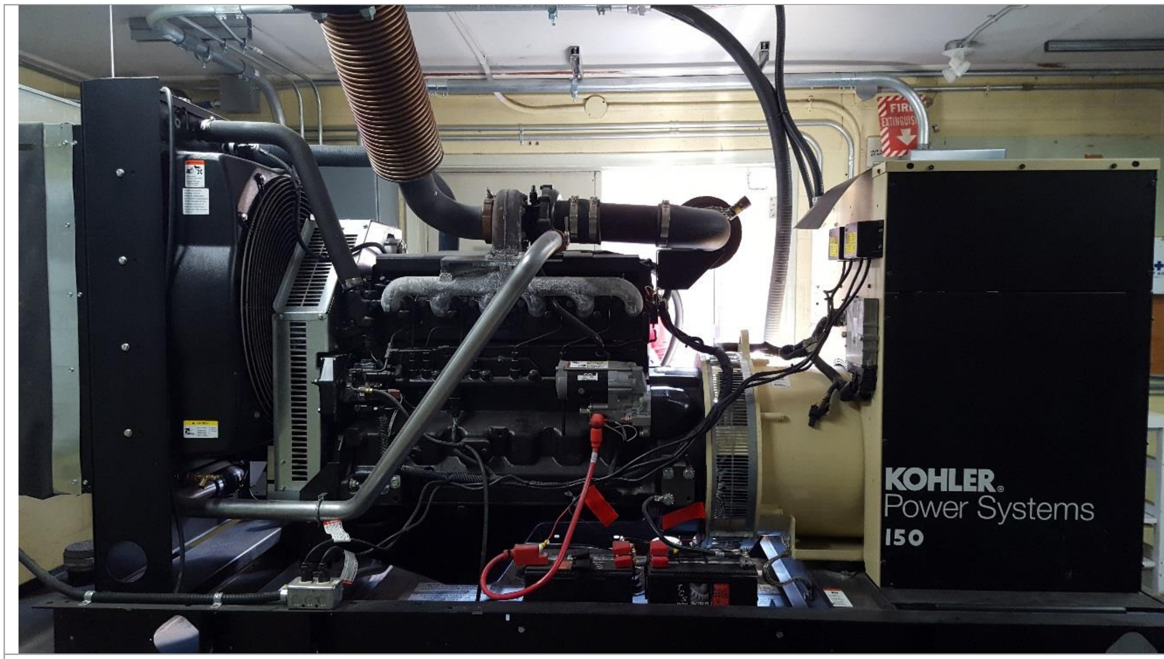
Riverside Booster Station & Riverside Reservoir

Riverside Reservoir

Two (2) Distribution Pumps, in Lead-Lag Configuration



Pump Control Panel



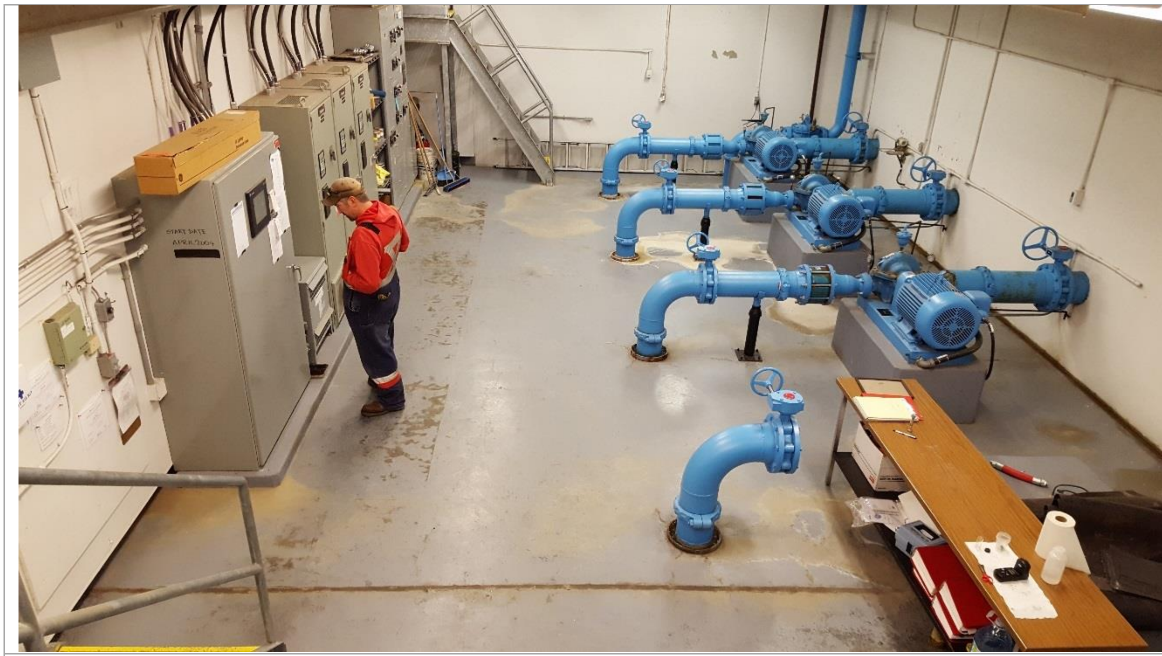
Diesel Generator for Back-up Pump

Distribution Pump Controllers

Back-up Pump, Separate Facility

Back-Up Pump Controller

39th Ave Reservoir & 39th Ave Reservoir



Three (3) Distribution Pumps, Control Panels / Pump Controller on Left

Pump Controller

Back-Up Pump with Diesel Generator, Diesel Tank

Back-Up Pump Controller

Additional set points:

Reservoir	High Level	3.7m
Reservoir	Low Level	3.3m
Reservoir	Low Low Alarm	1.4m
Reservoir	High High Alarm	3.8m
Reservoir	Low Level Pump Lockout	0.15m
System low pressure alarm		240 kPa

Published Alarm Set Points

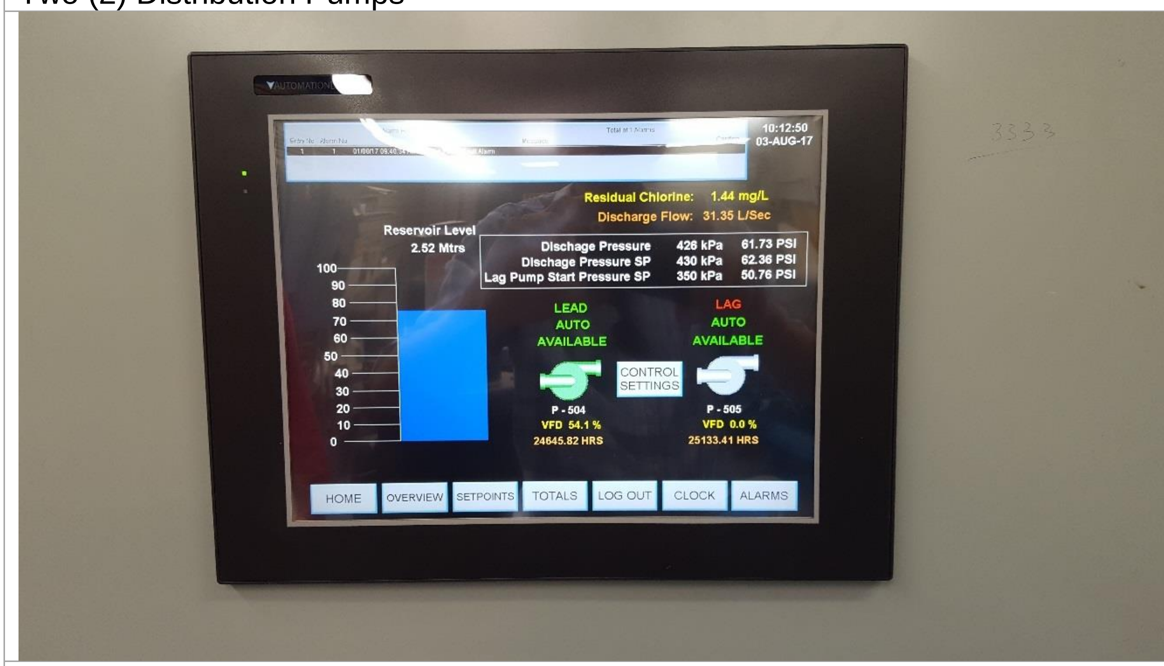
39th Ave Reservoir

Lucas Heights Pumphouse & Lucas Heights Reservoir

Back-Up Pump Diesel Generator

Back-Up Pump Motor

Two (2) Distribution Pumps



Pump Controller

Lucas Heights Reservoir

Jeff Amundson

Field Inspector

Appendix B-2: WaterCAD Modelling Assumptions

Project Name	Ponoka Water Master Servicing Study
MCSL No.	2131-00247-14
Prepared by:	Daniel Archila
Review by:	Nav Sandhu
Date:	December 2017

	Parameter	Associated Assumptions
Model Calculation Options (ADD, MDD, PHD)	Time Analysis Type	Steady State
	Friction Method	Hazen-Williams
	Calculation Type	Hydraulics Only
	Engine Compatibility	WaterGEMS 2.00.12
	Convergence Check Frequency	2
	Convergence Check Cut Off	10
Model Calculation Options (Automated Fire Flow)	Time Analysis Type	Steady State
	Friction Method	Hazen-Williams
	Calculation Type	Fire Flow
	Engine Compatibility	WaterGEMS 2.00.12
	Convergence Check Frequency	2
	Convergence Check Cut Off	10
Base Fire Flow (Automated Fire Flow)	Fire Flow (needed)	75 l/s
	Fire Flow (Upper Limit)	225 l/s
	Apply Fire Flows By:	Adding to Baseline Demand (MDD)
	Pressure (Residual Lower Limit)	150 kPa
	Pressure (Zone Lower Limit)	150 kPa
Variable Speed Pump Battery	Battery Pump Definition	varies
	Relative Speed Factor	1
	VSBP Type	Target Head
	Lag Pump Count	varies
Pipes	Number of Breaks	0
	Status	Open
	Hazen-Williams C	varies
	Has User Defined Length?	False
	Minor Loss Coefficient (Local)	0

Appendix B-3: List of Modelling Scenarios

Model File	Scenario	Modelled system	Purpose
(1) MCSL Ponoka Water Model - Existing.wtg	Static	Existing	Determine existing pressure zone's HGL and maximum pressure head in the system
	ADD	Existing	Analyze the performance of the existing water system during ADD
	MDD	Existing	Analyze the performance of the existing water system during MDD
	PHD	Existing	Analyze the performance of the existing water system during PHD
	MDD + Automated Fire Flow	Existing	Determine the capacity of the existing system to deliver required fire flows at hydrant nodes
(2) MCSL Ponoka Water Model - Existing with Upgrades.wtg	Static	Existing + Upgrades	Determine maximum pressure head in the system
	ADD	Existing + Upgrades	Analyze the performance of the existing + proposed upgrades water system during ADD
	MDD	Existing + Upgrades	Analyze the performance of the existing + proposed upgrades water system during MDD
	PHD	Existing + Upgrades	Analyze the performance of the existing + proposed upgrades water system during PHD
	MDD + Automated Fire Flow	Existing + Upgrades	Determine the capacity of the existing + proposed upgrades water system to deliver required fire flows at hydrant nodes
(3) MCSL Ponoka Water Model - Future.wtg	Static	Existing + Upgrades + Future	Determine maximum pressure head in the system
	ADD	Existing + Upgrades + Future	Analyze the performance of the existing + proposed upgrades + future water system during ADD
	MDD	Existing + Upgrades + Future	Analyze the performance of the existing + proposed upgrades + future water system during MDD
	PHD	Existing + Upgrades + Future	Analyze the performance of the existing + proposed upgrades + future water system during PHD
	MDD + Automated Fire Flow	Existing + Upgrades + Future	Determine the capacity of the existing + proposed upgrades + future water system to deliver required fire flows at hydrant nodes

Appendix B-4: Water Costing

Preliminary Costing for Proposed Upgrades

Item	Description	Unit	Quantity	Unit Price	Amount	Total including contingency (40%)
PU-1	Supply connection from the NRDRWSC Regional System: 300mm	LM	150	$365	$54,750	$76,650
PU-2	New 3,000 m^3 reservoir tank east of 38 Street	m^3	3000	$2,750	$8,250,000	$11,550,000
	New booster station east of 38 Street.	L.S.	1	$1,000,000	$1,000,000	$1,400,000
PU-3	New 300mm watermain along 38 Street	LM	160	$365	$58,400	$81,760
PU-4	New 300mm watermain along 39 Avenue	LM	550	$365	$200,750	$281,050
PU-5	New PRV station at 39 Avenue	L.S.	1	$150,000	$150,000	$210,000
PU-6	Install and close new valves at 50 Avenue and 48 Avenue - 150mm	Unit	2	$4,500	$9,000	$12,600
PU-7	Upsize existing watermain at 57 Avenue: 300mm	LM	1600	$365	$584,000	$817,600
PU-8	Upsize existing watermain at 54 Street: 200mm	LM	400	$280	$112,000	$156,800
PU-9	Upsize existing watermain at 60 Street: 200mm	LM	225	$280	$63,000	$88,200
PU-10	Upsize existing watermain at 49 Steet: 300mm	LM	1050	$365	$383,250	$536,550
PU-11	Upsize existing watermain at 49A Steet: 250mm	LM	545	$345	$188,025	$263,235
PU-12	Upsize existing watermain at 52 Steet: 150mm	LM	300	$245	$73,500	$102,900
PU-13	Upsize existing watermain at 62 Steet: 150mm	LM	110	$245	$26,950	$37,730
PU-14	Upsize existing watermain at 52 Steet: 250mm	LM	100	$345	$34,500	$48,300
	TOTAL					**$15,663,375**

Preliminary Costing for Future Water System

Item	Description	Unit	Quantity	Unit Price	Amount	Total including contingency (40%)
FS-1	Expansion of reservoir tank east of 38 Street.	m^3	3000	$2,750	$8,250,000	$11,550,000
FS-2	New 300mm grid south of 39th Avenue and east of 44 Street.	LM	4000	$273	$1,092,000	$1,528,800
FS-3	New 3,000 m^3 reservoir tank on Highway 53.	m^3	3000	$2,750	$8,250,000	$11,550,000
	New booster station on Highway 53.	L.S.	1	$1,000,000	$1,000,000	$1,400,000
FS-4	Supply connection from the NRDRWSC Regional System: 300mm	LM	2900	$273	$791,700	$1,108,380
FS-5	New 300mm grid to service industrial areas north of Highway 53	LM	2800	$273	$764,400	$1,070,160
FS-6	New 300mm grid and watermain to service industrial areas west of Highway 2A and the future development south of Battle River	LM	3300	$273	$900,900	$1,261,260
FS-7	New 150mm grid and watermain to service the future residential developments around Baker Road.	LM	1600	$185	$296,000	$414,400
FS-8	New 300mm grid to service industrial areas north of Highway 53	LM	2200	$273	$600,600	$840,840
FS-9	New 300mm grid to service industrial areas and connect the watermains on 39th Avenue and 48th Avenue	LM	1500	$273	$409,500	$573,300
FS-10	New 300mm grid to service industrial areas and connect the FS-9 grid to the existing watermain on 57th Avenue	LM	1500	$273	$409,500	$573,300
FS-11	Expand FS -3 reservoir	m^3	3000	$2,750	$8,250,000	$11,550,000
FS-12	New 300mm watermain to connect FS-5 / FS-8 grid to the Town's distribution system	LM	1800	$273	$491,400	$687,960
FS-13	New PRV Station	LM	1	$150,000	$150,000	$210,000
	TOTAL					**$44,318,400**

Appendix C-1: Field Review

Site Review Summary

PROJECT NAME Master Servicing Study	PROJECT NUMBER 2131-00247-14
PROJECT LOCATION Ponoka, AB	
ATTENDING Jeff Amundson (MCSL), Todd Chahley (Foreman, Town of Ponoka)	
START DATE (MM/DD/YY) 08/04/2017	END DATE (MM/DD/YY) 08/04/2017
PURPOSE OF VISIT Site Visit	

SITE OBSERVATIONS

1. Lift Station A

INFORMATION	COMMENTS
PUMP INFORMATION	
2 distribution pumps	
-lead-lag configuration	
-both pumps same model	
-constant speed motors	
-pump information:	
-make: Vaughan	
-Serial Number: 64014B	
-Model No.: VDP8M10S	
-GPM: 2000	
-TDH: 50 FT	
-RPM: 1170	
1 back-up pump	
-back-up during power outage	
-diesel generator	
DISTRIBUTION INFORMATION	
-FM from LS discharges to lagoon	
WET WELL INFORMATION	
-Pump On 1.50 m	
-Pump Off 0.85 m	

2. Lift Station B

INFORMATION	COMMENTS
PUMP INFORMATION	
2 distribution pumps	
-lead-lag configuration	
-different model, equal capacity	
-constant speed motors	
-distribution pumps pull off of (_)	
-pump information:	
-Make: Gorman-Rupp	
-Model Number: T6C60SC-B /F	
-Serial Number: 1601316	
-Make: Vaughan	
-Serial Number: 64011B	
-Model No.: SP6K	
-GPM: 500	
-TDH: 95 FT	
-RPM: 1500	
1 back-up pump	
-back-up during power outage	
-diesel generator	
WET WELL INFORMATION	
-Pump On 0.90 m	
-Pump Off 0.50 m	

3. Lagoon

INFORMATION	COMMENTS
SEQUENCING	
1. FM discharges to two (2) anaerobic cells	Total four (4) anaerobic cells. Two sets of anaerobic cells, operating in series
2. LS pumps from anaerobic cells to aeration ponds	Total three (3) aeration ponds
3. LS pumps from aeration ponds to holding ponds	Total three (3) holding ponds, used for polishing wastewater.

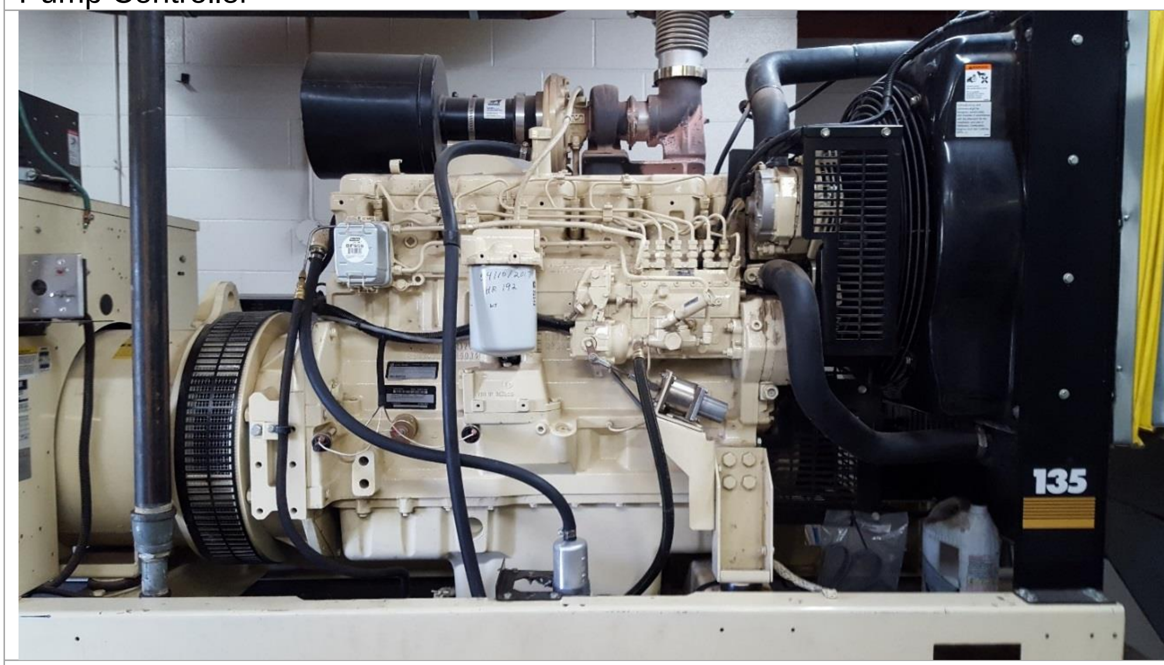
	Third holding pond primarily used for final polishing
4. Discharge into Battle River	

DISCUSSION/RECOMMENDATION
-Town of Ponoka to confirm whether reservoir maximum height is 3.3 m or 3.7 m. -Town of Ponoka to confirm wet well volume information. -Report updated to reflect new information provided by design engineer Bryan Gurnon.

Lift Station A

Two (2) Distribution Pumps

Pump Controller

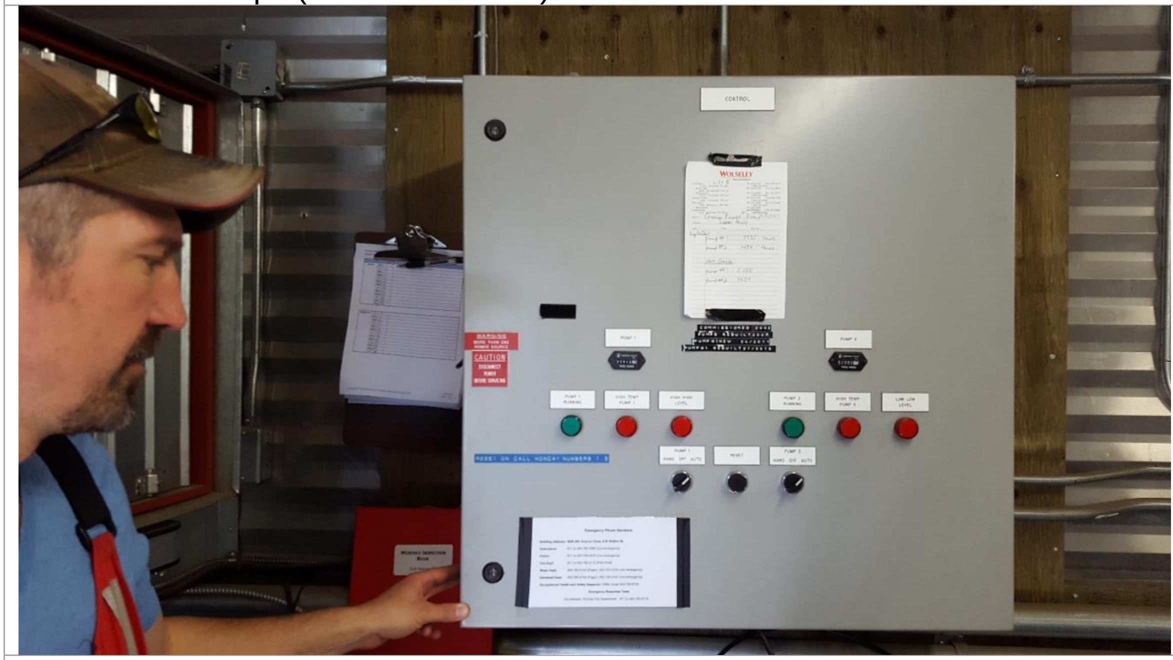


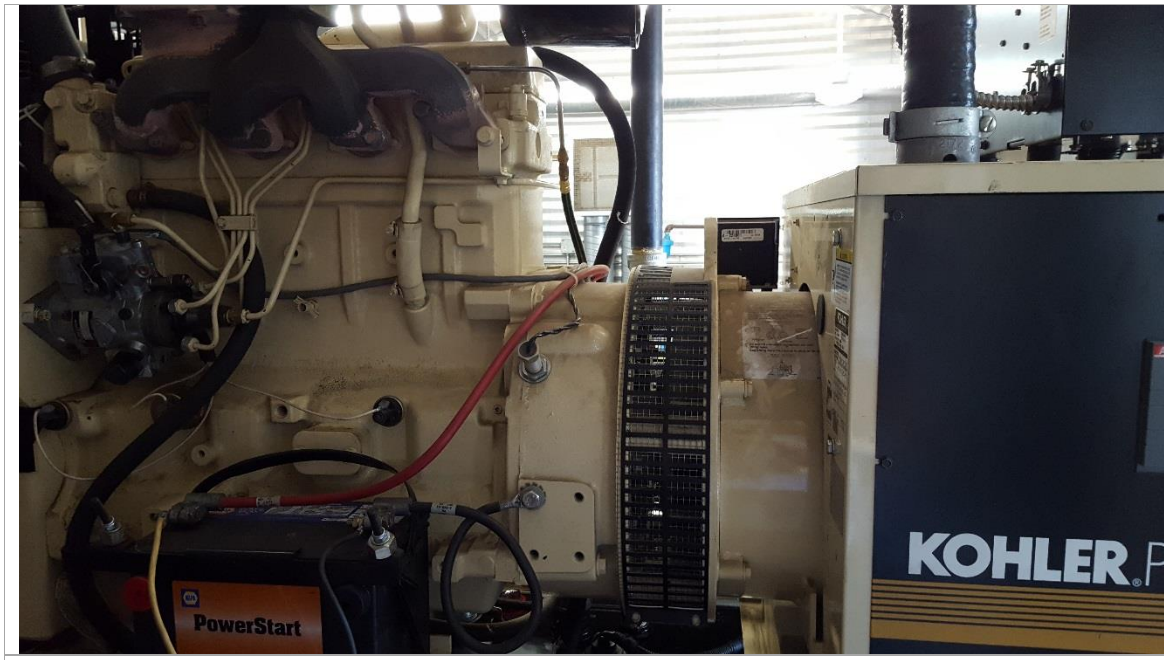
Back-Up Diesel Generator

Back-Up Pump Controller

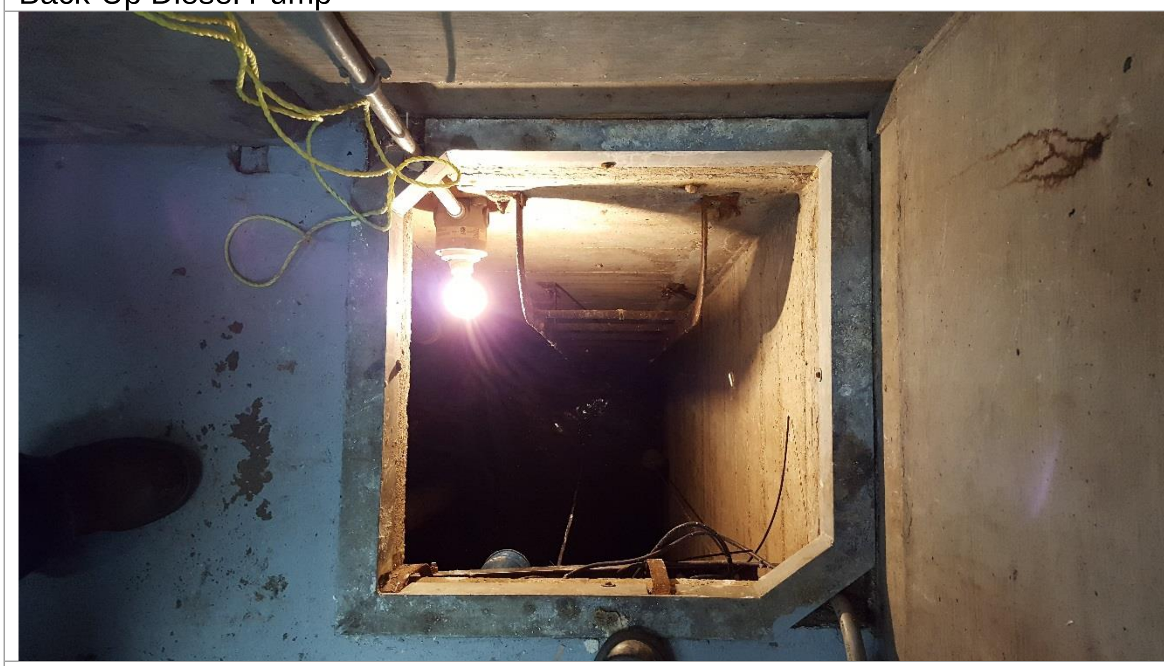
Wet Well Inlet

Lift Station B

Distribution Pumps (Different Models)

Pump Controller



Back-Up Diesel Pump



Wet Well

Lagoon

Anaerobic Cell

Anaerobic Cell

Lift Station Constant Speed Pumps

Lift Station Wet Well

Aeration Pond

Aeration Pond

Lift Station

Holding Pond

Battle River

Jeff Amundson

Field Inspector

Appendix C-2: Modelling Assumptions

Project Name Ponoka Sanitary Master Servicing Study
MCSL No. 2131-00247-14
Prepared by: Jack McKee
Review by: Daniel Archila
Date: December 2017

Layer	Parameter	Associated Assumptions
Catchments	Population	The population for each catchment was calculated based on a density of 21.07 people/hectare (Total Population / Total Residential Area = 7229 / 343).
	Flow	Residential flow: 0.0037 l/s/person (320 l/person/day - Design Guidelines 2016 Edition – CoRD) Institutional flows: 0.15 l/s/ha (Design Guidelines 2016 Edition – CoRD) Commercial flows: 0.15 l/s/ha (Design Guidelines 2016 Edition – CoRD) Industrial flows: 0.15 l/s/ha (Design Guidelines 2016 Edition – CoRD)
	Peaking Factor	$Pf = 1+ [14 / (4+\sqrt{P})]$
	Infiltration & Inflow	0.20 l/s/ha
	Area	Delineated based on lot lines.

Layer	Parameter	Associated Assumptions
Conduits	Roughness	Based on the City of Red Deer Engineering Services Design Guidelines (Section 10, 2016) • Concrete: 0.013 • PVC: 0.013
Junctions	Inverts	Based on GIS data provided by the Town of Ponoka

Appendix C-3: Modelling Scenarios

Scenario Number	File Name	Development Condition	Purpose	Coordinate System
1	*Main Model – Exist conditions V2.inp*	Existing	Analyze the performance of the sanitary system under existing conditions.	NAD83 CSRS Alberta 3TM ref merid 114W
2	*Main Model – Exist conditions - Full Dev V2.inp*	Existing	Analyze the performance of the sanitary system under full development conditions.	NAD83 CSRS Alberta 3TM ref merid 114W
3	*Main Model – Exist conditions Full Dev (w.upgrades) V2.inp*	Existing	Sizing of the proposed upgrades to service the existing catchments considering full development conditions.	NAD83 CSRS Alberta 3TM ref merid 114W
4	*Main Model – Fut conditions V2.inp*	Future	Sizing of the proposed upgrades and future infrastructure to service the existing catchments (considering full development conditions) and future catchments.	NAD83 CSRS Alberta 3TM ref merid 114W

Appendix C-4: Wastewater Costing

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
UE-1	1.1	Supply and Install 375 mm	LM	686	$850.00	$583,100.00
	1.2	Supply and Install MH	EA	5	$7,000.00	$35,000.00
			SUBTOTAL:			$618,100.00
		Add Contingency (40%)				$247,240.00
	TOTAL Conduit UE1 ESTIMATE					**$866,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
	2.1	Supply and Install 300 mm	LM	457	$780.00	$356,460.00
UE-2	2.2	Supply and Install 375 mm	LM	274	$850.00	$232,900.00
	2.3	Supply and Install MH	EA	5	$7,000.00	$35,000.00
			SUBTOTAL:			$624,360.00
		Add Contingency (40%)				$249,744.00
	TOTAL Conduit UE2 ESTIMATE					**$875,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
	3.1	Supply and Install 250 mm	LM	373	$650.00	$242,450.00
	3.2	Supply and Install 675 mm	LM	337	$1,190.00	$401,030.00
UE-3	3.3	Supply and Install 750 mm	LM	2213	$1,210.00	$2,677,730.00
	3.4	Supply and Install 900 mm	LM	624	$1,320.00	$823,680.00
	3.5	Supply and Install MH	EA	32	$7,000.00	$224,000.00
			SUBTOTAL:			$4,368,890.00
		Add Contingency (40%)				$1,747,556.00
	TOTAL Conduit UE3 ESTIMATE					**$6,117,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
	4.1	Supply and Install 250 mm	LM	315	$650.00	$204,750.00
UE-4	4.2	Supply and Install 300 mm	LM	330	$780.00	$257,400.00
	4.3	Supply and Install MH	EA	8	$7,000.00	$56,000.00
			SUBTOTAL:			$518,150.00
		Add Contingency (40%)				$207,260.00
	TOTAL Conduit UE4 ESTIMATE					**$726,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
UE-5	5.1	Supply and Install 300 mm	LM	580	$780.00	$452,400.00
	5.2	Supply and Install MH	EA	6	$7,000.00	$42,000.00
			SUBTOTAL:			$494,400.00
		Add Contingency (40%)				$197,760.00
	TOTAL Conduit UE5 ESTIMATE					**$693,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
Lift Station A Upgrades	6.1	LS A Pump Upgrades	LS	1	$500,000.00	$500,000.00
			SUBTOTAL:			$500,000.00
		Add Contingency (40%)				$200,000.00
	TOTAL LSA Upgrades ESTIMATE					**$700,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
Lift Station C	8.1	Construction of LS	LS	1	$750,000.00	$750,000.00
			SUBTOTAL:			$750,000.00
		Add Contingency (40%)				$300,000.00
	TOTAL LSC ESTIMATE					**$1,050,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
Lift Station D	9.1	Construction of LS	LS	1	$750,000.00	$750,000.00
			SUBTOTAL:			$750,000.00
		Add Contingency (40%)				$300,000.00
	TOTAL LSD ESTIMATE					**$1,050,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
Lift Station E	9.1	Construction of LS	LS	1	$750,000.00	$750,000.00
			SUBTOTAL:			$750,000.00
		Add Contingency (40%)				$300,000.00
	TOTAL LSD ESTIMATE					**$1,050,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
FD-1	10.1	Supply and Install 250 mm	LM	464	$420.00	$194,880.00
	10.2	Supply and Install MH	EA	4	$7,000.00	$28,000.00
			SUBTOTAL:			$222,880.00
		Add Contingency (40%)				$89,152.00
	TOTAL Conduit FD1 ESTIMATE					**$313,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
FD-2	11.1	Supply and Install 450 mm	LM	1189	$520.00	$618,280.00
	11.2	Supply and Install 525 mm	LM	1619	$570.00	$922,830.00
	11.3	Supply and Install MH	EA	19	$7,000.00	$133,000.00
			SUBTOTAL:			$1,674,110.00
		Add Contingency (40%)				$669,644.00
	TOTAL Conduit FD2 ESTIMATE					**$2,344,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
FD-3	12.1	Supply and Install 250 mm	LM	246	$420.00	$103,320.00
	12.2	Supply and Install MH	EA	2	$7,000.00	$14,000.00
			SUBTOTAL:			$117,320.00
		Add Contingency (40%)				$46,928.00
	TOTAL Conduit FD3 ESTIMATE					**$165,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
FD-4	10.1	Supply and Install 250 mm	LM	732	$420.00	$307,440.00
	10.2	Supply and Install 250 mm	LM	895	$450.00	$402,750.00
	10.3	Supply and Install MH	EA	4	$7,000.00	$28,000.00
			SUBTOTAL:			$738,190.00
		Add Contingency (40%)				$295,276.00
	TOTAL Conduit FD4 ESTIMATE					**$1,034,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
FD-5	11.1	Supply and Install 250 mm	LM	696	$420.00	$292,320.00
	11.2	Supply and Install MH	EA	5	$7,000.00	$35,000.00
			SUBTOTAL:			$327,320.00
		Add Contingency (40%)				$130,928.00
	TOTAL Conduit FD7 ESTIMATE					**$459,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
FD-6A	12.1	Supply and Install 200 mm	LM	604	$330.00	$199,320.00
	12.2	Supply and Install MH	EA	4	$7,000.00	$28,000.00
			SUBTOTAL:			$227,320.00
		Add Contingency (40%)				$90,928.00
	TOTAL Conduit FD8A ESTIMATE					**$319,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
FD-6B	12.1	Supply and Install 200 mm	LM	101	$330.00	$33,330.00
	12.2	Supply and Install MH	EA	1	$7,000.00	$7,000.00
			SUBTOTAL:			$40,330.00
		Add Contingency (40%)				$16,132.00
	TOTAL Conduit FD8B ESTIMATE					**$57,000**

Appendix D-1: Site Photos & Field Reviews

Site Review Summary

PROJECT NAME Master Servicing Study	PROJECT NUMBER 2131-00247-14
PROJECT LOCATION Ponoka, AB	
ATTENDING Jeff Amundson (MCSL),Rod Carrick (Foreman, Public Works, Town of Ponoka)	
START DATE (MM/DD/YY) 08/11/2017	END DATE (MM/DD/YY) 08/11/2017
PURPOSE OF VISIT Review of Detention Ponds / Outfalls	

SITE OBSERVATIONS

1. Detention Pond P1

INFORMATION	COMMENTS
Inlet	
Type: Surface runoff	
Dimensions:	
Material:	
Protection:	
Outlet	
Type: CBs	Ties into storm drain system
Dimensions:	
Material: Grated	
Protection: None	
Additional Information	
Dry pond	

2. Detention Pond P2

INFORMATION	COMMENTS
Inlet	
Type: Arch wingwalls, possible circular pipe inside	Difficult to observe interior pipe based on water / sludge and culvert characteristics
Dimensions: W 1.5 m, Height 0.70 m, estimated diameter of interior pipe 0.60 m	
Material: Concrete	
Protection: Grated, rip-rap	
Notes: Large sludge build-up at outlet	
Outlet	
Type: Circular	
Dimensions: 0.300 m	

Material: Plastic	
Protection: Small rip-rap	
Additional Information	

3. Detention Pond P3

INFORMATION	COMMENTS
Inlet	
Type: Arch	
Dimensions: W 1.00 m, Height 0.60 m	
Material: Concrete	
Protection: Rock rip-rap	
Outlet	
Type: Circular	
Dimensions: Dia 0.33 m	
Material: Steel	
Protection:	
Standing Water: Y, 0.02 m	
Notes: Drainage ditch discharging into pond on north side	

4. Outfall 1

INFORMATION	COMMENTS
Type: Circular, protruding	
Dimensions: Estimated 4 ft (1.21 m)	
Material: Steel	
Protection: Steel apron, no rip-rap	
Flow Observed (Y/N, Level): Y, negligible	
Notes: Large accumulation of debris at outlet	

5. **Outfall 2**

INFORMATION	COMMENTS
Type:	
Dimensions:	
Material:	
Protection:	
Flow Observed (Y/N, Level):	
Notes: Could not locate, despite open viewing from opposite side of river	

6. **Outfall 3**

INFORMATION	COMMENTS
Type: Circular, rectangular weir	
Dimensions: Estimated 4 ft (1.21 m)	
Material: Steel culvert, concrete weir	
Protection: Rectangular weir, large rip-rap	
Flow Observed (Y/N, Level): Y, continuously flowing	
Notes:	

7. **Outfall 4**

INFORMATION	COMMENTS
Type: Circular	
Dimensions: 0.300 m	
Material: Steel	
Protection: None	
Flow Observed (Y/N, Level): N, saturated ground	
Notes:	

8. Outfall 5

INFORMATION	COMMENTS
Type: Circular	
Dimensions: 0.750 m	
Material: Steel	
Protection: Concrete headwall, large rip-rap	
Flow Observed (Y/N, Level): ?, Saturated ground	
Notes:	

9. Outfall 6 / 7

INFORMATION	COMMENTS
Type: Circular	
Dimensions: 1.0 m	Approximate, very difficult to measure
Material: Concrete	
Protection: Concrete wingwall, no rip-rap	
Flow Observed (Y/N, Level): N	
Notes: Cannot locate second outfall identified on drawing in immediate vicinity. Area is heavily vegetated	Foreman firmly believes he observed the second outfall at some point, but could not recall exact location

10. Outfall 8

INFORMATION	COMMENTS
Type: Circular, protruding	
Dimensions: 1.0 m	
Material: Steel	
Protection: Minor rip-rap, angled steel weir	
Flow Observed (Y/N, Level): Y	
Notes:	

11. Outfall 9

INFORMATION	COMMENTS
Type: Circular, protruding	
Dimensions: 2 ft (0.600 m)	
Material: Steel	
Protection: Large rocks at base of culvert	
Flow Observed (Y/N, Level): Y	
Notes:	

12. Outfall 10

INFORMATION	COMMENTS
Type: Circular, protruding	
Dimensions: 2 ft (0.600 m)	
Material: Concrete	
Protection: None	
Flow Observed (Y/N, Level): N, ground saturated	
Notes: -Culvert is NOT oriented towards road, culvert is oriented SW. Could be a different culvert. -Pipe is not freely draining, large buildup of dirt is present at outlet location; pipe obvert at grade. -Area very difficult to explore due to dense vegetation	

13. Outfall 11

INFORMATION	COMMENTS
Type: Circular	
Dimensions: 3 ft (0.92 m)	
Material: Steel	
Protection: Concrete slabs at base (old, broken)	
Flow Observed (Y/N, Level): Y, negligible	
Notes:	

14. Outfall 12

INFORMATION	COMMENTS
Type: Arch	
Dimensions: W 4 ft (1.21 m); H 2 ft (0.200 m)	Measurements difficult due to dense vegetation
Material: Concrete	
Protection: Grate over wingwalls	
Flow Observed (Y/N, Level): N, ground saturated	
Notes: 1 ft diameter culvert immediately downstream of arch culvert outfall	

15. Outfall 13

INFORMATION	COMMENTS
Type:	
Dimensions:	
Material:	
Protection:	
Flow Observed (Y/N, Level):	
Notes: Could not locate, dense vegetation. Plant-life present indicates presence of outfall is likely.	

16. Outfall 14

INFORMATION	COMMENTS
Type: Circular	
Dimensions: 0.41 m	
Material: Steel	
Protection: None	
Flow Observed (Y/N, Level): N, ground saturated	
Notes: Area heavily vegetated	

17. Outfall 16

Private property, cannot access. Cows present at assumed location of outfall.

18. Outfall A

INFORMATION	COMMENTS
Type: Arch	
Dimensions: W 4 ft, H 4 ft	
Material: Concrete	
Protection: Headwall	
Flow Observed (Y/N, Level): ?, ground saturated	
Notes: Foreman remarked this is a large culvert that has not been marked on the map. The approximate location has been recorded in the field notes.	

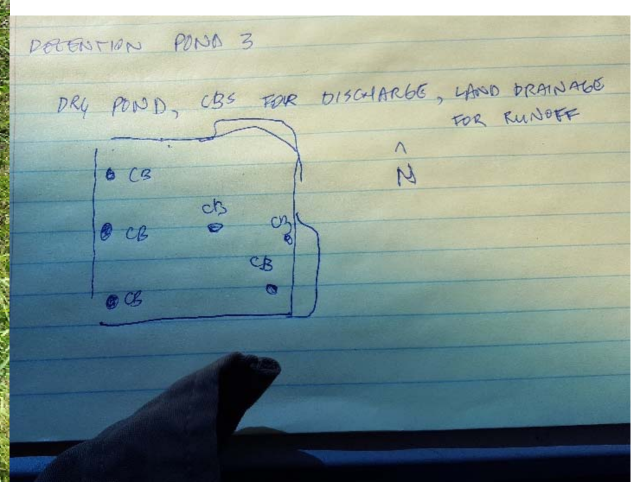
DISCUSSION/RECOMMENDATION

REFERENCE PHOTOS

Detention Pond P1

Detention Pond P1

Detention Pond P2



Typical CB Grate, Approximate CB Layout

Detention Pond P2

Detention Pond P2

Circular Culvert

Detention Pond Downstream of Arch

Arch Culvert

Detention Pond P3

Detention Pond P3

Arch Culvert Rip-Rap Protection

Concrete Arch Culvert

Circular Culvert

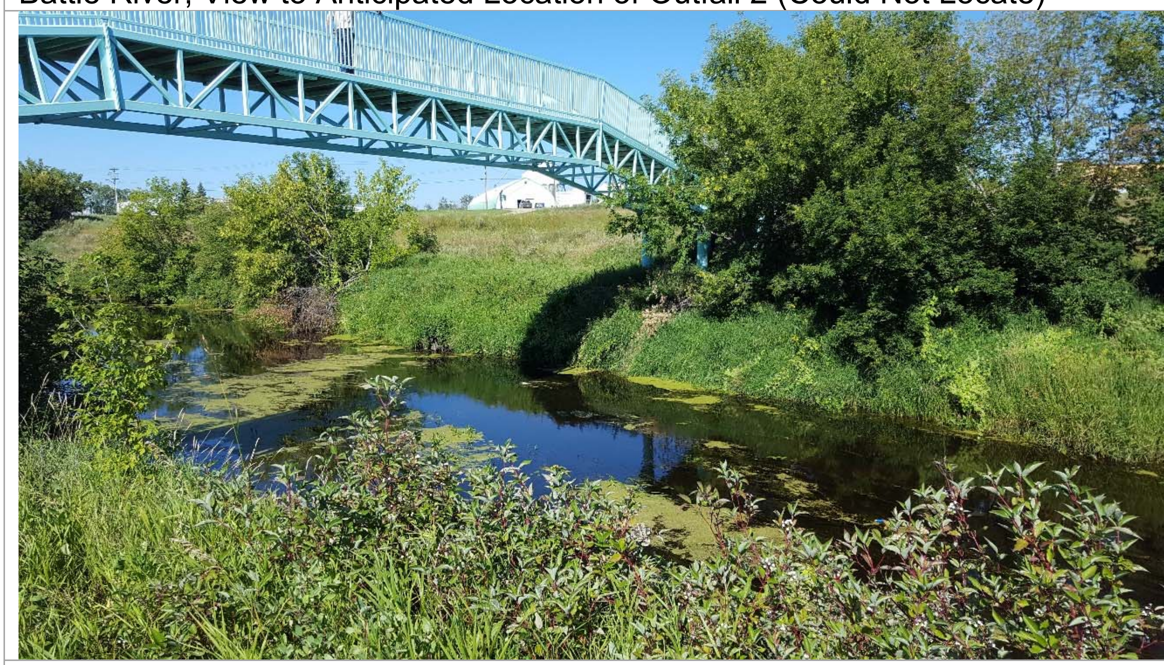
Outfall 1

Outfall 1

Downstream from Outfall 1

Outfall 2

Battle River, View to Anticipated Location of Outfall 2 (Could Not Locate)

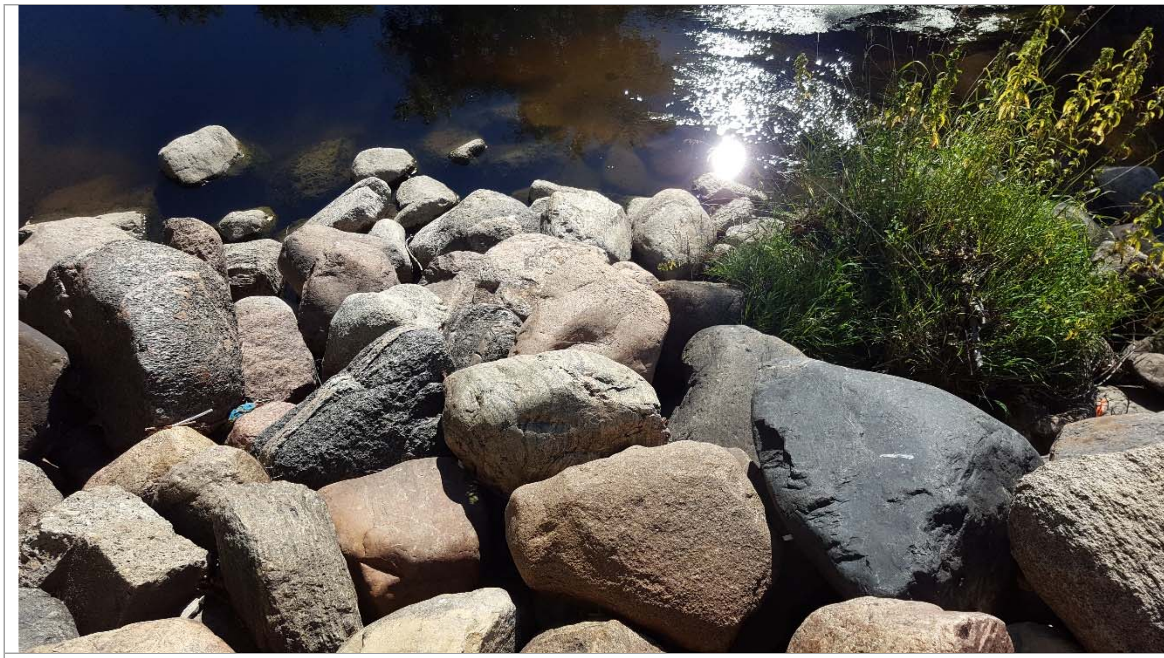


Battle River, View to Anticipated Location of Outfall 2 (Could Not Locate)

Outfall 3

Outfall 3

Outfall 3



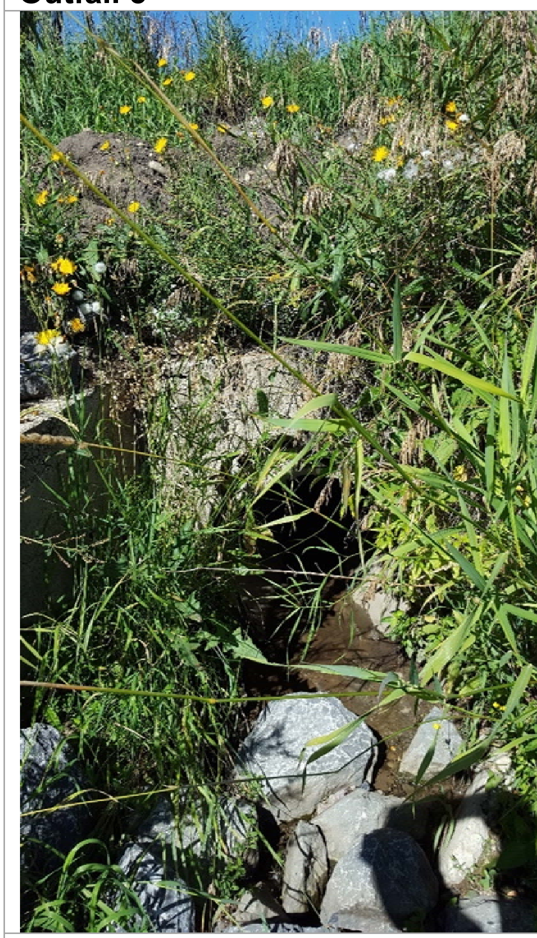
Downstream Rip-Rap Protection

Outfall 4

Outfall 4

Downstream of Outfall 4

Outfall 5



Outfall 5

Rip-Rap Protection Downstream of Outfall 5

Outfall 6

Outfall 6

Downstream of Outfall 6

Anticipated Location of Outfall 7 (Cannot Locate)

Outfall 8

Outfall 8

Steel Weir

Outfall 9

Outfall 9

Broken Concrete Slabs at Base of Outfall

Outfall 10

Outfall 10

Downstream of Outfall 10

Outfall 11

Outfall 11

Broken Concrete Slabs at Outfall

Outfall 12

Outfall 12

Outfall 12

Culvert Downstream of Outfall

Outfall 13

Dense Plant-Life, Cannot Locate Outfall

Outfall 14

Outfall 14

Dense Vegetation Downstream of Outfall

Outfall 16

Anticipated Location of Outfall 16
Outfall A

Outfall A

Jeff Amundson

Field Inspector

Appendix D-2: PCSWMM Modelling Assumptions

Project Name	Ponoka Stormwater Master Servicing Study
MCSL No.	2131-00247-14
Prepared by:	Jack McKee
Review by:	Haimanot Yadete
Date:	July 2017

Layer	**Parameter**	**Associated Assumptions**
Sub-catchment	Rainfall parameters	As per the City of Red Deer Engineering Services Design Guidelines (Section 10, pg. 6, 2016) the Chicago synthetic design storm is used.
	Catchment area (ha)	Sub-catchments were delineated using existing LiDAR terrain data and considering the existing drainage infrastructure.
	Width (m)	$Width = \frac{Area}{FlowLength}$
	Flow length (m)	Maximum length of overland flow
	Slope (%)	The average slope for the sub-catchment areas was obtained from the LiDAR terrain data. The slopes were found to be between 0.9% - 12.6%.
	Percent impervious (%)	The percent of imperviousness for the sub-catchments was defined based on a review of the existing land use and typical imperviousness values used by the City of Red Deer and Alberta Environment and Parks: • Road Right of Way: 70% • Residential Properties: 25% • Commercial Properties: 80% • Industrial: 80% • Institutional: 50% • Parks: 15% • Undeveloped: 2%
	Manning's N for impervious area	A Manning's "n" roughness value of 0.013 was used for impervious areas.
	Manning's N for pervious area	A Manning's "n" roughness value of 0.25 was used for pervious areas.
	Infiltration method	based on sandy loam, the soil characteristics outlined the Town of Ponoka Master Servicing Study (2013)., the Green Ampt infiltration method was used with the following parameters (sandy loam soils): • Suction head (mm) = 110.1 • Conductivity (mm/hr) = 21.8 • Initial deficit (frac.) = 0.246
	Depression storage	The following depression storage values were used based on the undulating nature of the catchments: • Impervious surface (mm) = 2.5 • Pervious surface (mm) = 7.5

	Subarea routing	Based on a review of typical residential, commercial and industrial properties a percent impervious disconnect of 25% was applied to all properties. 100% routing to the outlet was applied to all roadway areas.

Layer	Parameter	Associated Assumptions
Conduits	Roughness	Based on the City of Red Deer Engineering Services Design Guidelines (Section 10, 2016) • Concrete: 0.013 • PVC: 0.013 • CMP: 0.025 • Ditches/Swales: 0.025 • Unknown: 0.013
	Exit loss coefficient	Based on losses due to bends. Values are from Figure 5-9 in the City of Calgary Stormwater Management Design Guidelines, 2011. • Angle: 0, Loss: 0.05 • Angle: 20, Loss: 0.15 • Angle 40, Loss: 0.35 • Angle: 60, Loss: 0.65 • Angle: 90, Loss: 1.6
Outfalls	Type	Free Flowing
	Free Flowing	Since the analysis was completed with 5 year runoff the Battle River level was assumed to be within the banks and therefore not have an impact on the outfall structures. All outfall structures were modeled during the 5 year analysis as free flowing

Appendix D-3: List of Modelling Scenarios

Scenario Number	File Name	Development Condition	Purpose	Coordinate System
1	*247-Ponoka-Ex-STRM.inp*	Existing Minor System	Analyze the performance of the existing minor system during the 5-year and 100-year return period storm event.	NAD83 CSRS Alberta 3TM ref merid 114W
2	*247-Ponoka-Prop_Upgrades-STRM.inp*	Proposed Minor System	Analyze the performance of the proposed minor system upgrades and extension during the 5-year and 100-year return period storm event.	NAD83 CSRS Alberta 3TM ref merid 114W
3	*247-Ponoka-5Yr_Develop-STRM.inp*	5-year Development	Sizing of the proposed SWMF and trunk sewers for the proposed 5 year developments.	NAD83 CSRS Alberta 3TM ref merid 114W
4	*247-Ponoka-10Yr_Develop-STRM.inp*	10-year Development	Sizing of the proposed SWMF and trunk sewers for the proposed 10 year developments.	NAD83 CSRS Alberta 3TM ref merid 114W
5	*247-Ponoka-25Yr_Develop-STRM.inp*	25-year Development	Sizing of the proposed SWMF and trunk sewers for the proposed 25 year developments.	NAD83 CSRS Alberta 3TM ref merid 114W

Appendix D-4: Proposed Minor System Upgrades

Group	Pipe Name	Location	Manhole US	Manhole DS	Len (m)	Ex. Dia. (mm)	Prop. Dia. (mm)	Slope (%)	Q_5 (L/s)	V_5 (m/s)	Q_5/Q_{CAP} (%)	Priority
1	P1304	57 Ave	MH817	MH433	16	300	450	5.70	338	3.35	50	HIGH
	P1546	57 Ave	MH433	MH809	89	450	675	0.17	372	1.08	106	HIGH
	P1544	57 Ave	MH641	MH696	49	525	750	0.36	425	1.15	67	HIGH
	P1545	57 Ave	MH809	MH641	87	450	750	0.22	461	1.29	88	HIGH
	P1543	57 Ave	MH696	MH695	52	525	750	0.21	590	1.5	115	HIGH
	P1116	57 Ave	MH695	MH690	101	600	750	0.38	709	1.96	104	HIGH
	P1114	57 Ave	MH640	MH124	41	675	900	0.79	1004	1.8	63	HIGH
	P1548	57 Ave	MH690	MH640	8	600	900	0.71	1019	2.25	67	HIGH
	P1115	57 Ave	MH124	MH686	52	675	900	0.19	1031	1.63	132	HIGH
	P1393	57 Ave	MH686	MH152	49	675	900	0.22	1190	1.92	142	HIGH
	P1392	57 Ave	MH152	MH153	56	675	900	0.36	1203	2.12	111	HIGH
	P1560	57 Ave	MH153	MH684	41	675	900	0.45	1238	2.36	102	HIGH
	P1564	57 Ave	MH684	J5	6	675	900	1.60	1309	2.74	104	HIGH
	P1563	57 Ave	J5	MH683	161	675	900	1.03	1379	3.08	75	HIGH
	P1570	57 Ave	MH683	MH682	102	675	900	1.07	1496	3.25	80	HIGH
	P1391	57 Ave	MH682	MH592	32	675	900	2.39	1554	4.05	55	HIGH
	P1569	57 Ave	MH592	MH580	59	675	1200	0.75	1559	1.51	46	HIGH
	P1451	57 Ave	MH580	MH796	11	675	1200	0.69	1849	1.95	57	HIGH
	P1574	57 Ave	MH796	J6	153	835	1200	0.55	1854	3.88	64	HIGH
	P1573	57 Ave	J6	MH571	7	835	1200	8.76	1885	5.6	16	HIGH
	P1572	57 Ave	MH571	MH572	23	835	1200	2.60	1885	4.27	30	HIGH
	P1580	57 Ave	MH572	MH873	41	1200	1200	1.49	2736	2.74	70	HIGH
	P3	57 Ave	MH873	MH578	32	1200	1200	0.40	2769	2.57	112	HIGH
	P1288	57 Ave	MH578	MH352	118	1200	1500	0.23	2862	2.15	85	HIGH
	P1579	57 Ave	MH352	MH579	63	1200	1500	0.61	2895	2.19	75	HIGH
	P1331	57 Ave	MH579	MH412	130	1200	1500	0.05	3639	3.03	103	HIGH
	P1587	57 Ave	MH412	MH574	53	1200	1500	0.76	3672	3.56	59	HIGH
	P1594	57 Ave	MH574	MH845	231	1200	1500	0.90	4077	3.78	61	HIGH
	P1598	57 Ave	MH845	MH847	24	1200	1500	4.84	4470	3.93	62	HIGH
	P1597	57 Ave	MH847	MH569	124	1200	1500	0.12	4483	3.93	69	HIGH
	P1493	57 Ave	MH569	Outfall3	59	1200	1500	0.94	4625	4.12	68	HIGH
2	P1642	52 St	MH559	J8	50	250	300	0.44	44	0.9	68	HIGH
	P1647	52 St	MH558	MH669	82	250	300	0.57	57	0.9	78	HIGH
	P1641	52 St	MH868	MH666	66	250	300	0.51	57	1.12	82	HIGH
	P1653	52 St	MH607	MH670	42	250	375	0.27	58	0.71	63	HIGH
	P1338	52 St	MH819-N	MH607	25	250	300	0.31	60	0.97	112	HIGH
	P1650	52 St	MH302	MH605	33	250	300	0.30	63	1.04	119	HIGH
	P1649	52 St	MH605	MH668	48	250	300	0.13	63	0.9	181	HIGH

Group	Pipe Name	Location	Manhole		Len (m)	Ex. Dia. (mm)	Prop. Dia. (mm)	Slope (%)	Q_5 (L/s)	V_5 (m/s)	Q_5/Q_{CAP} (%)	Priority
			US	DS								
	P1631	52 St	MH664	MH663	14	250	300	1.60	78	1.5	64	HIGH
	P1514	52 St	MH606	MH664	35	250	300	0.22	79	1.32	93	HIGH
	P1645	52 St	MH303	MH644	81	250	375	0.37	85	1.01	80	HIGH
	P1336	52 St	MH595	MH644	24	250	375	0.26	88	1.05	99	HIGH
	P1337	52 St	MH670	MH595	22	250	375	0.36	89	1.02	84	HIGH
	P1652	52 St	MH644	MH669	54	250	375	0.91	160	1.73	95	HIGH
	P1651	52 St	MH669	MH668	46	250	525	0.47	245	1.27	101	HIGH
	P1639	52 St	MH668	J8	54	250	525	0.43	275	1.41	97	HIGH
	P1638	52 St	J8	MH666	90	250	525	0.51	342	1.74	112	HIGH
	P1335	52 St	MH666	MH814	54	250	675	0.44	432	1.43	77	HIGH
	P1640	52 St	MH814	MH665	55	250	675	0.20	468	1.55	126	HIGH
	P1047	52 St	MH665	MH663	99	250	675	0.53	526	1.61	86	HIGH
	P1584	52 St	MH663	MH662	52	250	675	0.26	610	1.81	142	HIGH
	P1583	52 St	MH662	MH579	50	250	675	1.25	623	2.34	66	HIGH
3	P1314	51 St	MH240	MH643	11	250	300	2.74	117	2.31	73	HIGH
	P1316	51 St	MH239	MH240	30	250	300	0.92	106	1.81	114	HIGH
	P1317	51 St	MH238	MH239	22	250	300	0.38	81	1.16	136	HIGH
	P1330	51 St	MH660	MH594	73	250	450	0.47	170	1.22	87	HIGH
	P1332	51 St	MH643	MH575	50	250	450	0.30	114	0.93	72	HIGH
	P1585	51 St	MH594	MH574	46	250	525	1.23	345	2.06	72	HIGH
	P1586	51 St	MH349	MH594	70	250	375	0.34	61	0.84	59	HIGH
	P1607	51 St	MH575	MH660	50	250	450	0.40	176	1.44	98	HIGH
4	P1009	50 St	MH22	MH705	47	300	525	0.33	231	1.29	93	HIGH
	P1219	Alley	MH702	MH848	45	300	525	0.14	250	1.16	155	HIGH
	P1318	Alley	MH846	MH820	38	300	450	0.78	114	0.99	51	HIGH
	P1610	50 St	MH611	MH610	48	250	300	2.74	116	2.23	72	HIGH
	P1611	50 St	MH610	MH22	52	250	450	0.24	148	0.99	106	HIGH
	P1614	50 St	MH705	MH704	99	250	525	0.40	268	1.88	98	HIGH
	P1616	50 St	MH704	MH701	104	250	525	3.75	401	3.44	48	HIGH
	P1621	52 Ave	MH703	MH702	42	300	300	1.35	62	1.4	55	HIGH
	P1625	50 St	MH701	MH863	32	250	750	1.48	913	2.38	67	HIGH
	P1626	53 Ave	MH638	MH701	46	300	525	4.91	486	3.56	51	HIGH
	P1627	Alley	MH848	MH638	47	300	525	0.60	330	1.81	106	HIGH
	P1628	52 Ave	MH820	MH702	15	300	450	0.40	118	0.74	99	HIGH
5	P1172	Alley	MH719	MH178	88	200	600	0.52	307	1.65	69	HIGH
	P1173	52 St	MH720	MH174	10	200	450	2.03	222	1.98	55	HIGH
	P1698	52 St	MH723	MH722	51	200	375	1.16	83	1.64	44	HIGH
	P1699	52 St	MH722	MH721	48	200	450	0.77	148	1.3	59	HIGH

Group	Pipe Name	Location	Manhole US	Manhole DS	Len (m)	Ex. Dia. (mm)	Prop. Dia. (mm)	Slope (%)	Q_5 (L/s)	V_5 (m/s)	Q_5/Q_{CAP} (%)	Priority
	P1700	52 St	MH721	MH720	51	200	450	0.54	169	1.32	81	HIGH
	P1702	Alley	MH174	MH719	53	200	525	0.53	224	1.46	73	HIGH
	P1704	Alley	MH178	MH718	20	200	600	1.09	286	1.1	45	HIGH
	P1733	Alley	MH850	MH709	66	300	600	0.27	260	1.33	82	HIGH
	P1734	Alley	MH710	MH850	54	300	450	0.74	141	1.26	57	HIGH
	P1736	Alley	MH709	MH708	52	300	600	1.09	272	1.47	42	HIGH
	P1737	50 Ave	MH708	MH707	42	750	900	0.51	1459	2.52	113	HIGH
	P1738	50 Ave	MH173	MH708	55	750	900	0.73	947	1.8	61	HIGH
6	P986	Easement	J43	MH573	99	675	1200	0.33	1169	1.78	52	HIGH
	P989	Easement	MH870	MH597	100	675	900	0.28	1045	1.96	108	HIGH
	P1079	44 Ave	MH730	MH729	78	250	525	0.48	244	1.59	82	HIGH
	P1322	Easement	MH573	MH587	43	675	1200	0.64	1215	1.84	53	HIGH
	P1415	50 St	MH733	MH729	41	750	1200	0.64	1213	2.04	39	HIGH
	P1439	54 St	MH834	MH615	35	300	450	0.81	302	2.21	118	HIGH
	P1440	54 St	MH615	MH614	52	300	450	1.97	336	2.86	84	HIGH
	P1445	55 St	MH739	J42	50	600	900	0.48	399	1.15	32	HIGH
	P1685	46 Ave	MH833	MH739	121	300	375	0.46	74	1.05	62	HIGH
	P1691	54 St	MH736	MH735	11	600	900	0.83	782	1.36	47	HIGH
	P1692	46 Ave	MH737	MH736	71	600	900	0.16	503	1.18	69	HIGH
	P1693	46 Ave	J42	MH737	88	600	900	0.11	337	0.83	55	HIGH
	P1696	54 St	MH735	MH870	78	600	900	0.30	766	1.38	77	HIGH
	P1775	Easement	MH587	MH733	18	675	1200	0.87	1213	1.75	25	HIGH
	P1777	44 Ave	MH731	MH730	83	250	525	0.25	212	1.22	98	HIGH
	P1778	44 Ave	MH732	MH731	17	250	450	1.22	169	1.69	54	HIGH
	P1783	50 St	J39	MH729	111	250	300	3.92	136	2.83	71	HIGH
	P8	44 Ave	MH729	Outfall11	97	750	1200	2.43	1372	4.34	23	HIGH
7	P1308	60 St	MH692	MH800	42	300	450	0.85	278	1.82	115	HIGH
	P1487	60 St	MH800	MH691	44	300	525	0.47	288	1.75	86	HIGH
	P1488	60 St	MH600	MH692	60	300	450	0.14	146	0.92	136	HIGH
	P1550	60 St	MH691	MH690	183	450	675	0.18	311	1.18	87	HIGH
	P1674	60 St	MH694	MH691	108	300	450	0.29	113	1.05	73	HIGH
8	P1102	Easement	MH673	MH1	123	450	900	0.28	558	1.37	58	HIGH
	P1176	Easement	MH836	MH182	44	300	525	0.61	284	2.07	85	HIGH
	P1348	Hw2A	MH808	MH815	55	525	900	0.35	777	1.89	73	HIGH
	P1655	54 St	MH672	MH2	96	450	900	0.20	624	1.13	78	HIGH
	P1660	57 St	MH676	MH675	81	375	600	0.22	168	0.68	58	HIGH
	P1665	56 St	MH62	MH673	45	450	900	0.05	459	1.13	54	HIGH
	P1666	53 Ave	MH674	MH62	103	450	750	0.69	450	1.76	49	HIGH

Group	Pipe Name	Location	Manhole		Len (m)	Ex. Dia. (mm)	Prop. Dia. (mm)	Slope (%)	Q_5 (L/s)	V_5 (m/s)	Q_5/Q_{CAP} (%)	Priority
			US	DS								
	P1667	57 St	MH675	MH674	18	450	600	0.62	369	1.48	76	HIGH
	P1668	57 St	MH182	MH675	5	300	525	11.23	285	2.54	20	HIGH
	P1669	Easement	MH609	MH836	56	300	450	1.10	226	2.04	76	HIGH
	P4	Easement	MH1	MH3	62	450	900	0.18	518	1.01	68	HIGH
	P5	54 St	MH3	MH672	54	450	900	0.17	529	0.99	72	HIGH
	P6	Easement	MH2	MH808	117	450	900	0.26	719	1.45	78	HIGH
	P7	Hwy 2A	MH815	MH572	65	525	900	1.05	824	2.39	44	HIGH
	P1661	57 St	MH188	MH676	54	375	525	0.22	115	0.76	57	HIGH
9	P1146	61 St	MH431	MH696	81	200	450	0.59	146	1.37	67	HIGH
	P1538	61 St	MH699	MH698	87	200	300	0.18	23	0.5	57	HIGH
	P1539	61 St	MH698	MH697	76	200	450	0.42	158	1.73	86	HIGH
10	P1205	50 Ave	J3	MH776	61	450	750	3.70	1637	4.04	76	HIGH
	P1295	50 Ave	MH568	MH567	70	600	1200	0.14	1949	2.62	132	HIGH
	P1397	42 St	MH772	J73	70	300	375	3.98	371	3.91	90	HIGH
	P1398	42 St	MH773	MH772	60	300	375	5.43	261	3.37	54	HIGH
	P14	50 Ave	J73	J3	167	300	375	8.90	503	4.83	96	HIGH
	P1413	46 St	MH776	MH768	25	450	1050	1.11	1737	2.55	60	HIGH
	P1414	46 ST	MH768	MH767	84	450	1050	1.40	1830	3.31	57	HIGH
	P1505	50 Ave	MH567	Outfall8	35	600	1200	3.59	1958	3.11	58	HIGH
	P1742	50 Ave	MH767	MH766	62	600	1050	2.90	1911	3.18	41	HIGH
	P1743	50 Ave	MH766	MH568	85	600	1200	0.25	1925	2.15	98	HIGH
11	P17	Easement	102	OFNA	82	300	600	0.57	588	2.17	127	HIGH
	P1757	42A Ave	MH780	102	53	300	600	2.78	605	2.46	59	HIGH
	P1759	46 St	J83	MH780	49	300	600	0.76	511	1.92	95	HIGH
	P1760	46 St	MH781	J83	26	300	600	1.66	464	1.92	59	HIGH
	P1761	46 St	MH782	MH781	61	300	600	0.35	443	1.73	122	HIGH
	P1762	46 St	MH783	MH782	32	300	600	0.83	423	1.67	76	HIGH
	P1764	42 Ave	MH784	MH783	97	300	525	1.17	394	2.05	85	HIGH
12	P1341	46 St	MH787	MH786	55	300	450	1.04	132	1.33	46	HIGH
	P1506	46 St	MH785	Outfall10	84	300	525	0.05	232	1.24	235	HIGH
	P1771	46 St	MH786	MH618	88	300	450	0.73	208	1.8	83	HIGH
	P1772	46 St	MH618	MH785	41	300	525	0.65	192	1	55	HIGH

Group	Pipe Name	Location	Manhole		Len (m)	Ex. Dia. (mm)	Prop. Dia. (mm)	Slope (%)	Q_5 (L/s)	V_5 (m/s)	Q_5/Q_{CAP} (%)	Priority
			US	DS								
13	P1355	SE Industrial	MH602	Outfall16	154	1200	1350	0.59	3850	3.26	94	Medium
	P1466	SE Industrial	MH810	MH190	125	1050	1200	0.21	1750	1.92	97	Medium
	P1476	SE Industrial	J68	MH829	82	300	525	0.37	198	1.49	66	Medium
	P1795	SE Industrial	MH749	MH810	68	1050	1200	0.29	1659	1.71	78	Medium
	P1796	SE Industrial	MH750	MH749	79	1050	1200	0.06	1557	1.57	159	Medium
	P1802	SE Industrial	MH759	MH757	192	600	675	0.32	440	1.3	95	Medium
	P1933	SE Industrial	J56	J57	119	600	900	0.17	701	1.28	93	Medium
	P1936	SE Industrial	J67	J56	37	450	900	0.38	770	1.67	58	Medium
	P1938	SE Industrial	J66	J67	114	450	750	0.20	380	0.95	64	Medium
	P1939	SE Industrial	J65	J66	37	375	600	0.40	390	1.54	85	Medium
	P1940	SE Industrial	J60	J65	128	375	600	0.17	363	1.4	123	Medium
	P1941	SE Industrial	J62	J60	51	375	600	1.09	382	1.95	68	Medium
	P1946	SE Industrial	J57	OF2	159	900	900	0.07	716	1.47	152	Medium
14	P1431	HWY 2A	MH855	MH854	155	375	450	0.28	105	0.89	69	Medium
	P1432	HWY 2A	MH854	MH840	69	375	450	0.28	161	1.19	108	Medium
	P1433	HWY 2A	MH840	MH742	55	375	450	0.33	154	1.26	94	Medium
15	P1368	45 Ave	MH625	MH92	45	300	600	0.55	456	1.93	101	Medium
	P1471	Easement	MH816	MH825	45	300	600	0.29	339	1.3	103	Medium
	P1474	Easement	J52	MH625	35	300	600	0.47	459	1.78	109	Medium
	P1473	Easement	MH825	J52	51	300	600	0.32	355	1.32	102	Medium
16	P999	52 St	MH489	MH12	90	250	300	1.82	122	2.02	94	Medium
	P1352	52 St	MH60	MH579	54	250	450	2.20	272	2.51	64	Medium
	P1578	52 St	MH61	MH60	51	250	450	1.68	206	1.99	56	Medium
	P2	52 St	MH12	MH61	206	250	450	0.54	212	1.76	102	Medium
17	P1353	51 St	MH28	MH574	49	250	450	2.19	334	2.53	79	Medium
	P1593	51 ST	MH658	MH28	52	250	450	1.20	289	2.06	93	Medium
18	C1291	48 Ave	MH777	Outfall 9	56	600	750	10.2	1002	6.91	0.36	High
	C1756	48 Ave	MH82	MH777	70	600	750	2.79	970	4.73	0.47	High
	C1755	48 Ave	MH779	MH82	90	600	750	5.10	900	4.12	0.50	High
	P1754_1	48 Ave	MH60-N	MH779	52	450	600	9.59	794	5.38	0.42	High
	P1881	Easement	J79	MH58-N	20	450	525	2.73	475	2.44	0.67	High
	P1882	Easement	MH58-N	MH59-N	150	450	525	2.25	532	3.12	0.83	High
	P1883	Easement	MH59-N	MH60-N	92	450	525	3.25	564	3.75	0.73	High

Group	Pipe Name	Location	Manhole US	Manhole DS	Len (m)	Ex. Dia. (mm)	Prop. Dia. (mm)	Slope (%)	Q_5 (L/s)	V_5 (m/s)	Q_5/Q_{CAP} (%)	Priority
19	P1340	42 St	MH637	MH228	42	600	750	1.47	932	2.88	69	Low
	P1401	42 St	MH636	MH637	10	600	750	6.04	383	2.6	14	Low
	P1412	Easement	J1	J2	42	600	750	4.02	1047	2.59	47	Low
	P15	Easement	MH228	J1	137	600	750	8.86	981	4.64	30	Low
	P16	44 St	J2	J3	62	600	750	0.75	1101	2.73	114	Low
20	P1329	49 St	MH236	MH401	64	300	375	0.79	48	0.74	31	Low
	P1601	49 St	MH401	MH569	110	300	375	0.53	166	1.59	130	Low
21	P1350	53 St	MH608	MH117	105	250	375	0.82	162	1.68	101	Low
	P1575	53 St	MH117	MH578	38	250	375	2.16	184	2.2	72	Low
22	P1450	58 St	MH645	Outfall1	91	1200	1350	0.08	1481	1.89	101	Low
23	P1525	61 Ave	MH418	MH657	40	200	300	2.03	69	51	50	Low
24	P1670	58 St	MH678	MH609	17	300	450	1.68	168	1.57	0.52	Low
	P1671	58 St	J9	MH678	40	300	450	0.99	170	1.73	0.6	Low
	P1672	58 St	MH671	J9	69	300	375	0.87	74	1.44	0.45	Low
25	P1819	64A St	MH6-N	MH5-N	46	200	300	0.80	48	1.31	47	Low
	P1820	64A St	MH7-N	MH6-N	92	200	300	0.66	49	1.27	53	Low
	P1825	64A St	T2	MH1-N	36	250	300	1.40	112	1.84	83	Low
	P1828	64A St	MH4-N	J45	190	600	675	0.37	456	1.77	89	Low

Appendix D-5: Stormwater Costing

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
1	1.1	Supply and Install 450 mm	LM	16	$930.00	$14,880.00
	1.2	Supply and Install 675 mm	LM	89	$1,190.00	$105,910.00
	1.3	Supply and Install 750 mm	LM	290	$1,210.00	$350,900.00
	1.4	Supply and Install 900 mm	LM	549	$1,320.00	$724,680.00
	1.5	Supply and Install 1200 mm	LM	326	$1,920.00	$625,920.00
	1.6	Supply and Install 1500 mm	EA	802	$2,590.00	$2,077,180.00
	1.7	Supply and Install MH Type 5'A'	EA	31	$7,000.00	$217,000.00
	1.8	Supply and Install Cacthbasin	EA	62	$6,600.00	$409,200.00
			SUBTOTAL:			$4,525,670.00
		Add Contingency (40%)				$1,810,268.00
	TOTAL GROUP 1 ESTIMATE					**$6,336,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
2	2.1	Supply and Install 300 mm	LM	397	$780.00	$309,660.00
	2.2	Supply and Install 375 mm	LM	180	$850.00	$153,000.00
	2.3	Supply and Install 525 mm	LM	189	$1,000.00	$189,000.00
	2.4	Supply and Install 675 mm	LM	309	$1,190.00	$367,710.00
	2.5	Supply and Install MH Type 5'A'	EA	22	$7,000.00	$154,000.00
	2.6	Supply and Install Cacthbasin	EA	44	$6,600.00	$290,400.00
			SUBTOTAL:			$1,463,770.00
		Add Contingency (40%)				$585,508.00
	TOTAL GROUP 2 ESTIMATE					**$2,050,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
3	3.1	Supply and Install 300 mm	LM	63	$780.00	$49,140.00
	3.2	Supply and Install 375 mm	LM	70	$850.00	$59,500.00
	3.3	Supply and Install 450 mm	LM	172	$930.00	$159,960.00
	3.4	Supply and Install 525 mm	LM	46	$1,000.00	$46,000.00
	3.5	Supply and Install MH Type 5'A'	EA	7	$7,000.00	$49,000.00
	3.6	Supply and Install Cacthbasin	EA	14	$6,600.00	$92,400.00
			SUBTOTAL:			$456,000.00
		Add Contingency (40%)				$182,400.00
	TOTAL GROUP 3 ESTIMATE					**$639,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
4	4.1	Supply and Install 300 mm	LM	90	$780.00	$70,200.00
	4.2	Supply and Install 450 mm	LM	105	$930.00	$97,650.00
	4.3	Supply and Install 525 mm	LM	389	$1,000.00	$389,000.00
	4.4	Supply and Install 750 mm	LM	32	$1,210.00	$38,720.00
	4.5	Supply and Install MH Type 5'A'	EA	13	$7,000.00	$91,000.00
	4.6	Supply and Install Cacthbasin	EA	26	$6,600.00	$171,600.00
			SUBTOTAL:			$858,170.00
		Add Contingency (40%)				$343,268.00
	TOTAL GROUP 4 ESTIMATE					**$1,202,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
5	5.1	Supply and Install 375 mm	LM	51	$850.00	$43,350.00
	5.2	Supply and Install 450 mm	LM	163	$930.00	$151,590.00
	5.3	Supply and Install 525 mm	LM	53	$1,000.00	$53,000.00
	5.4	Supply and Install 600 mm	LM	225	$1,070.00	$240,750.00
	5.5	Supply and Install 900 mm	LM	150	$1,320.00	$198,000.00
	5.6	Supply and Install MH Type 5'A'	EA	15	$7,000.00	$105,000.00
	5.7	Supply and Install Cacthbasin	EA	30	$6,600.00	$198,000.00
			SUBTOTAL:			$989,690.00
		Add Contingency (40%)				$395,876.00
	TOTAL GROUP 5 ESTIMATE					**$1,386,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
6	6.1	Supply and Install 300 mm	LM	111	$780.00	$86,580.00
	6.2	Supply and Install 375 mm	LM	121	$850.00	$102,850.00
	6.3	Supply and Install 450 mm	LM	105	$930.00	$97,650.00
	6.4	Supply and Install 525 mm	LM	161	$1,000.00	$161,000.00
	6.5	Supply and Install 900 mm	LM	398	$1,320.00	$525,360.00
	6.6	Supply and Install 1200 mm	LM	298	$1,920.00	$572,160.00
	6.7	Supply and Install MH Type 5'A'	EA	17	$7,000.00	$119,000.00
	6.8	Supply and Install Cacthbasin	EA	34	$6,600.00	$224,400.00
			SUBTOTAL:			$1,889,000.00
		Add Contingency (40%)				$755,600.00
	TOTAL GROUP 6 ESTIMATE					**$2,645,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
7	7.1	Supply and Install 450 mm	LM	210	$930.00	$195,300.00
	7.2	Supply and Install 525 mm	LM	44	$1,000.00	$44,000.00
	7.3	Supply and Install 675 mm	LM	183	$1,190.00	$217,770.00
	7.4	Supply and Install MH Type 5'A'	EA	6	$7,000.00	$42,000.00
	7.5	Supply and Install Cacthbasin	EA	12	$6,600.00	$79,200.00
			SUBTOTAL:			$578,270.00
		Add Contingency (40%)				$231,308.00
	TOTAL GROUP 7 ESTIMATE					**$810,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
8	8.1	Supply and Install 450 mm	LM	56	$930.00	$52,080.00
	8.2	Supply and Install 525 mm	LM	103	$1,000.00	$103,000.00
	8.3	Supply and Install 600 mm	LM	99	$1,070.00	$105,930.00
	8.4	Supply and Install 750 mm	LM	103	$1,320.00	$135,960.00
	8.5	Supply and Install 900 mm	LM	616	$1,320.00	$813,120.00
	8.6	Supply and Install MH Type 5'A'	EA	15	$7,000.00	$105,000.00
	8.7	Supply and Install Cacthbasin	EA	30	$6,600.00	$198,000.00
			SUBTOTAL:			$1,513,090.00
		Add Contingency (40%)				$605,236.00
	TOTAL GROUP 8 ESTIMATE					**$2,119,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
9	9.1	Supply and Install 300 mm	LM	87	$780.00	$67,860.00
	9.2	Supply and Install 450 mm	LM	157	$930.00	$146,010.00
	9.3	Supply and Install MH Type 5'A'	EA	5	$7,000.00	$35,000.00
	9.4	Supply and Install Cacthbasin	EA	10	$6,600.00	$66,000.00
			SUBTOTAL:			$314,870.00
		Add Contingency (40%)				$125,948.00
	TOTAL GROUP 9 ESTIMATE					**$441,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
10	10.1	Supply and Install 375 mm	LM	297	$780.00	$231,660.00
	10.20	Supply and Install 750 mm	LM	61	$1,320.00	$80,520.00
	10.3	Supply and Install 1050 mm	LM	171	$1,620.00	$277,020.00
	10.4	Supply and Install 1200 mm	LM	190	$1,920.00	$364,800.00
	10.5	Supply and Install MH Type 5'A'	EA	10	$7,000.00	$70,000.00
	10.6	Supply and Install Cacthbasin	EA	20	$6,600.00	$132,000.00
			SUBTOTAL:			$1,156,000.00
		Add Contingency (40%)				$462,400.00
	TOTAL GROUP 10 ESTIMATE					**$1,619,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
11	11.1	Supply and Install 525 mm	LM	97	$1,000.00	$97,000.00
	11.2	Supply and Install 600 mm	LM	303	$1,070.00	$324,210.00
	11.3	Supply and Install MH Type 5'A'	EA	7	$7,000.00	$49,000.00
	11.4	Supply and Install Cacthbasin	EA	14	$6,600.00	$92,400.00
			SUBTOTAL:			$562,610.00
		Add Contingency (40%)				$225,044.00
	TOTAL GROUP 11 ESTIMATE					**$788,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
12	12.1	Supply and Install 450 mm	LM	143	$930.00	$132,990.00
	12.2	Supply and Install 525 mm	LM	125	$1,000.00	$125,000.00
	12.3	Supply and Install MH Type 5'A'	EA	4	$7,000.00	$28,000.00
	12.4	Supply and Install Cacthbasin	EA	8	$6,600.00	$52,800.00
			SUBTOTAL:			$338,790.00
		Add Contingency (40%)				$135,516.00
	TOTAL GROUP 12 ESTIMATE					**$475,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
18	18.1	Supply and Install 525 mm	LM	262	$1,000.00	$262,000.00
	18.2	Supply and Install 600 mm	LM	52	$1,070.00	$55,640.00
	18.3	Supply and Install 750 mm	LM	216	$1,320.00	$285,120.00
	18.4	Supply and Install MH Type 5'A'	EA	3	$7,000.00	$21,000.00
	18.5	Supply and Install Cacthbasin	EA	6	$6,600.00	$39,600.00
			SUBTOTAL:			$663,360.00
		Add Contingency (40%)				$265,344.00
	TOTAL GROUP 18 ESTIMATE					**$929,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
13	13.1	Supply and Install 525 mm	LM	82	$1,000.00	$82,000.00
	13.2	Supply and Install 600 mm	LM	215	$1,070.00	$230,050.00
	13.3	Supply and Install 675 mm	LM	192	$1,190.00	$228,480.00
	13.4	Supply and Install 750 mm	LM	114	$1,210.00	$137,940.00
	13.5	Supply and Install 900 mm	LM	315	$1,320.00	$415,800.00
	13.6	Supply and Install 1200 mm	LM	272	$1,920.00	$522,240.00
	13.7	Supply and Install 1350 mm	LM	154	$2,250.00	$346,500.00
	13.8	Supply and Install MH Type 5'A'	EA	16	$7,000.00	$112,000.00
	13.9	Supply and Install Cacthbasin	EA	32	$6,600.00	$211,200.00
			SUBTOTAL:			$2,286,210.00
		Add Contingency (40%)				$914,484.00
	TOTAL GROUP 13 ESTIMATE					**$3,201,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
14	14.1	Supply and Install 450 mm	LM	280	$930.00	$260,400.00
	14.2	Supply and Install MH Type 5'A'	EA	3	$7,000.00	$21,000.00
	14.3	Supply and Install Cacthbasin	EA	6	$6,600.00	$39,600.00
			SUBTOTAL:			$321,000.00
		Add Contingency (40%)				$128,400.00
	TOTAL GROUP 14 ESTIMATE					**$450,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
15	15.1	Supply and Install 600 mm	LM	176	$1,070.00	$188,320.00
	15.2	Supply and Install MH Type 5'A'	EA	4	$7,000.00	$28,000.00
	15.3	Supply and Install Cacthbasin	EA	8	$6,600.00	$52,800.00
			SUBTOTAL:			$269,120.00
		Add Contingency (40%)				$107,648.00
	TOTAL GROUP 15 ESTIMATE					**$377,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
16	16.1	Supply and Install 300 mm	LM	90	$780.00	$70,200.00
	16.2	Supply and Install 450 mm	LM	311	$930.00	$289,230.00
	16.3	Supply and Install MH Type 5'A'	EA	4	$7,000.00	$28,000.00
	16.4	Supply and Install Cacthbasin	EA	8	$6,600.00	$52,800.00
			SUBTOTAL:			$440,230.00
		Add Contingency (40%)				$176,092.00
	TOTAL GROUP 16 ESTIMATE					**$617,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
17	17.1	Supply and Install 450 mm	LM	101	$930.00	$93,930.00
	17.2	Supply and Install MH Type 5'A'	EA	2	$7,000.00	$14,000.00
	17.3	Supply and Install Cacthbasin	EA	4	$6,600.00	$26,400.00
			SUBTOTAL:			$134,330.00
		Add Contingency (40%)				$53,732.00
	TOTAL GROUP 17 ESTIMATE					**$189,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
18	18.1	Supply and Install 525 mm	LM	262	$1,000.00	$262,000.00
	18.2	Supply and Install 600 mm	LM	52	$1,070.00	$55,640.00
	18.3	Supply and Install MH Type 5'A'	EA	3	$7,000.00	$21,000.00
	18.4	Supply and Install Cacthbasin	EA	6	$6,600.00	$39,600.00
			SUBTOTAL:			$378,240.00
		Add Contingency (40%)				$151,296.00
	TOTAL GROUP 18 ESTIMATE					**$530,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
	19.1	Supply and Install 750 mm	LM	293	$1,210.00	$354,530.00
19	19.2	Supply and Install MH Type 5'A'	EA	4	$7,000.00	$28,000.00
	19.3	Supply and Install Cacthbasin	EA	8	$6,600.00	$52,800.00
			SUBTOTAL:			$435,330.00
		Add Contingency (40%)				$174,132.00
	TOTAL GROUP 19 ESTIMATE					**$610,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
	20.1	Supply and Install 375 mm	LM	174	$850.00	$147,900.00
20	20.2	Supply and Install MH Type 5'A'	EA	2	$7,000.00	$14,000.00
	20.3	Supply and Install Cacthbasin	EA	4	$6,600.00	$26,400.00
			SUBTOTAL:			$188,300.00
		Add Contingency (40%)				$75,320.00
	TOTAL GROUP 20 ESTIMATE					**$264,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
	21.1	Supply and Install 375 mm	LM	142	$850.00	$120,700.00
21	21.2	Supply and Install MH Type 5'A'	EA	2	$7,000.00	$14,000.00
	21.3	Supply and Install Cacthbasin	EA	4	$6,600.00	$26,400.00
			SUBTOTAL:			$161,100.00
		Add Contingency (40%)				$64,440.00
	TOTAL GROUP 21 ESTIMATE					**$226,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
	22.1	Supply and Install 1350 mm	LM	91	$2,250.00	$204,750.00
22	22.2	Supply and Install MH Type 5'A'	EA	1	$7,000.00	$7,000.00
	22.3	Supply and Install Cacthbasin	EA	0	$6,600.00	$0.00
			SUBTOTAL:			$211,750.00
		Add Contingency (40%)				$84,700.00
	TOTAL GROUP 22 ESTIMATE					**$297,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
	23.1	Supply and Install 300 mm	LM	40	$780.00	$31,200.00
23	23.2	Supply and Install MH Type 5'A'	EA	1	$7,000.00	$7,000.00
	23.3	Supply and Install Cacthbasin	EA	2	$6,600.00	$13,200.00
			SUBTOTAL:			$51,400.00
		Add Contingency (40%)				$20,560.00
	TOTAL GROUP 23 ESTIMATE					**$72,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
24	24.1	Supply and Install 375 mm	LM	69	$850.00	$58,650.00
	24.2	Supply and Install 450 mm	LM	57	$930.00	$53,010.00
	24.3	Supply and Install MH Type 5'A'	EA	4	$7,000.00	$28,000.00
	24.4	Supply and Install Cacthbasin	EA	8	$6,600.00	$52,800.00
			SUBTOTAL:			$192,460.00
		Add Contingency (40%)				$76,984.00
	TOTAL GROUP 24 ESTIMATE					**$270,000**

Grouping	Item	Description	Unit	Quantity	Unit Price	Amount
25		Supply and Install 300 mm	LM	174	$780.00	$135,720.00
		Supply and Install 675 mm	LM	190	$1,190.00	$226,100.00
		Supply and Install MH Type 5'A'	EA	6	$7,000.00	$42,000.00
		Supply and Install Cacthbasin	EA	12	$6,600.00	$79,200.00
			SUBTOTAL:			$483,020.00
		Add Contingency (40%)				$193,208.00
	TOTAL GROUP 25 ESTIMATE					**$677,000**