MPE Engineering Ltd.

Final Report for:

TOWN OF Westlock

TOWN OF WESTLOCK

SANITARY SEWER MASTER PLAN UPDATE

Date: January 31, 2020
Project: 5454-009-00

Proud of Our Past... Building the Future

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10003-106 Street
Westlock, AB
T7P 2K3

January 31, 2020
File: N:\5454-009-00

Attention: Simone Wiley
Director of Development Services

Dear Simone:

Re: Town of Westlock Sanitary Sewer Master Plan Update
Final Report

MPE Engineering Ltd. is pleased to submit a Final Report to the Town of Westlock for the Sanitary Sewer Master Plan Update.

We appreciate the opportunity to provide our services for this project. Should you have any questions or require additional information, please contact the undersigned at (780) 509-4304 or mgrzeszczuk@mpe.ca.

Yours truly,

MPE ENGINEERING LTD.

Mirek Grzeszczuk, P.Tech.(Eng.)
Edmonton Region Manager

SK/es

Enclosure

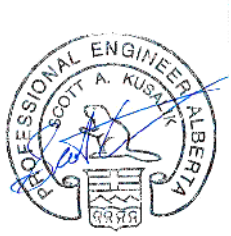
CORPORATE AUTHORIZATION

This report has been prepared by MPE Engineering Ltd. under authorization of the Town of Westlock. The material in this report represents the best judgment of MPE Engineering Ltd. given the available information. Any use that a third party makes of this report, or reliance on or decisions made based upon it is the responsibility of the third party. MPE Engineering Ltd. accepts no responsibility for damages, if any, suffered by a third party as a result of decisions made or actions taken based upon this report.

Should any questions arise regarding content of this report, please contact the undersigned.

MPE ENGINEERING LTD.

Professional Stamp



2020-01-31

Scott Kusalik, P.Eng.

PERMIT TO PRACTICE
MPE ENGINEERING LTD.
PERMIT NUMBER: P 3680
The Association of Professional Engineers and Geoscientists of Alberta

Professional Seal

Corporate Permit

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1.0 INTRODUCTION

1.1 Background

The last update to the Town of Westlock's (Town) Sanitary Sewer Master Plan was in 2009 with the *Wastewater Collection System Master Plan, 2009 Update – Final Report, November, 2009* (Wastewater Collection System Master Plan) completed by ISL Engineering and Land Services. This update occurred almost a decade ago. As such, the Town has commissioned MPE Engineering Ltd. (MPE) to prepare the update to the Sanitary Sewer Master Plan.

1.2 Scope

The scope of the master plan update includes:

- Assess the physical condition of the sanitary sewer system through CCTV inspection and known issues in the system.
- Assess the hydraulic condition of the sanitary sewer system through an update of the existing sanitary sewer model with additional data gathered.
- Assess the capability of the sanitary sewer system to satisfy short- and long-term requirements.
- Prepare options for system expansion including cost estimates.

1.3 Objective

The objective of the master plan update is to assess the structural and hydraulic condition of the sanitary sewer system and provide options, cost estimates, and recommendations to expand and upgrade the sanitary sewer system to meet short- and long-term requirements.

1.4 Acknowledgements

MPE gratefully acknowledges the Town of Westlock for their assistance on this project.

2.0 EXISTING CONDITIONS

2.1 Existing System

The Town's existing sanitary sewer system is shown in **Figure 2.1**. The system generally drains to the north and west towards the Town's Wastewater Treatment Plant approximately 2 kilometres northwest of Town. The sanitary sewer system is comprised of approximately 56.7 km of 150 mm, 200 mm, 250 mm, 300 mm, 350 mm, 375 mm, 400 mm, 450 mm, 525 mm, 600 mm, and 675 mm diameter sanitary sewer mains. The known pipe materials are clay tile and PVC.

2.2 Existing Development

The majority of the Town is residential development. Commercial areas are present along Highway 18 and Highway 44, and downtown. Existing industrial areas are west of 96 Avenue and north of Highway 18.

2.3 Future Development

Two future development scenarios are considered in this study. A reduced build-out scenario that reflects current development trends in Westlock, and a full development scenario that includes everything within the Town's current development boundary. The reduced build-out scenario is shown in **Figure 2.2**, and the full build-out scenario is shown in **Figure 2.3**.

TO SEWAGE LAGOON
SEE INSET 'A'

NE1/4-6-60-26-4

NW1/4-5-60-26-4

NE1/4-5-60-26-4

NE1/4-4-60-26-4

ROAD ALLOWANCE

HIGHWAY 44/104 AVE

HIGHWAY 18/100 ST

TOWN BOUNDARY

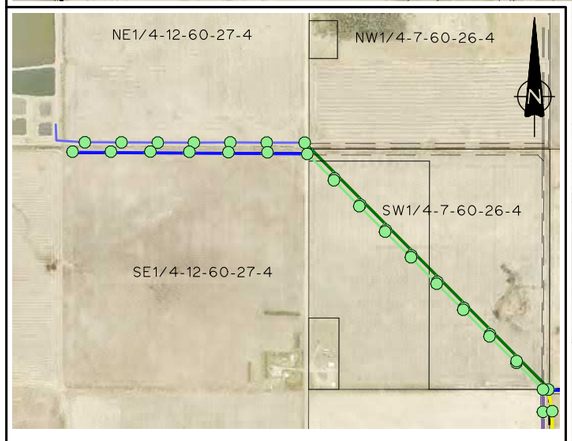
NW1/4-32-59-26-4

NW1/4-33-59-26-4

NE1/4-33-59-26-4

SW1/4-32-59-26-4

SE1/4-32-59-26-4



INSET 'A'
NOT TO SCALE

LEGEND:

- 150mm DIA
- 200mm DIA
- 250mm DIA
- 300mm DIA
- 350mm DIA
- 375mm DIA
- 400mm DIA
- 450mm DIA
- 525mm DIA
- 600mm DIA
- 675mm DIA
- UNKNOWN PIPE DIA
- SANITARY MANHOLE

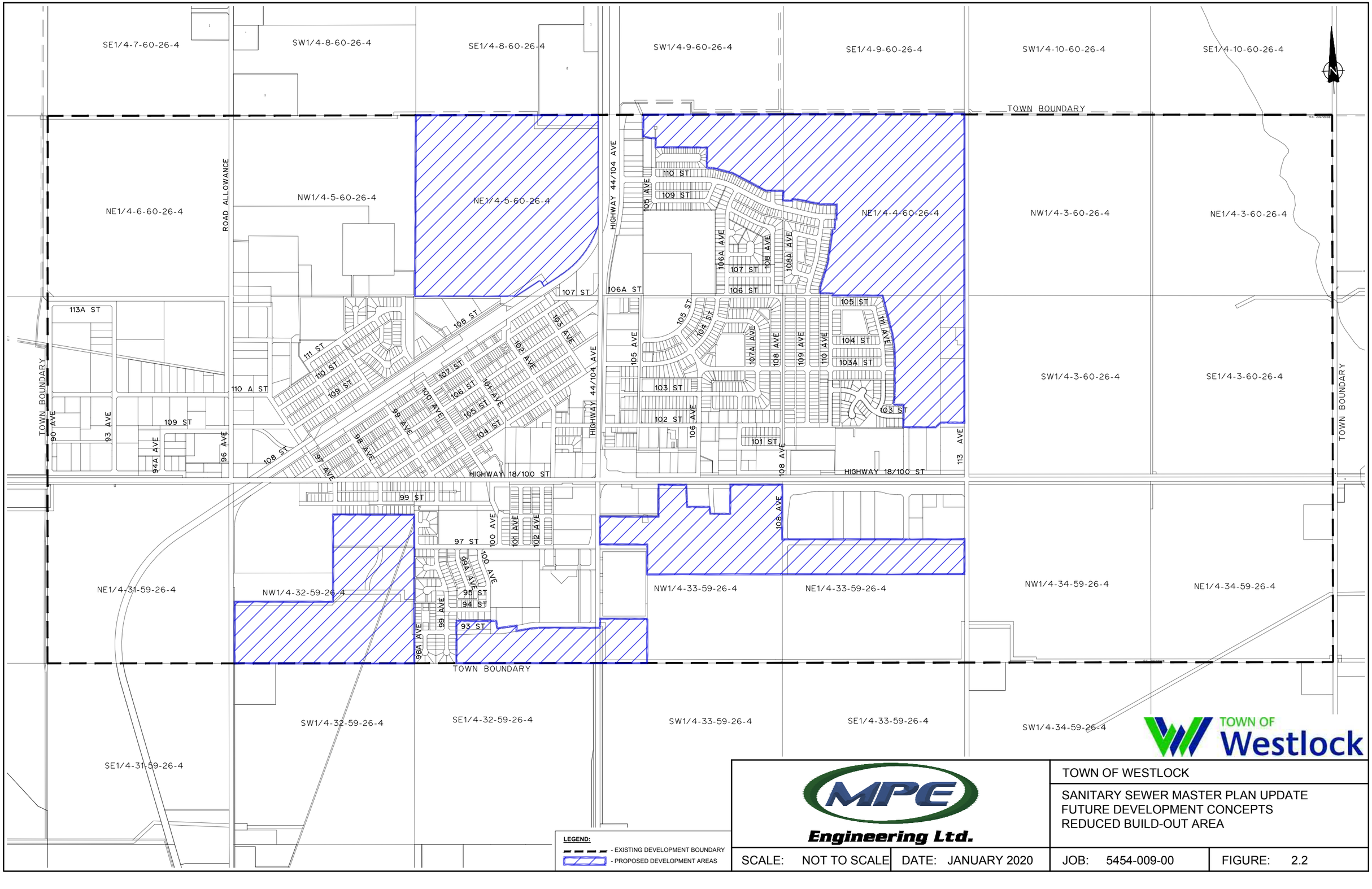
TOWN OF Westlock

MPE Engineering Ltd.

TOWN OF WESTLOCK

SANITARY SEWER MASTER PLAN UPDATE
EXISTING SANITARY SEWER SYSTEM PIPE DIAMETER

SCALE: NOT TO SCALE	DATE: JANUARY 2020	JOB: 5454-009-00	FIGURE: 2.1



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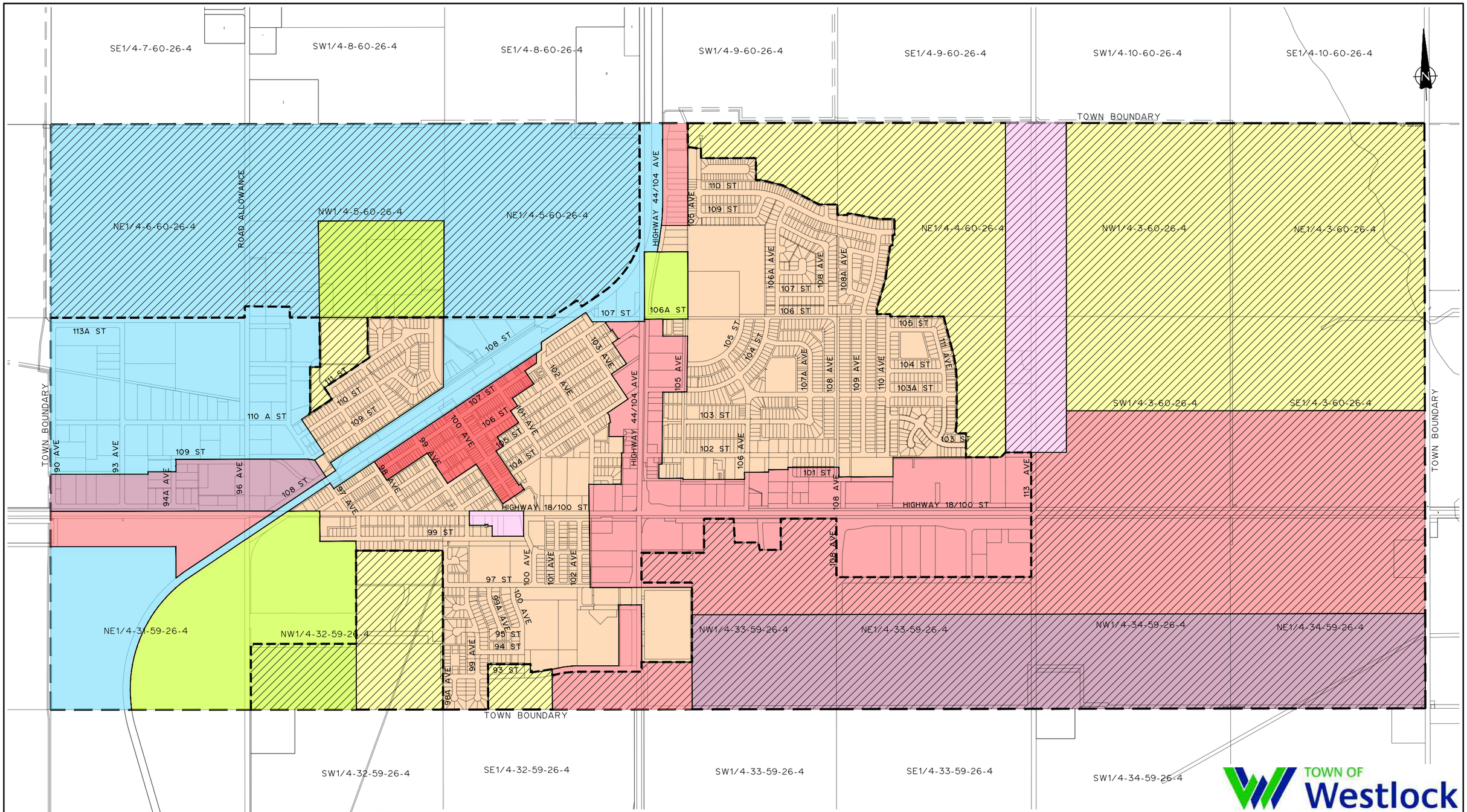
TOWN OF WESTLOCK

SANITARY SEWER MASTER PLAN UPDATE
FUTURE DEVELOPMENT CONCEPTS
REDUCED BUILD-OUT AREA

SCALE:	NOT TO SCALE	DATE:	JANUARY 2020	JOB:	5454-009-00	FIGURE:	2.2



LEGEND:

MN	- EX MATURE NEIGHBOURHOODS (A=244.9 Ha)	FN	- FUTURE NEIGHBOURHOODS (A=287.0 Ha)
IP	- EX INDUSTRIAL PARK (A=126.6 Ha)	IP	- FUTURE INDUSTRIAL PARK (A=171.6 Ha)
BP	- EX BUSINESS PARK (A=20.1 Ha)	BP	- FUTURE BUSINESS PARK (A=120.3 Ha)
DT	- EX DOWNTOWN (A=14.6 Ha)	HC	- FUTURE HIGHWAY CORRIDOR (A=182.4 Ha)
HC	- EX HIGHWAY CORRIDOR (A=105.4 Ha)	MUC	- FUTURE MIXED USE CORRIDOR (A=34.8 Ha)
MUC	- EX MIXED USE CORRIDOR (A=2.0 Ha)	RAA	- FUTURE REGIONAL AMENITIES AREA (A=33.0 Ha)
RAA	- EX REGIONAL AMENITIES AREA (A=53.0 Ha)		
	- EX DEVELOPMENT BOUNDARY (A=1,395.6 Ha)		

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TOWN OF WESTLOCK

SANITARY SEWER MASTER PLAN UPDATE
FUTURE DEVELOPMENT CONCEPTS
FULL BUILD-OUT AREA

SCALE: NOT TO SCALE | DATE: JANUARY 2020 | JOB: 5454-009-00 | FIGURE: 2.3

3.0 DESIGN CRITERIA

3.1 Population Analysis and Projections

Population figures obtained from Statistics Canada show that the population of the Town was 5,101 in the 2016 Federal Census.

The *Town of Westlock, Water Tower and Pumping Station Assessment, April 13, 2017 completed* by MPE Engineering Ltd. (Water Tower Assessment) assumed a 1.1% growth rate for the Town to calculate a 2017 population of 5,157. This growth rate is consistent with the Westlock Regional Water System Business Plan.

Table 3.1 shows the population of the Town recorded in the last four Federal Censuses and last two Municipal Censuses.

TABLE 3.1: HISTORICAL POPULATION OF THE TOWN OF WESTLOCK

Year	Population	Growth Rate
2001 (Federal Census)	4,819	
2006 (Federal Census)	5,008	3.9%
2008 (Municipal Census)	4,964	-0.9%
2011 (Federal Census)	4,823	-2.8%
2015 (Municipal Census)	5,147	6.7%
2016 (Federal Census)	5,101	-0.9%

For the purpose of this study, MPE used the 1.1% growth rate for the Town that was used in the Water Tower Assessment, which is consistent with the Westlock Regional Water System Business Plan. MPE will also use a population of 5,101 from the 2016 Federal Census.

For future development, MPE will assume that residential development occurs at a density of 30 persons/hectare. It is also assumed that non-residential development growth area is equivalent to half the residential area developed.

3.2 Sanitary Sewer Design Criteria

The *Town of Westlock Procedures and Design Standards for Development, October 2009* (Design Standards), and the *Wastewater Collection System Master Plan, 2009 Update*, completed by ISL Engineering and Land Services in November 2009 (2009 Wastewater Master Plan Update) uses an average day sewage generation of 350 L/c/day. MPE will use this value for the residential sewage generation for the Town.

The design criteria used to assess the commercial/institutional and industrial development within the existing sanitary sewer collection system was taken from the *Wastewater Collection System Master Plan* completed by ISL in January 2005 (2005 Wastewater Master Plan). The sewage generation was based on billing records as follows:

- Commercial/Institutional: 3,250 L/ha/day
- Industrial/Regional Amenities: 2,000 L/ha/day

The Town's Design Standards, as well as those for other municipalities, do not provide sewage generation values for existing systems. The Town's design standard values are developed for future developments, and are conservative because the type of development is not known. As such, MPE has assumed that the commercial/industrial generation within the existing sanitary sewer system from the 2005 Wastewater Master Plan have not changed. These values are based on water billings, and are a better representation of actual sewage generation within the Town than the design standard values. MPE recommends the Town confirm these numbers when the Water Master Plan is updated.

For future development, the Town's Design Standards and the 2009 Wastewater Master Plan Update used:

- Commercial/Institutional: 40,000 L/ha/day
- Industrial/Regional Amenities: 20,000 L/ha/day

The future sewage generation rate for future industrial development is consistent with those values for future industrial development from other municipalities such as the Town of Whitecourt, Town of High Prairie, and Strathcona County. The sewage generation rate for future commercial development is twice the value of many other municipalities, but is consistent with the sewage generation recommended in the Alberta Environment and Parks Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems.

Table 3.2 provides a summary of Commercial and Industrial Sewage Generation Rates for other Alberta Municipalities.

TABLE 3.2: SEWAGE GENERATION RATE FOR OTHER ALBERTA MUNICIPALITIES

Municipality	Commercial/Industrial Sewage Generation
City of Fort Saskatchewan	17,280 L/ha/day
City of Lloydminster	17,280 L/ha/day
Parkland County	6,170 L/ha/day plus Inflow and Infiltration
Regional Municipality of Wood Buffalo	17,280 L/ha/day
Strathcona County	18,000 L/ha/day
Sturgeon County	6,170 L/ha/day
Town of High Prairie	18,000 L/ha/day
City of Edmonton	17,200 L/ha/day
Town of Whitecourt	17,000 L/ha/day – Commercial 22,500 L/ha/day - Industrial
Town of Morinville	22,500 L/ha/day – Commercial 16,878 L/ha/day – Industrial

Based on the above sewage generation rates, and discussions with the Town, MPE will use 18,000 L/ha/day for future commercial/institutional developments.

MPE used the following parameters from the 2009 Wastewater Master Plan Update and the Design Standards to assess the existing and future sanitary sewer systems:

- Inflow/Infiltration Rate: 0.20 L/s/ha
- Pipe Roughness: 0.013

  MPE will calculate the peak residential flow using a peak factor of 2.5 or Harmon's Peaking Factor, whichever is larger.

$$Harmon's\ Peaking\ Factor = 1 + \frac{14}{(4 + \sqrt{P})}$$

Where P equals the tributary population in thousands.

- Commercial, Industrial and Institutional peak flows will be calculated using a value of 3.0 times the average daily design flow.
- Acceptable velocity of sewage flows will be between 0.61 m/s (minimum) and 3.0 m/s (maximum).
- MPE will use a maximum design pipe capacity of 86% of full flow.

4.0 PREVIOUS STUDIES

4.1 Previous Recommendations

The 2009 Wastewater Master Plan Update lists recommendations to address existing system needs and future servicing.

The recommendations to address existing system needs are:

1. Conduct sewer flow monitoring on 200 mm diameter sanitary sewer mains at the following locations to determine current system performance during wet weather and the need for upgrades:
   a. On 107 Street east of 103 Avenue, and south on 103 Avenue from 107 Street
   b. On 102 Street between 105 Avenue and 106 Avenue
   c. Northwest from 107 Street and 100 Avenue through the CNR lands
2. Survey the sludge build-up in the wastewater treatment lagoons to determine current lagoon capacities. Compare to design capacities, and if required, remove the sludge to ensure adequate lagoon capacity.
3. Conduct further investigation into lagoon system capacities within the next few years to determine the need for upgrades.

The recommendations related to the Town's future sanitary sewer servicing concept are:

1. Construct a new 450 mm diameter sewer main along 113A Street from 96 Avenue to 90 Avenue, and construct a new 600 mm diameter sanitary sewer main on 90 Avenue from 113A Street to the northwest corner of Town.
2. Construct an extension of the 375 mm diameter sewer main from near the Hospital east across Highway 44 to the new extension of the 375 mm diameter sanitary sewer main from the hospital.
3. Construct a pump station and forcemain from the 200 mm diameter sanitary sewer main at 106 Street south of Highway 44 to the new extension of the 375 mm diameter sanitary sewer main from the hospital.
4. Construct a 250 mm diameter sanitary sewer main along the west Town boundary (90 Avenue) from Highway 18 to 113A Street.
5. Construct a network of new trunk sanitary sewer mains to feed a pump station in the extreme northeast.
6. Construct a new 750 mm diameter trunk sanitary sewer main from Highway 44 to the northwest corner of Town along the north Town boundary.
7. Construct a new 1,050 mm diameter outfall line to the lagoons from the northwest corner of Town.

The *Town of Westlock Flow Monitoring Report, Model Calibration and Validation* completed by WSP in July 31, 2018 (Flow Monitoring Report) lists recommendations to improve the performance of the sanitary sewer system based on flow monitoring in Westlock in 2016 and 2017.

The recommendations to improve sanitary sewer system performance are:

1. Construct the new outfall line running to the lagoons northwest of Town to reduce the loading on the trunk sewers in the northwest part of Westlock. This will reduce surcharging in areas upstream of the upgrade.
2. Upgrade and install new sewers along 105 Avenue and 102 Street to reduce the hydraulic loading in the area and accommodate additional development in East Business Park.
3. Conduct an inflow and infiltration identification program, particularly within older portions of the Town to identify what may be causing the high flows in wet weather. This program could include ditch walks, smoke tests and camera inspections.
4. Investigate additional options such as storage including pumping to empty storage facilities after peak flows subside.

4.2 Implemented Recommendations

Further to the 2009 Wastewater Master Plan Update and discussions with the Town, MPE understands that the Town has completed the following upgrades:

1. The Town conducted sewer flow monitoring on 200 mm diameter sanitary sewer mains at the following locations to determine current system performance during wet weather and the need for upgrades:
    a. On 107 Street east of 103 Avenue
    b. Northwest from 107 Street and 100 Avenue through CNR lands

For recommendations related to the Town's future sanitary sewer servicing concept:

1. The Town constructed a 300 mm and 250 mm diameter sanitary sewer main along the west Town boundary (90 Avenue) from Highway 18 to 113A Street.

With the Flow Monitoring Report being recently completed, the recommendations for sanitary sewer system improvements will be carried forward into the existing system upgrades.

5.0 EXISTING SYSTEM CONDITION

5.1 Sanitary Sewer Condition

Cam-Trac Inspection Services Ltd. (Cam-Trac) was retained to provide flushing and camera inspection services to determine the condition of a sample of sanitary sewer mains within the Town. The location of these mains was determined by the Town, and is shown as **Figure 5.1** on the following page. Cam-Trac flushed all the mains selected, however, some mains were not inspected by CCTV due to high flows and debris. This is also shown in **Figure 5.1**. Cam-Trac flushed and inspected these mains between August 1 and August 8, 2018.

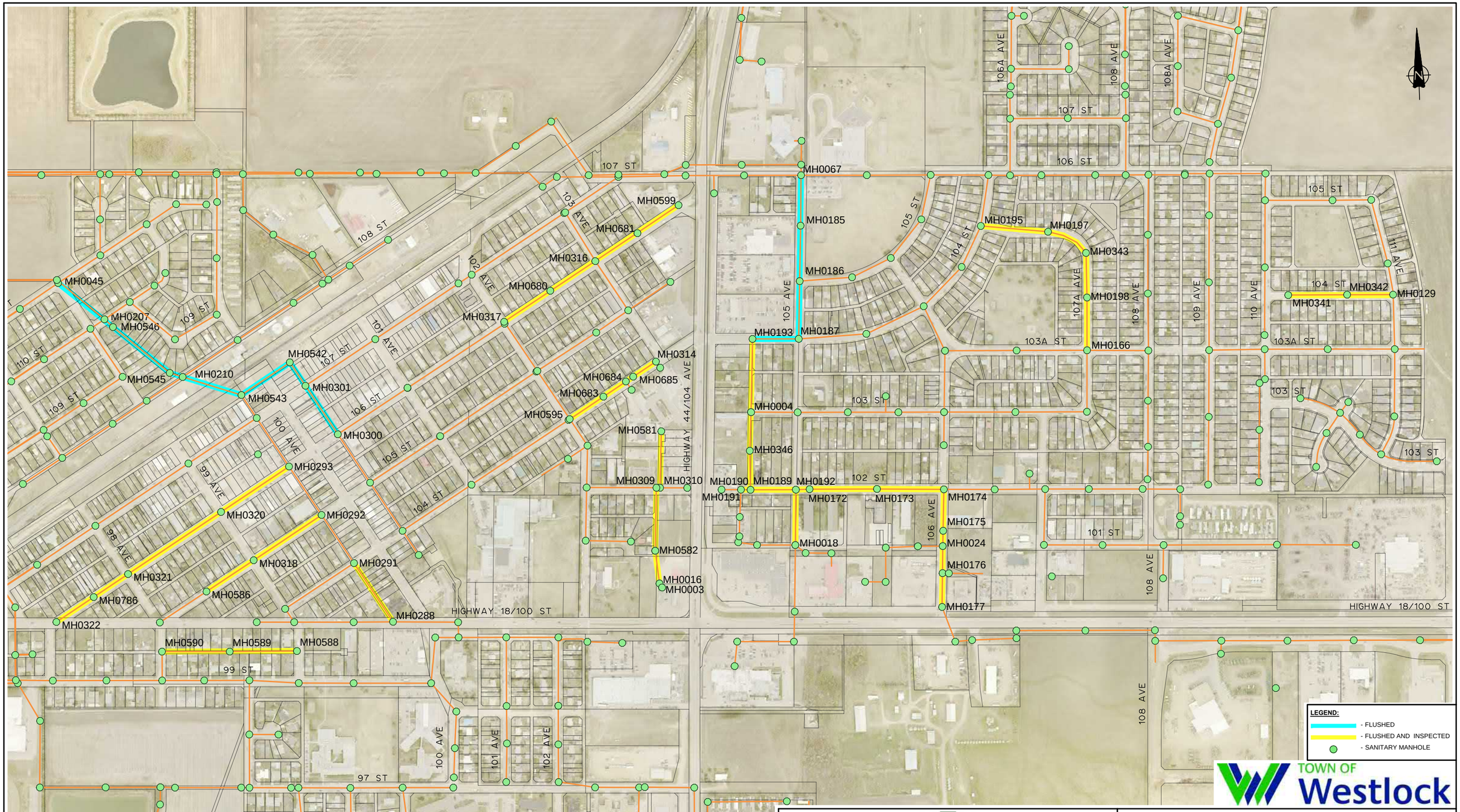
Cam-Trac reported that the section between MH0045 and MH0300 had high water and heavy debris during flushing. Additional flushing and cleaning is required along this line to complete a proper inspection. MPE recommends that the Town complete additional flushing and cleaning along this section so that it can be inspected.

Cam-Trac also reported high flows in the section between MH0193 and MH0067. The camera was under water for 60% to 70% of the inspection of this section during flushing and cleaning. This section was not inspected due to high flows. The high flows correspond to flows being above the capacity of the sanitary sewer main in the Flow Monitoring Report. This confirms the recommendation that the Town upgrade and install new sewers along 105 Avenue and 102 Street to reduce the hydraulic loading in the area and accommodate additional development in the East Business Park.

In 2016, the Town retained Sewer Infrastructure Investigation 360 to inspect the sanitary sewer by CCTV on 104 Street between 110 Avenue and 111 Avenue. The Town undertook this work as part of the preliminary design for the rehabilitation of the road surface on that block. The results of the inspection are shown in **Table 5.1** and **Figure 5.2** on the following pages.

5.2 CCTV Summary

Cam-Trac reviewed and rated each section using the NASSCO Pipeline Assessment Certification Program (PACP). Each observed defect is assigned a score, and these scores are used to provide structural and O&M condition ratings for each sanitary sewer section. The structural condition of a sanitary sewer main is determined by observed defects such as cracks, fractures, pipe deformation, offset joints, and broken pipe. The O&M condition is determined by observed items such as grease, encrustations, debris, roots, protruding services, and the camera being underwater.



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TOWN OF WESTLOCK

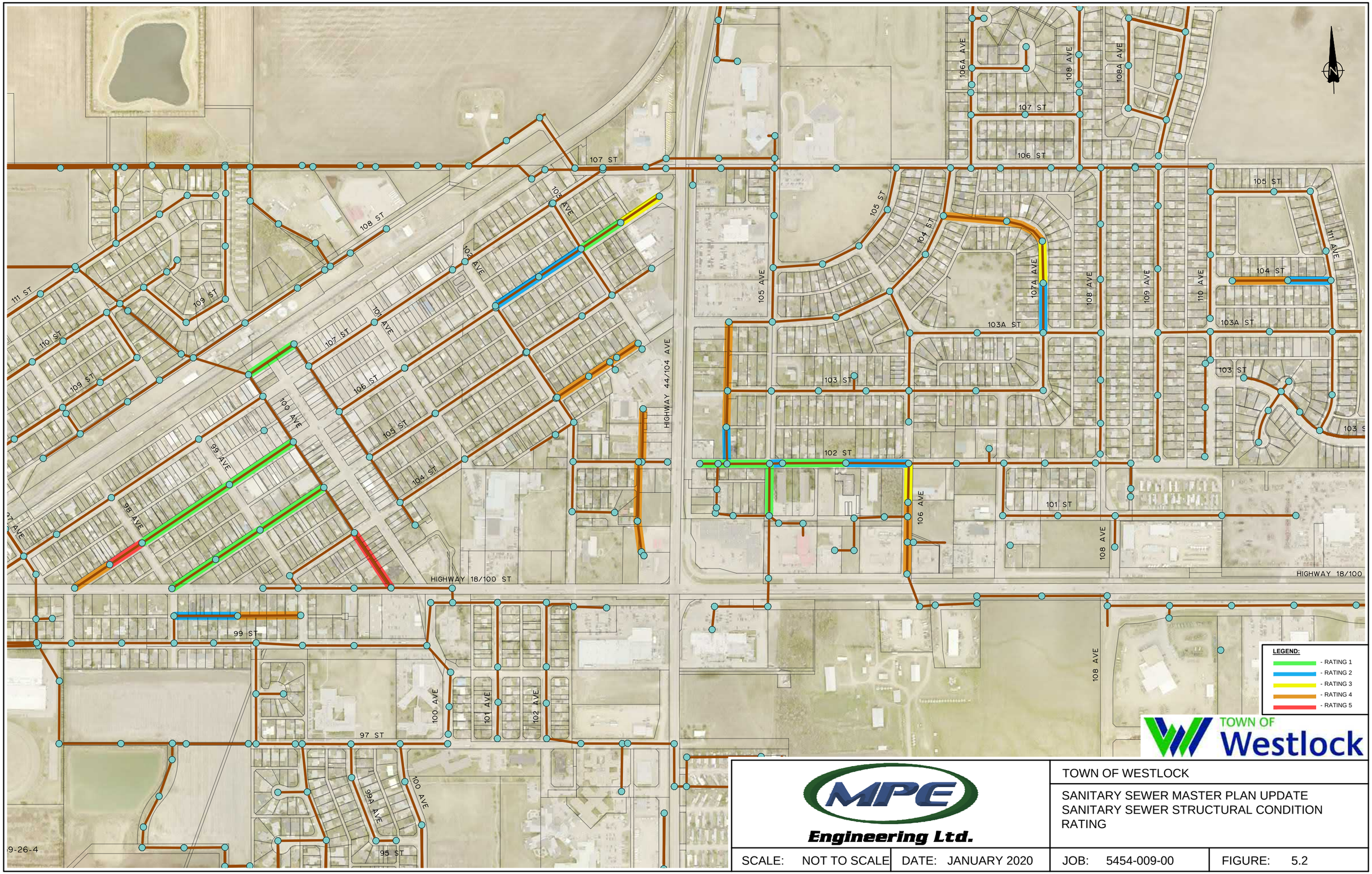
SANITARY SEWER MASTER PLAN UPDATE
2018 CCTV PROGRAM

SCALE:	NOT TO SCALE	DATE:	JANUARY 2020	JOB:	5454-009-00	FIGURE:	5.1

Town of Westlock
Sanitary Sewer Master Plan Update
Table 5.1 - Sanitary Sewer Main Condition Ratings

Legend:		
	1	Good
	2	Good
	3	Fair
	4	Fair to Poor
	5	Poor

								Structural Condition				O&M Condition				
No.	Date	From	To	Street	Material	Complete	Length (m)	Total Score	Avg.	Peak	Condition Rating	Total Score	Avg.	Peak	Condition Rating	Notes
1	9-Nov-16	MH0341	MH0342	104 Street	Clay Tile	Yes	107.1	14	0.131	4	4	4	0.037	2	2	Multiple Multiple Fractures, Multiple Cracks, Multiple Encrustations
2	9-Nov-16	MH0342	MH0129	104 Street	Clay Tile	Yes	53.1	3	0.056	2	2	9	0.169	3	3	Longitudinal Crack, Circumfrential Crack, Multiple Encrustations
01-33	1-Aug-18	MH0166	MH0198	107A Avenue	Clay Tile	Yes	94.7	8	0.084	2	2	8	0.084	2	2	Multiple Longitudinal Cracks, Multiple Encrustations, Grease
01-38	2-Aug-18	MH0189	MH0346	Alley W. 105 Ave.	Clay Tile	Yes	69.1	2	0.029	2	2	69	0.999	4	4	Longitudinal Crack, Camera Underwater Multiple Times, roots, grease, encrustations
02-33	1-Aug-18	MH0198	MH0343	107A Avenue	Clay Tile	No	87.3	18	0.206	3	3	18	0.206	2	2	Sprial fracture, Sprial Crack, Multiple Longitudinal cracks, service prevents complete inspection
02-33	1-Aug-18	MH0343	MH0198	107A Avenue	Clay Tile	No	0.6	0	0.000	0	1	0	0.000	0	1	Reached service that cannot be passed to complete reverse run
02-38	2-Aug-18	MH0346	MH0193	Alley W. 105 Ave.	Clay Tile	Yes	203.2	13	0.064	4	4	304	1.496	4	4	Multiple Fractures, Camera Underwater Multiple times., Longitudinal Cracks
03-33	1-Aug-18	MH0343	MH0197	107A Avenue	Clay Tile	No	41.2	18	0.437	4	4	12	0.291	2	2	Multiple Fractures, Multiple Longitudinal Cracks, Protruding Service Prevents Complete Inspection
03-33	1-Aug-18	MH0197	MH0343	107A Avenue	Clay Tile	No	32.3	20	0.619	4	4	6	0.186	2	2	Multliple Fractures, Multiple Longitudinal Cracks, reverse run complete
03-38	3-Aug-18	MH0309	MH0582	Alley W. 104 Ave.	Clay Tile	No	74.4	2	0.027	2	2	75	1.008	5	5	Longitudinal Crack, Camera Underwater, Root Ball and Grease prevent complete inspection
03-38	3-Aug-18	MH0582	MH0309	Alley W. 104 Ave.	Clay Tile	No	35.6	6	0.169	4	4	68	1.910	4	4	Multiple Fractures, Root mass reached to complete reverse run
04-33	1-Aug-18	MH0197	MH0195	107A Avenue	Clay Tile	Yes	120.8	42	0.348	4	4	4	0.033	2	2	Multiple Fractures, Multiple Cracks, Multiple Longitudinal Cracks
04-38	3-Aug-18	MH0016	MH0582	Alley W. 104 Ave.	Clay Tile	Yes	49.4	4	0.081	4	4	85	1.721	5	5	Longitudinal Hinge Fracture, Multiple Encrustations from 5% to 40% of pipe diameter, Infiltration - Dripper
05-33	1-Aug-18	MH0177	MH0176	106 Avenue	Clay Tile	No	1.5	0	0.000	0	1	0	0.000	0	1	Camera was underwater at start, would not advance
05-33	1-Aug-18	MH0177	MH0176	106 Avenue	Clay Tile	No	59.4	6	0.101	4	4	4	0.067	2	2	Multiple Fractures, Circumfrential Fracture, reverse run complete
05-38	3-Aug-18	MH0683	MH0595	104 Street	Clay Tile	No	60	4	0.067	4	4	19	0.317	4	4	Multiple fractures, Camera Underwater, Encrustation prevents complete survey
05-38	3-Aug-18	MH0595	MH0683	104 Street	Clay Tile	No	15.2	1	0.066	1	1	6	0.395	4	4	Medium Joint Displacement, Reached encrustation to complete reverse run
06-33	1-Aug-18	MH0176	MH0024	106 Avenue	Clay Tile	Yes	48.2	9	0.187	4	4	9	0.187	3	3	Multiple Fractures, multiple cracks, multiple encrustations
06-38	3-Aug-18	MH0314	MH0685	104 Street	Clay Tile	Yes	49	13	0.265	4	4	16	0.327	4	4	Multiple Fractures, multiple Cracks, Multiple Longitudinal Cracks, Camera Underwater
07-33	1-Aug-18	MH0024	MH0175	106 Avenue	Clay Tile	Yes	28.3	4	0.141	4	4	2	0.071	2	2	Multiple Fractures, Encrustation
07-38	3-Aug-18	MH0685	MH0684	104 Street	Clay Tile	Yes	15.3	4	0.261	4	4	4	0.261	4	4	Multiple Fractures, Camera Underwater
08-33	1-Aug-18	MH0175	MH0174	106 Avenue	Clay Tile	Yes	74	5	0.068	3	3	11	0.149	4	4	Multiple Cracks, Longitudinal Cracks, Camera Underwater
08-38	3-Aug-18	MH0684	MH0683	104 Street	Clay Tile	Yes	49.3	6	0.122	4	4	26	0.527	4	4	Multiple Fractures, Circumfrential Fracture, Multiple Camera Underwater
09-33	2-Aug-18	MH0174	MH0173	102 Street	Clay Tile	Yes	121.3	3	0.025	2	2	48	0.396	2	2	Circumfrentail crack, spiral crack, multiple encrustations
09-38	7-Aug-18	MH0542	MH0543	Alley N. 107 St.	Clay Tile	No	2.5	0	0.000	0	1	4	1.600	4	4	Camera underwater at start of inspection, cannot continue, line requires extra flushing
10-33	2-Aug-18	MH0173	MH0172	102 Street	Clay Tile	No	75.7	0	0.000	0	1	24	0.317	3	3	Multiple encrustations, multiple grease, cannot pass auger sticking out of service
10-33	2-Aug-18	MH0172	MH0173	102 Street	Clay Tile	No	44.9	0	0.000	0	1	34	0.757	4	4	Camera Underwater, multiple grease, reverse run complete
10-38	7-Aug-18	MH0322	MH0786	106 Street	Clay Tile	No	52.1	43	0.825	4	4	30	0.576	4	4	Multiple fractures, longitudinal fractures, camera underwater, protruding service prevents complete inspection
10-38	8-Aug-18	MH0786	MH0322	106 Street	Clay Tile	No	0.1	0	0.000	0	1	0	0.000	0	1	Camera cannot enter line due to offset benching. Also a void between benching and main. No reverse run.
11-33	2-Aug-18	MH0172	MH0192	102 Street	Clay Tile	No	19.8	0	0.000	0	1	4	0.202	4	4	Camera underwater, protruding service prevents complete inspection.
11-33	2-Aug-18	MH0192	MH0172	102 Street	Clay Tile	No	3.5	4	1.143	2	2	0	0.000	0	1	Multiple Spiral Cracks
11-38	7-Aug-18	MH0786	MH0321	106 Street	Clay Tile	No	0.1	5	50.000	5	5	0	0.000	0	1	Broken pipe, void visible, prevents complete survey
11-38	8-Aug-18	MH0321	MH0786	106 Street	Clay Tile	No	0.1	0	0.000	0	1	0	0.000	0	1	No benching in MH0321, camera cannot enter line. No reverse run is possible
12-33	2-Aug-18	MH0192	MH0189	102 Street	Clay Tile	Yes	81.6	0	0.000	0	1	12	0.147	4	4	Camera Underwater Multiple Times
12-38	8-Aug-18	MH0581	MH0310	Alley W. 104 Ave. N. 102 St.	Clay Tile	No	2.3	5	2.174	4	4	2	0.870	2	2	Multiple fractures, medium joint displacement, protruding service prevents complete inspection
12-38	8-Aug-18	MH0310	MH0581	Alley W. 104 Ave. N. 102 St.	Clay Tile	No	70.4	3	0.043	3	3	12	0.170	4	4	Longitudinal fracture, multiple camera underwater, transition from PVC to VCP prevents complete inspection.
13-33	3-Aug-18	MH0018	MH0192	101 St & 105 Ave	Clay Tile	No	59.8	0	0.000	0	1	47	0.786	4	4	Multiple grease deposits, one of which prevents complete survey.
13-33	3-Aug-18	MH0192	MH0018	101 St & 105 Ave	Clay Tile	No	2.5	0	0.000	0	1	4	1.600	4	4	Camera Underwater, unseen obstruction prevents complete survey.
14-33	3-Aug-18	MH0191	MH0190	101 St & 105 Ave	PVC	Yes	34.3	0	0.000	0	1	4	0.117	2	2	Grease, encrustation
15-33	3-Aug-18	MH0190	MH0189	101 St & 105 Ave	PVC	Yes	16.4	0	0.000	0	1	2	0.122	2	2	Grease
16-33	3-Aug-18	MH0599	MH0681	106 Street	Clay Tile	No	74.3	3	0.040	3	3	22	0.296	2	2	Multiple cracks, multiple encrustation, multiple gravel, encrustation prevents complete survey
16-33	3-Aug-18	MH0681	MH0599	106 Street	Clay Tile	No	15.5	0	0.000	0	1	2	0.129	2	2	Encrustation, reverse run complete
17-33	3-Aug-18	MH0681	MH0316	106 Street	Clay Tile	No	57.3	0	0.000	0	1	0	0.000	0	1	Protruding service prevents complete survey
17-33	3-Aug-18	MH0316	MH0681	106 Street	Clay Tile	No	30	0	0.000	0	1	11	0.367	3	3	Multiple roots, protruding service prevents complete survey
18-33	3-Aug-18	MH0317	MH0680	106 Street	Clay Tile	Yes	100.3	6	0.060	2	2	4	0.040	2	2	Multiple longitudinal cracks, spiral crack, multiple encrustations
19-33	3-Aug-18	MH0680	MH0316	106 Street	Clay Tile	No	50.2	3	0.060	2	2	6	0.120	2	2	Circumfrential crack, spiral crack, multiple grease, cannot pass under water structure
19-33	7-Aug-18	MH0316	MH0680	106 Street	Clay Tile	No	48.7	2	0.041	2	2	22	0.452	4	4	Longitudinal crack, multiple camera underwater, multiple grease, reverse run complete
20-33	7-Aug-18	MH0288	MH0291	104 Street	Clay Tile	No	3.7	5	1.351	5	5	0	0.000	0	1	Broken pipe, void visible, survey abandoned, camera cannot proceed
20-33	8-Aug-18	MH0291	MH0288	99 Ave. - 105 St.	Clay Tile	No	27.2	6	0.221	3	3	11	0.404	2	2	Multiple cracks, multiple grease, protruding service prevents complete inspeciton
21-33	7-Aug-18	MH0588	MH0589	99 Street	Clay Tile	Yes	122.9	18	0.146	4	4	21	0.171	4	4	Multiple fractures, multiple circumfrential fractures, longitudinal crack, multiple grease
22-33	7-Aug-18	MH0589	MH0590	99 Street	Clay Tile	No	40.9	4	0.098	2	2	0	0.000	0	1	Circumfrential fracture, longitudinal crack, suvery abandoned at 100% sag
22-33	8-Aug-18	MH0590	MH0589	99 Street	Clay Tile	No	41.4	0	0.000	0	1	2	0.048	2	2	Grease, Protruding service prevents complete inspection, reverse run abandoned
23-33	8-Aug-18	MH0586	MH0318	99 Ave. - 105 St.	PVC	Yes	102.5	0	0.000	0	1	0	0.000	0	1	
24-33	8-Aug-18	MH0318	MH0318A	99 Ave. - 105 St.	PVC	Yes	67	0	0.000	0	1	0	0.000	0	1	
25-33	8-Aug-18	MH0318A	MH0292	99 Ave. - 105 St.	PVC	Yes	79.8	0	0.000	0	1	16	0.201	2	2	Multiple grease, encrustation
26-33	8-Aug-18	MH0321	MH0320	106 Street	Clay Tile	No	28.5	0	0.000	0	1	2	0.070	1	1	Multiple roots, protruding service prevents complete survey
26-33	8-Aug-18	MH0320	MH0321	106 Street	Clay Tile	No	0.1	0	0.000	0	1	0	0.000	0	1	No manhole benching, camera under water in mud.
27-33	8-Aug-18	MH0320	MH0293	106 Street	Clay Tile	No	64.9	0	0.000	0	1	2	0.031	2	2	Encrustation, protruding service prevents complete inspection
27-33	8-Aug-18	MH0293	MH0320	106 Street	Clay Tile	No	82	0	0.000	0	1	2	0.024	2	2	Grease, reverse run complete



Engineering Ltd.

TOWN OF WESTLOCK

SANITARY SEWER MASTER PLAN UPDATE
SANITARY SEWER STRUCTURAL CONDITION RATING

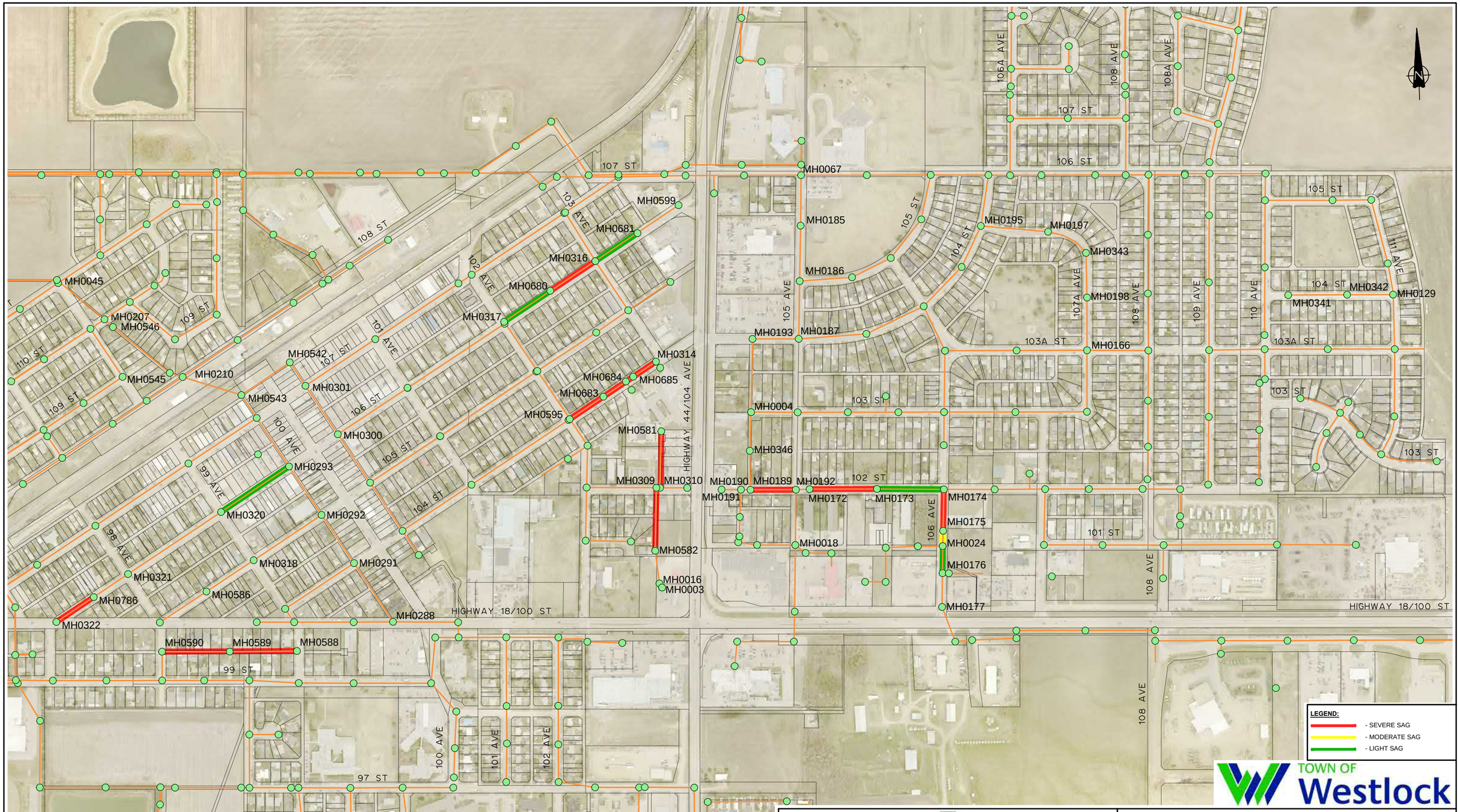
SCALE:	NOT TO SCALE	DATE:	JANUARY 2020	JOB:	5454-009-00	FIGURE:	5.2

A summary of the scores and condition ratings for each sanitary sewer section is provided in **Table 5.1**. The structural condition ratings for each section of sanitary sewer main are shown in **Figure 5.2**. A rating of 5 means that the sanitary sewer section is in poor structural or O&M condition. A rating of 1 means that the sanitary sewer is in good structural or O&M condition.

While sags are not assigned a score in the PACP program, other rating systems assign scores for these defects. Severe sags occur when the camera is underwater, moderate sags occur when the camera is partially submerged, and light sags occur when the water level is below the camera level. A summary of the sags observed is provided in **Table 5.2** below and are shown in **Figure 5.3** on the following page. MPE will consider sections of sanitary sewer main with severe sags to be in poor structural condition, with a rating of 5, and will consider sections of sanitary sewer main with moderate sags to be in moderate structural condition, with a rating of 3.

TABLE 5.2: SAG SUMMARY

From	To	Condition Rating	Sags
MH0309	MH0582	4	Light Sag, Severe Sag
MH0683	MH0595	4	Severe sag, 3 moderate sags
MH0176	MH0024	4	Multiple light sags
MH0314	MH0685	4	Severe sag
MH0024	MH0175	4	Moderate sag
MH0685	MH0684	4	Severe sag
MH0175	MH0174	3	Severe sag
MH0684	MH0683	4	Multiple Severe Sags
MH0174	MH0173	2	Multiple Light Sags
MH0173	MH0172	1	Multiple Light Sags, severe sag
MH0322	MH0786	4	Severe sag
MH0192	MH0190	1	Multiple Severe Sags
MH0310	MH0581	4	Multiple Severe Sags
MH0681	MH0316	1	Multiple light sags
MH0317	MH0680	2	Multiple light sags
MH0680	MH0316	2	Severe sag, light sag
MH0588	MH0589	4	Severe sag, light sag
MH0589	MH0590	2	Severe sag, multiple light sags
MH0320	MH0293	1	Multiple light sags



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TOWN OF WESTLOCK

SANITARY SEWER MASTER PLAN UPDATE
SANITARY SEWER SAG SUMMARY

SCALE:	NOT TO SCALE	DATE:	JANUARY 2020	JOB:	5454-009-00	FIGURE:	5.3

Table 5.1 and **Figure 5.2** show the majority of sanitary sewer mains inspected by CCTV have a structural condition rating of 4. There are two sanitary sewer mains with structural condition ratings of 5:

1. MH0786 to MH0321 on 106 Street
2. MH0291 to MH0288 in the alley west of 100 Avenue, between 104 Street and 100 Street

MPE recommends that sanitary sewer mains receiving a structural condition rating of 5 be the first priority for structural condition rehabilitation. We understand that the Town rehabilitated the sanitary sewer main between MH0291 and MH0288. MPE recommends that sanitary sewer mains receiving a structural condition rating of 4 be the second priority for structural condition rehabilitation. As part of the Town's ongoing operation and maintenance program, MPE recommends that sanitary sewer mains receiving a structural condition rating of 3 or less have their condition monitored.

The section of sanitary sewer main between MH0321 and MH0320 on 106 Street has a structural condition rating of 1. Less than half the main was inspected due to a protruding service and no benching in MH0321. MPE recommends that part of the rehabilitation of the sanitary sewer main between MH0786 and MH0321 include the installation of benching in MH0321. Once the benching is installed, it is recommended that the sanitary sewer main between MH0321 and MH0320 be inspected again to determine its' condition.

Table 5.1 also shows the O&M condition ratings for each section of sanitary sewer main inspected by Cam-Trac. O&M condition items can be remedied through proper operation and maintenance of the sanitary sewer system such as flushing. MPE recommends that the Town develop a flushing program to remedy the sections of sanitary sewer main with O&M condition ratings of 5 and 4. After the inspection, Cam-Trac performed root cutting between MH0582 and MH0309 and grease cutting between MH0018 and MH0192.

5.3 Manhole Condition

Manholes were not inspected as part of the sanitary sewer CCTV inspection work. MPE recommends the Town evaluate the condition of the manholes prior to any sanitary sewer rehabilitation. If the manholes are in poor condition, it is recommended that the Town repair or replace them as part of the sanitary sewer rehabilitation.

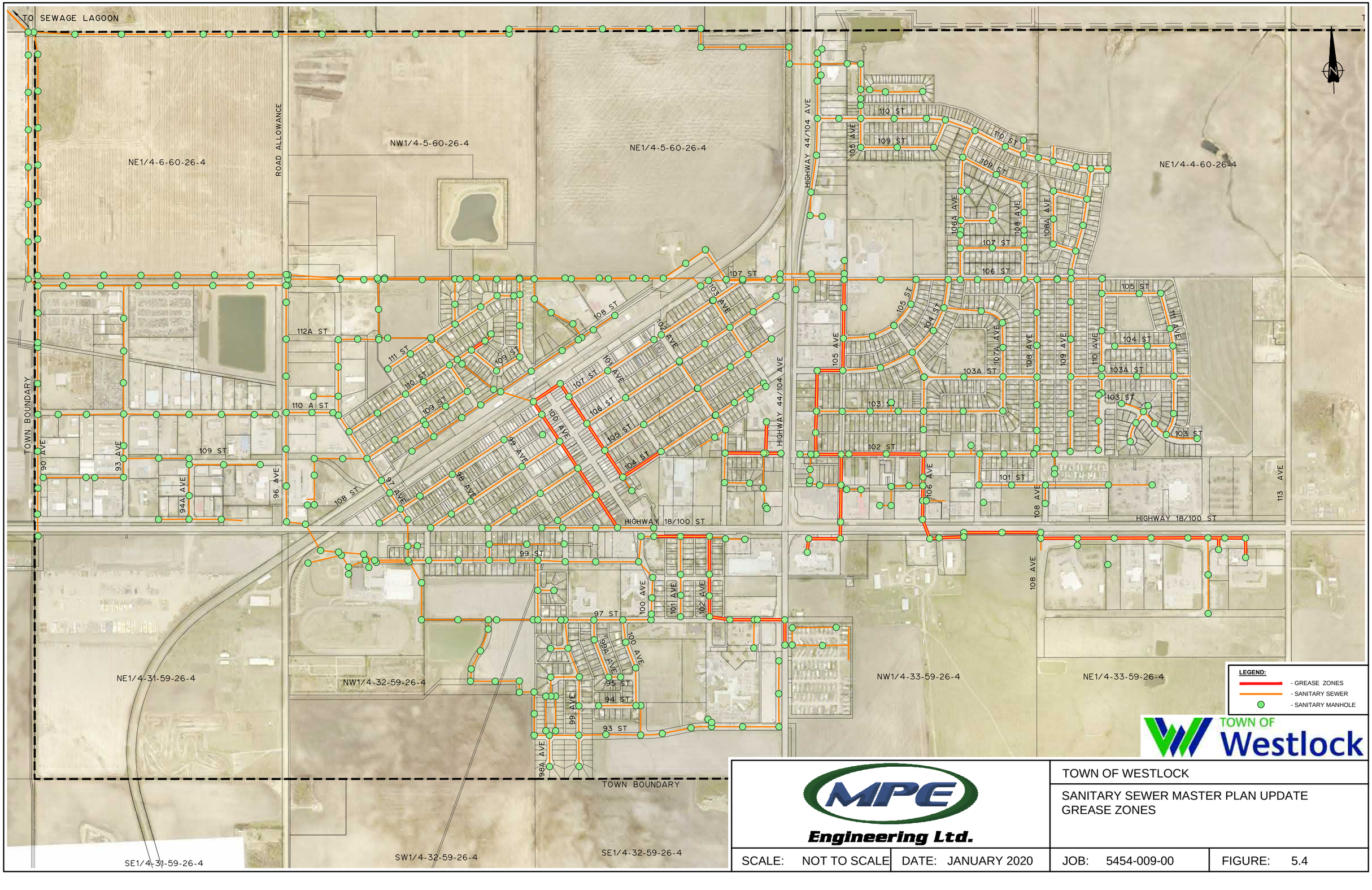
5.4 Future Assessment

The CCTV work completed by Cam-Trac totals 2.8 km of sanitary sewer main inspected and rated for condition. With a total of approximately 56.7 km of sanitary sewer main, MPE recommends that the Town develop a program as part of the ongoing operation and maintenance to inspect part of the sanitary sewer system every year and assess its' condition. This will help the Town in identifying areas requiring replacement and rehabilitation, and developing future infrastructure upgrade programs.

MPE also recommends that the Town inspect the sanitary sewer manholes as part of this future assessment to determine their condition.

5.5 Grease Zones

Figure 5.4 on the following page shows grease zones identified by Town staff. These zones correspond to two areas that were not inspected due to high flow and debris. The zones are in proximity to commercial areas. The trunk mains moving sewage north and west towards the wastewater treatment plant are considered grease zones. To remedy the grease zones, MPE recommends the Town inspect the grease traps in commercial businesses to determine if they are being cleaned by their owners and are working properly.



MPE Engineering Ltd.

TOWN OF WESTLOCK

SANITARY SEWER MASTER PLAN UPDATE
GREASE ZONES

SCALE:	NOT TO SCALE	DATE:	JANUARY 2020	JOB:	5454-009-00	FIGURE:	5.4

6.0 SANITARY SEWER SYSTEM MODEL

6.1 Computer Model

The computer model of the Town's Sanitary Sewer System is an XPSWMM model. XPSWMM is a Windows based stormwater and sanitary management modelling software package. The model was created in 2004, and was updated in July 2018 as part of the Flow Monitoring Report. This model update included a calibration using flow and rainfall data collected in 2016 and 2017 as part of the Flow Monitoring project.

As part of the Master Plan, MPE has reviewed and verified the July 2018 update of the model.

6.2 Existing System Assessment

6.2.1 Existing System Hydraulics

MPE tested the existing system hydraulics using a historical storm event from July 7-8, 2004. This event was used in the Flow Monitoring Report, as it represents an approximately 1:5-year return period storm. This event is also similar in size to the events used in the calibration process for the Flow Monitoring Report.

The performance of the existing system is shown in **Figure 6.1**. The model review and verification found issues with system capacity in the downtown, East Business Park, and the industrial area.

As shown in **Figure 6.1**, there are situations where the existing pipe utilization is 0-100%, but the HGL is shown to be at the surface or 0 to 1.5 m below the surface. These are situations where a pipe is backed up due to high levels of infiltration during the peak of a storm event. This infiltration causes upstream manholes at lower elevations to surcharge due to temporary reverse flow. In these cases, the pipe downstream of the upstream manhole that is surcharging is not running beyond 100% flow capacity, it is just backing up.

6.2.2 Existing System Upgrades

The model review and verification found that central Westlock, the East Business Park, and the industrial area have capacity issues. The large storm event of August 2016 caused significant inflow and infiltration into the sanitary sewer system in the industrial area. The Flow Monitoring Report showed that other storm events resulted in significant inflow and infiltration contributions in this area.

To solve these issues, MPE developed two scenarios:

TO SEWAGE LAGOON
SEE INSET 'A'

TOWN BOUNDARY

NE 1/4 6-60-26-W4M

ROAD ALLOWANCE

NW 1/4 5-60-26-W4M

NE 1/4 5-60-26-W4M

HIGHWAY 44/104 AVE

NE 1/4 4-60-26-W4M

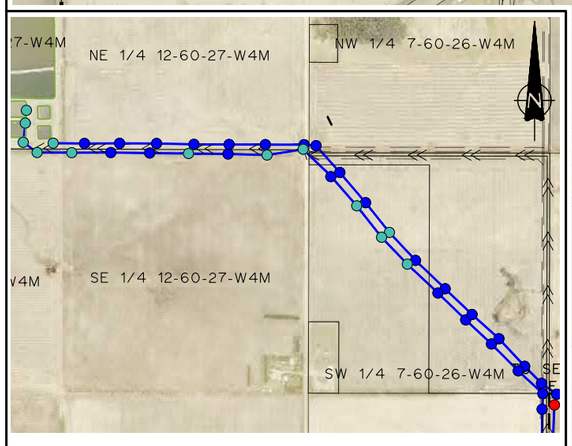
HIGHWAY 18/100 ST

NW 1/4 32-59-26-W4M

NW 1/4 33-59-26-W4M

NE 1/4 33-59-26-W4M

TOWN BOUNDARY



INSET 'A'
NOT TO SCALE

LEGEND:

- TOWN BOUNDARY
- HGL RELATIVE TO GROUND
  - AT SURFACE
  - 0 - 1.5m BELOW SURFACE
  - 1.5 - 2.5m BELOW SURFACE
  - >2.5m BELOW SURFACE
- EXISTING PIPE UTILIZATION
  - 0 - 100%
  - 100 - 150%
  - >150%

TOWN OF Westlock

MPE Engineering Ltd.

TOWN OF WESTLOCK

SANITARY SEWER MASTER PLAN UPDATE
EXISTING SYSTEM PERFORMANCE

SCALE: 1:10000	DATE: JANUARY 2020	JOB: 5454-009-00	FIGURE: 6.1

- Scenario 1 includes construction of a proposed outfall line from 96 Avenue and 113A Street to the sewage lagoons as shown in **Figure 6.2**. The Town can construct this trunk main in phases, with the 450 mm and 600 mm diameter pipe installed first, and the remaining 1050 mm diameter pipe installed afterwards.
- Scenario 2 includes construction of a proposed 450 mm diameter main across the NE ¼ Sec. 5-60-26 W4M and the same 1050 mm diameter outfall line shown in Scenario 1. This is shown in **Figure 6.3**. The Town can also construct this scenario in phases, with the 450 mm diameter pipe installed first, and the remaining 1050 mm diameter pipe installed afterwards.

With the construction of either scenario, the existing system still has capacity issues in the eastern part of Westlock, north of Highway 18 on 102 Street and 105 Avenue. To resolve these issues, MPE recommends upgrades to the sewer from 106 Street and 105 Avenue to Highway 18 and 108 Avenue. These upgrades include the following:

- Upgrade the existing sanitary sewer main on 106 Street between 105 Avenue to 106A Avenue from 250 mm to 375 mm.
- Upgrade the existing sanitary sewer main on 105 Avenue between 106 Street and 104 Street from 250 mm diameter to 375 mm diameter.
- Construct a new 375 mm diameter sanitary sewer main along 105 Avenue from 102 Street to 104 Street.
- Re-grade the new sanitary sewer mains along 105 Avenue from 106 Street to 102 Street to 0.57%.
- Re-grade the existing sanitary sewer main on 104 Street from 105 Avenue west to 0.49%.
- Upgrade the sanitary sewer main on 102 Street from 105 Avenue to 106 Avenue from 200 mm diameter to 300 mm diameter.
- Upgrade the sanitary sewer main on 105 Avenue between 102 Street and Highway 18 from 200 mm diameter to 375 mm diameter.
- Install a new 375 mm diameter sanitary sewer main on Highway 18 between 105 Avenue and 106 Avenue.
- Upgrade the sanitary sewer main on Highway 18 between 106 Avenue and 108 Avenue from 200 mm diameter to 300 mm diameter.

MPE recommends that the Town confirm the actual manhole elevations and sanitary sewer main grades prior to construction of any sanitary sewer upgrades.

The existing 200 mm diameter main that flows east-west on 100 Street from 102 Avenue to 101 Avenue is modelled to surcharge, and be over capacity. This is due to one of the mains being installed at 0.12%

NEW 1050mm

TO SEWAGE LAGOON
SEE INSET 'A'

NEW 600mm

NEW 450mm

NE 1/4 6-60-26-W4M

ROAD ALLOWANCE

NW 1/4 5-60-26-W4M

NE 1/4 5-60-26-W4M

HIGHWAY 44/104 AVE

TOWN BOUNDARY

NE 1/4 4-60-26-W4M

REPLACE EX.
250mm WITH
375mm PIPE

RE-GRADE
PIPE TO
0.57%

REPLACE EX.
250mm WITH
375mm PIPE

RE-GRADE
TO 0.49%

NEW 375mm
PIPE

REPLACE EX 200mm
WITH 300mm PIPE

REPLACE EX
200mm WITH
375mm PIPE

REPLACE EX 200mm
WITH 300mm PIPE

NEW 375mm PIPE

NEW 200mm PIPE

HIGHWAY 18/100 ST

HIGHWAY 44/104 AVE

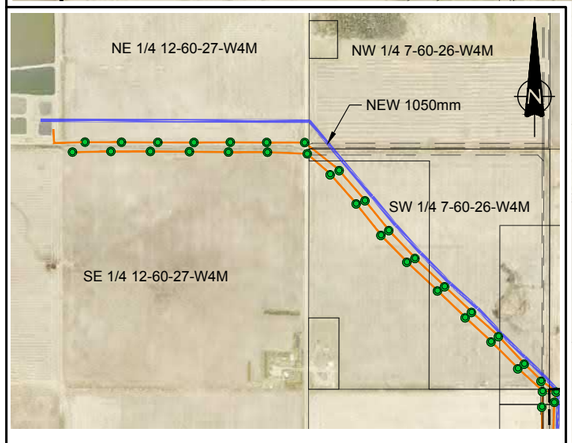
HIGHWAY 18/100 ST

NW 1/4 32-59-26-W4M

NW 1/4 33-59-26-W4M

NE 1/4 33-59-26-W4M

TOWN BOUNDARY



INSET 'A'
NOT TO SCALE

LEGEND:
- EXISTING PIPE
- SYSTEM UPGRADES
- EXISTING MANHOLE

TOWN OF Westlock

MPE Engineering Ltd.

TOWN OF WESTLOCK

SANITARY SEWER MASTER PLAN UPDATE
PROPOSED UPGRADES TO SANITAY SEWER SYSTEM
REDUCED BUILD-OUT SCENARIO 1

SCALE: 1:10000	DATE: JANUARY 2020	JOB: 5454-009-00	FIGURE: 6.2

NEW 1050mm

TO SEWAGE LAGOON
SEE INSET 'A'

TOWN BOUNDARY

NE 1/4 6-60-26-W4M

ROAD ALLOWANCE

NW 1/4 5-60-26-W4M

NE 1/4 5-60-26-W4M

NEW 450mm

HIGHWAY 44/104 AVE

NE 1/4 4-60-26-W4M

REPLACE EX.
250mm WITH
375mm PIPE

RE-GRADE
PIPE TO
0.57%

REPLACE EX.
250mm WITH
375mm PIPE

RE-GRADE
TO 0.49%

NEW 375mm PIPE

REPLACE EX 200mm
WITH 300mm PIPE

REPLACE EX
200mm WITH
375mm PIPE

REPLACE EX 200mm
WITH 300mm PIPE

NEW 375mm PIPE

NEW 200mm PIPE

HIGHWAY 18/100 ST

HIGHWAY 44/104 AVE

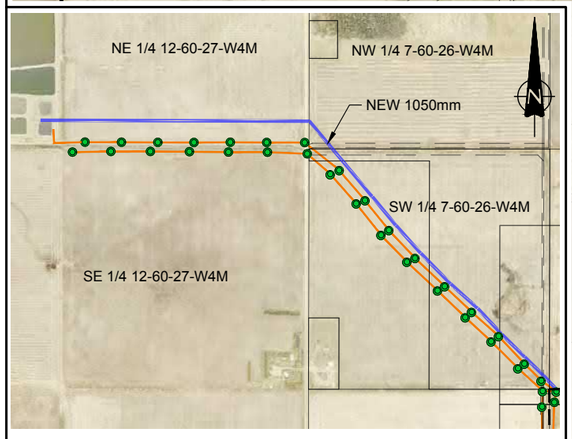
HIGHWAY 18/100 ST

NW 1/4 32-59-26-W4M

NW 1/4 33-59-26-W4M

NE 1/4 33-59-26-W4M

TOWN BOUNDARY



INSET 'A'
NOT TO SCALE

LEGEND:
EXISTING PIPE
SYSTEM UPGRADES
EXISTING MANHOLE

TOWN OF Westlock

MPE Engineering Ltd.

TOWN OF WESTLOCK

SANITARY SEWER MASTER PLAN UPDATE
PROPOSED UPGRADES TO SANITARY SEWER SYSTEM
REDUCED BUILD-OUT SCENARIO 2

SCALE: 1:10000	DATE: JANUARY 2020	JOB: 5454-009-00	FIGURE: 6.3

grade, which is less than the minimum 0.4% grade in the Design Standards. To resolve these issues, we examined the following options:

- Construction of a 200 mm diameter sanitary sewer main crossing Highway 18 east of the intersection with 100 Avenue.
- Replacement of the main with 0.12% grade, and the main immediately upstream, by with new mains with increased size or slope.

When examining these options, the 200 mm diameter sanitary sewer main alleviated some of the manhole surcharging. Increasing the size of the main with 0.12% grade would result in a larger diameter main flowing into a smaller diameter main. This is because the mains downstream are not modelled to surcharge, and do not require upgrading. According to information available to MPE, the mains and road surface in the area were rehabilitated by the Town in 2016. Recommending upgrading of mains in an area that was recently rehabilitated will have a negative public perception for the Town amongst neighbourhood residents. As such, we recommend that the Town conduct flow monitoring along this section to determine the actual flows in the area to confirm the degree of surcharging that occurs in the area.

If the Town proceeds with crossing Highway 18 with a sanitary sewer main, MPE recommends the Town consider a sanitary sewer main larger than 200 mm in diameter to accommodate future growth. The costs associated with this upgrade are mostly due to crossing the Highway, and an increase in pipe size is minimal in comparison.

Upgrades to the existing sanitary sewer system for each scenario are shown in **Figures 6.2** and **6.3**. The performance of the Town's sanitary sewer system with the proposed upgrades for each scenario is shown in **Figure 6.4** and **Figure 6.5**.

As mentioned above, the sanitary sewer system has issues with inflow and infiltration. The exact causes of the inflow and infiltration are unknown. MPE recommends that the Town undertake an Inflow and Infiltration program to determine the sources of flow into the sanitary sewer system. This program could include:

- Walking ditches to look for faulty manholes or ponding locations;
- Smoke tests to identify poor or illegal connections; and
- CCTV inspection of the sanitary sewers.

NE 1/4 6-60-26-W4M

NW 1/4 5-60-26-W4M

NE 1/4 5-60-26-W4M

NE 1/4 4-60-26-W4M

NW 1/4 33-59-26-W4M

NE 1/4 33-59-26-W4M

NW 1/4 32-59-26-W4M

TOWN BOUNDARY

ROAD ALLOWANCE

HIGHWAY 44/104 AVE

FUTURE PIPE

HIGHWAY 18/100 ST

113A ST

110 A ST

111 ST

110 ST

109 ST

108 ST

107 ST

106 ST

105 ST

104 ST

103A ST

103 ST

102 ST

101 ST

99 ST

97 ST

95 ST

94 ST

90 AVE

93 AVE

94A AVE

96 AVE

98 AVE

99 AVE

100 AVE

101 AVE

102 AVE

103 AVE

104 AVE

105 AVE

106 AVE

106A AVE

107 AVE

107A AVE

108 AVE

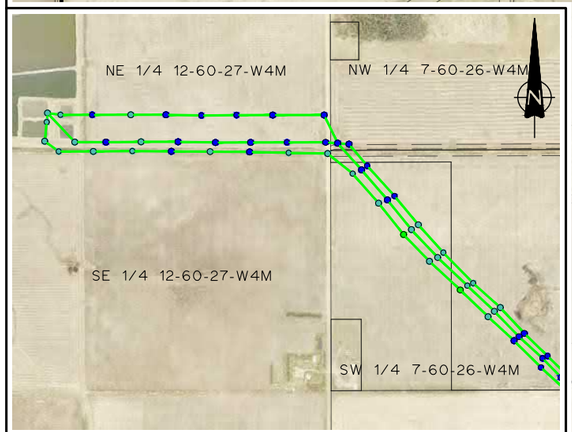
108A AVE

109 AVE

110 AVE

111 AVE

113 AVE



INSET 'A'
NOT TO SCALE

LEGEND:

- TOWN BOUNDARY
- HGL RELATIVE TO GROUND
  - AT SURFACE
  - 0 - 1.5m BELOW SURFACE
  - 1.5 - 2.5m BELOW SURFACE
  - >2.5m BELOW SURFACE
- EXISTING PIPE UTILIZATION
  - 0 - 100%
  - 100 - 150%
  - >150%

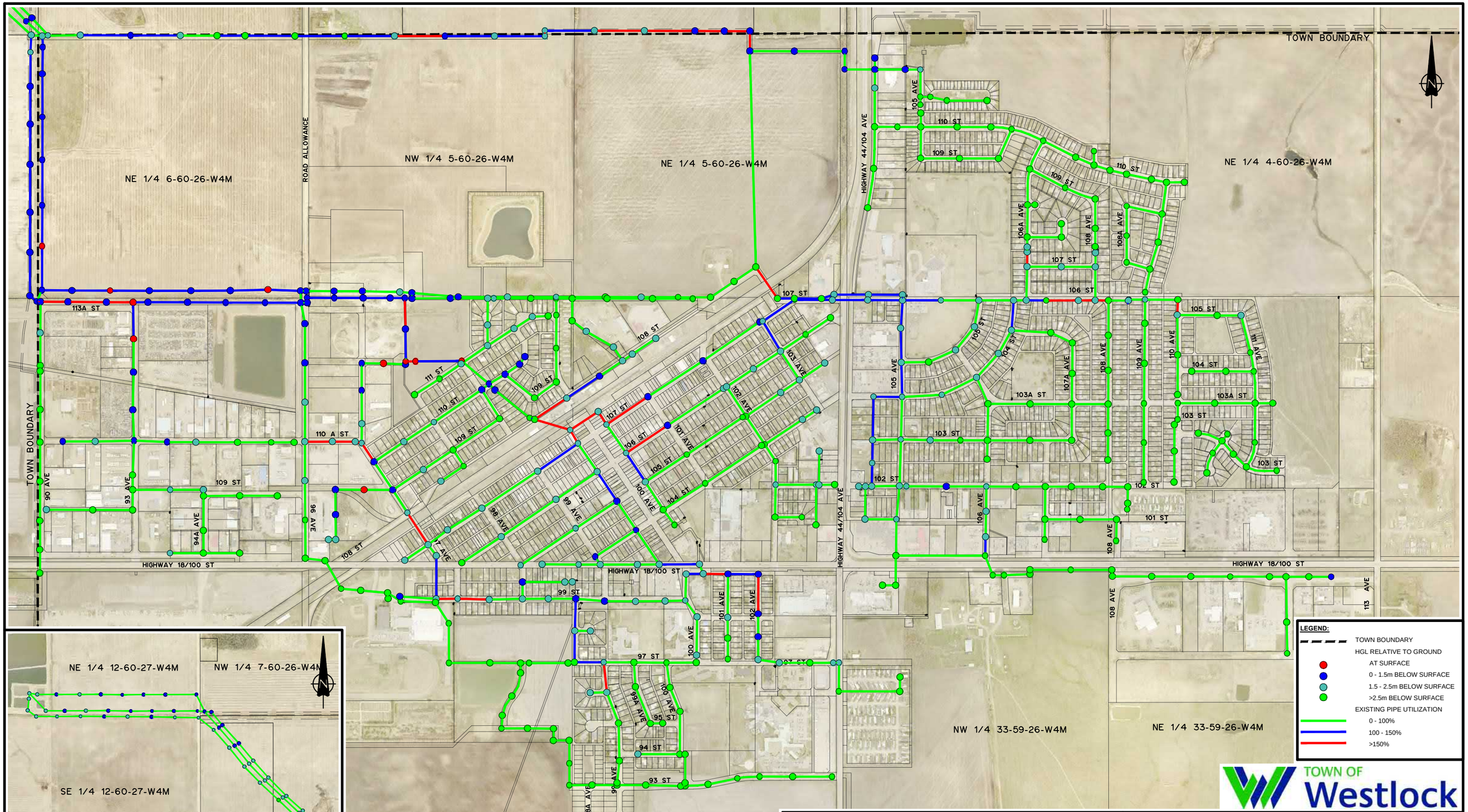
TOWN OF Westlock

MPE Engineering Ltd.

TOWN OF WESTLOCK

SANITARY SEWER MASTER PLAN UPDATE
EXISTING SYSTEM PERFORMANCE WITH UPGRADES
SCENARIO 1

SCALE: 1:10000	DATE: JANUARY 2020	JOB: 5454-009-00	FIGURE: 6.4



INSET 'A'
NOT TO SCALE

TOWN OF Westlock

MPE Engineering Ltd.

TOWN OF WESTLOCK

SANITARY SEWER MASTER PLAN UPDATE
EXISTING SYSTEM PERFORMANCE WITH UPGRADES
SCENARIO 2

SCALE: 1:10000	DATE: JANUARY 2020	JOB: 5454-009-00	FIGURE: 6.5

Addressing some of the poor or illegal connections and areas ponding over manhole covers will aid in relieving the sanitary sewer system during storm events.

MPE also recommends that the Town monitor newer neighborhoods (Aspendale, Altador, Polymanth) to monitor the new sanitary sewer mains performance in comparison to the older portions of the system. This monitoring will provide further model calibration data in the northeast part of the Town.

6.3 Servicing of Future Development Areas

6.3.1 Servicing Concepts for Future Development Areas

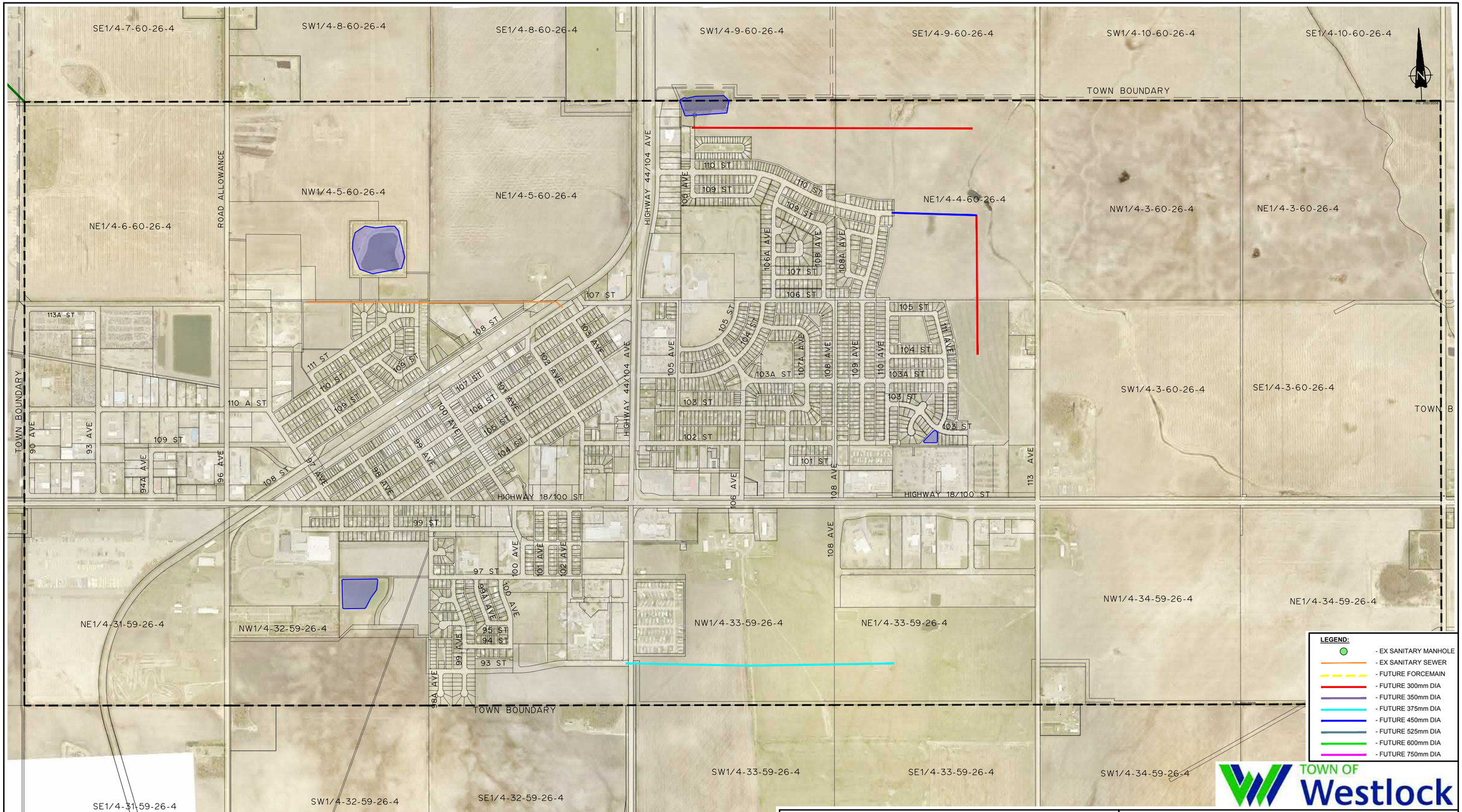
MPE investigated servicing concepts for future development within the Town for both reduced and full build-out scenarios. The servicing follows the network outlined in the 2009 Wastewater Master Plan Update. Servicing concepts are shown in **Figures 6.6** and **6.7**. The future system also includes the upgrades to the existing system for both scenarios outlined above.

MPE eliminated the future lift station in the NW ¼ Sec. 33-59-26 W4M recommended in the 2009 Wastewater Master Plan Update and Flow Monitoring Report. This results in larger sanitary sewer mains required along 106 Avenue, 102 Street and 105 Avenue to create a sanitary sewer trunk. Development of this trunk includes upgrades to the existing system shown in **Figure 6.2**. Construction of the trunk will result in a long-term net cost savings for the Town, as eliminating the lift station reduces the associated annual operation and maintenance costs.

New development inputs to the future system for reduced and full build-out scenarios are shown in **Figure 6.8** and **6.9.** The performance of the future system for Scenarios 1 and 2 for reduced and full build-outs are shown in **Figures 6.10** to **6.13**.

MPE did not develop a detailed ultimate system as part of this concept. A lift station and forcemain in the northeast corner of Town may be required. It is recommended that the Town investigate this further in a more detailed review.

The model results do not include the future forcemain along the north Town limits. The flow from the forcemain is input into the manhole in the model at the SW corner of SE ¼ Sec. 7-60-26 W4M.



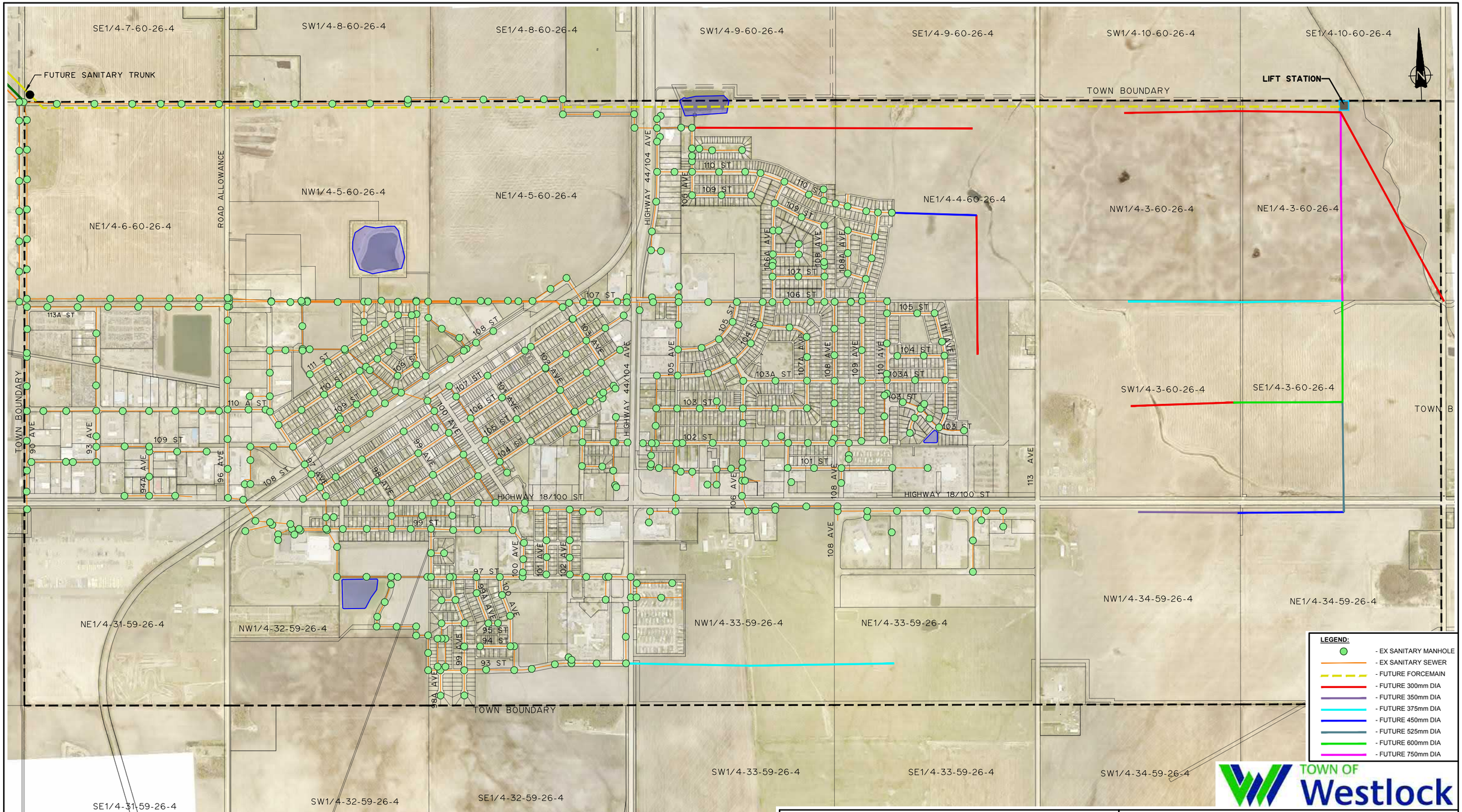
TOWN OF Westlock

MPE Engineering Ltd.

TOWN OF WESTLOCK

SANITARY SEWER MASTER PLAN UPDATE
FUTURE SYSTEM
REDUCED BUILD-OUT

SCALE: NOT TO SCALE	DATE: JANUARY 2020	JOB: 5454-009-00	FIGURE: 6.6



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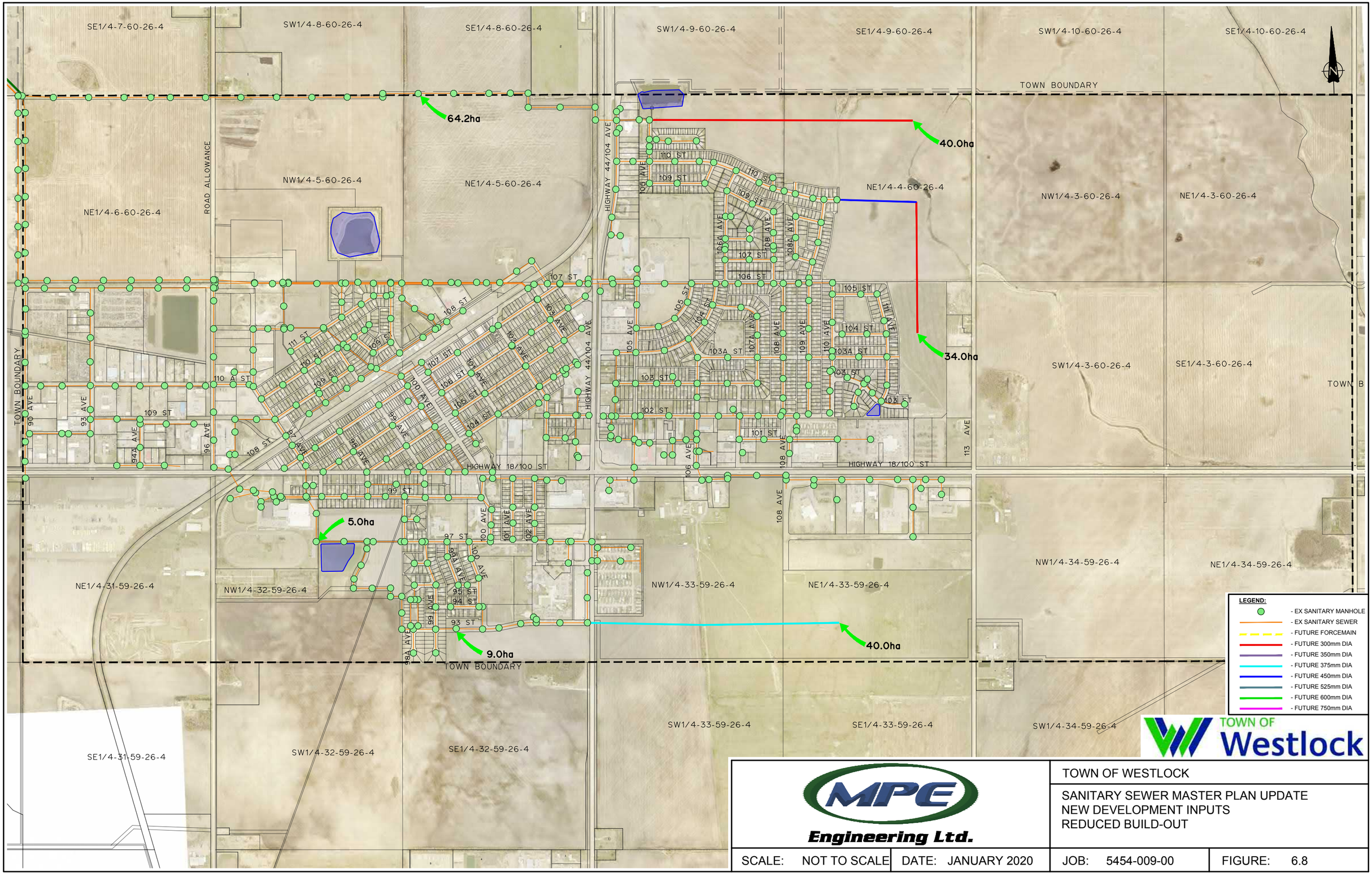
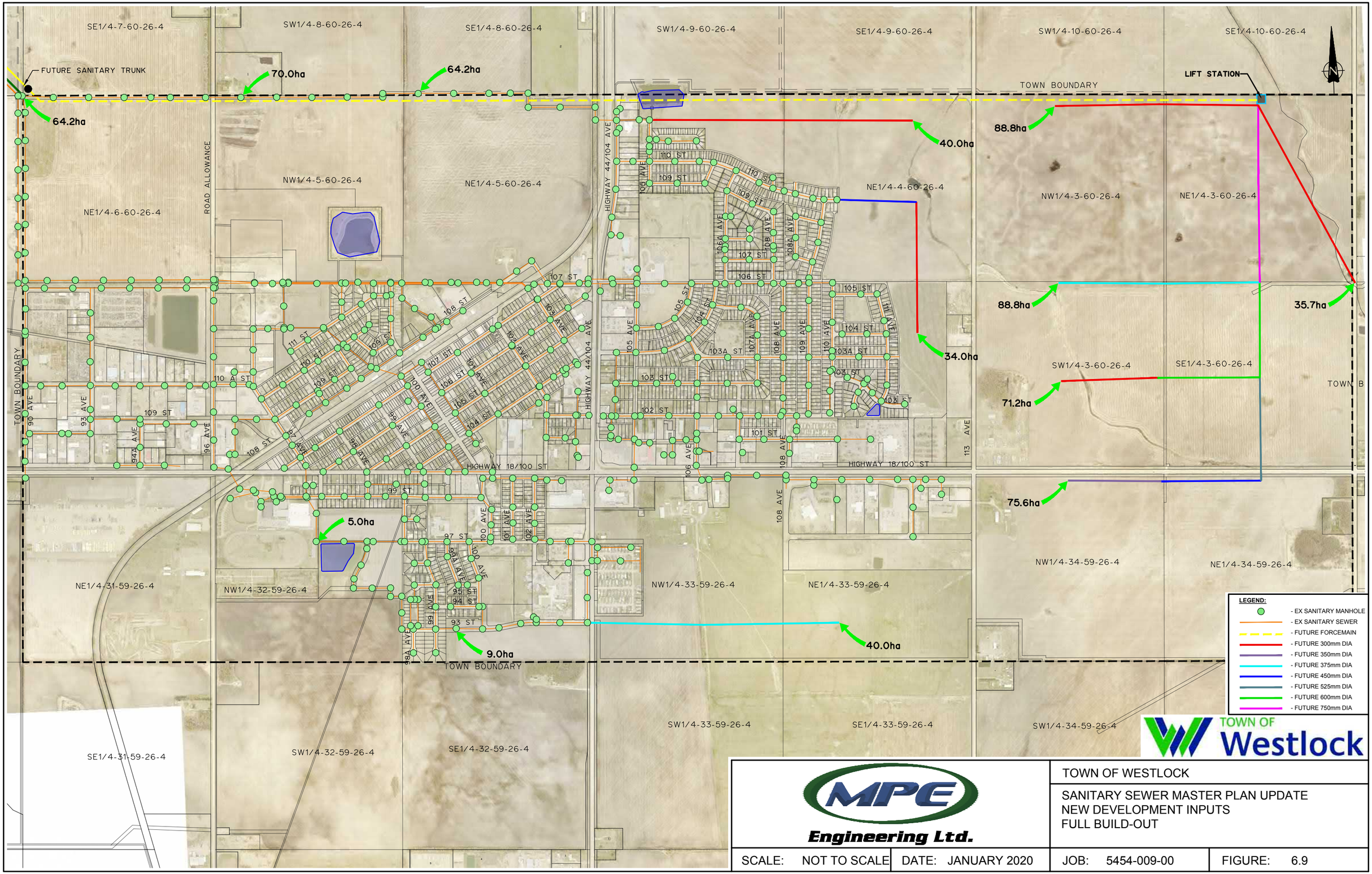
TOWN OF WESTLOCK

SANITARY SEWER MASTER PLAN UPDATE
FUTURE SYSTEM
FULL BUILD-OUT

SCALE:	NOT TO SCALE	DATE:	JANUARY 2020	JOB:	5454-009-00	FIGURE:	6.7


64.2ha
40.0ha
34.0ha
5.0ha
9.0ha
40.0ha
TOWN BOUNDARY
HIGHWAY 44/104 AVE
HIGHWAY 18/100 ST
ROAD ALLOWANCE
SE1/4-7-60-26-4
SW1/4-8-60-26-4
SE1/4-8-60-26-4
SW1/4-9-60-26-4
SE1/4-9-60-26-4
SW1/4-10-60-26-4
SE1/4-10-60-26-4
NW1/4-5-60-26-4
NE1/4-5-60-26-4
NE1/4-6-60-26-4
NE1/4-4-60-26-4
NW1/4-3-60-26-4
NE1/4-3-60-26-4
SW1/4-3-60-26-4
SE1/4-3-60-26-4
NE1/4-31-59-26-4
NW1/4-32-59-26-4
SW1/4-32-59-26-4
SE1/4-32-59-26-4
NW1/4-33-59-26-4
NE1/4-33-59-26-4
SW1/4-33-59-26-4
SE1/4-33-59-26-4
NW1/4-34-59-26-4
NE1/4-34-59-26-4
SW1/4-34-59-26-4
LEGEND:
- EX SANITARY MANHOLE
- EX SANITARY SEWER
- FUTURE FORCEMAIN
- FUTURE 300mm DIA
- FUTURE 350mm DIA
- FUTURE 375mm DIA
- FUTURE 450mm DIA
- FUTURE 525mm DIA
- FUTURE 600mm DIA
- FUTURE 750mm DIA
TOWN OF Westlock
MPE Engineering Ltd.
TOWN OF WESTLOCK
SANITARY SEWER MASTER PLAN UPDATE
NEW DEVELOPMENT INPUTS
REDUCED BUILD-OUT
SCALE: NOT TO SCALE
DATE: JANUARY 2020
JOB: 5454-009-00
FIGURE: 6.8



MPE Engineering Ltd.

TOWN OF WESTLOCK

SANITARY SEWER MASTER PLAN UPDATE
NEW DEVELOPMENT INPUTS
FULL BUILD-OUT

SCALE: NOT TO SCALE	DATE: JANUARY 2020	JOB: 5454-009-00	FIGURE: 6.9

NE 1/4 6-60-26-W4M

NW 1/4 5-60-26-W4M

NE 1/4 5-60-26-W4M

NE 1/4 4-60-26-W4M

NW 1/4 33-59-26-W4M

NE 1/4 33-59-26-W4M

NW 1/4 32-59-26-W4M

TOWN BOUNDARY

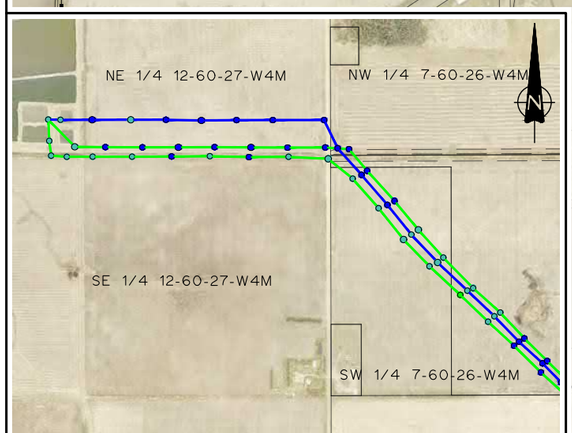
ROAD ALLOWANCE

HIGHWAY 44/104 AVE

FUTURE PIPE

HIGHWAY 18/100 ST

105 AVE
110 ST
109 ST
106A AVE
108 AVE
108A AVE
107 ST
106 ST
105 ST
104 ST
103A ST
103 ST
102 ST
101 ST
107A AVE
109 AVE
110 AVE
111 AVE
106 AVE
113 AVE
113A ST
111 ST
110 A ST
108 ST
107 AVE
103 AVE
102 AVE
101 AVE
100 AVE
99 ST
98 AVE
97 ST
96 AVE
95 ST
94 ST
93 ST
90 AVE
93 AVE
94A AVE
96A AVE
99A AVE
100A AVE



INSET 'A'
NOT TO SCALE

LEGEND:

- TOWN BOUNDARY
- HGL RELATIVE TO GROUND
  - AT SURFACE
  - 0 - 1.5m BELOW SURFACE
  - 1.5 - 2.5m BELOW SURFACE
  - >2.5m BELOW SURFACE
- EXISTING PIPE UTILIZATION
  - 0 - 100%
  - 100 - 150%
  - >150%

TOWN OF Westlock

MPE Engineering Ltd.

TOWN OF WESTLOCK

SANITARY SEWER MASTER PLAN UPDATE
FUTURE SYSTEM PERFORMANCE WITH UPGRADES
REDUCED BUILD-OUT SCENARIO 1

SCALE: 1:10000	DATE: JANUARY 2020	JOB: 5454-009-00	FIGURE: 6.10

NE 1/4 6-60-26-W4M

NW 1/4 5-60-26-W4M

NE 1/4 5-60-26-W4M

NE 1/4 4-60-26-W4M

NW 1/4 33-59-26-W4M

NE 1/4 33-59-26-W4M

NW 1/4 32-59-26-W4M

ROAD ALLOWANCE

HIGHWAY 44/104 AVE

TOWN BOUNDARY

HIGHWAY 18/100 ST

113A ST

110 A ST

111 ST

110 ST

109 ST

108 ST

107 ST

106 ST

105 ST

104 ST

103 ST

102 ST

101 ST

99 ST

97 ST

95 ST

94 ST

93 ST

90 AVE

93 AVE

94A AVE

96 AVE

99 AVE

99A AVE

100 AVE

101 AVE

102 AVE

103 AVE

103A ST

105 AVE

106 AVE

106A AVE

107 AVE

107A AVE

108 AVE

108A AVE

109 AVE

110 AVE

111 AVE

113 AVE

NE 1/4 12-60-27-W4M

NW 1/4 7-60-26-W4M

SE 1/4 12-60-27-W4M

SW 1/4 7-60-26-W4M

INSET 'A'

NOT TO SCALE

LEGEND:

- TOWN BOUNDARY
- HGL RELATIVE TO GROUND
  - AT SURFACE
  - 0 - 1.5m BELOW SURFACE
  - 1.5 - 2.5m BELOW SURFACE
  - >2.5m BELOW SURFACE
- EXISTING PIPE UTILIZATION
  - 0 - 100%
  - 100 - 150%
  - >150%

TOWN OF Westlock

MPE Engineering Ltd.

TOWN OF WESTLOCK

SANITARY SEWER MASTER PLAN UPDATE
FUTURE SYSTEM PERFORMANCE WITH UPGRADES
REDUCED BUILD-OUT SCENARIO 2

SCALE: 1:10000	DATE: JANUARY 2020	JOB: 5454-009-00	FIGURE: 6.11

NE 1/4 6-60-26-W4M

NW 1/4 5-60-26-W4M

NE 1/4 5-60-26-W4M

NE 1/4 4-60-26-W4M

NW 1/4 33-59-26-W4M

NE 1/4 33-59-26-W4M

NW 1/4 32-59-26-W4M

ROAD ALLOWANCE

HIGHWAY 44/104 AVE

TOWN BOUNDARY

FUTURE PIPE

HIGHWAY 18/100 ST

110 ST

109 ST

108 ST

107 ST

106 ST

105 ST

104 ST

103 ST

103A ST

102 ST

101 ST

99 ST

97 ST

95 ST

94 ST

93 ST

110 A ST

111 ST

111A ST

90 AVE

93 AVE

94A AVE

96 AVE

97 AVE

98 AVE

98A AVE

99 AVE

99A AVE

100 AVE

101 AVE

102 AVE

103 AVE

104 AVE

105 AVE

106 AVE

106A AVE

107 AVE

107A AVE

108 AVE

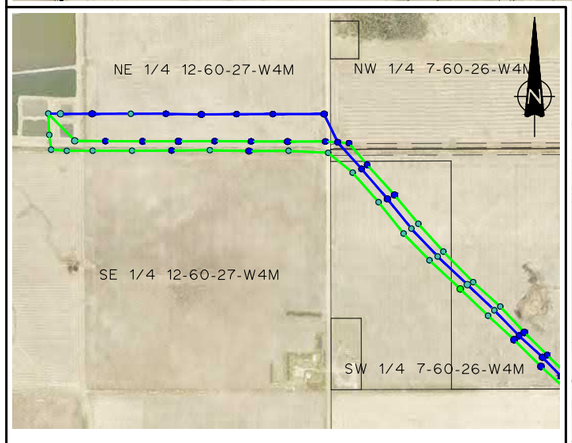
108A AVE

109 AVE

110 AVE

111 AVE

113 AVE



INSET 'A'
NOT TO SCALE

LEGEND:

- TOWN BOUNDARY
- HGL RELATIVE TO GROUND
  - AT SURFACE
  - 0 - 1.5m BELOW SURFACE
  - 1.5 - 2.5m BELOW SURFACE
  - >2.5m BELOW SURFACE
- EXISTING PIPE UTILIZATION
  - 0 - 100%
  - 100 - 150%
  - >150%

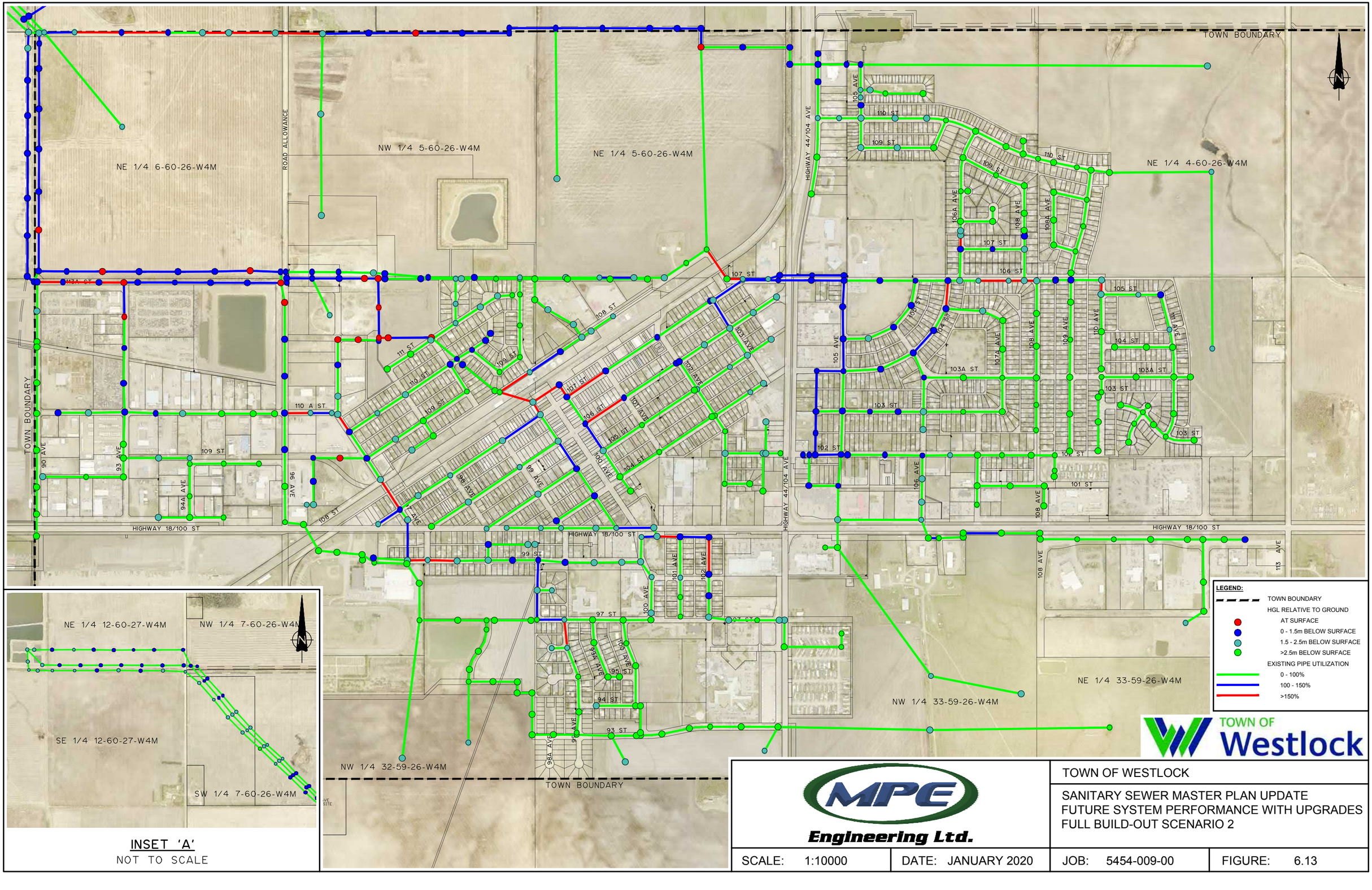
TOWN OF Westlock

MPE Engineering Ltd.

TOWN OF WESTLOCK

SANITARY SEWER MASTER PLAN UPDATE
FUTURE SYSTEM PERFORMANCE WITH UPGRADES
FULL BUILD-OUT SCENARIO 1

SCALE: 1:10000	DATE: JANUARY 2020	JOB: 5454-009-00	FIGURE: 6.12



INSET 'A'
NOT TO SCALE

TOWN OF WESTLOCK

SANITARY SEWER MASTER PLAN UPDATE
FUTURE SYSTEM PERFORMANCE WITH UPGRADES
FULL BUILD-OUT SCENARIO 2

MPE Engineering Ltd.

SCALE: 1:10000	DATE: JANUARY 2020	JOB: 5454-009-00	FIGURE: 6.13

6.4 Scenario Analysis

6.4.1 Existing Plus Upgrades

Scenario 1 model results (**Figure 6.4**) resolves the manhole surcharging at the west industrial park. This scenario also resolves most of the surcharging in the eastern part of Westlock, north of Highway 18 on 102 Street and 105 Avenue.

There is a section of sanitary sewer on 106 Street between 106A Avenue and 108 Avenue that has greater than 150% utilization in both scenarios. However, the adjacent manholes are not surcharging. This high utilization is caused by the sanitary sewer main having less grade than the mains upstream or downstream. The Town could resolve this high utilization of this pipe through re-grading the sanitary sewer on 106 Street. However, this area is not considered a high priority for upgrades due to the manholes not surcharging in the model.

There are other sanitary sewer sections with high utilization that are not surcharging. This is typically a result of a lower pipe slope than adjacent pipe, similar to the 106 Street example above.

Scenario 2 model results (**Figure 6.5**) resolves the manhole surcharging along the eastern part of Westlock. This scenario conveys flows to the sanitary trunk along the north limits of the Town. Some manhole surcharging from the west industrial park is resolved in this scenario, but not as much as in Scenario 1.

6.4.2 Reduced Build-out

Scenario 1 model results (**Figure 6.10**) continues to resolve the majority of the manhole surcharging from the west industrial park. The scenario also resolves most of the surcharging along the eastern part of Westlock. One manhole on 102 Street is surcharging at this stage. This is due to the depth of the manholes on 102 Street. They are not as deep as other manholes along the alignment.

Scenario 2 model results (**Figure 6.11**) continues to resolve the manhole surcharging along the eastern part of Westlock. Surcharging along the trunk along the north limits of Westlock is present. The surcharging condition of the manholes in the west industrial park and existing sanitary trunk in the NE ¼ Sec. 6-60-26 W4M remains the same as that for the existing plus upgrades stage (**Figure 6.5**).

6.4.3 Full Build-Out

Scenario 1 model results (**Figure 6.12**) continues to resolve the majority of the manhole surcharging from the west industrial park. The scenario also resolves most of the surcharging along the eastern part of Westlock. This scenario has two manholes surcharging on 102 Street.

Scenario 2 model results (**Figure 6.13**) continues to resolve the manhole surcharging along the eastern part of Westlock. The surcharging manholes in the west industrial park and existing sanitary trunk in the NE ¼ Sec. 6-60-26 W4M remains the same as that for the existing plus upgrades stage.

6.4.4 Recommendation

The majority of the recommended upgrades to the existing sanitary sewer system are:

- To improve the capacity issues in the eastern residential part of Westlock; and
- To accommodate additional flows from planned developments in the southeast of Westlock (serviced by the sanitary sewer on Highway 18, 102 Street, and 105 Avenue).

Scenario 2 resolves the capacity issues in the eastern part of Westlock at every stage of development with less surcharging than Scenario 1. Scenario 1 resolves more capacity issues from the west industrial park than Scenario 2. However, there is no development planned in the west industrial park.

MPE recommends that the Town implement Scenario 2 if they can accept the surcharging in the west industrial park. If the Town proceeds with Scenario 2, MPE recommends that the Town proceed with an inflow and infiltration program within the west industrial park to determine the sources of inflow in that area and explore options to reduce it. Inflow and infiltration was a cause of surcharging in the west industrial park during the 2016 storm event.

7.0 WASTEWATER TREATMENT SYSTEM

MPE has conducted a review of the Town's wastewater treatment capacity to determine if it is adequate for future growth, and to set potential upgrades for it on that basis.

7.1 Sanitary Lagoon Storage Requirements

The sanitary lagoons are located northwest of Town, and consist of the following:

- Four anaerobic cells
- Two facultative (anaerobic) cells
- Three storage cells

Using the record drawings available to MPE, the current lagoon system capacities are shown in **Table 7.1** below:

TABLE 7.1: CURRENT LAGOON SYSTEM CAPACITIES

Anaerobic Cell	Depth (m)	Volume (m^3)	Total Volume (m^3)
1	3.5	4,550	31,100
2	3.5	4,550	
3	3.0	11,000	
4	3.0	11,000	
Facultative Cell	**Depth (m)**	**Volume (m^3)**	**Total Volume (m^3)**
1	1.5	63,700	234,380
2	1.5	170,680	
Storage Cell	**Depth (m)**	**Volume (m^3)**	**Total Volume (m^3)**
1	Varies from 1.8 to 2.47	430,000	1,393,600
2	2.5	333,800	
3	2.5	629,800	

It should be noted that these capacities are based on the design drawings for the lagoons available to MPE, and do not consider sludge accumulation or any other revisions to the system where engineering drawings are not available. These capacities only exist when the system is fully maintained (e.g., solids removed from the lagoons).

Lagoon storage requirements for the Town are dictated by Alberta Environment and Parks based on a standardized set of guidelines for municipalities. Lagoon guidelines are not dependent on effluent water quality, but are instead built around designated retention times for treatment processes occurring in each cell of the lagoon. Based on the average daily flow, the sanitary lagoon storage requirements are presented in **Table 7.2**. All requirements are based on Alberta Environment and Parks' guidelines.

7.1.1 Anaerobic Cells

In anaerobic cells, much of the solid material present in the waste stream settles out, and microbial action from bacteria present in the waste stream breaks down organic compounds. The breakdown of organic compounds in an anaerobic cell is a three-stage process that can be susceptible to influent that is acidic or which has highly variable amounts of Biological Oxygen Demand (BOD).

The reduction of BOD present in the waste stream is a vital function within a wastewater lagoon that occurs in the highest intensity in anaerobic cells. Alberta Environment and Parks specifies a contact time within each anaerobic cell of 48 hours, and that each cell maintains a depth of 3 m. The depth of each cell is important to mitigate the amount of oxygen that enters the lagoon through the water surface. Due to the high solids loading rate, anaerobic cells require more frequent maintenance than other cells within the sanitary lagoon system. Each cell is intended to operate independently of the other cell for a period of 48 hours to allow for additional repair and maintenance without negatively impacting the quality or operation of other parts of the lagoon.

7.1.2 Facultative Cells

Despite the reduction of BOD in the anaerobic cells, the constant influx of fresh sewage prevents effluent from reaching the levels required for release into the environment. To reach these levels, two further stages of treatment are required. The first of these stages takes place in the facultative cell. In the facultative cell, both anaerobic and aerobic bacteria act on the sludge in different layers. The Alberta Environment and Parks Standards and Guidelines for Facultative Cells dictate a maximum depth of 1.5 m for these cells, which increases the volume of oxygen that can be absorbed through the water's surface to support the growth of aerobic bacteria.

Alberta Environment and Parks dictates a retention time in the facultative cell of a lagoon system of 60 days. This long retention time allows most of the remaining solids to settle out and significantly reduces the concentration of BOD in the waste stream.

7.1.3 Storage Cell

The final cell in the lagoon is sized to store 12 months of flow at a given time as per Alberta Environment and Parks Standards. This size allows for final finishing of the wastewater effluent to further reduce the environmental loading caused during annual releases. Alberta Environment and Parks identifies that the maximum depth of the storage pond should be 3 m. The anaerobic and facultative cells have treated the water entering the storage cells to a high degree. Because of this, sedimentation of the storage cells is not a concern unless qualitative observations made after lagoon discharge identify sedimentation as an issue. The Town has not identified any such issues at this time.

TABLE 7.2: SEWAGE LAGOON CAPACITY ASSESSMENT

Component	Units	2020	2030
Population	Persons	5,329	5,945
Average Day Flow	m^3/day	1,865	2,081
Anaerobic Cells			
Number of Cells Required	each	2	2
Number of Cells Existing	each	4	4
Retention Required, Each Cell	days	2	2
Retention Available	days	2.4	2.2
Additional Retention Required	**days**	**None**	**None**
Volume Required, Each Cell	m^3	3,730	4,162
Volume Available (Total)	m^3	31,100	31,100
Additional Volume Required	**m^3**	**None**	**None**
Facultative Cells			
Retention Required	days	60	60
Retention Available	days	126	113
Additional Retention Required	**days**	**None**	**None**
Volume Required	m^3	111,900	124,860
Volume Available	m^3	234,380	234,380
Additional Volume Required	**m^3**	**None**	**None**
Storage Cells			
Retention Required	days	365	365
Retention Available	days	747	670
Additional Retention Required	**days**	**None**	**None**
Volume Required	m^3	680,725	759,565
Volume Available	m^3	1,393,600	1,393,600
Additional Volume Required	**m^3**	**None**	**None**

Based on Alberta Environment and Parks' Wastewater Lagoon Standards and Guidelines, the Town does not require any additional anaerobic cells, facultative cells, or storage cells leading into the year 2030. If the average daily flow increases dramatically, it is recommended to reassess the sewage lagoon capacities.

7.2 Sanitary Lagoon Maintenance

The 2009 Wastewater Master Plan Update recommended the Town survey the sludge build-up in the lagoons to determine the current lagoon capacities. MPE understands that the Town has not completed this work. MPE recommends that the Town survey the sludge build-up in the lagoons to determine current capacities.

8.0 UPGRADING RECOMMENDATIONS AND COST ESTIMATES

8.1 Structural Condition Rehabilitation

Table 8.1 on the following page show the recommended rehabilitation for sanitary sewer mains with structural condition ratings of 5 and 4. Also included are sections of sanitary sewer mains with structural conditions less than 4, but with observed severe or moderate sags. MPE's recommended rehabilitation for each section is based on the results of the CCTV inspection.

The two options for rehabilitation are full length replacement and spot repair and relining. Where one or two defects are responsible for the poor condition rating, there is a cost savings to the Town to repair the defective areas and reline the sanitary sewer main. The spot repair will remove the defective area responsible for the poor structural condition rating of the main, and the relining will extend the service life of the main by providing a new inside surface for the pipe. MPE recommends this method of rehabilitation for sanitary sewer mains with one or two defects responsible for the poor condition rating.

Where there are multiple defects responsible for the poor condition rating, it is more cost effective to replace the entire manhole to manhole length of sanitary sewer main. For sanitary sewer mains with multiple defects responsible for the poor condition rating, MPE recommends a full length replacement of the sanitary sewer main, from manhole to manhole.

The unit rates used for the rehabilitation recommendations are:

- Spot Repair: $3,250/m
- Reline Sanitary Sewer: $315/m
- Full Length Replacement (200 mm): $1,950/m
- Full Length Replacement (Upgrade to 300 mm): $2,200/m
- Full Length Replacement (Upgrade to 375 mm): $2,325/m

These unit rates include surface restoration, engineering (15%) and contingency (10%). The surface restoration is assumed to be roadway reconstruction within the trench area.

Estimated costs for structural condition rehabilitation of the inspected sanitary sewer are:

- Structural Condition Rating of 5: $56,062.00
- Structural Condition Rating of 4: $1,903,728.00
- Observed Sags: $1,029,460.00

Table 8.1
Rehabilitation Recommendations for Sewer Mains with Poor Structural Condition

No.	From	To	Street	Structural Condition	Length (m)	Recommended Rehabilitation	Cost Estimate
11-38	MH0786	MH0321	106 Street	5	74.8	Spot Repair (10 m)	$32,500.00
						Relining	$23,562.00
1	MH0341	MH0342	104 Street	4	107.1	Full Length Replacement (200 mm)	$208,845.00
05-38	MH0683	MH0595	104 Street	4	71.2	Full Length Replacement (200 mm)	$138,840.00
06-38	MH0314	MH0685	104 Street	4	49.0	Full Length Replacement (200 mm)	$95,550.00
07-38	MH0685	MH0684	104 Street	4	15.3	Full Length Replacement (200 mm)	$29,835.00
08-38	MH0684	MH0683	104 Street	4	49.3	Full Length Replacement (200 mm)	$96,135.00
10-38	MH0322	MH0786	106 Street	4	81.0	Full Length Replacement (200 mm)	$157,950.00
12-38	MH0581	MH0310	Alley W. 104 Ave N. 102 St.	4	102.0	Full Length Replacement (200 mm)	$198,900.00
21-33	MH0588	MH0589	99 Street	4	122.9	Full Length Replacement (200 mm)	$239,655.00
08-33	MH0175	MH0174	106 Avenue	3	74.0	Full Length Replacement (200 mm)	$144,300.00
19-33	MH0680	MH0316	106 Street	2	98.2	Full Length Replacement (200 mm)	$191,490.00
22-33	MH0589	MH0590	99 Street	2	125.8	Full Length Replacement (200 mm)	$245,310.00
10-33	MH0173	MH0172	102 Street	1	122.2	Full Length Replacement (Upgrade to 300 mm)	$268,840.00
12-33	MH0192	MH0189	102 Street	1	81.6	Full Length Replacement (Upgrade to 300 mm)	$179,520.00
02-38	MH0346	MH0193	Alley W. 105 Avenue	4	203.2	Spot Repair (20 m)	$65,000.00
						Relining	$64,008.00
03-33	MH0343	MH0197	107A Avenue	4	75.6	Spot Repair (20 m)	$65,000.00
						Relining	$23,814.00
03-38	MH0309	MH0582	Alley W. 104 Avenue	4	110.0	Full Length Replacement	$214,500.00
04-33	MH0197	MH0195	107A Avenue	4	120.8	Spot Repair (20 m)	$65,000.00
						Relining	$38,052.00
04-38	MH0016	MH0582	Alley W. 104 Avenue	4	49.4	Spot Repair (10 m)	$32,500.00
						Relining	$15,561.00
05-33	MH0177	MH0176	106 Avenue	4	61.0	Spot Repair (10 m)	$32,500.00
						Relining	$19,215.00
06-33	MH0176	MH0024	106 Avenue	4	48.2	Spot Repair (10 m)	$32,500.00
						Relining	$15,183.00
07-33	MH0024	MH0175	106 Avenue	4	28.3	Full Length Replacement (200 mm)	$55,185.00
						Total Structural Condition of 5	$56,062.00
						Total Structural Condition of 4	$1,903,728.00
						Total Observed Sags	$1,029,460.00

MPE recommends that where possible the Town consider rehabilitation of the sanitary sewer mains in conjunction with any proposed watermain, storm sewer main, roadway and sidewalk work on the same street. This will result in an overall cost savings for the Town.

8.2 Hydraulic Capacity Upgrades

Table 8.2 shows the recommended hydraulic upgrades to the existing sanitary sewer system, and estimated costs. MPE is using the recommended hydraulic upgrades from Scenario 2 described in Section 6.2. As shown in the Table, some sections that require hydraulic upgrades also require upgrading due to structural condition. The unit rates for the upgrading recommendations are the same for those shown for the structural condition rehabilitation, including surface restoration, engineering, and contingency. The total estimated costs of the existing system upgrades is $9,472,500.00. MPE recommends that where possible the Town consider upgrades of the sanitary sewer mains in conjunction with any proposed watermain, storm sewer main, roadway and sidewalk work on the same street. This will result in an overall cost savings for the Town. Update based on recommended scenario.

TABLE 8.2: HYDRAULIC UPGRADES TO EXISTING SANITARY SEWER SYSTEM

Project Number	Description	Length (m)	Total Cost
1	New 450 mm through NE ¼ Sec. 5-60-26 W4M	700	$525,000.00
2	New 1050 mm Outfall Line from Northwest Corner of Westlock to Lagoons	2,100	$3,750,000.00
2	Upgrade Sanitary Sewer Main, 105 Ave from 106 St to 104 St	300	$697,500.00
3	New Sanitary Sewer Main, 105 Ave from 104 St to 102 St	275	$639,375.00
4	Upgrade Sanitary Sewer Main, 104 St from 105 Ave East	90	$175,500.00
5	Upgrade Sanitary Sewer Main, 106 St from 105 Ave to 106A Ave	380	$883,500.00
6	Upgrade Sanitary Sewer Main, 102 St from 105 Ave to 106 Ave	270	$594,000.00
7	Upgrade Sanitary Sewer Main, Hwy 18 from 106 Ave to 108 Ave	380	$836,000.00
8	Upgrade Sanitary Sewer Main, 105 Ave from 102 St to Hwy 18	310	$720,750.00
9	New Sanitary Sewer Main, Hwy 18 from 105 Ave to 106 Ave	280	$651,000.00
		Total	**$9,472,625.00**

Table 8.3 shows the estimated costs to build-out the future trunk mains. The unit rates for the future trunks, including engineering and contingency are:

- 300 mm diameter: $500/m
- 375 mm diameter: $625/m

- 450 mm diameter: $750/m
- 525 mm diameter: $825/m
- 600 mm diameter: $1,000/m
- 750 mm diameter: $1,250/m

The total estimated cost of the future trunks, including the northeast lift station and forcemain, is $11,500,000.00.

TABLE 8.3: FUTURE SANITARY SEWER SYSTEM TRUNKS

Project Number	Description	Length (m)	Total Cost
10	Trunk Sanitary Sewer System, East Side of Town to Future NE Lift Station	6,000	$4,450,000.00
11	NE Lift Station		$3,125,000.00
12	Forcemain from NE Lift Station to Future Trunk sewer in the SW corner of SE ¼ Sec. 7-60-26 W4M	5,300	$2,120,000.00
13	375 mm Diameter Sanitary Sewer Connecting to Existing Sanitary Sewer at 104 Ave and 93 St	1,100	$690,000.00
14	300 and 400 mm Diameter Sanitary Sewer Connecting to Existing Sanitary Sewer at 110 St and 109 Ave	950	$545,000.00
15	300 mm Diameter Sanitary Sewer Connecting to Existing Sanitary Sewer at 105 Ave North of 110 St	1,140	$570,000.00
		Total	**$11,500,000.00**

8.3 Sanitary Lagoon Upgrades

As described in Section 7.0, MPE recommends that the Town survey the sludge build-up in the lagoons to determine the current capacities. The estimated cost of this work is $10,000.00.

9.0 CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusions

- With the Flow Monitoring Report being recently completed, the recommendations for sanitary sewer system improvements will be carried forward into the 10-Year Capital Plan.
- MPE cannot accurately determine the condition of the sanitary sewer mains inspected in 2008 and 2012.
- Sanitary sewer mains between MH0045 and MH0300 had high water and heavy debris during flushing. These mains were not inspected by CCTV.
- The majority of sanitary sewer mains inspected by CCTV in 2018 have a structural condition rating of 4.
- There are two sanitary sewer mains with structural condition ratings of 5.
- The model review and verification found issues with system capacity in the downtown, East Business Park, and the industrial area.
- Inflow and infiltration in the industrial area is an issue where the large storm event of August 2016 caused significant inflow and infiltration into the sanitary sewer system.
- To resolve these issues, MPE developed two upgrade scenarios.
- Scenario 1 satisfies the manhole surcharging from the west industrial park, but does not resolve all the pipe and manhole surcharging along the eastern part of Westlock.
- Scenario 2 satisfies the manhole surcharging along the eastern part of Westlock, but does not resolve the manhole surcharging from the west industrial park.
- Based on Alberta Environment's Wastewater Lagoon Standards and Guidelines, the Town does not require any additional anaerobic cells, facultative cells, or storage cells leading into the year 2028.
- Costs for structural condition rehabilitation of the inspected sanitary sewer are:
  - Structural Condition Rating of 5: $56,062.00
  - Structural Condition Rating of 4: $1,903,728.00
  - Observed Sags: $978,510.00
- The total estimated costs to complete the hydraulic upgrades to the existing sanitary sewer system is $9,472,625.00.
- The total estimated cost of the future sanitary sewer trunks, including the northeast lift station and forcemain is $11,500,000.00.

9.2 Recommendations

- Flushing, cleaning, and inspection of the sanitary sewer mains between MH0045 and MH0300 so that they can be inspected.
- Sanitary sewer mains receiving a structural condition rating of 5 be the first priority for structural condition rehabilitation.
- Sanitary sewer mains receiving a structural condition rating of 4 be the second priority for structural condition rehabilitation.
- The rehabilitation of the sanitary sewer main between MH0786 and MH0321 includes the installation of benching in MH0321. Once the benching is installed, the sanitary sewer main between MH0321 and MH0320 should be inspected again to determine its' condition.
- The Town develop a flushing program to remedy the sections of sanitary sewer main with O&M condition ratings of 5 and 4.
- The Town develop a flushing/inspection/monitoring program as part of the ongoing operation and maintenance to inspect part of the sanitary sewer system every year to assess its' condition.
- The Town construct a proposed outfall line from 96 Avenue and 103A Street to the sewage lagoons.
- The Town upgrade the sewer from 106 Street and 105 Avenue to Highway 18 and 108 Avenue.
- The Town confirm the actual manhole elevations and sanitary sewer main grades prior to construction of any sanitary sewer upgrades.
- The Town conduct flow monitoring along the section of sanitary sewer main on 100 Street between 101 Avenue and 102 Avenue to determine the actual flows in the area to determine if the modeled surcharging in the area is accurate.
- If the Town proceeds with crossing Highway 18 with a sanitary sewer main, the Town should consider a sanitary sewer main larger than 200 mm in diameter to accommodate future growth.
- The Town undertake an inflow and infiltration program to determine the sources of flow into the sanitary sewer system.
- The Town monitor newer neighborhoods (Aspendale, Altador, Polymanth) to see how the new sanitary sewer main performs in comparison to the older portions of the system. This monitoring will provide further model calibration data in the northeast part of the Town.
- The Town implement Scenario 2 if they can accept the model results that indicate surcharging in the west industrial park.
- If the Town proceeds with Scenario 2, the Town should proceed with an inflow and infiltration program within the west industrial park to determine the sources of inflow in that area.

- The Town investigate whether a lift station and forcemain in the northeast corner of Westlock is required in a more detailed ultimate system review.
- The Town survey the sludge build-up in the lagoons to determine current capacities.
- Where possible, the Town consider rehabilitation of the sanitary sewer mains in conjunction with any proposed watermain, storm sewer main, roadway and sidewalk work on the same street.
- Where possible, the Town consider upgrades of the sanitary sewer mains in conjunction with any proposed watermain, storm sewer main, roadway and sidewalk work on the same street.