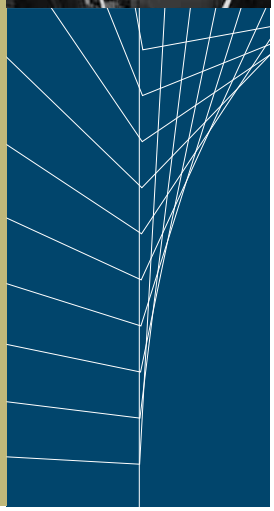
TRANSPORTATION MUNICIPAL/ENVIRONMENTAL STRUCTURAL
LAND DEVELOPMENT LANDSCAPE ARCHITECTURE
PLANNING/COMMUNICATIONS GIS/MAPPING



Town of Westlock

Final Report

Wastewater Collection System Master Plan - 2009 Update

ISL Engineering and Land Services

November, 2009

BEST SMALL & MEDIUM EMPLOYERS IN CANADA

November 25, 2009

Our Reference: 12703

Town of Westlock
10003 – 106 Street
Westlock, Alberta
T7P 2K3

Attention: Colleen Thome
Director of Planning and Development

Dear Colleen:

Reference: Wastewater Collection System Master Plan – 2009 Update

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ISL Engineering and Land Services Ltd. is pleased to submit 20 bound copies, one (1) unbound copy and one (1) electronic copy of the Wastewater Collection System Master Plan – 2009 Update report. This report incorporates comments received on the draft report and comments received from Town Council at the presentation held October 19, 2009.

This Master Plan builds on the Town's 2005 Wastewater Collection System Master Plan and identifies near-term wastewater collection system needs and guidance to accommodate future growth. The report also includes an initial assessment of lagoon system capacities, identifies that the lagoon system is expected to reach capacity sometime before 2020, and recommends further investigations.

Should you have any questions or further comments please contact the undersigned at your convenience.

Sincerely,

Russell Barth, P.Eng.
Project Manager

RB/dw

ISL Engineering and Land Services Ltd.
Suite 100, 7909 - 51 Avenue NW, Edmonton, AB T6E 5L9
T: 780.438.9000 F: 780.438.3700

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Corporate Authorization

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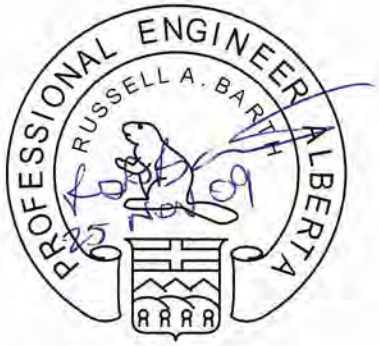


Russell A. Barth, P.Eng.

PERMIT TO PRACTICE

ISL Engineering and Land Services Ltd.

Signature

Date Nov 25/09

PERMIT NUMBER: P 4741

The Association of Professional Engineers, Geologists and Geophysicists of Alberta

Executive Summary

The Town of Westlock commissioned ISL Engineering and Land Services Ltd. (ISL) to develop an update to the existing Town Wastewater Collection System Master Plan to consider growth plans current to the year 2009 to determine upgrading requirements for the existing wastewater collection system to mitigate existing system problems and to address future growth in response updated growth plans and the annexation of six quarter sections of land to the east. Major activities undertaken in this analysis included:

- Utilize the Town's existing XP-SWMM computer model of the wastewater collection system to review constraints in the existing network.
- Identify upgrading required to the existing wastewater collection system to provide an acceptable level of service reflective of future growth plans.
- Recommend future wastewater collection system elements required for future development areas.

As per the Town's Wastewater Collection System Master Plan (ISL, January 2005), fundamental conclusions as per system performance remain generally the same with the exception of the addition of the lagoon capacity review. That is to say that:

1. Generally, the wastewater collection system performs well under both dry and wet weather conditions. There are, however, several locations where surcharge conditions under wet weather exist that could either cause basement flooding and/or discharge to the ground surface. These problem locations require action either in the form of system upgrades or the construction of new trunk sewers to alleviate the surcharge problems. Sewer flow monitoring is recommended to determine the effect of the problems and the need for upgrades.

2. The Town's lagoon system appears to be adequate for existing growth conditions and appears to have capacity for the next several years. Further study on actual flow rates to the lagoon within the next 5 years is recommended to better determine the actual timing and degree of upgrade required in the future. Regular sludge monitoring and removal is also recommended to ensure design capacities are maintained.

Departure from the previous study is generally resultant from the significantly expanded future growth area. Generally speaking, revised and/or new upgrades are recommended to ensure the system can meet the required future system performance.

Carry out the following activities to address existing system needs:

1. Conduct sewer flow monitoring on 200 mm sewers at the following locations to determine current system performance during wet weather and the need for upgrades:
    - on 107 Street east of 103 Avenue, and south on 103 Avenue from 107 Street;
    - on 102 Street between 105 Avenue and 106 Avenue; and
    - 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.

Recommendations related to the Town's wastewater collection system future servicing concept are as follows:

1. Construct a new 450 mm sewer main along 113A Street from 96 Avenue to 90 Avenue, and construct a new 600 mm sewer main on 90 Avenue from 113A Street to the northwest corner of Town, at a cost of $390,000 for the 450 mm sewer and $470,000 for the 600 mm sewer. This would facilitate development in the west, southwest, south, and southeast parts of Town.

2. Construct an extension of the 375 mm sewer from near the Hospital east across Highway 44 approximately 450 m to the east at a cost of $250,000. This would facilitate development in the southeast.

3. Construct a pump station and forcemain from the 200 mm sewer at 106 Street south of Highway 44 to the new extension of the 375 mm line from the hospital at a cost of $1,500,000 for the lift station plus $300,000 for the forcemain . This would facilitate development in the southeast.

4. Construct a 250 mm sewer along the west Town boundary from Highway 18 to 113A Street at a cost of $300,000.

5. Construct a network of new trunk sewers to feed a pump station in the extreme northeast. Construct the pump station and a forcemain west to Highway 44 at costs of $2,500,000 and $1,000,000, respectively.

6. Construct a new 750 mm trunk sewer from Highway 44 to the northwest corner of Town along the north Town boundary at a cost of $1,930,000.

7. Construct a new 1050 mm outfall line to the lagoons from the northwest corner of Town at a cost of $2,430,000.

Table of Contents

Figures

1.0 Introduction

1.1 Authorization

ISL Engineering and Land Services Ltd. (ISL) was commissioned by the Town of Westlock to prepare an update to the Town's Wastewater Collection System Master Plan (ISL, January 2005). This project was initiated in response to Town growth and the annexation of six quarter sections of land to the east in 2008.

Developing a Wastewater Collection System Master Plan represents an investment in the infrastructure of a community. This plan provides a "road map" to Council and the administration in assessing the status of the existing infrastructure, and the capability of the infrastructure to accommodate new development in the short term and long term. This information is useful for both administration and elected officials in carrying out long term planning and budgeting. It is critical that the areas assessed in a Master Plan are representative of a municipality's future growth plans.

It is important to update the Town's Wastewater Collection System Master Plan (ISL, January 2005) to reflect these additional future growth areas to provide proper infrastructure planning to ensure future serviceability of the respective areas and facilitate review of suitable funding options while encouraging sustainable growth. This report will also focus on growth and development of new infrastructure within the former Town Boundary.

1.2 Purpose of Study

There are several reasons for developing a Wastewater Collection System Master Plan:

1. To inventory and analyze the existing wastewater collection system under wet weather conditions to identify problem areas associated with surcharge or basement flooding.
2. To determine if excessive inflow/infiltration to the system occurs under wet weather conditions and to recommend remedial measures if necessary.
3. To develop plans for future growth. Location and timing of development can be coordinated with the availability of adequate infrastructure.
4. To determine what, if any, upgrades are needed to the existing wastewater collection system to meet present Town needs, as well as upgrades or new wastewater collection network construction to facilitate future growth within the Town and to assist in developing funding formulations for this infrastructure.

For the purposes of this update to the Town's Wastewater Collection System Master Plan, the focus will be on developing plans for future growth in response to revised growth plans, to determine system upgrades necessary to support the future expanded system, and to assess the relevance of previous existing and future system upgrades in the context of the newly developed growth plans.

1.3 Background

The Town of Westlock presently has a population of approximately 4,964 people based on recent census results (2008). It is located at the junction of Highways 44 and 18 approximately 60 km northwest of the City of Edmonton. The Town primarily consists of residential development, but also contains industrial areas along the CN Rail alignment and adjacent to Highway 18 into the east and west ends, as well as commercial areas along Highways 18 and 44 and in the downtown core.

2.0 Existing and Future Development

2.1 Existing Development

Existing development and land use in the Town is shown on Figure 2.1. Commercial development within the Town primarily exists along Highways 18 and 44, as well as in the downtown core. Industrial development is situated primarily at the west end of Town, generally west of 96 Avenue. Some industrial development is also present on the extreme east side of Town along Highway 18. Schools are located in the northeast part of Town as well as in the centre of Town. The Hospital and long term care institutional development is located in the south of Town, just west of Highway 44.

The majority of the northeast section of Town is residential, along with areas surrounding downtown and the majority of existing development south of Highway 18. Parks and recreation lands are located throughout the residential areas with a large area of parks and recreation land in the southwest where the recreation centre, rodeo grounds, and agriculture museum are located.

The Town of Westlock covers an area of 21 quarter sections or 1,360 hectares. Current development covers an area of about 510 hectares, or 38% of the Town limits. As a result, total undeveloped land within the Town is about 850 hectares at present. Generally speaking, the majority of the undeveloped land within Town is considered to be developable.

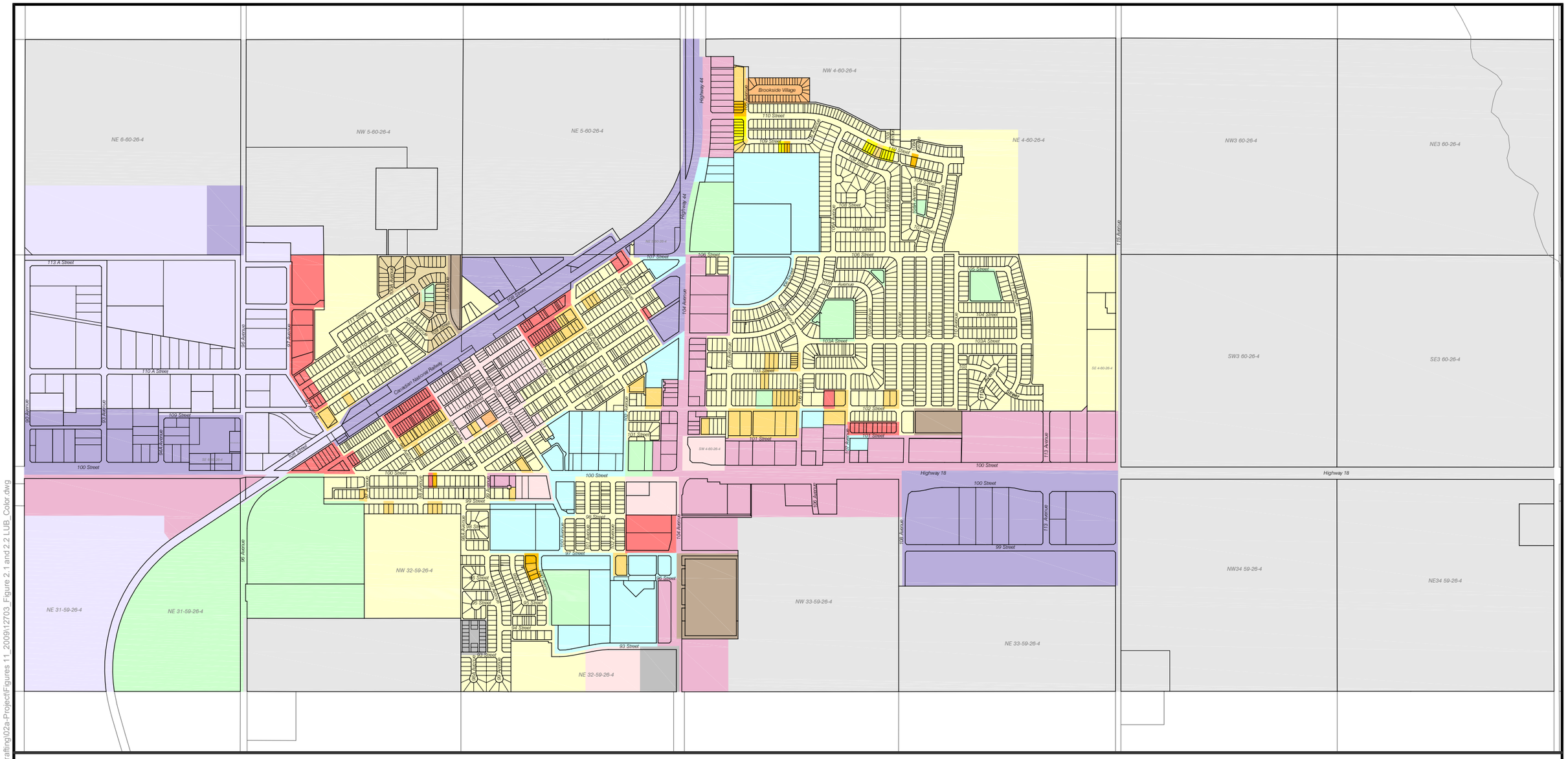
2.2 Future Development

Future development in the Town of Westlock will encompass the existing undeveloped areas within Town along with the recently annexed area at the east end of Town. The annexation area encompasses roughly six quarter sections of land.

Potential future development for the Town of Westlock is shown on Figure 2.2. The Town of Westlock is projected to grow at a moderately aggressive rate of about 2% per annum (although, historic rates have been less than 2%). At this rate, the undeveloped land within the former Town Boundary plus the annexation area will take many decades to fully develop. Future development is assumed to be primarily residential and industrial with a lesser amount of commercial development.

Residential development is proposed for the north central and northeast parts of Town, as well as in the south central portion of Town. Near term residential developments are being planned for the Skyrider and Oxford areas in the south and Aspendale area in the northeast. Commercial development is anticipated along Highways 18 and 44, while industrial development is proposed in the northwest and southwest along 96 Avenue and to the west. There will also be future industrial development in the southeast to the south of the highway commercial development along Highway 18 and east of Highway 44. An expansion of the parks and recreation lands containing the Recreation Centre and Rodeo Grounds is also planned. It is assumed that these lands will be expanded south to the Town boundary.

Land use for the newly annexed land is assumed to be generally residential in the central and northern portions, commercial adjacent to Highway 18, and industrial in the south.



C-1	Multi-Purpose Commercial	I	Institutional	R-1	One Family Residential	R-4	Low Density Multi-Family Residential
C-2	Service Commercial	IG	General Industrial	R-1A	Small Lot One Family Residential	RMH-1	Manufactured Home Subdivision Residential
C-3	Highway Commercial	IR	Restricted Industrial	R-2	Two Family Residential	RMH-2	Manufactured Home Park Residential
DC	Direct Control	UR	Urban Reserve	R-3	Multi-Family Residential	PR	Parks and Recreation

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Town of Westlock

TOWN OF WESTLOCK MASTER PLAN - 2009 UPDATE
WASTEWATER COLLECTION SYSTEM
EXISTING LAND USE BYLAW MAP

FIGURE 2.1

12703

SCALE

100 0 m 100 200 300 400 500 600 700 800 900
300 0 ft 200 400 600 800 1000 1200 1400 1600 1800 2000 2200 2400 2600 2800 3000

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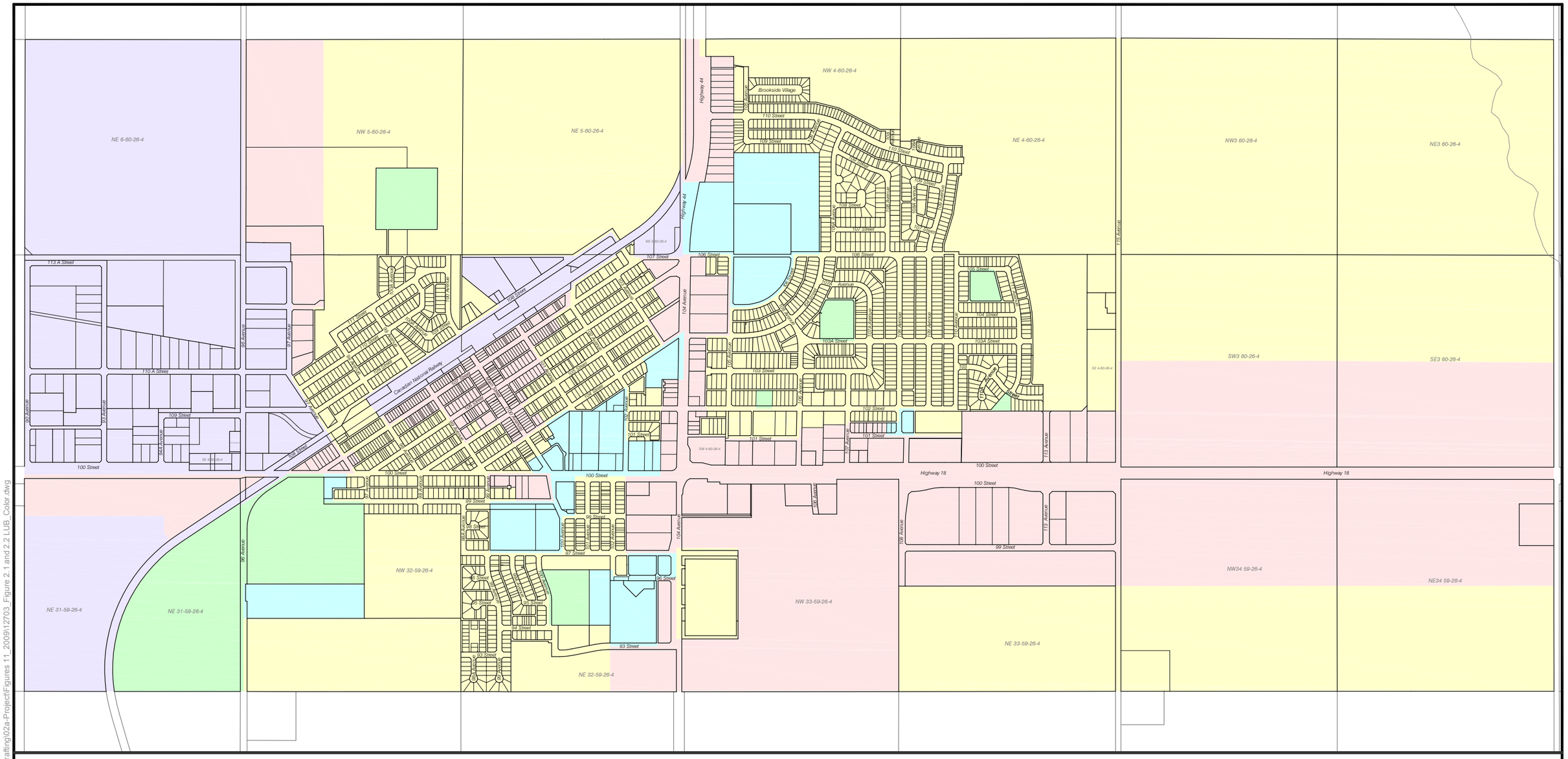

Legend

I	Institutional	C	Service Commercial	PR	Parks and Recreational
IN	Industrial	R	Residential		

N

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Town of Westlock

TOWN OF WESTLOCK MASTER PLAN - 2009 UPDATE
WASTEWATER COLLECTION SYSTEM
FUTURE LAND USE PLAN

FIGURE 2.2

12703

SCALE

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Low (1%), medium (2%) and high (3%) population growth projects are shown on Figure 2.3. A summary of a number of projected population thresholds for the medium (2%) growth rate is as follows:

- 2008 – 4,964 persons
- 2025 – 6,951 persons
- 2040 – 9,355 persons
- 2070 – 16,945 persons

Assuming future development occurs at a realistic density of 30 persons/hectare, and assuming that non-residential development growth will be equivalent to roughly half the residential area developed, an estimation of additional land consumption for each the above noted thresholds is as follows:

- 2008 to 2025 – 99 hectares
- 2025 to 2040 – 121 hectares (cumulative development of 220 hectares)
- 2040 to 2070 – 380 hectares (cumulative development of 600 hectares)

This suggests that full build-out for all undeveloped lands within the new Town Boundary (1,360 hectares) is not expected to occur until well after 2070.

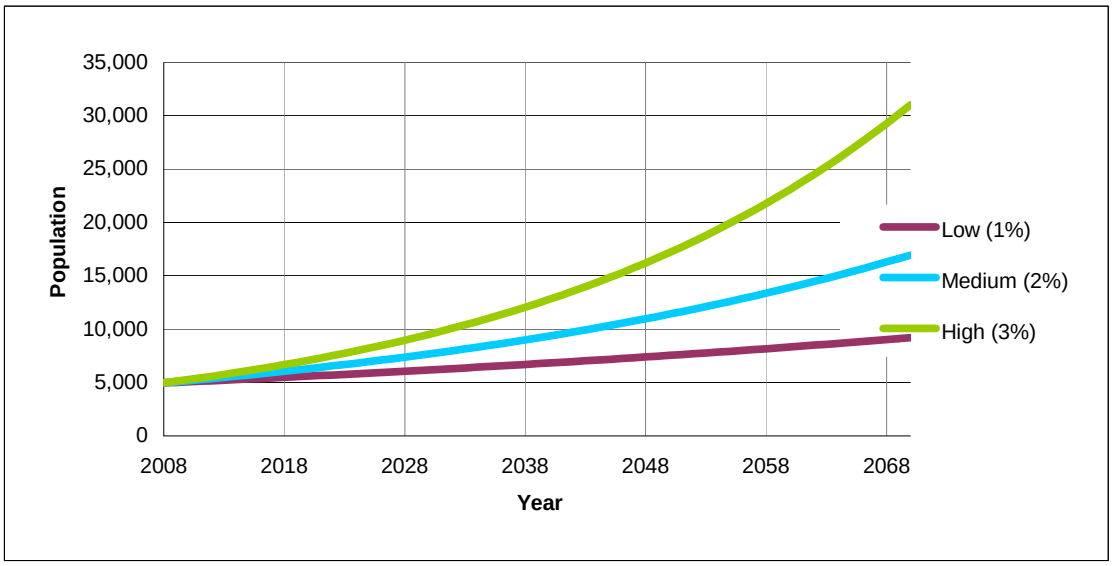


Figure 2.3: Town of Westlock Growth Projections

3.0 Existing Wastewater Collection System

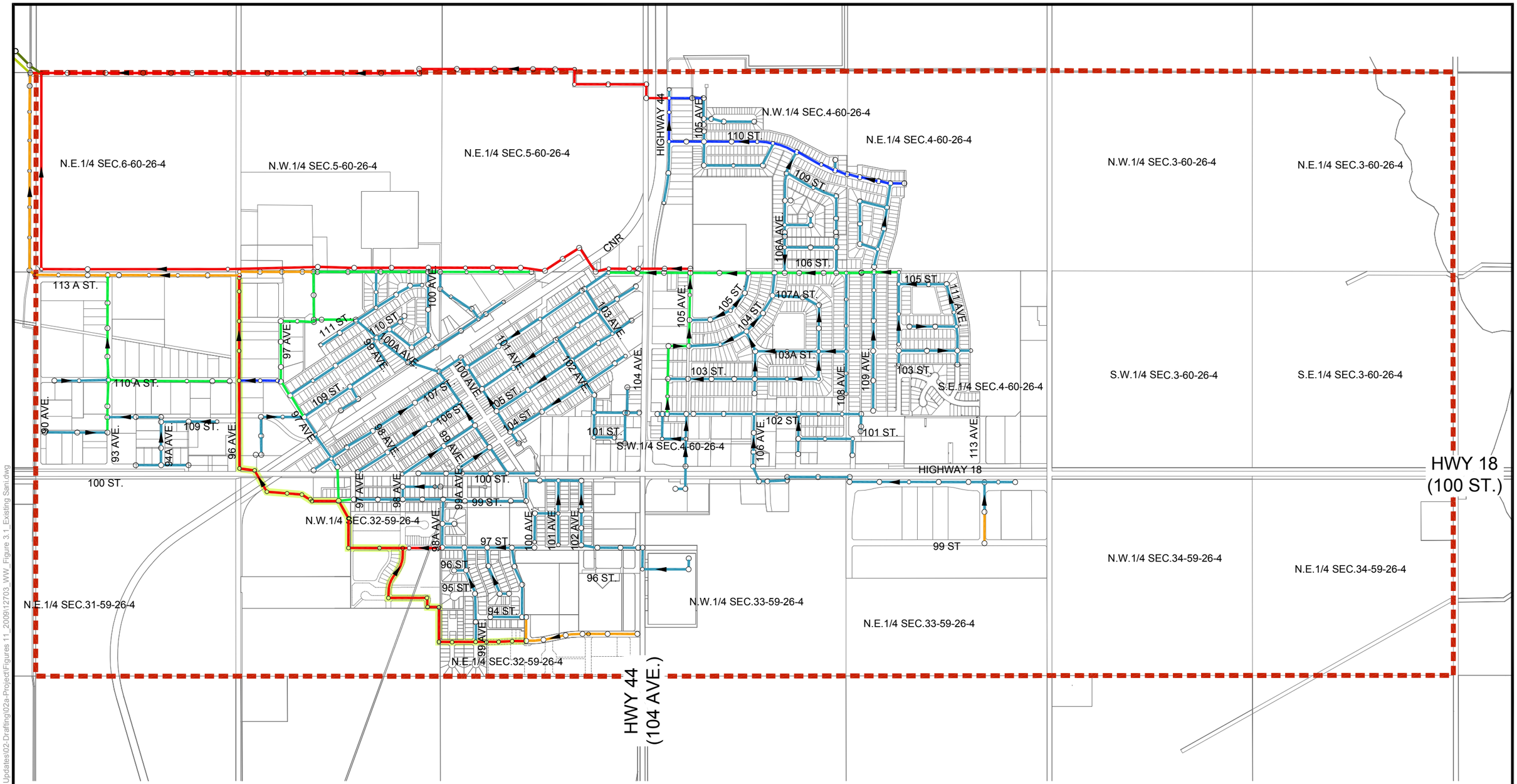
3.1 Existing System

The Town's existing wastewater collection system is shown on Figure 3.1. The piped system discharges through a pair of outfall lines to a facultative lagoon treatment system located about two kilometres northwest of the Town. The wastewater collection system including outfall lines is shown on Figure 3.2. The majority of the piping is asbestos-cement (AC), particularly in the older areas, with newer areas utilizing PVC piping. Predominantly, the wastewater collection system consists of 200 mm pipes with some larger pipes of 250 mm and 300 mm for local trunks and primary trunk sewers of 350 mm or 450 mm size in downstream areas.

The Town is divided into three wastewater collection service areas:

1. Areas north of 106 Street and east of Highway 44 are serviced by a major 450 mm trunk sewer running along the north town boundary to the northwest corner of Town where it joins the outfall lines.
2. Areas south of 106 Street and east of Highway 44 are serviced by a major 450 mm trunk sewer running west along 106 Street on the east side of Town to 113A Street on the west end of Town. The line then turns north at the west Town boundary and joins the outfall lines at the northwest corner of Town.
3. Areas west of Highway 44 are serviced by a 350 mm trunk sewer from the north end of downtown west along 113A Street which turns north at the west Town boundary and joins the outfall lines at the northwest corner of Town. The 350 mm trunk is cross-connected to the adjacent 450 mm trunk for overall improved system capacity.

At the northwest corner of Town, flows proceed down either of the two outfall lines to the lagoon. These include an older 400/450 mm line and a newer 675 mm line. At the lagoons, flows proceed into the first pair of anaerobic cells by gravity and are then pumped up into the second set of anaerobic cells.



Legend

Pipe diameters

- TOWN BOUNDARY
- 200 mm
- 250 mm
- 300 mm
- 350 or 375 mm
- 450 mm
- 675 mm
- SOUTHWEST WASTEWATER TRUNK

N

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TOWN OF WESTLOCK MASTER PLAN - 2009 UPDATE
WASTEWATER COLLECTION SYSTEM
EXISTING WASTEWATER COLLECTION SYSTEM

FIGURE 3.1

12703

SCALE

0 100 200 300 400 500 600 700 800 metres
0 500 1000 1500 2000 2500 feet

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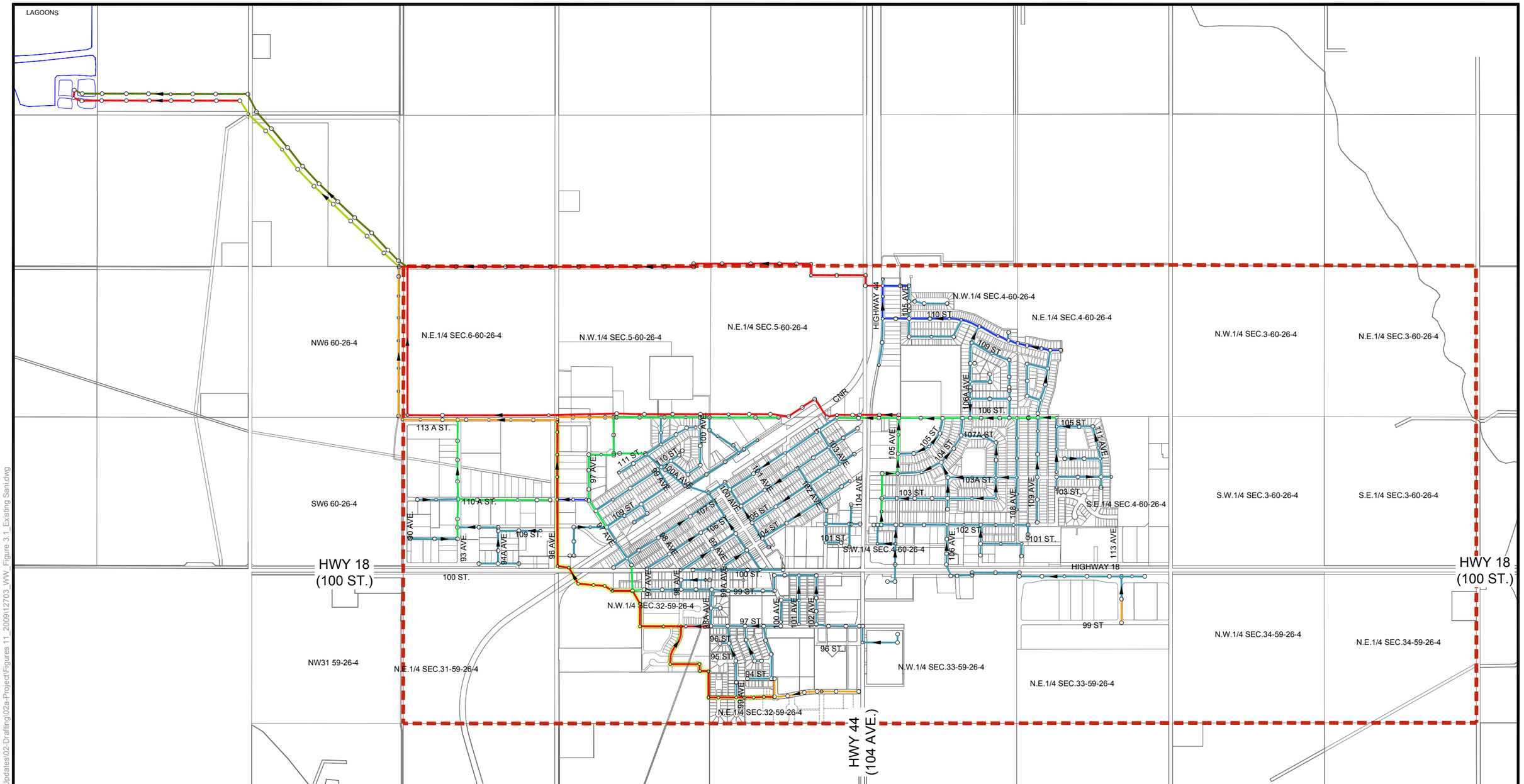

Legend

TOWN BOUNDARY

Pipe diameters

- 200 mm
- 250 mm
- 300 mm
- 350 or 375 mm
- 400 mm
- 450 mm
- 675 mm
- SOUTHWEST WASTEWATER TRUNK

N

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TOWN OF WESTLOCK MASTER PLAN - 2009 UPDATE
WASTEWATER COLLECTION SYSTEM
EXISTING SYSTEM LAGOONS OUTFALLS

0 100 200 300 400 500 600 700 800 metres
0 500 1000 1500 2000 2500 feet

FIGURE 3.2

12703

SCALE

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4.0 Previous Master Plan - 2005

The following section summarizes key items from the Town's Wastewater Collection System Master Plan (ISL, January 2005).

4.1 Previous Study Conclusions / Recommendations

The Town's Wastewater Collection System Master Plan (ISL, January 2005) involved the construction of an XP-SWMM hydraulic model to assess the Town's wastewater collection system. Major conclusions included the following:

- Generally, the wastewater collection system performs well under both dry and wet weather conditions. There are, however, several locations where surcharge conditions under wet weather exist that could either cause basement flooding and/or discharge to the ground surface. These problem locations require action either in the form of system upgrades or the construction of new trunk sewers to alleviate the surcharge problems.

Based on these conclusions, a number of system upgrades were recommended to address existing system deficiencies:

1. Construct a connection between the existing 350 mm and 450 mm trunk sewers along 113A Street east of 96 Avenue to divert a portion of the flows from the 350 mm sewer to the 450 mm sewer main.

2. Construct a new 450 mm trunk sewer along 96 Avenue from 113A Street to 110A Street. Also construct a new 300 mm sewer from the existing 250 mm line along 97 Avenue west to this new 450 mm trunk sewer.

3. Construct a new 450 mm trunk sewer from 98A Avenue, 97 Street to 97 Avenue, 99 Street to divert flows around the 99 Street bottleneck. Also construct 300 mm connections to the existing sewer system at each end of the sewer. In conjunction with this construction, twin the existing 200 mm sewer across the railroad tracks along 97 Avenue with a 300 mm line.

4. Monitor the 200 mm sewers upstream of the bottleneck along 107 Street east on 103 Avenue and then south along 103 Avenue to 106 Street. If surcharge of greater than 0.3 m above the pipe occurs upstream of this, then the 200 mm sewers in question should be twinned.

5. Monitor the 200 mm sewer main along 102 Street between 105 and 106 Avenue. If surcharge greater than 0.5 m above the pipe occurs in the area, then upgrades are required. In the event that the Southwest Wastewater Trunk sewer had not been completed as far as the hospital, this would either involve twinning the 250 mm sewer main along 105 Avenue from 102 Street to just north of 105 Street as well as the 200 mm sewer main along 102 Street between 105 and 106 Avenue. If the Southwest Wastewater Trunk sewer has been constructed as far as the hospital, then the upgrade would involve an extension east for this sewer as well as a pump station and forcemain from the 200 mm sewer just south of Highway 18 near 106 Avenue to the 375 mm trunk near the hospital. This pump station and forcemain would allow for future servicing of the southeast part of Town.

To facilitate future development in the Town, a number of upgrades to the Town's wastewater system were recommended (listed in priority sequence):

1. Construct a new 450 mm sewer main along 113A Street from 93 Avenue to 90 Avenue, then construct a new 600 mm sewer main from 113A Street at 90 Avenue to the northwest corner of Town. This would facilitate development in the west, southwest, south, southeast, and east parts of Town.

2. Construct the middle portion of the Southwest Wastewater Trunk sewer from 99 Street, 97 Avenue west to 96 Avenue, then north to 110A Street. This would facilitate development in the southeast.

3. Construct an extension of the Southwest Wastewater Trunk sewer from 97 Street at 98A Avenue south and then east around Southview to the existing 375 mm sewer main near the hospital. This extension would be 375 mm in size and would facilitate development in the southeast.

4. Construct an extension of the 375 mm sewer from near the Hospital east across Highway 44 approximately 400 m to the east. This would facilitate development in the southeast.

5. Construct a pump station and forcemain from the 200 mm sewer at 106 Street south of Highway 44 to the new extension of the 375 mm line from the hospital. This would facilitate development in the southeast.

4.2 Subsequently Implemented Works

The following works recommended in the 2005 Wastewater Collection System Master Plan have been subsequently implemented:

1. A connection was made between the 350 mm and 450 mm trunk sewers on 113A Street east of 96 Avenue to balance flows between those systems.
2. The new 450 mm Southwest Wastewater Trunk Sewer has been completed from 93 Street and 100 Avenue downstream to 96 Avenue and 113A Street, with connections to the existing system at:
    - 93 Street and 100 Avenue (overflow north),
    - 93 Street and 99 Avenue (overflow north),
    - 98A Avenue and 97 Street,
    - 99 Street and 97 Avenue, and
    - 110A Street and 96 Avenue.

The following works or activities recommended in the 2005 Wastewater Collection System Master Plan to deal with existing system deficiencies have not been implemented:

1. The existing 200 mm sewer running northwest along 97 Avenue below the CNR was not twinned. This work has since been determined to be unnecessary as the completion of the Southwest Wastewater Trunk has relieved pressure on that line.
2. Sewer flow monitoring has not been conducted at the following two recommended locations:

- on 107 Street east of 103 Avenue, and south on 103 Avenue from 107 Street; and
- on 102 Street between 105 Avenue and 106 Avenue.

The following works recommended in the 2005 Wastewater Collection System Master Plan to facilitate future development in the Town have not been implemented:

1. A new 450 mm sewer along 113A Street from 93 Avenue to 90 Avenue, and a new 600 mm sewer along 90 Avenue north from 113A Street to the north Town boundary have not been constructed.
2. 450 mm of 375 mm sewer along 93 Street east from Highway 44 have not been constructed.
3. A pump station at 106 Avenue and Highway 18 with a forcemain south to the above proposed 375 mm sewer have not been constructed.

5.0 Design Criteria

5.1 Wastewater System Design Criteria

Based on the Town's previous Wastewater Collection System Master Plan (ISL, January 2005), wastewater system design and assessment criteria previously recommended were reviewed and found to still be appropriate for use in this updated assessment. The following summarized the parameters used to develop wastewater flows for new future development areas as well as the criteria used to assess the portions of the existing wastewater collection system impacted under the expanded future development scenario:

- The following per capita sewage generation rates were employed:
- Residential – 350 L/p/d and density of 95 persons/hectare
- Commercial – 40,000 L/ha/day
- Institutional – 40,000 L/ha/day
- Industrial – 20,000 L/ha/day
- The following factors were employed to establish peak flow rates:
    - Residential Peaking Factor determined with Harmon's Formula
    - Non-residential peaking factor of 3.0
- Inflow-infiltration rate of 0.20 L/s/ha.

Generally speaking, the 2009 Update to the Town's Wastewater Collection System Master Plan did not require revisiting assessment of the Town's existing wastewater collection system infrastructure given the layout of future development areas is generally conducive to the development of new trunk sewers discharging only to the Town's outfall lines.

5.2 Model Parameters

The model used for assessing the Town's wastewater collection system was XP-SWMM 2009. XP-SWMM is a powerful analysis tool that takes inflow from sewage generation and inflow/infiltration and routes it through the complex hydraulic system. Based on the hydraulic analysis the model predicts which locations have surcharge or flooding conditions. Pipe flows are also determined, and based on peak flows, over-capacity pipes can be identified.

The model was used to consider available capacity in existing sewers during an actual storm, that had a return frequency of about 1:5 years, that occurred in July of 2004. Available capacities were determined on this basis. Based on these capacities, future development area servicing was considered using existing and proposed sewers. For the purpose of designing proposed sewers, several design parameters were necessary:

- New trunk sewers are assumed to be either PVC or concrete with a Manning's "n" roughness value of 0.013.
- New trunk sewers were run at a minimum slope as per the Standards and Guidelines for Municipal Waterworks, Wastewater, and Storm Drainage Systems (Alberta Environment, 2006).

6.0 Servicing of Future Development Areas

6.1 Servicing Concepts for Future Development Areas

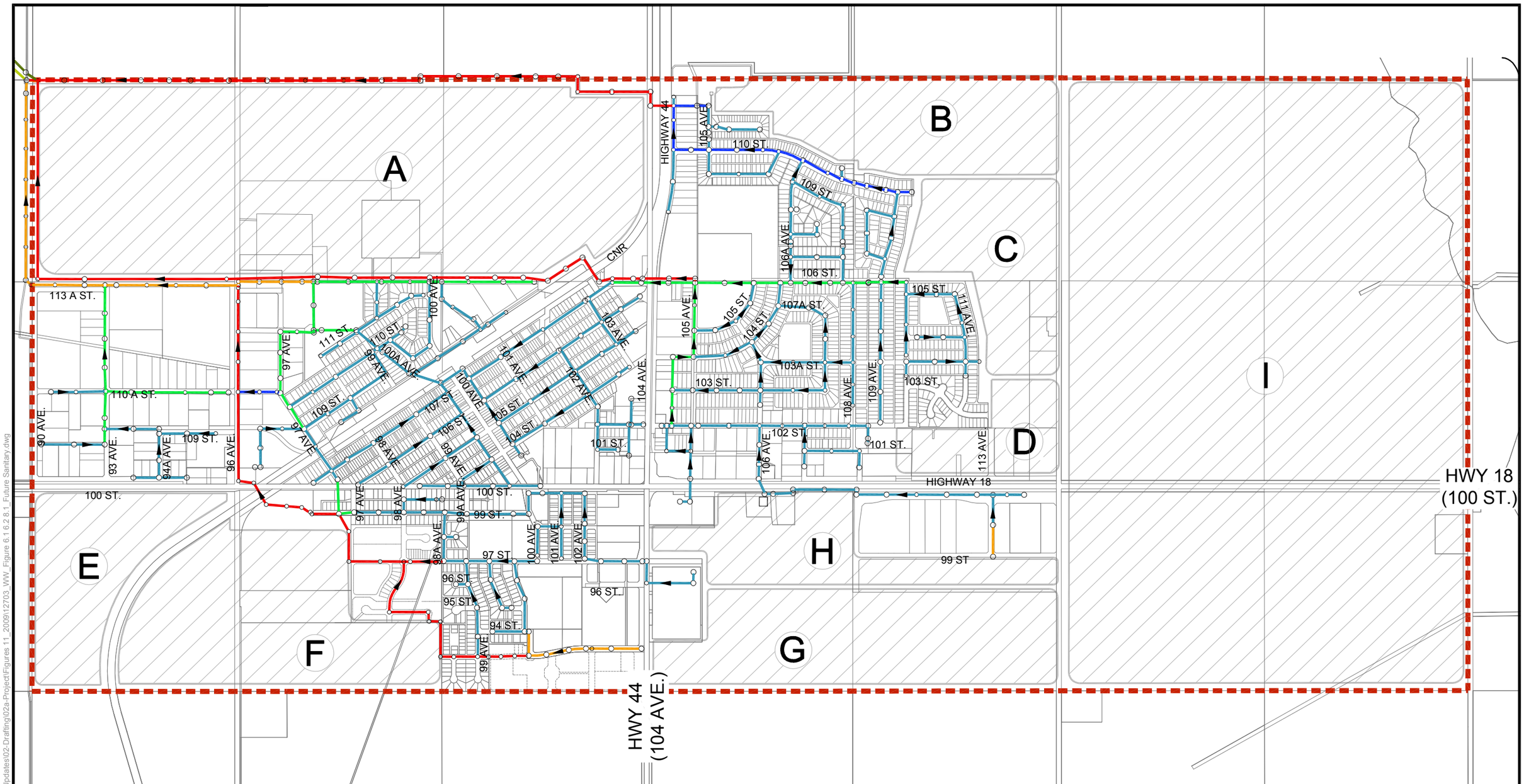
In order to develop a future wastewater servicing concept for the Town, servicing concepts for each future development area were considered. Servicing Areas A through I are shown on Figure 6.1, along with the existing wastewater collection system in the Town.

Servicing concepts for the future development areas are as follows (independent of consideration for capacity upgrades; these are discussed in Section 6.2):

- Area A — The three undeveloped quarter sections in the northwest portion of Town can be serviced by gravity to the existing 450 mm trunk sewer along the north Town boundary.
- Area B — Areas in the far northeast portion of Town, generally below 650 m in elevation, can be serviced by gravity to the existing 300 mm line near the northeast storm pond. Downstream service can be provided by the existing 450 mm sewer main along the north Town boundary.
- Area C — Areas east of 109 Avenue north of 103 Street and generally above 650 m in elevation can be serviced by gravity to the existing 300 mm line along 110 Street. These areas could, alternatively, be serviced by the same 300 mm line as Area B. Downstream service will be provided by the existing 450 mm sewer main along the north Town boundary.
- Area D — Areas south of 102 Street, north of Highway 18 and east of 109 Avenue can be serviced by gravity to three existing 200 mm sewers along 110 and 111 Avenues as well as along 103 Street. Downstream service can be provided by the existing 450 mm sewer main along 113A Street.
- Area E — Areas in the southwest, west of the railroad tracks can be serviced by gravity to a future trunk sewer along the west Town boundary.
- Area F — Areas to the south of Highway 18 between the railroad tracks and 98A Avenue can be serviced by gravity to the Southwest Wastewater Trunk.
- Area G — Areas east of Highway 44 generally above 658 m in elevation can be serviced by gravity to an extension of the existing 375 mm sewer near the hospital which will discharge into the Southwest Wastewater Trunk.
- Area H — Areas generally below 658 m in elevation to the east of Highway 44 and south of Highway 18 can be serviced to the same sewer as Area G but will require pumping to get the flows to the sewer. The pump station would be near 106 Avenue just south of Highway 18. All of Area H can be serviced by gravity to this location.
- Area I — The newly annexed area can be servicing by gravity to a new pump station in the extreme northeast near an existing watercourse. Flows would then be pumped back west to either the 450 mm sewer along the north Town boundary, or to the northwest corner of Town where they would enter the outfall lines to the lagoon.

6.2 Future Wastewater Collection System

Based on the above noted servicing concept considerations and taking into account the recommended servicing schemes, a future wastewater collection system concept for the Town was developed. The system generally involves servicing the majority of future



Legend

TOWN BOUNDARY

Pipe diameters

- 200 mm
- 250 mm
- 300 mm
- 350 or 375 mm
- 400 mm
- 450 mm
- 525 mm
- 600 or 675 mm
- 750 mm
- 1050 mm
- Forcemain

A Service Areas

ISL Engineering and Land Services

Town of Westlock

TOWN OF WESTLOCK MASTER PLAN - 2009 UPDATE
WASTEWATER COLLECTION SYSTEM
FUTURE WASTEWATER SERVICING AREAS

FIGURE 6.1

0 100 200 300 400 500 600 700 800 metres
0 500 1000 1500 2000 2500 feet

12703

SCALE

OCTOBER, 2009

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development areas through new trunk sewers feeding the outfall lines to the lagoons with the exception of development in the south and southeast parts of Town, which will be serviced to the Southwest Wastewater Trunk Sewer.

Relating to the system upgrades to service near to medium term future developments, the following would apply (as per Figure 6.2):

1. Construct a new 450 mm sewer main along 113A Street from 93 Avenue to 90 Avenue, and construct a new 600 mm sewer main on 90 Avenue from 113A Street to the northwest corner of Town. This would facilitate development in the west (western portion of Area A), southwest (Area E), south (Area F), and southeast (Areas G and H) parts of Town.

2. Construct an extension of the 375 mm sewer from near the Hospital east across Highway 44 approximately 450 m to the east. This would facilitate development in the southeast (Areas G and H).

3. Construct a pump station and forcemain from the 200 mm sewer at 106 Street south of Highway 44 to the new extension of the 375 mm line from the hospital. This would facilitate development in the southeast (Area H) and off-load the existing sewer system north of the highway.

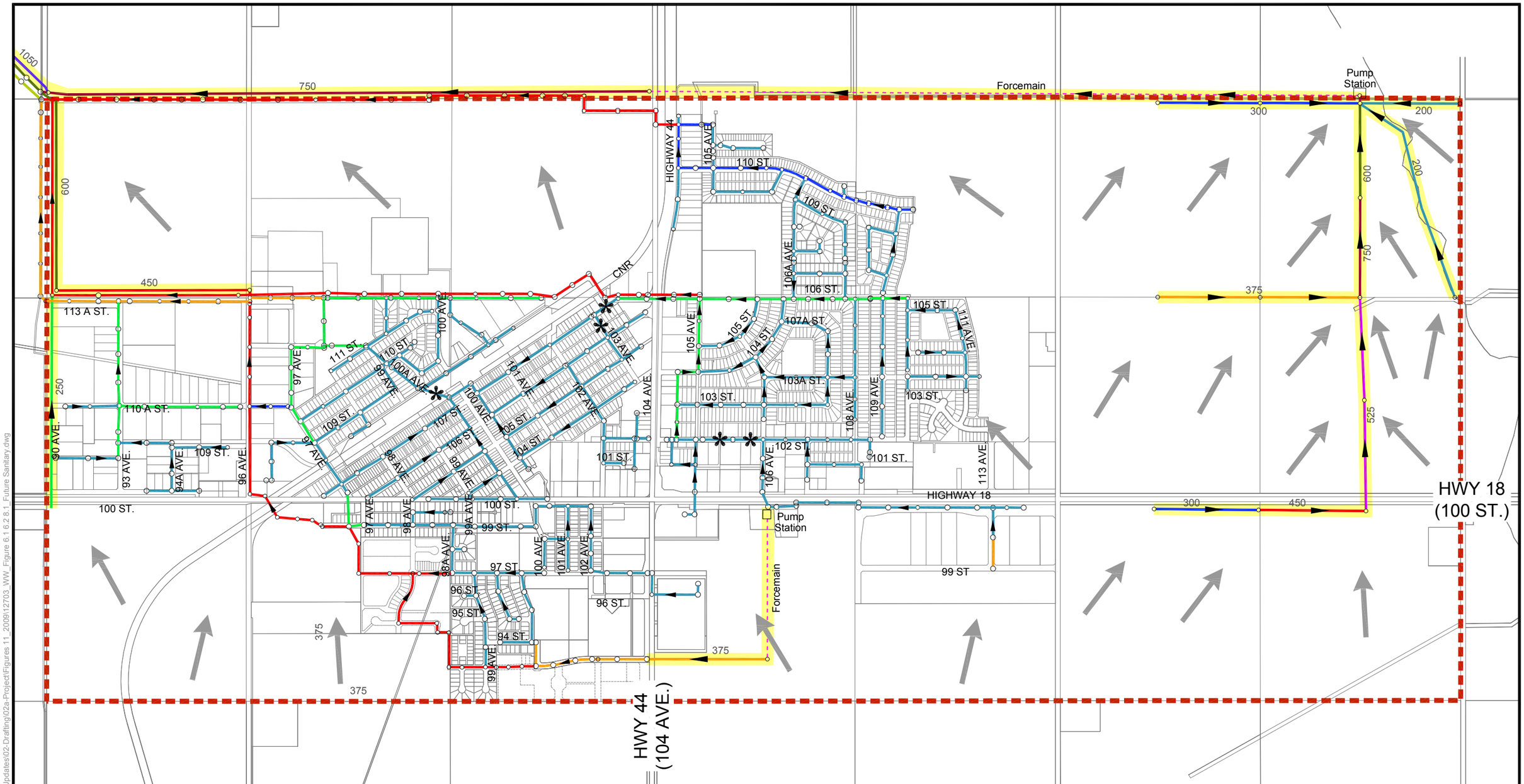
Additional upgrades were reviewed to facilitate servicing to the future development areas, including a trunk sewer to service Area E, outfall line upgrades, and new trunk sewers to facilitate servicing of the annexation area (Area I). These upgrades are summarized as follows (as per Figure 6.2):

1. To service Area E, construct a new 250 mm gravity sewer along the west Town boundary from Highway 18 to 113A Street where it would connect to the lagoon outfall lines.

2. To service Area I (the newly annexed area), construct a network of trunk sewers draining to a pump station in the extreme northeast, adjacent to an existing watercourse. A forcemain along the North Town Boundary would be required, along with a new 750 mm gravity sewer from roughly Highway 44 to the northwest corner of Town. The 750 mm gravity sewer will also assist in servicing of Areas A, B, and C.

3. To service ultimate development in all future development areas, the Town's lagoon outfall lines will require upgrading. The upgrades would include:
    a. Construct a new 450 mm sewer from 96 Avenue to 93 Avenue along 113A Street. This sewer would connect to the upstream end of the recently constructed 450 mm sewer.
    b. Construct a new 1050 mm outfall line from the northwest corner of Town to the lagoons.

Considering the upgrades noted above, the future wastewater collection system concept for the Town was developed. This proposed future wastewater collection system for the Town is shown on Figures 6.2 and 6.3.



Legend

TOWN BOUNDARY

Pipe diameters

- 200 mm
- 250 mm
- 300 mm
- 350 or 375 mm
- 400 mm
- 450 mm
- 525 mm
- 600 or 675 mm
- 750 mm
- 1050 mm
- Forcemain
- Upgrade
- Monitor

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TOWN OF WESTLOCK MASTER PLAN - 2009 UPDATE
WASTEWATER COLLECTION SYSTEM
FUTURE WASTEWATER COLLECTION SYSTEM AND MONITORING SITES

FIGURE 6.2

0 100 200 300 400 500 600 700 800 metres
0 500 1000 1500 2000 2500 feet

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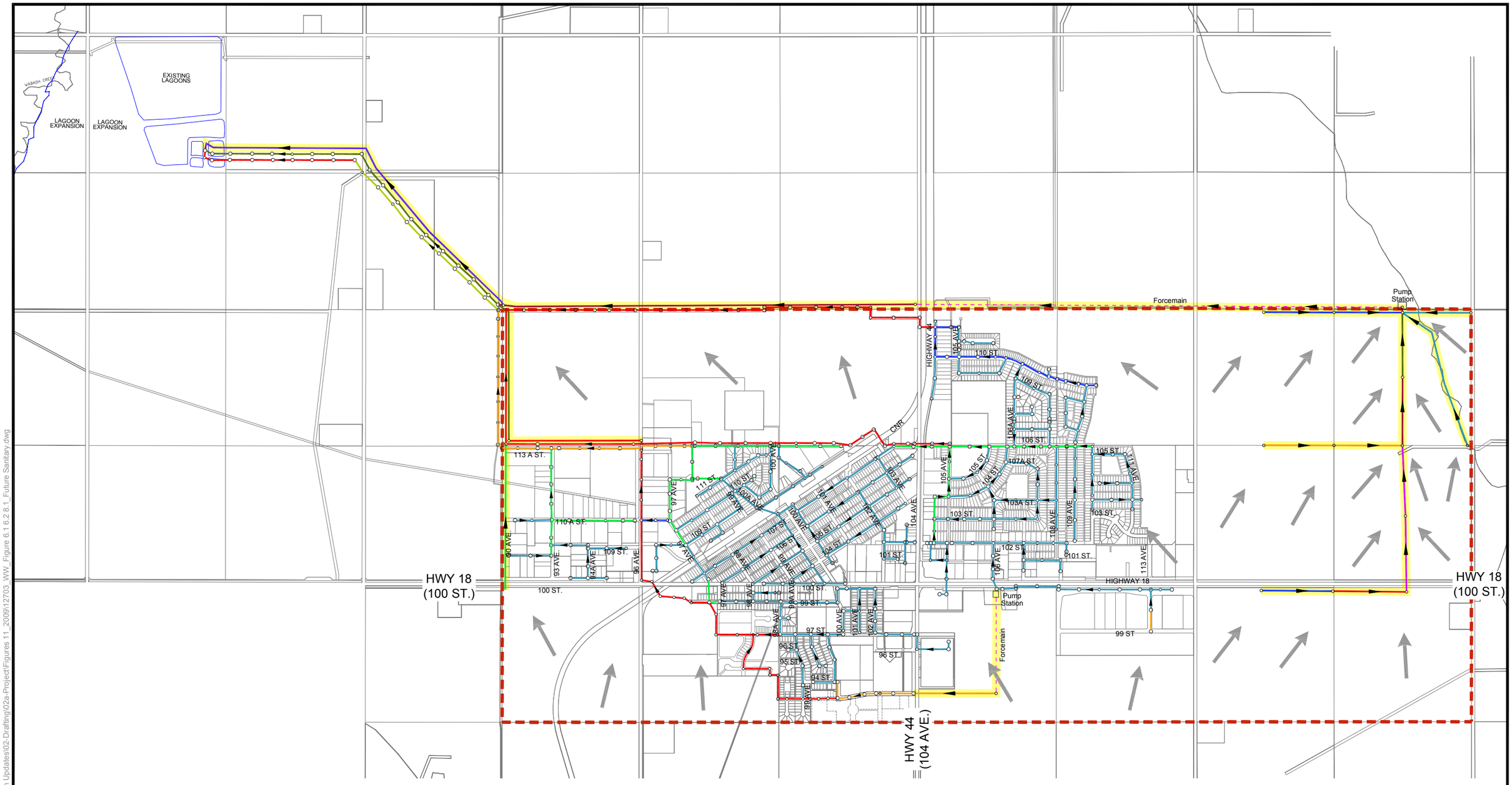

Legend

Pipe diameters

- TOWN BOUNDARY
- 200 mm
- 250 mm
- 300 mm
- 350 or 375 mm
- 400 mm
- 450 mm
- 525 mm
- 600 or 675 mm
- 750 mm
- 1050 mm
- Forcemain
- UPGRADE

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TOWN OF WESTLOCK MASTER PLAN - 2009 UPDATE
WASTEWATER COLLECTION SYSTEM
FUTURE SYSTEM WITH LAGOON OUTFALLS

FIGURE 6.3

0 100 200 300 400 500 600 700 800 metres
0 500 1000 1500 2000 2500 feet

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6.3 Wastewater Treatment System

One addition to the updated version of this study is a review of the Town's wastewater treatment capacity to ensure that it is adequate for some future growth, and to set upgrading horizons for it on that basis.

6.3.1 Lagoon Design Capacities

To do this, the Town's lagoon system drawings were reviewed. The system is shown on Figure 6.4. It consists of four anaerobic cells, two facultative (aerobic) cells, and three storage cells. Drawings were reviewed and the volumes of the cells were estimated.

The current lagoon system design capacities are:

- Anaerobic Cells – four cells with a total volume of roughly 25,500 m^3
- Facultative (Aerobic) Cells – two cells with a total volume of roughly 191,310 m^3
- Storage Cells – two cells with a total volume of roughly 1,399,500 m^3

Please note that these capacities are based on the design drawings for the lagoons and do not consider sludge accumulation or any other revisions to the system that do not have engineering drawings available. Accordingly, these capacities exist only when the system is fully maintained (e.g. solids removed, etc.).

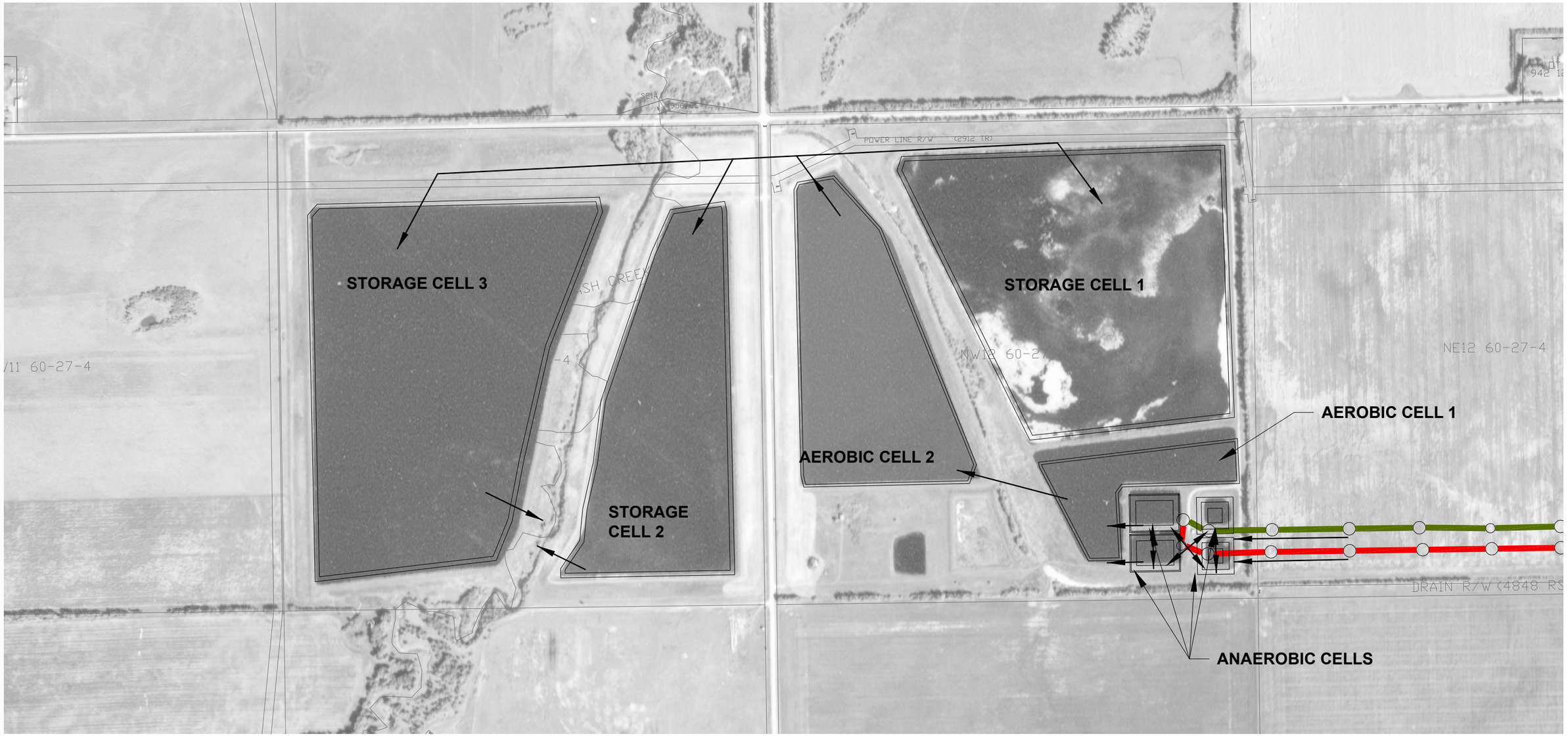
As per the Standards and Guidelines for Municipal Waterworks, Wastewater, and Storm Drainage Systems (Alberta Environment, 2006), minimum required hydraulic residence times in conventional facultative wastewater lagoon treatment systems are as follows:

- Anaerobic Cells – 2 days per cell with 4 cells required for a community the size of the Town of Westlock; i.e. 8 days total (at average daily design flow, where average daily design flow is the total annual wastewater flow divided by 365 days in a year)
- Facultative Cells – 60 days total (at average daily design flow)
- Storage Cells – 365 days total (at average daily design flow, with an allowance for evaporation)

On the basis of the existing lagoon volumes as well as the required lagoon residence times, the system capacity was then calculated. This is summarized in Table 6.1.

Table 6.1: Lagoon Capacity

Lagoon Cells	**Total Volume (m^3)**	**Retention Time (days)**	**Average Daily Flow Capacity (m^3/day)**
4 Anaerobic Cells (in series)	25,500	8	3,188
2 Facultative Cells (Aerobic)	191,310	60	3,189
3 Storage Cells Physical Capacity	1,399,500		
Net Evaporation Over Storage Cell	230,918		
Effective Storage Cell Capacity	1,630,418	365	4,467



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TOWN OF WESTLOCK MASTER PLAN - 2009 UPDATE
WASTEWATER COLLECTION SYSTEM
EXISTING LAGOONS

FIGURE 6.4

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Note that net evaporation determined for the Westlock area is 495 mm per year, based on average annual precipitation for the Edmonton City Centre Airport from Environment Canada being 469 mm per year, while total annual evaporation for Edmonton is roughly 964 mm per year based on data for the same location. This has been accounted for in the capacity of the lagoon storage cells.

6.3.2 Average Daily Design Flow

To properly assess the capacity of the lagoon system, the average daily wastewater flow for the Town on an annual basis needed to be determined. Flows were calculated largely based on past sewer flow monitoring undertaken in 2004 (growth in the Town since 2004 has been relatively nominal, hence flow estimates can be considered relatively accurate).

In 2004, as part of the Town's Wastewater Collection System Master Plan (ISL, January 2005), flow monitoring was conducted towards the downstream end of the Town's wastewater collection system from April to August. The flows monitored, when averaged over each month, ranged from daily averages of roughly 2,300 to 3,600 m^3/day.

A review of night-time flow rates, when taken against expected flows for the Town's population suggested that roughly 6 L/s of baseflow occurs during the summer. Accordingly, flows for the winter period were estimated at April flows of roughly 2,370 m^3/day less the baseflow for an estimated winter average daily flow of 1,790 m^3/day. It was assumed that winter flows extend from November to February. This, combined with the flow monitoring covers the majority of the year. To cover the remainder of the year, September was considered to be roughly equal to April in terms of flows, while flows for March and October were taken as an average of the preceding and following months. Averaging all of the months together yielded an average of 2,295 m^3/day of average daily design flow. It is noted that the flow monitor used to derive these flows was located near 94 Avenue and 113A Street. This means that it would only have encompassed flows from roughly 80% of the Town. A review of modeled flows in at the flow monitoring location versus the existing trunk sewer along the North Town Boundary indicated that these flows needed to be scaled upward by roughly 17% to account for the entire Town. Scaling all monthly flows yielded an average daily design flow of 2,685 m^3/day. Annual flows on this basis are plotted on Figure 6.5.

Considering the Town's high baseflows suggests that a high degree of inflow and infiltration exists in the Town. High continuous infiltration rates like this suggest a full-blown inflow-infiltration program should be implemented. This should include sealing of sanitary manholes to reduce inflow, revision of roadway profiles to remove sag manholes (if possible), CCTV of lines to determine sewer condition, and plan for upgrading of problematic sections. This could reduce overall flow rates by a considerable amount.

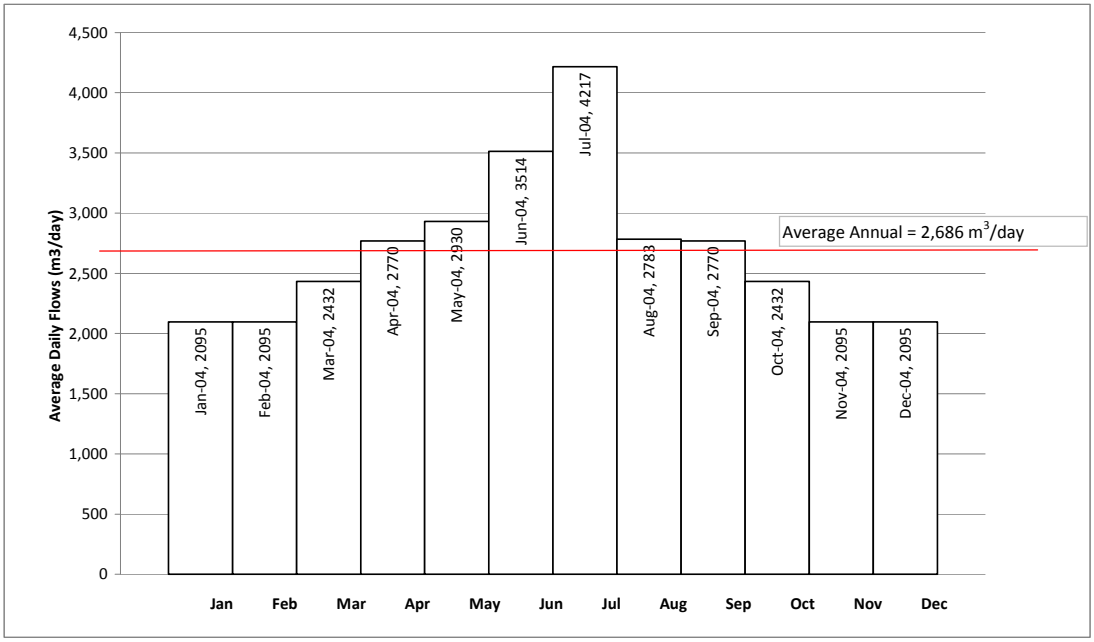


Figure 6.5: Average Daily Design Flow

6.3.3 Lagoon Capacity Assessment

To determine the current state of the Town's lagoon system relative to existing flow rates, the determined average daily design flow was compared to the estimated lagoon capacities determined above. Table 6.2 shows the available capacity in each type of lagoon cells and the estimated service population for each cell group.

In addition to the theoretical growth population that can be serviced to each cell type, future wastewater flows were estimated for each of the 2025 and 2040 growth horizons (assuming future wastewater flows of 350 L/p/d as per the Town's Wastewater Collection System Master Plan (ISL, January 2005) and an annual growth rate of 2%). These results are also shown in Table 6.2 and on Figure 6.6. It is noted that the anaerobic and facultative capacity at the Town's lagoon may be exceeded before 2020. Accordingly, the lagoon capacity is judged to be adequate at this time, but flows should be revisited in more detail within the next five years to better determine exact wastewater flows from the Town and get a more exact timeline on when upgrades may be required. Given that several years of capacity appear to exist by this approach, no upgrades are recommended or detailed at this time.

Table 6.2: Lagoon Capacity for Growth

Lagoon Cells	Average Daily Flow Capacity (m3/day)	Existing Average Daily Flows (m3/day)	Existing Spare Capacity (m3/day)	Estimated Growth Service Population	Future Average Daily Flows 2025 (m3/day)	Spare Capacity	Future Average Daily Flows 2040 (m3/day)	Spare Capacity
Four Anaerobic Cells	3188	2686	502	1433	3761	-574	5062	-1874
Two Facultative Cells	3189	2686	503	1436	3761	-573	5062	-1873
Three Storage Cells	4467	2686	1781	5088	3761	706	5062	-595

Note: Assumed 350 L/p/d future wastewater flow generation

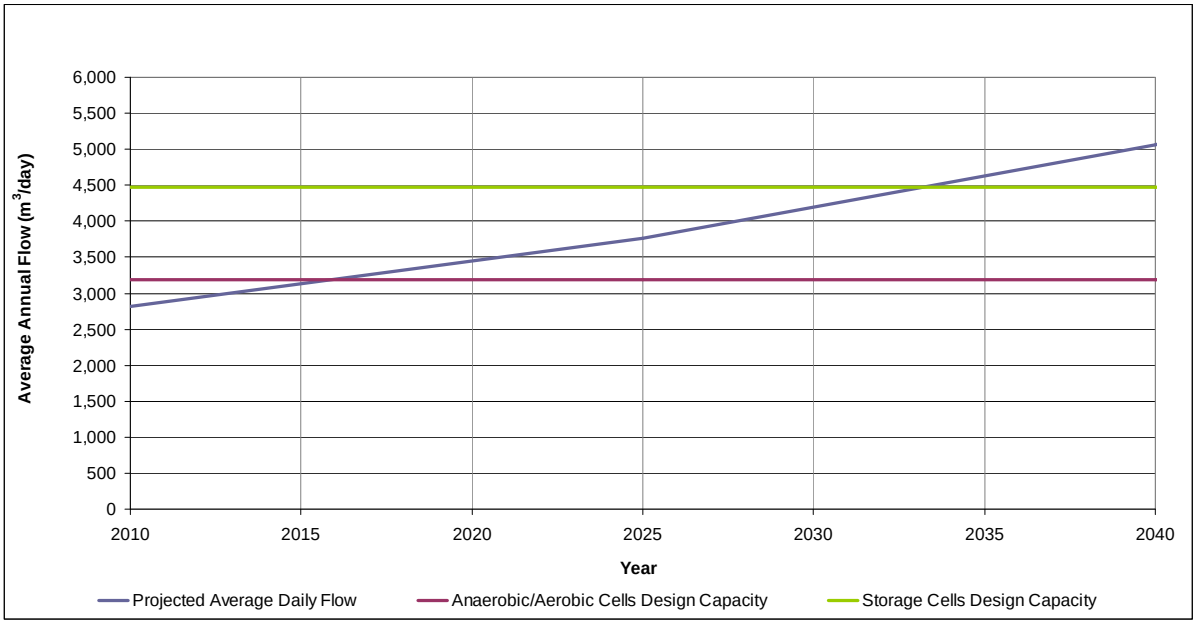


Figure 6.6: Projected Loss of Lagoon System Capacity

7.0 Upgrading Recommendations for Existing System - 2009

7.1 System Upgrade Recommendations

The following three monitoring activities are recommended to identify potential upgrades that may be needed to address existing system needs (refer to Figure 6.2):

1. Monitor the 200 mm sewers upstream of the bottleneck along 107 Street east on 103 Avenue and then south along 103 Avenue to 106 Street. If surcharge of greater than 0.3 m above the pipe occurs upstream of this, then the 200 mm sewers in question should be twinned.

2. Monitor the 200 mm sewer main along 102 Street between 105 and 106 Avenue. If surcharge greater than 0.5 m above the pipe occurs in the area, then upgrades are required. The upgrades would involve an extension east for the Southwest Wastewater Trunk sewer as well as a pump station and forcemain from the 200 mm sewer just south of Highway 18 near 106 Avenue to the 375 mm trunk near the hospital. This pump station and forcemain would also off-load the 200 mm 102 Street sewer and allow for future servicing of the southeast part of the Town.

3. Monitor the 200 mm sewer main running northwest from 107 Street and 100 Avenue draining the downtown through the CNR lands. If surcharge of the pipe begins to occur, plans to upsize this sewer should be put in place.

It should also be noted that consideration for reduction of wastewater flows should be made. This would include inflow-infiltration reduction through such means as disconnection of weeping tile or sump pumps connected to the wastewater collection system, as well as rehabilitation of degraded sewer conveyance infrastructure. A plan for this program could be developed under separate cover in conjunction with Town Public Works staff.

As well, considering that the Town's wastewater lagoon treatment system is expected to approach design capacity in the next ten years or less (at an average annual growth rate of 2%), it is recommended that the lagoons be regularly monitored for sludge build-up to ensure that design capacities for each cell are maintained.

8.0 Cost Estimates

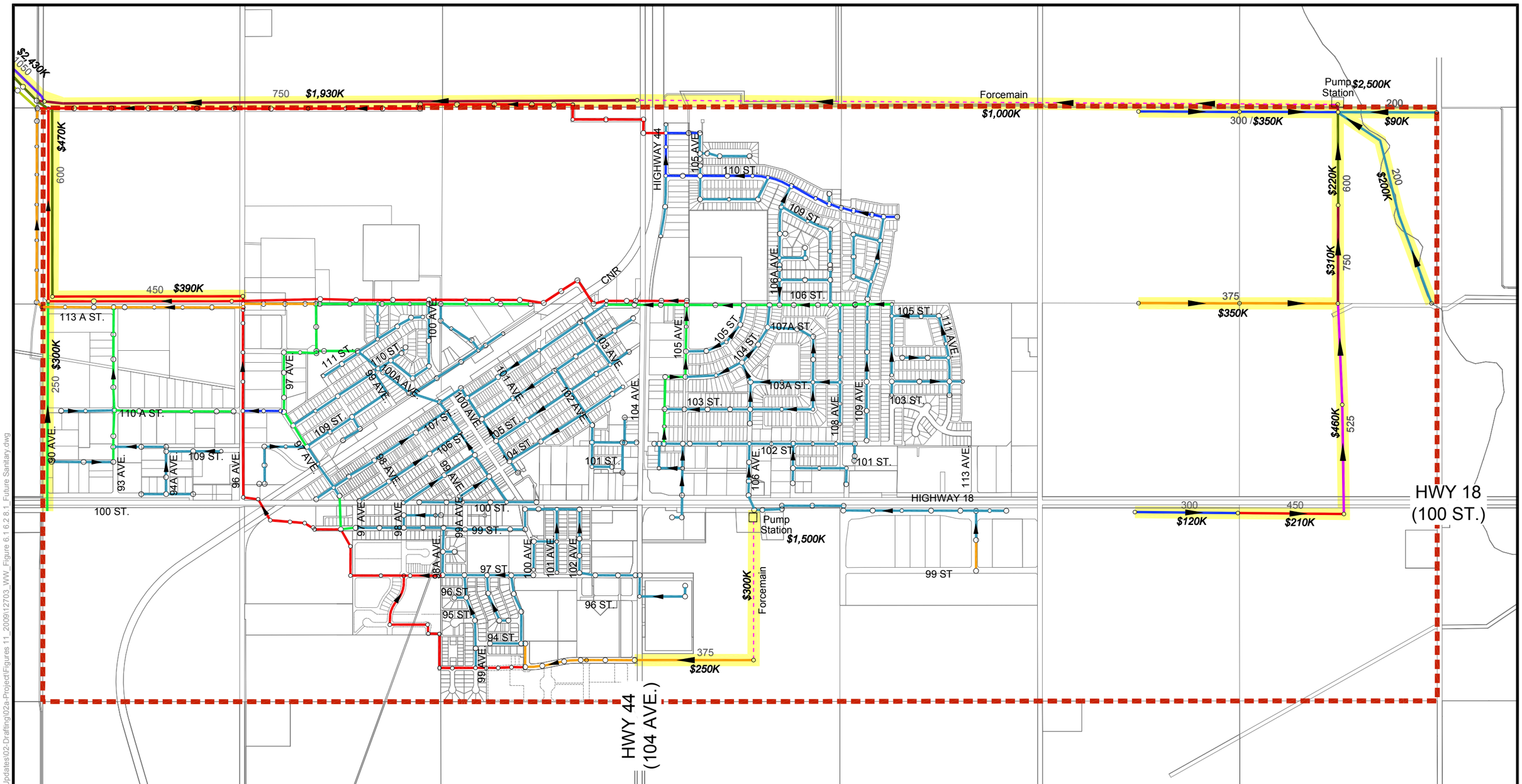
8.1 Overall Cost Estimates

Cost estimates were prepared for the recommended future wastewater trunk sewers from the concepts developed in Section 6.0. These cost estimates are shown on Figure 8.1.

8.2 Potential Cost Sharing

It is useful to consider potential cost sharing for the future wastewater collection system. Given that the new trunk sewers are generally being constructed to benefit future development areas, the cost sharing formulation for the sewers could be based on the total contributing area to each sewer with each developer's contribution based on the proportion of the area their respective development represents. It must be noted that in the event development does not start at the downstream end of each sewer and proceed upstream that the Town may either need to front the trunk sewer construction costs or require an upstream developer to fund the trunk sewer with the Town contributing an amount to be negotiated with the developer. In this case, both the Town and developer funding the sewer could recover costs through future off-site levies.

All costs would be revisited as part of a future detailed off-site levy review to better share costs between existing and future development areas.



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Town of Westlock

TOWN OF WESTLOCK MASTER PLAN - 2009 UPDATE
WASTEWATER COLLECTION SYSTEM
FUTURE WASTEWATER COLLECTION SYSTEM COSTS

FIGURE 8.1

0 100 200 300 400 500 600 700 800 metres
0 500 1000 1500 2000 2500 feet

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9.0 Conclusions and Recommendations

9.1 Conclusions

As per the Town's Wastewater Collection System Master Plan (ISL, January 2005), fundamental conclusions as per system performance remain generally the same with the exception of the addition of the lagoon capacity review. That is to say that:

1. Generally, the wastewater collection system performs well under both dry and wet weather conditions. There are, however, several locations where surcharge conditions under wet weather exist that could either cause basement flooding and/or discharge to the ground surface. These problem locations require action either in the form of system upgrades or the construction of new trunk sewers to alleviate the surcharge problems. Sewer flow monitoring is recommended to determine the effect of the problems and the need for upgrades.

2. The Town's lagoon system appears to be adequate for existing growth conditions and appears to have capacity for the next several years. Further study on actual flow rates to the lagoon within the next 5 years is recommended to better determine the actual timing and degree of upgrade required in the future. Regular sludge monitoring and removal is also recommended to ensure design capacities are maintained.

Departure from the previous study is generally resultant from the significantly expanded future growth area. Generally speaking, revised and/or new upgrades are recommended to ensure the system can meet the required future system performance.

9.2 Recommendations

Carry out the following activities to address existing system needs:

1. Conduct sewer flow monitoring on 200 mm sewers at the following locations to determine current system performance during wet weather and the need for upgrades:
    - on 107 Street east of 103 Avenue, and south on 103 Avenue from 107 Street;
    - on 102 Street between 105 Avenue and 106 Avenue; and
    - 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.

Recommendations related to the Town's wastewater collection system future servicing concept are as follows:

1. Construct a new 450 mm sewer main along 113A Street from 96 Avenue to 90 Avenue, and construct a new 600 mm sewer main on 90 Avenue from 113A

Street to the northwest corner of Town, at a cost of $390,000 for the 450 mm sewer and $470,000 for the 600 mm sewer. This would facilitate development in the west, southwest, south, and southeast parts of Town.

2. Construct an extension of the 375 mm sewer from near the Hospital east across Highway 44 approximately 450 m to the east at a cost of $250,000. This would facilitate development in the southeast.

3. Construct a pump station and forcemain from the 200 mm sewer at 106 Street south of Highway 44 to the new extension of the 375 mm line from the hospital at a cost of $1,500,000 for the lift station plus $300,000 for the forcemain. This would facilitate development in the southeast.

4. Construct a 250 mm sewer along the west Town boundary from Highway 18 to 113A Street at a cost of $300,000.

5. Construct a network of new trunk sewers to feed a pump station in the extreme northeast. Construct the pump station and a forcemain west to Highway 44 at costs of $2,500,000 and $1,000,000, respectively.

6. Construct a new 750 mm trunk sewer from Highway 44 to the northwest corner of Town along the north Town boundary at a cost of $1,930,000.

7. Construct a new 1050 mm outfall line to the lagoons from the northwest corner of Town at a cost of $2,430,000.

10.0 References

Province of Alberta Water for Life – Alberta's Strategy for Sustainability - Alberta Environment, 2003.

Standards and Guidelines for Municipal Waterworks, Wastewater, and Storm Drainage Systems - Alberta Environment, 2006.

Town of Westlock Wastewater Collection System Master Plan - ISL Engineering and Land Services Ltd., January, 2005.

Town of Westlock Procedures and Design Standards for Development – ISL Engineering and Land Services Ltd., October 2009.