Core Asset Management Plan

City of Sarnia

July 1, 2022

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Executive Summary

Infrastructure is used to provide services to our community. Watermains bring clean drinking water to our taps, sidewalks provide a safe space to walk around our city, and sanitary sewers take our wastewater away to be cleaned. The purpose of asset management is to maximize the value we gain from our infrastructure. This plan is intended to provide a comprehensive reference for building, operating, maintaining, renewing, replacing, and disposing of the City's core infrastructure assets. Core assets include water, wastewater, stormwater, roads, and bridges. The plan is based on the guidelines provided in the Province of Ontario's Building Together Guide and Regulation 588/17 for Municipal Asset Management Planning.

Sarnia, like most municipalities, has ageing infrastructure and limited financial resources. This plan helps us understand the financial investments required to provide municipal services within the communities selected level of service and acceptable risk. The plan outlines the current condition, levels of service, optimal asset management, and financial strategies, for our core assets.

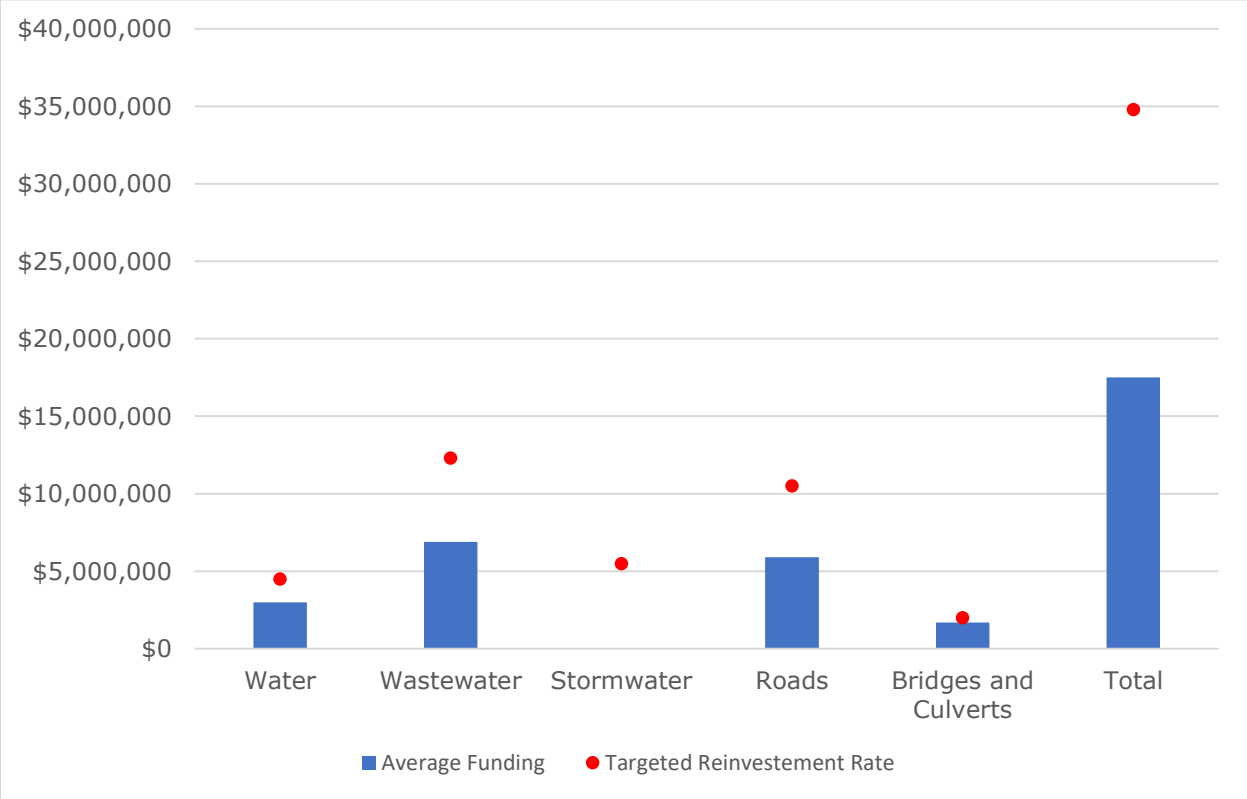
Asset management is complex and will be an ongoing initiative that is never fully complete. The plan will require continual updating and will become more comprehensive and accurate over time.

The replacement cost of the core assets is approximately $2.4 billion and the infrastructure backlog is estimated at $381 million. Details for each asset category are summarized in Table 1 and
Figure 1, respectively.

Table 1 Core infrastructure asset summary

Asset Type	Average Condition	Replacement Cost	Backlog
Water	Fair	$405,000,000	$111,000,000
Wastewater	Fair	$597,000,000	$134,000,000
Stormwater	Good	$501,000,000	$20,000,000
Roads	Fair	$823,000,000	$107,000,000
Bridges and Culverts	Good	$68,000,000	$8,700,000
Total	**Good**	**$2,394,000,000**	**$380,700,000**

Figure 1 Current funding versus sustainable reinvestment rate



Introduction

The City of Sarnia is located on the south shore of Lake Huron at the headwaters of the St. Clair River at the border of Ontario and Michigan. Sarnia is known for its breathtaking sky-blue waters and beautiful waterfront parks. The City's current population is approximately 74,000 people.

Most of the City's infrastructures assets were built during the post-war boom period, from the 1950s - 1970s, and are now approaching the end of their design life. In addition to ageing infrastructure, we need to upgrade and modernize infrastructure that was built under old design considerations, such as combined sewers in the core of the city that are at risk of causing basement flooding and overflows into the river. With a river along our western boundary, and a lake along the north, we must also factor in the impacts of climate change. The record high water levels in recent years have caused shoreline erosion and put pressure on our stormwater management systems. As a result, the City is faced with ever increasing infrastructure needs with limited financial resources. This asset management plan helps us understand the state of our assets and the investments required to properly maintain them.

How to Read the Asset Management Plan

Financial and Sustainability Analysis

The purpose of financial analysis sections are to provide a high-level overview of the City's current outlook for each category of core assets. The analysis does not provide in-depth information and are not appropriate for informing specific capital project prioritizations.

Financial analysis sections do not consider the impact of inflation. All funding increases are assumed to be above the value of inflation to demonstrate the expected impact on backlog and sustainability.

Replacement values are estimated using recent capital projects and are intended for use in high-level assessments.

Associated Capital and Master Plans

Relevant capital and master plan documents are used as support for the core asset categories. The purpose of the asset management plan is not to supersede these documents, but to provide a cohesive overview of the City's infrastructure. If more in-depth analysis is required, the listed plans should be reviewed.

Levels of Service

In an asset management environment, levels of service are used to define the quality of a given service. Community levels of service provide descriptions of the desired scope of the service being delivered. Corresponding technical levels of service provide metrics that are capable of measuring the quality of the service within the defined community level of service. O. Reg. 588/17 requires both legislated community and technical levels of service for each core asset category.

Water Distribution System

The City of Sarnia's water distribution system (WDS) provides clean drinking water to approximately 25,000 customers (~74,000 people). Water supply is purchased from the Lambton Area Water Supply System (LAWSS), which is operated as a separate board, so those assets are not included in Sarnia's asset management plan.

Inventory

Table 2 Water distribution system inventory

Asset Type	Quantity	Average Age	Replacement Cost
Watermains	501 km	48 Years	$405,000,000
Main Valves	3719	48 Years	Included with watermain replacement cost
Hydrants	2738	48 Years	

Figure 2 Watermain length by diameter

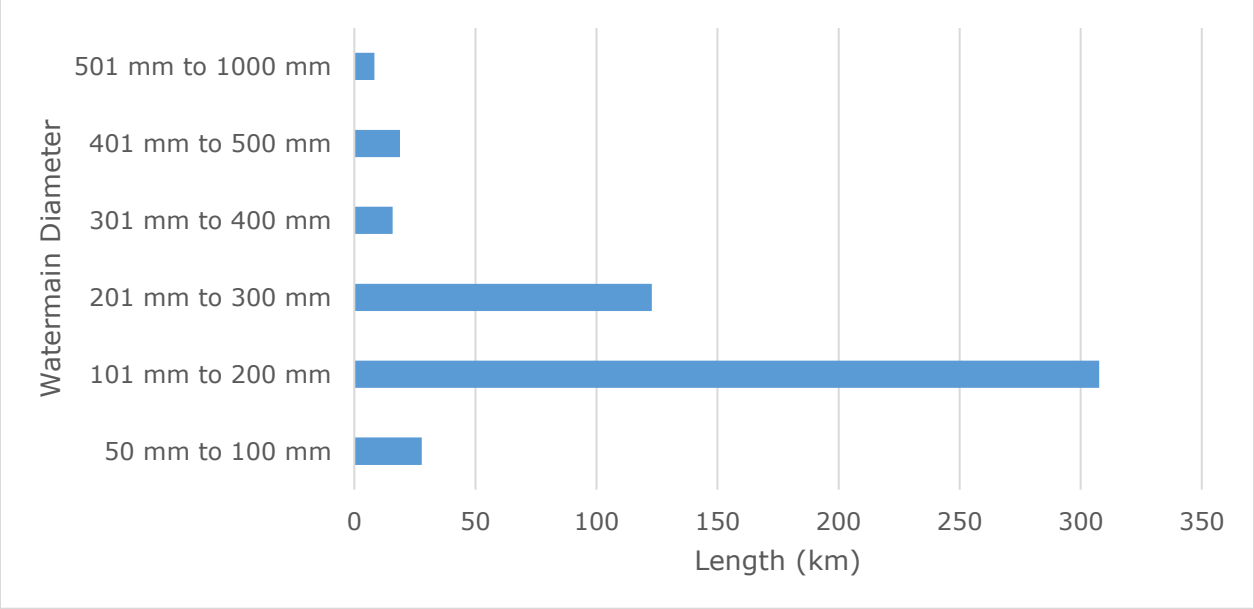
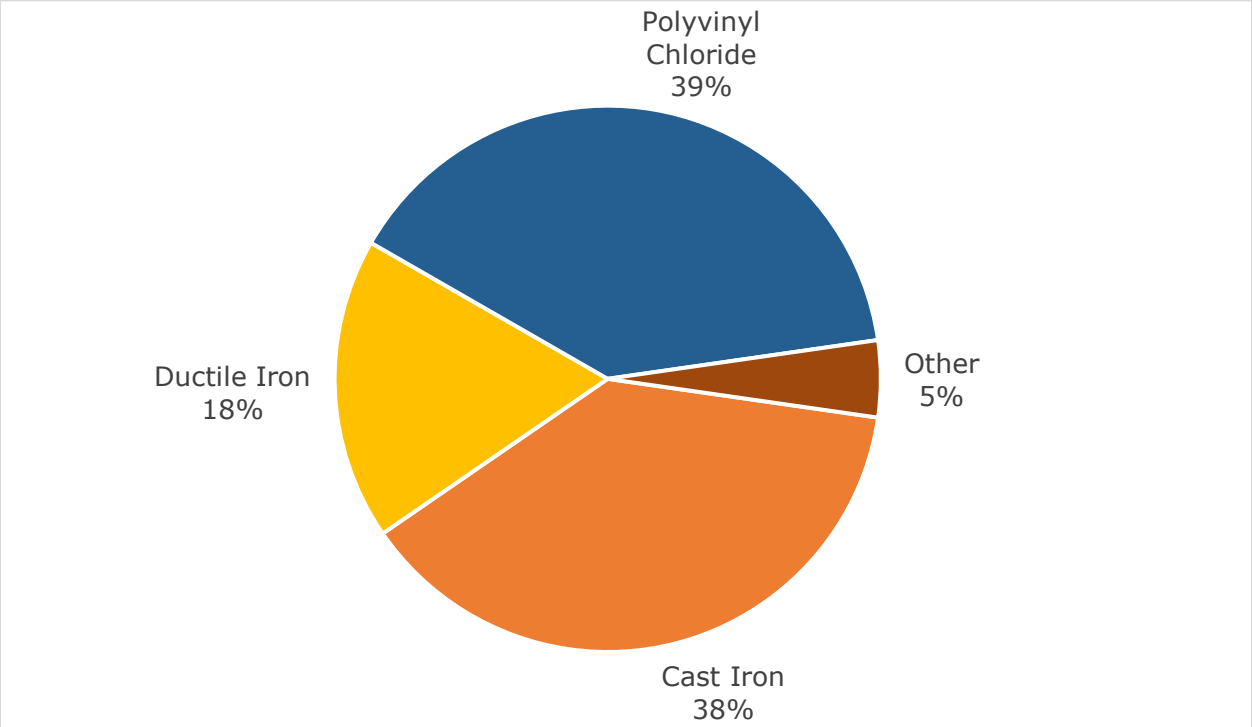
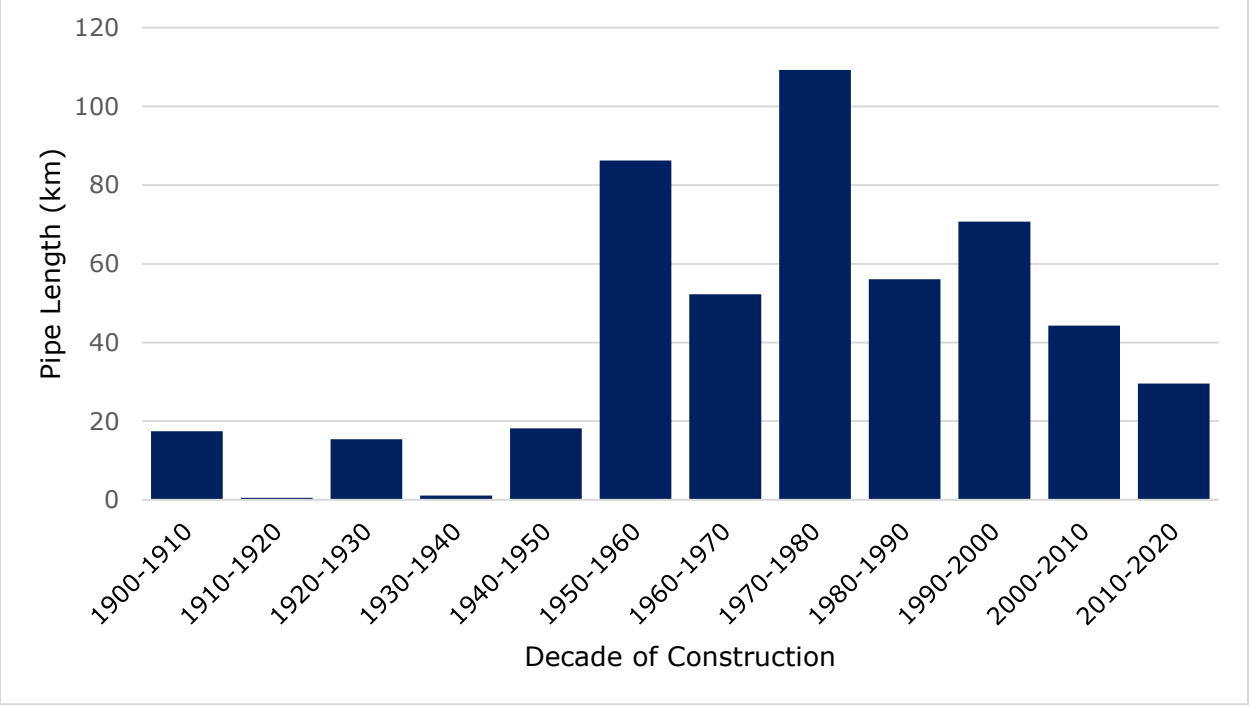


Figure 3 Watermain material distribution



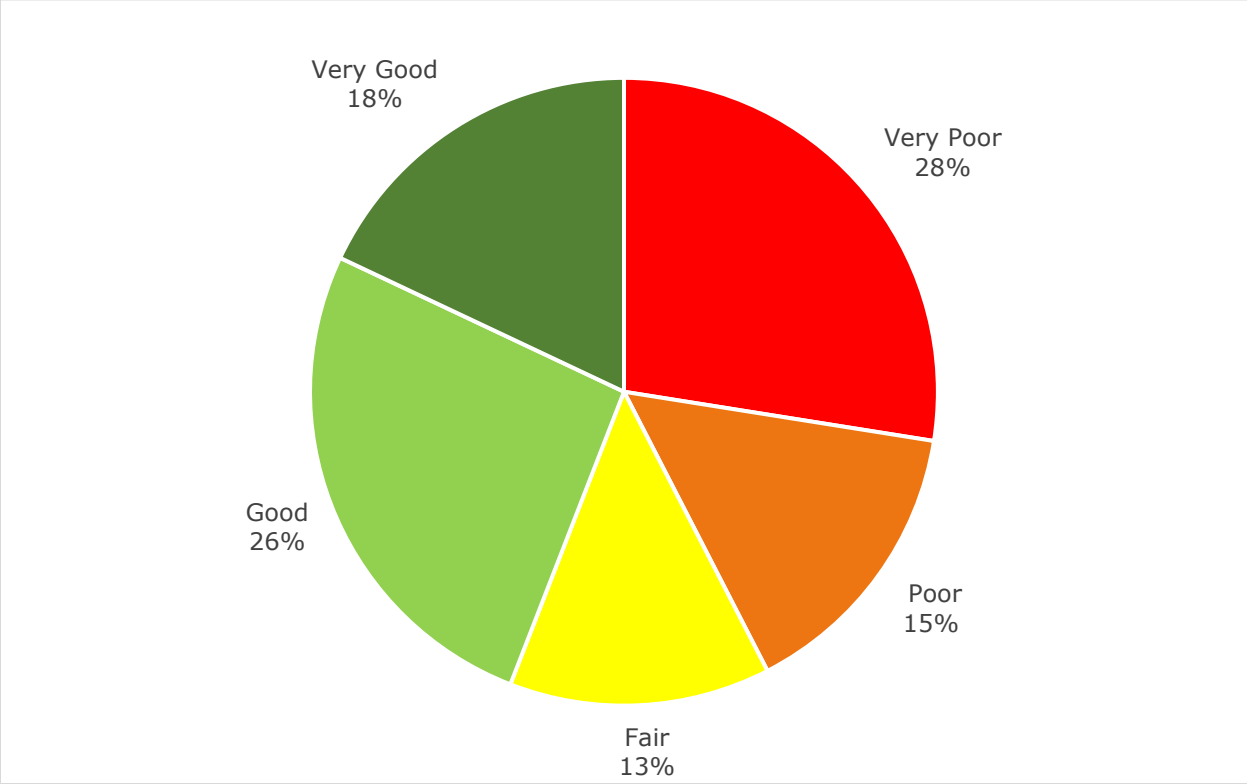
Age and Condition

Figure 4 Watermain length by installation decade



To calculate the condition score, Sarnia uses a combination of the watermain age, break history, and available fire-flow. The lowest scored category is used as the condition rating for each section of watermain. The risk assessment is incorporated in the proritization based on size of the watermain.

Figure 5 Summary of watermain condition ratings



Lifecycle Management Strategy

Operations and Maintenance

- Sarnia maintains a detailed operational plan that outlines the implementation of the Drinking Water Quality Management System (DWQMS)
- The City has annual valve-turning and hydrant flushing, which have been in place since 2010. City staff currently flush all 2738 City hydrants and turn an average of 300 watermain gate valves every year
- Curb box replacements are completed on an as needed basis

Rehabilitation and Replacement

- Watermain breaks and other failures are repaired as they are discovered in the system
- Watermain replacements are prioritized by a variety of factors outlined in Table 3

Table 3 Criteria for Prioritizing Watermain Replacement

Factor	Comments
Age and Material	"Age and Material" is the most significant assessment criterion: As a watermain ages its condition deteriorates by a combination of increased calcium deposits, low flows, low pressure, rusting, and breakage. The type of material significantly affects the rate at which deterioration occurs.
Watermain Breaks per 100 meters	The number of watermain breaks provides an accurate measure of operational decline due to pipe deterioration. Watermains that have a history of breakage are a significant burden on the operational budget.
Fire Flow	Several areas within the City experience very low water flows. Such low flow areas are both an operational and safety concern. Low flows are also directly related to increased water ages within the affected pipes.
Pipe Diameter	Large diameter pipes are often transmission lines that supply significant quantities of water to large areas within the City: As such, problems with larger diameter pipes are considered to have high associated social and economic risks. Small diameter pipes, less than 150mm, are also a priority as they often have low pressures.
Lead Services	Several areas within the City have properties that are still serviced lead pipes. Through water sampling, many of these areas have been identified and are being prioritized for replacement as lead services have a significant detrimental effect on water quality.

System Modeling

In 2013, Stantec Consulting Limited completed a hydraulic computer model of the City's WDS and a 'Water Distribution System Master Plan' (WDSMP) for the City of Sarnia.

The objective of this study was to obtain a detailed hydraulic assessment of the City's WDS and to develop a hydraulic computer model that accurately portrays the pressure, flow, and age of the water being distributed throughout the City's water network.

Using the hydraulic model, City staff can identify deficiencies in the available fire flows and/or in pipe water ages for different flow conditions, and to model possible solutions quickly and accurately for possible implementation.

The City is currently in the process of verifying and updating its water model. This will ensure the accuracy of fire flows and other flow conditions within the WDS. Increasing the confidence in the hydraulic model will allow for accurate results when modeling different scenarios.

The WDMP provides direction to the long-term management and operation of the City's water infrastructure. Specifically, its prioritised list of water projects and recommendations provide direct input for the City's long-term Capital Plan.

Financial and Sustainability Analysis

Multiple high level financial scenarios are outlined in Table 4. Each scenario highlights the average annual funding, average annual cost increase per residential user, and the projected backlog at the end of the 20-year window. The current WDS backlog is $115,000,000 and there is approximately a $1,500,000 annual gap between actual funding and the funding required to reach sustainability. This gap is added to the backlog at the end of each year. The 2021 Water Rate Study recommends that Sarnia target reaching annual sustainable funding through water user rates and utilize external grant funding to reduce the current backlog. Note that the average annual funding below does not match the annual funding in the capital budget as a portion of the water capital budget is allocated to road restoration costs. The second scenario displays the average cost per user required to become immediately sustainable. This would be a one-time permanent user rate increase to ensure that the current level of service is maintained.

Table 4 Water distribution network financial scenarios

Scenario	Average Annual Funding Required	Average Annual User Increase Per Year	2041 Backlog
Maintain Current Funding	$3,000,000	$-	$145,000,000
Reach Sustainability in 2022	$4,500,000	$60 *Permanent one time increase per user in 2022	$115,000,000
2.5% Annual Capital Funding Increase Above Inflation	$3,800,000	$3.59	$129,000,000
5% Annual Capital Funding Increase Above Inflation	$5,000,000	$9.16	$105,000,000

Figure 6 Water distribution network sustainability analysis

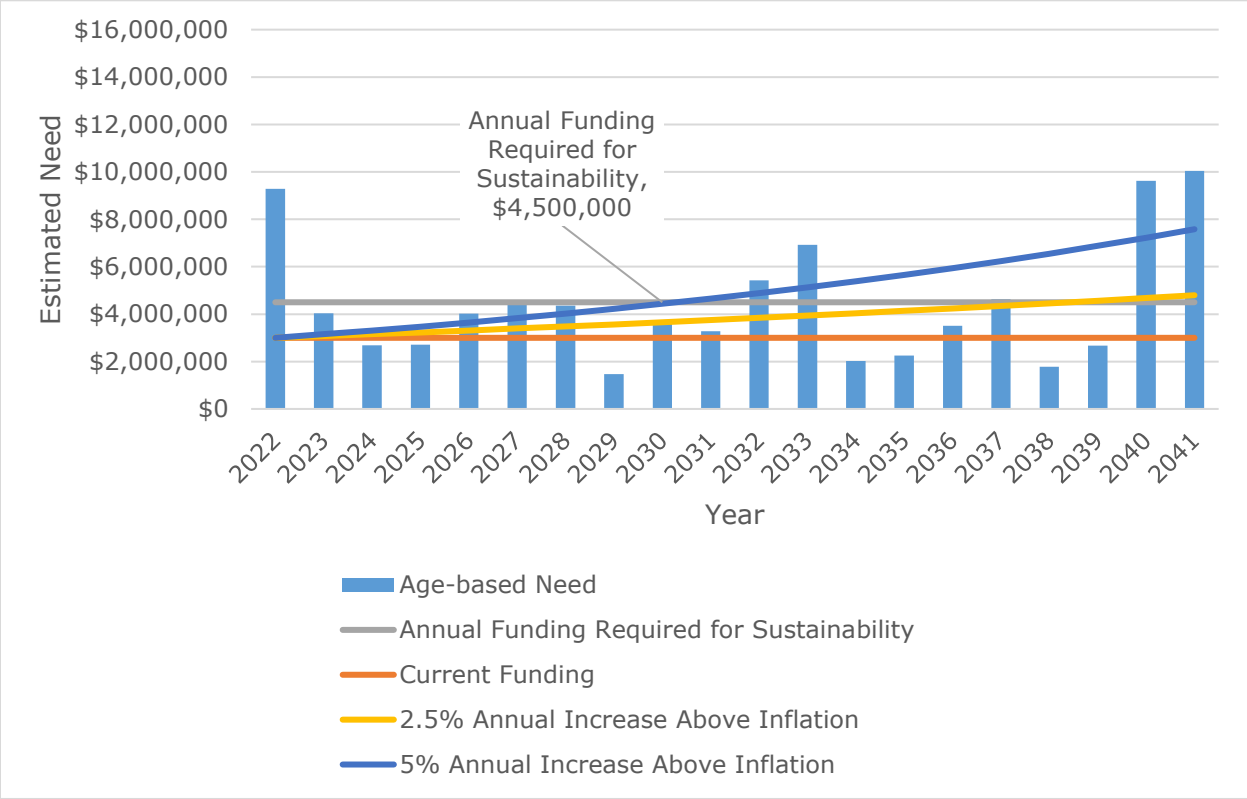


Figure *6* represents the four different financial scenarios outlined in Table 4. It is projected that the current funding level is insufficient to maintain the water distribution network without the $1,500,000 gap being bridged with external funding. To bridge this gap internally through the water user rate an increase above inflation is required. With a 2.5% increase above inflation sustainability will be reached by 2039.

Levels of Service

Community Levels of Service

Table 5 Community levels of service

Service Attribute	Community Levels of Service	Current levels of service (2021)
Scope	1. Description, which may include maps, of the user groups or areas of the municipality that are	See Appendix A

Service Attribute	Community Levels of Service	Current levels of service (2021)
	connected to the municipal water system. 2. Description, which may include maps, of the user groups or areas of the municipality have fire flow.	
Reliability	Description of boil water advisories and service interruptions	There were no boil water advisories issued in 2021. There were 89 watermain breaks in 2021. All watermain breaks were repaired within 24 hours of occurrence and extended service disruptions were avoided.

Technical Levels of Service

Table 6 Technical levels of service

Service Attribute	Technical levels of service	Current levels of service (2021)
Scope	% of properties connected to the municipal water system	98% See Appendix B
	% of properties where fire flow is available	93%
Reliability	The number of connection-days per year where a boil water advisory notice is in place compared to the total number of properties connected to the municipal water system.	0

Service Attribute	Technical levels of service	Current levels of service (2021)
	The number of connection-days per year due to water-main breaks compared to the total number of properties connected to the municipal water system.	The currently available data is not sufficient to provide an answer to this question. Additional data for watermain breaks will require collection. To be implemented in conjunction with CityWorks software.

Conclusion

In Ontario, the Safe Drinking Water Act (S.D.W.A) was passed in 2002 and regulates the production of drinking water and outlines the requirements that the municipality must fulfill to obtain a Municipal Drinking Water License. As a part of these requirements, the City of Sarnia has prepared a Financial Plan in accordance with Ontario Regulation 453/07, last updated in 2019. The information contained in the AMP should be considered in addition and not as a replacement for the Financial Plan or Water Rate Study.

While a large percentage of the City's water distribution assets are listed in poor or very poor condition, there are no indications that Sarnia will not be able to continue to provide the current service level being provided by the network. As such, high quality and safe water will continue to be provided to the City's residents. Condition and forecast costs are estimated based on the remaining service life and represent a water system that is aging normally. Any deficiencies that are identified outside of this general estimate (poor fire-flow, etc.) are addressed through mitigation plans and, if available, external funding.

The high-level budget analysis completed in the AMP indicates that Sarnia's water distribution network is close to reaching the funding level required for sustainability. For a more detailed outlook it is recommended that the Water Rate Study completed in 2021 is reviewed.

Recommendations

It is recommended that:

1. The Water Financial Plan is referred to and updated as needed to assist in guiding future decisions with regards to the management of the City's Water Distribution Network.
2. Sarnia implement additional service level metrics through the use of Sarnia's CityWorks software when it becomes available organization wide.
3. Sarnia work towards developing a formal risk management process to inform project prioritization.

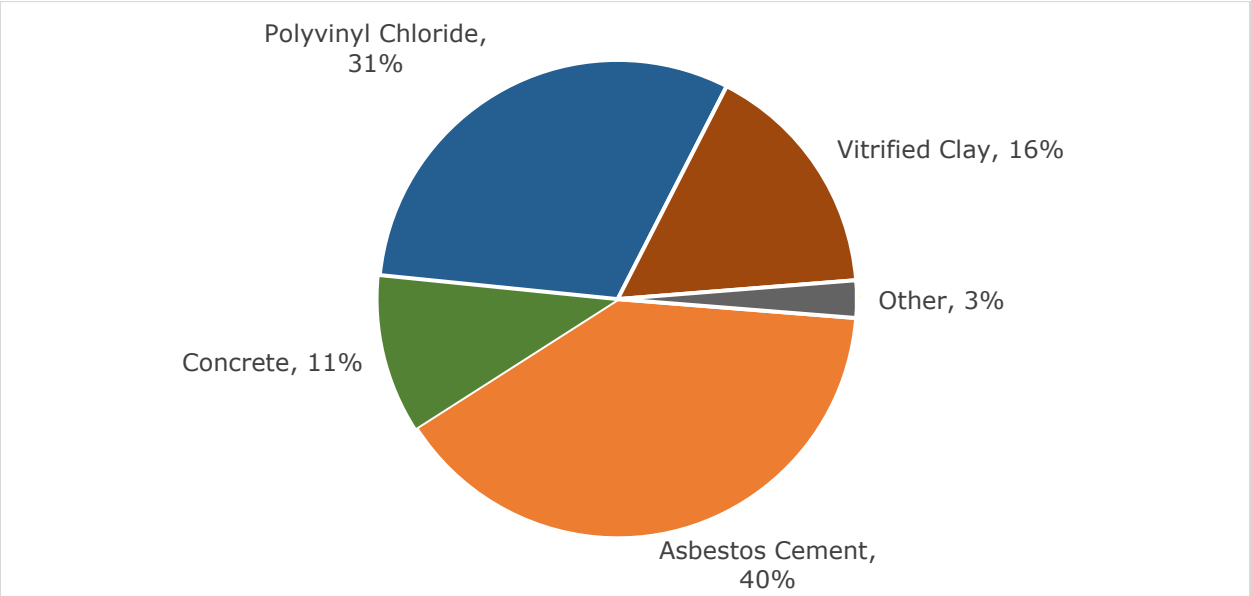
Wastewater Network

Inventory

Table 7 Wastewater management age and replacement cost

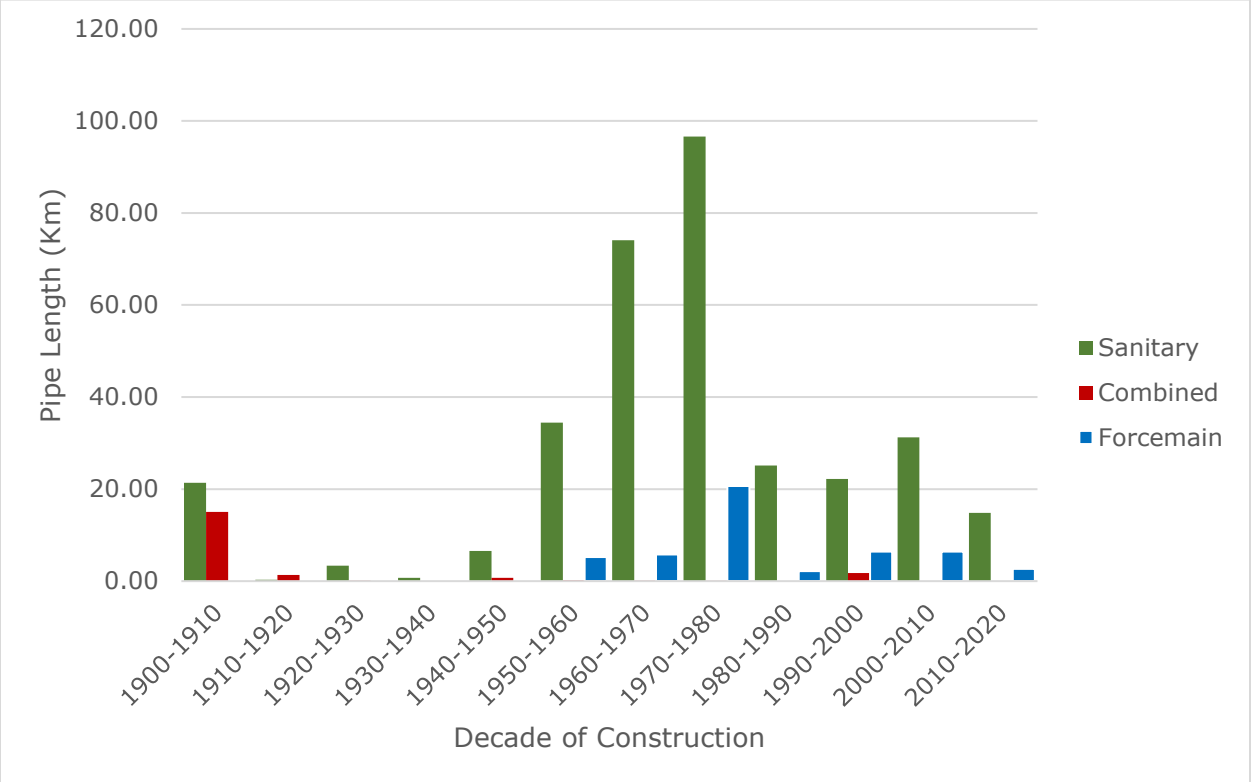
Asset Type	Quantity	Average Age	Replacement Cost
Sanitary Sewers	331 km	51 Years	$318,000,000
Sanitary Forcemains	49 km	40 Years	$46,000,000
Combined Sewers	19 km	109 Years	$23,000,000
CSO Tank	1	26 Years	$10,000,000
Sanitary Pumping Stations	56	22 Years	$55,000,000
Wastewater Treatment Facilities	2	N/A	$145,000,000
Total	**N/A**	**N/A**	**$597,000,000**

Figure 7 Sanitary sewer material distribution



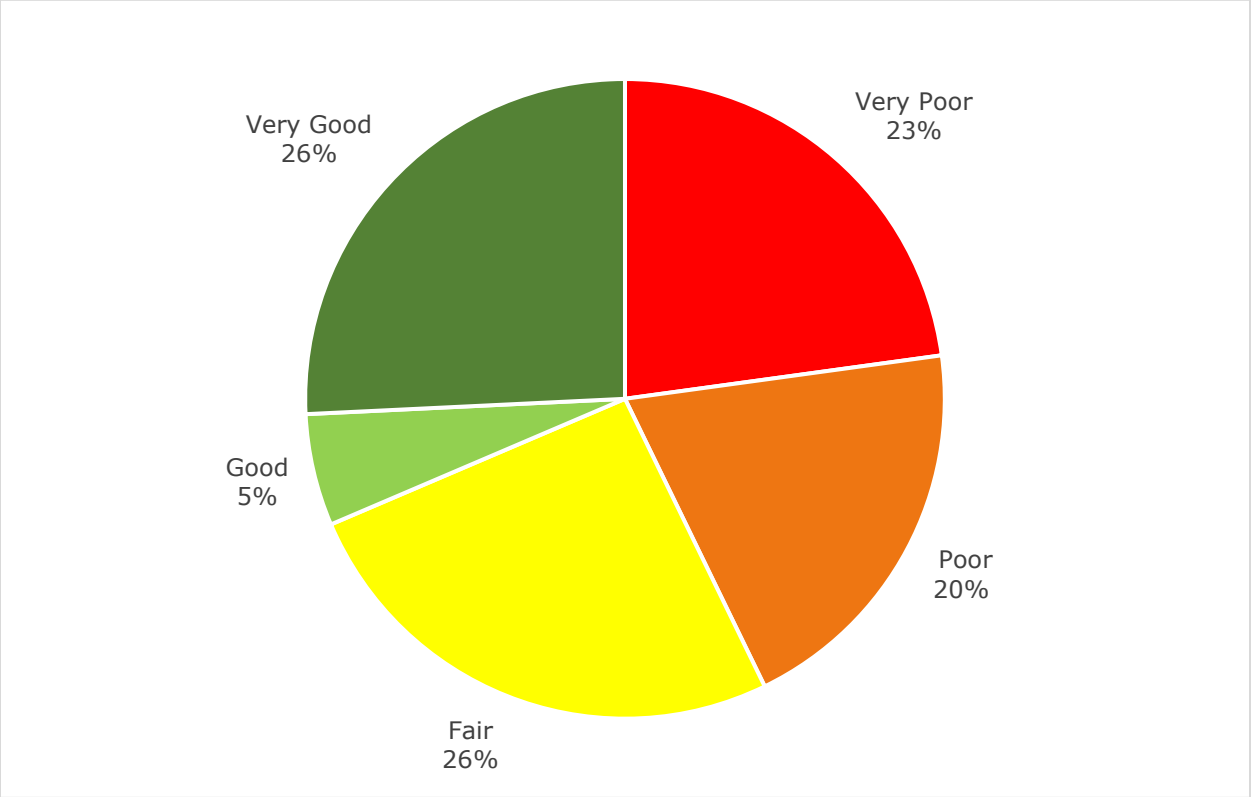
Age and Condition

Figure 8 Sanitary sewer length by installation decade



*If no age data is available the sewer is assigned to the 1900-1910 category

Figure 9 Condition of linear wastewater infrastructure



Sanitary Pumping Stations

Table 8 Sanitary pumping stations age and condition

Asset	Count (in service)	Average Age	Average Condition	Replacement Value
Sanitary Pumping Stations	51	30 Years	Fair	$55,000,000

Current condition of the existing sanitary pumping stations was determined using the age of the pumping station with the following breakdown.

Table 9 Sanitary pump station component service life

Component	% of Total Facility Cost	Expected Service Life of Wastewater Pumping Station
Architectural	10	30 Years

Component	% of Total Facility Cost	Expected Service Life of Wastewater Pumping Station
Electrical	15	25 Years
Life Safety	5	50 Years
Mechanical	10	30 Years
Process	25	40 Years
Site Elements	5	50 Years
Structural	30	100 Years
Total	**100**	**55 Years**

This section of the Asset Management Plan will be updated accordingly as detailed condition assessments for sanitary pumping stations are completed in the future.

Wastewater Treatment Facilities

The City of Sarnia owns and operates two wastewater treatment facilities: The St. Andrew Street Wastewater Pollution Control Centre (WPCC) located in the south end of the City's urban area, and the Bright's Grove Sewage Lagoons (BGSL) located in the community of Bright's Grove.

WPCC

The original WPCC plant, built in 1959, used an anaerobic waste treatment process with only primary treatment capabilities. In 2000, the plant was upgraded to include an aerobic primary treatment process and additional secondary treatment processes. An overview of the WPCC can be seen below in Figure *10*.

Figure 10 Water Pollution Control Centre

BGSL

The BGSL was originally constructed in 1974 and consisted of three different lagoon cells. Currently only two lagoon cells are active as seen in Figure 11.

Figure 11 Bright's Grove Sewage Lagoon

In 2017 a Submerged Attached Growth Reactor (SAGR) system was commissioned at the BGSL. The system was constructed with spare capacity and is also expandable for future growth needs.

Lifecycle Management Strategy

Operations and Maintenance

- Proactive maintenance needs with regards to the gravity fed sanitary sewers are generally driven by operational needs identified by the Public Works Department. Areas with known back-up/flow issues are regularly cleaned to mitigate risks.
- Sewer collapses are repaired when identified.
- Sarnia's pumping stations undergo general inspections each year with detailed condition assessments being completed periodically. Maintenance is completed as required with larger projects related to end of service life needs identified through detailed condition assessments.
- Currently the WPCC and the BGSL do not have an associated 10-year plan. Maintenance is performed on an as needed basis. The City has contracted a third party to complete a more detailed plan. This section will be updated as more information becomes available.

Rehabilitation and Replacement

- Sarnia completes select sanitary sewer relining when other buried assets are in good condition, but since this is not often the case it is not a routine project for the City. Sewer relining is an area of interest to the City with the hopes of increasing the use of this tool in the future.
- Sarnia routinely undertakes replacement at the end the sanitary sewers useful service life.
- Sanitary sewer replacement is currently focused in areas where combined sewers are present. Often water and road also require replacement in these areas.
- Sanitary pumping stations undergo major rehabilitation when components reach the end of their projected service life. Operational issues are also considered when scheduling rehabilitation and replacement projects.
- Both the WPCC and BGSL undergo major rehabilitation when critical components reach the end of their useful service life. Alternative solutions are also investigated at these points in time due to advancements in technology.

Financial and Sustainability Analysis

Multiple high level financial scenarios are outlined in Table 10. Each scenario highlights the average annual funding, average annual cost increase per residential user, and the projected backlog at the end of the 20-year

window. The current wastewater management backlog is $121,000,000 and there is approximately a $5,400,000 annual gap between actual funding and the funding required to reach sustainability. This gap is added to the backlog at the end of each year. The 2021 Rate Study recommends that Sarnia target reaching annual sustainable funding through sewer user rates and utilize external grant funding to reduce the current backlog. Note that the average annual funding below does not match the annual funding in the capital budget as a portion of the sewer capital budget is allocated to the stormwater management system. The second scenario displays the average cost per user required to become immediately sustainable. This would be a one-time permanent user rate increase to ensure that the current level of service is maintained.

Table 10 Wastewater management financial scenarios

Scenario	Annual Funding Required	Average Annual User Increase	2041 Backlog
Maintain Current Funding	$6,900,000	$-	$229,000,000
Reach Sustainability in 2022	$12,300,000	$216 *Permanent one time increase per user in 2022	$121,000,000
2.5% Annual Capital Funding Increase Above Inflation	$8,800,000	$8.26	$191,000,000
5% Annual Capital Funding Increase Above Inflation	$11,400,000	$21.07	$139,000,000

Figure 12 Wastewater management network sustainability analysis

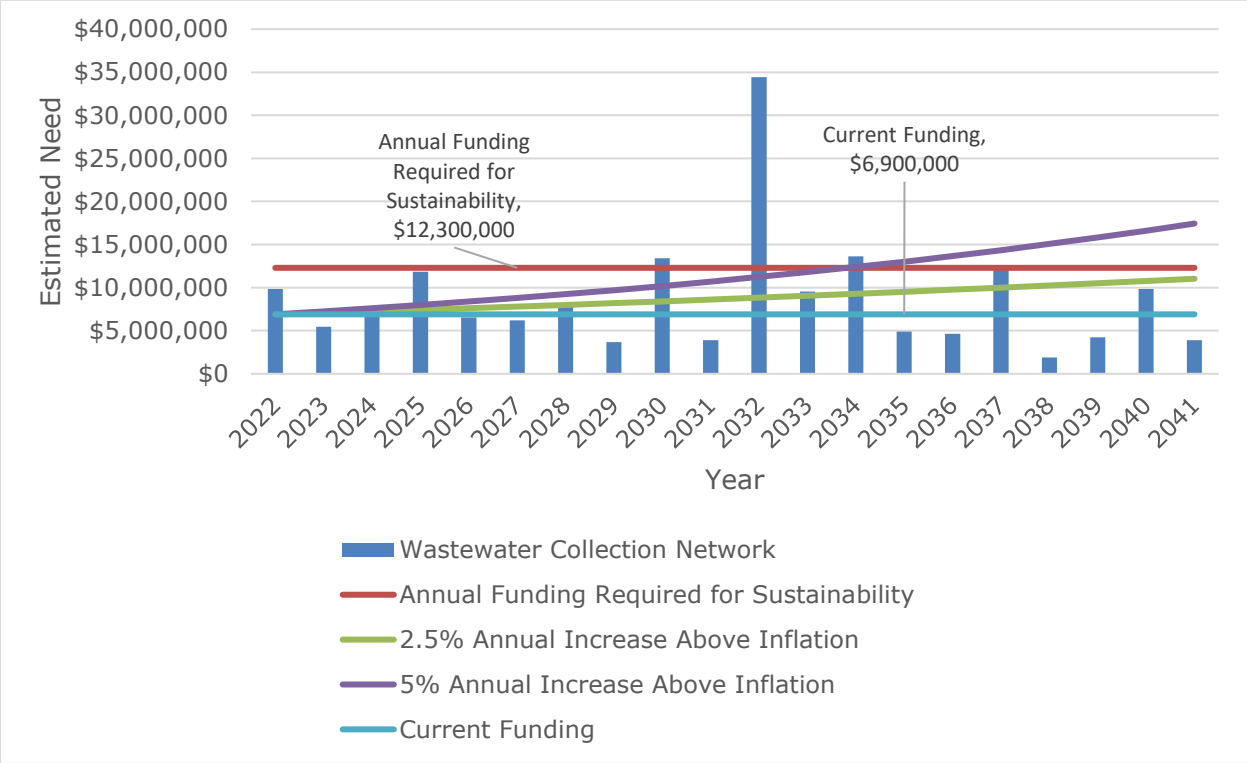


Figure 12 represents the four different financial scenarios outlined in Table 10. It is projected that the current funding level is insufficient to maintain the wastewater management network without the $5,400,000 gap being bridged with external funding. To bridge this gap internally through the sewer user rate an increase above inflation is required. With a 5% increase above inflation sustainability will be reached by 2034.

Levels of Service

Community Levels of Service

Table 11 Community levels of service

Service Attribute	Community Levels of Service	Current levels of service (2021)
Scope	Description which may include maps, of the user groups or areas of the municipality that are connected to the municipal wastewater system.	See Appendix A

Service Attribute	Community Levels of Service	Current levels of service (2021)
Reliability	Description of how combined sewers in the municipal wastewater system are designed with overflow structures in place which allow overflow during storm events to prevent backups into homes.	There are approximately 19km of combined sewers in the City's wastewater system. The City is actively working towards the separation of the remaining combined sewers. To stop sewer backups during storm events the City has installed overflows on these sewer lines. The overflows are designed to relieve overloaded sewers by directing flow to an adjacent storm sewer or body of water instead of backing up into a basement.
	Description of the frequency and volume of overflows in combined sewers in the municipal wastewater system that occur in habitable areas or beaches	Sarnia is undertaking a project to install equipment to track these overflows on all outlets. Currently, only the CSO tank is tracked and there were no overflow events recorded in 2021. Combined sewer overflows that do occur are released into the St. Clair River. There are no known overflows to Lake Huron.
	Description of how stormwater can get into sanitary sewers in the municipal wastewater system, causing sewage to overflow into streets or backup into homes	Inflow and infiltration (I&I) from both stormwater and groundwater enter the sanitary sewers in various ways. Cross-connections, cracks in sewer, foundation drain connections, and catchbasins are all ways that unwanted flow can enter the sewer and cause backups.

Service Attribute	Community Levels of Service	Current levels of service (2021)
	Description of how sanitary sewers in the municipal wastewater system are designed to be resilient to avoid events described in paragraph 3.	To minimize I&I into the wastewater system the City maintains design standards to accurately calculate the required sewer capacity/size. The City also eliminates discovered cross connections where possible and offers incentive to disconnect existing foundation drains from the sanitary system.
	Description of the effluent that is discharged from sewage treatment plants in the municipal wastewater system.	Effluent that is discharged from both the BGSL and WPCC have documented compliance limits, objectives, and actual performance data.

Technical Levels of Service

Table 12 Technical levels of service

Service Attribute	Technical levels of service	Current levels of service (2021)
Scope	Percentage of properties connected to the municipal wastewater system	90% See Appendix B
Reliability	The number of events per year where combined sewer flow in the municipal wastewater system exceeds system capacity compared to the total number of properties connected to the municipal wastewater system.	This data is currently unavailable. Sarnia is undertaking a project to install equipment to track this data on combined sewer overflows.

Service Attribute	Technical levels of service	Current levels of service (2021)
	The number of connection-days per year due to wastewater backups compared to the total number of properties connected to the municipal wastewater system.	This data is not immediately available. Tracking will occur in conjunction with the Cityworks implementation that is ongoing.
	The number of effluent violations per year due to wastewater discharge compared to the total number of properties connected to the wastewater system.	No effluent violations were recorded in 2021. For more detailed information refer to the annual reports for both WPCC and BGSL.

Conclusion

On average Sarnia's wastewater network is the oldest asset owned by the City. With much of the current infrastructure either at or reaching the end of its service life, it will be necessary for more funding to be allocated then in the recent past to maintain the current service level being provided.

While the gap between the City's targeted reinvestment rate and the projected capital funding is small, the estimated age-based need shows substantial investment requirements on the horizon. This indicates importance of working towards sustainability now before the gap between need and funding becomes too large to bridge. City staff are committed to investigating different rehabilitation methods to extend the service life of existing infrastructure in addition to replacement projects. Condition data for the wastewater system should continue to be collected to assist in verifying the information present in the AMP.

Recommendations

It is recommended that:

1. Capital funding is increased to close the gap between current funding and the reinvestment target.
2. Sarnia implement additional service level metrics using Sarnia's CityWorks software when it is implemented.
3. Sarnia work towards developing a formal risk management process to inform project prioritization.
4. Sarnia continue with CCTV inspections of sanitary sewers to verify existing infrastructure condition data.
5. Sarnia work towards obtaining detailed condition assessments on the sanitary pumping stations
6. Sarnia continues to separate combined sewers.

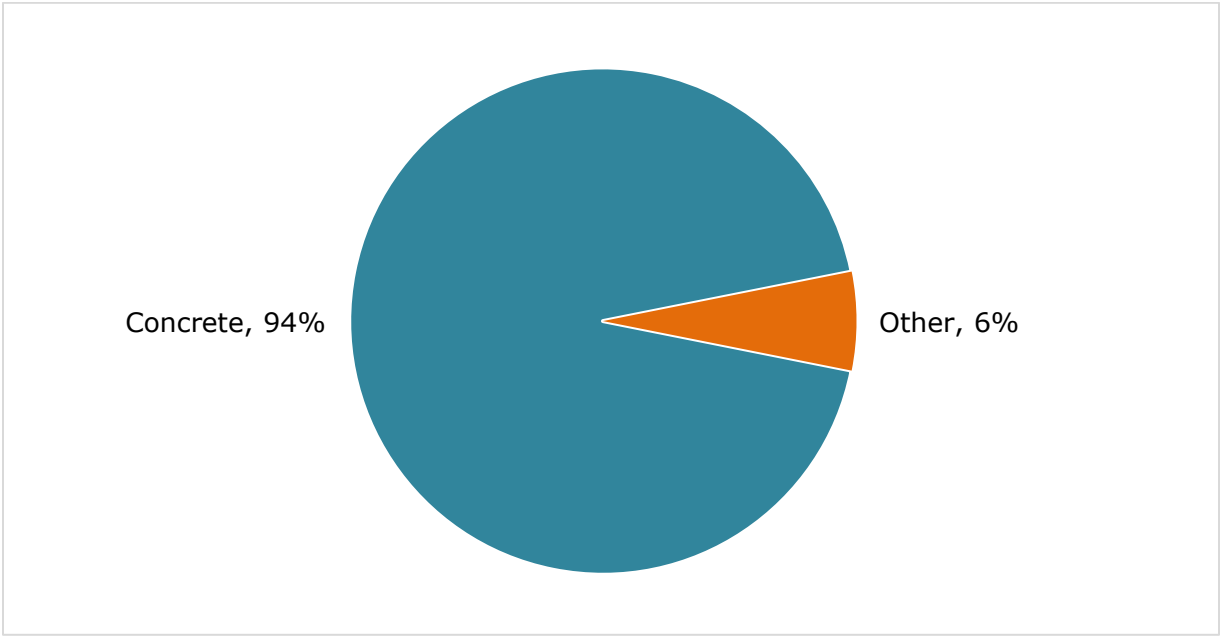
Stormwater Network

Inventory

Table 13 Stormwater management age and replacement cost

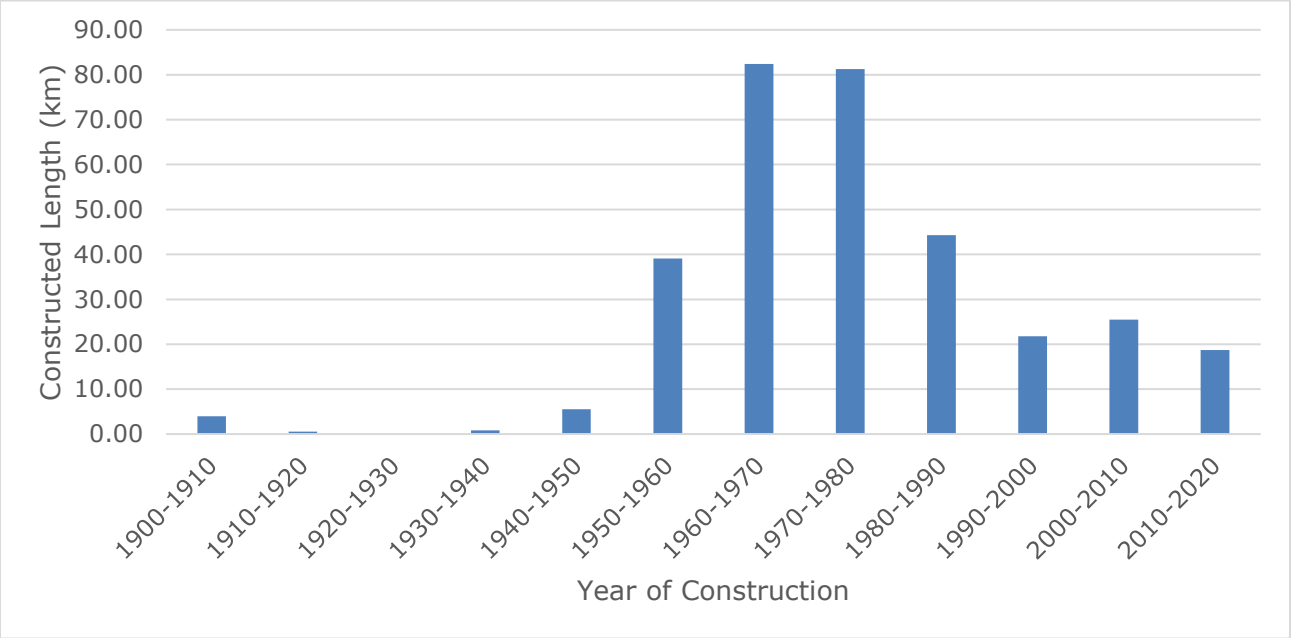
Asset Type	Quantity	Average Age	Replacement Cost
Stormwater Sewers	324 km	47 Years	$407,000,000
Stormwater Forcemains	1 km	26 Years	$1,000,000
Stormwater Pumping Stations	3	27 Years	$3,000,000
Stormwater Ponds	8	22 Years	Unknown
Total	**N/A**	**N/A**	**$411,000,000**

Figure 13 Storm sewer material distribution



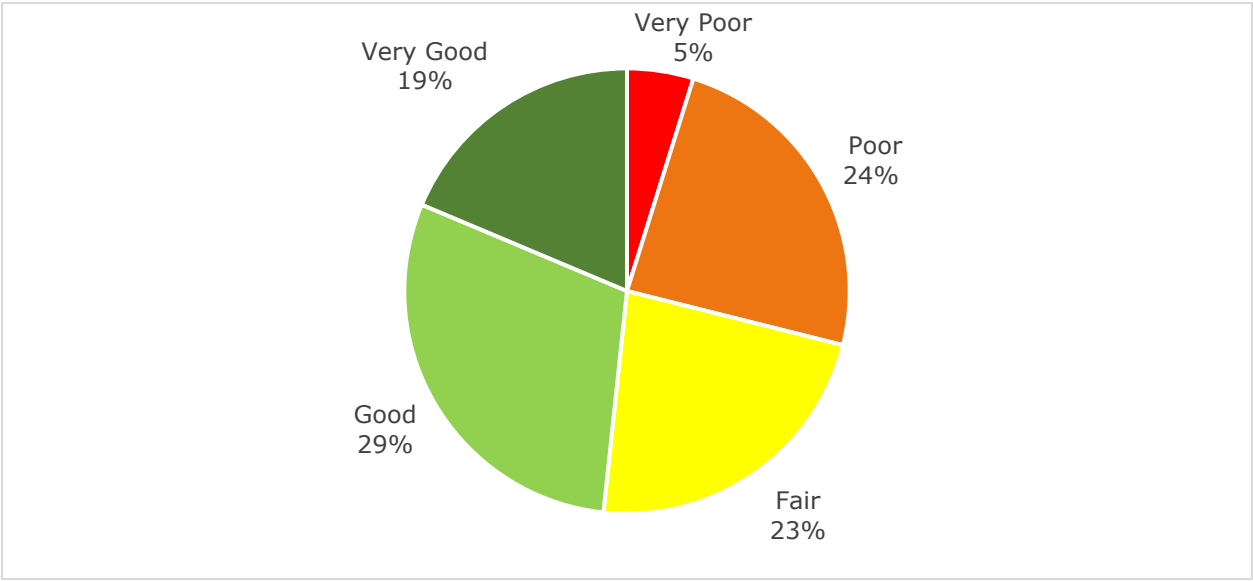
Age and Condition

Figure 14 Storm sewer length by installation decade



The condition of the existing storm sewer network has been based solely on the age and material of the sewer pipes. A breakdown of the state of the City's storm sewer pipes can be found below in Figure 15.

Figure 15 State of storm sewer linear infrastructure



Storm Pumping Stations

The City of Sarnia currently operates three storm pumping stations. Due to the last detailed condition assessments being completed back in 2009, the current assessments are based on age (Table 14).

Table 14 Summary of stormwater pumping stations

Pump Station	Year Constructed	Age	Major Upgrade	Electrical Upgrade	Condition Score
D-2-C Drain	2001	20	N/A	N/A	64
Clark Drain	1985	36	N/A	N/A	35
Upper Canada Drive	1995	26	N/A	N/A	53

Stormwater Management Ponds

Table 15 Summary of stormwater management ponds

SWMP	Year of Construction	Age
Blackwell Glen	2001	20
Area 1	2001	20
Phase 1 Heritage Park	1995	26
Business Park	2005	16
Phase 5 Heritage Park	2001	20
Research Park	2011	10

SWMP	Year of Construction	Age
Stone Hedge Subdivision	2004	17
Twin Lakes	1978	43

Both the predicted maintenance interval and predicted maintenance year were calculated using the design parameters of the stormwater ponds. Annual assessments are utilized to pinpoint the timing of the cleaning project. The Twin Lakes SWMP was excluded from the maintenance interval study due to the unknown design characteristics (i.e. permanent pool depth, etc.) of the retrofitted quarry pit in which it was created. It is assumed that the pond is extremely oversized and will not require sediment removal for an extended time.

Lifecycle Management Strategy

Operations and Maintenance

- There are very few proactive maintenance needs with regards to the gravity fed storm sewers except for catchbasin cleaning which is routinely completed to assist with the flow of stormwater into the sewer mains.
- Sarnia's stormwater management ponds undergo yearly inspections to assess the needs for each facility.

Rehabilitation and Replacement

- Sarnia does not currently rehabilitate storm sewers and instead will undertake replacement at the end of its useful service life.
- New storm sewer infrastructure is being installed in conjunction with combined sewer separation projects.
- Storm water management ponds are monitored yearly with major rehabilitation efforts focused on cleaning out the ponds when required. A tentative cleaning schedule based on design factors is available for budget planning, but cleaning projects are driven by actual condition data that is collected.

Financial and Sustainability Analysis

Multiple high level financial scenarios are outlined in Table 16. Each scenario highlights the average annual funding, average annual cost increase per residential user, and the projected backlog at the end of the 20-year

window. The current stormwater management backlog is $19,600,000 and there is approximately a $5,500,000 annual gap between actual funding and the funding required to reach sustainability. This gap is added to the backlog at the end of each year. The 2021 Rate Study investigated multiple solutions to close the funding gap. Currently there is no dedicated funding for stormwater management infrastructure, meaning all stormwater projects currently use funds raised from the sanitary sewer rate. The sanitary sewer rate has never been adjusted to maintain stormwater infrastructure in addition to sanitary infrastructure. The second scenario displays the average cost per user required to become immediately sustainable. This would be a one-time permanent user rate increase to ensure that the current level of service is maintained.

Table 16 Stormwater management system financial scenarios

Scenario	Average Annual Funding Required	Average Annual User Increase	2041 Backlog
Maintain Current Funding	$0	$-	$129,600,000
Reach Sustainability in 2022	$5,500,000	$220 *Permanent one time increase per user in 2022	$19,600,000
50% of Sustainable Rate by 2041	$1,444,000	$5.50	$100,720,000
100% of Sustainable Rate by 2041	$2,888,000	$11	$71,840,000

Figure 16 Stormwater management 20-year sustainability forecast

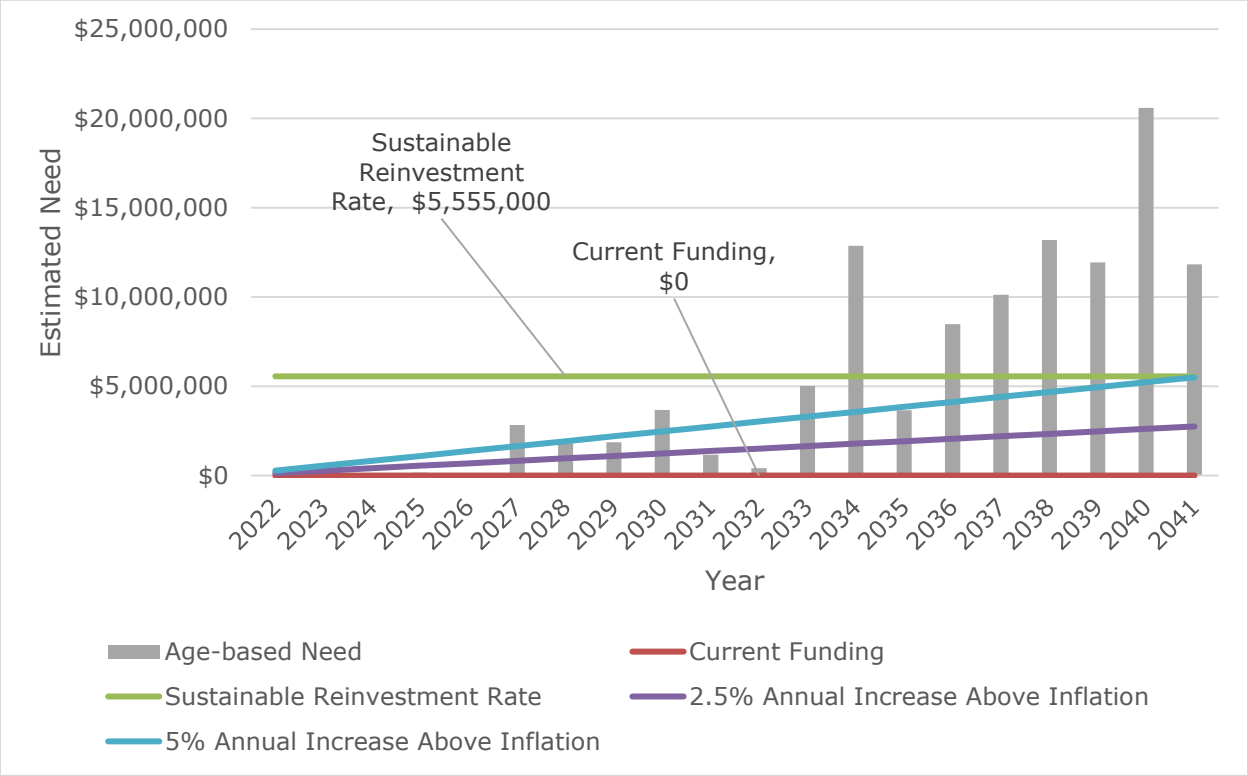


Figure 16 represents the four different financial scenarios outlined in Table 17. Without a dedicated funding source, the stormwater assets are extremely underfunded. From 2033 onward it is expected that significant funding will be required to renew the City's stormwater assets based on their design life. Most of the existing stormwater system does not meet today's design standards due to the increase in intensity and frequency of rain events. Securing dedicated funding for these assets is crucial to maintaining a sustainable stormwater management system.

Levels of Service

Community Levels of Service

Table 17 Community levels of service

Service Attribute	Community Levels of Service	Current levels of service (2022)
Scope	Description, which may include maps, of the user groups or areas of the municipality that are protected from flooding, including the extent of the	See Appendix A

Service Attribute	Community Levels of Service	Current levels of service (2022)
	protection by the municipal stormwater management plan	

Technical Levels of Service

Table 18 Technical levels of service

Service Attribute	Technical levels of service	Current levels of service (2022)
Scope	Percentage of properties in municipality resilient to a 100-year storm.	78% See Appendix B
	Percentage of the municipal stormwater management system resilient to a 5-year storm	53% See Appendix B

Conclusion

Most of the City's stormwater infrastructure value is contained within the linear storm sewers. These sewers typically require little to no lifecycle maintenance until the useful service life has ended. Due to this, it is rare for projects to be initiated due to the stormwater infrastructure. Instead, these assets are replaced as part of integrated projects with other assets located within the right of way thereby mitigating replacement costs. Stormwater infrastructure replacements are currently funded through the wastewater rate. The City must investigate separate dedicated funding for the stormwater system to address end of life needs for assets that are on the horizon.

While the gap between the City's targeted reinvestment rate and the estimated annual capital requirement is large (approx. $5,500,000), City staff is confident that the targeted rate will be adequate to sustainably fund the stormwater management system. Relatively minor annual operations and maintenance costs attributed to stormwater management do not

support the age-related condition data and indicates that overall, the system is in good condition. Condition data for the storm system should continue to be collected to assist in verifying this information.

Recommendations

It is recommended that:

1. Sarnia investigates dedicating funding for the stormwater management system to address future replacement needs.
2. Sarnia investigate rehabilitation options for the stormwater system to increase the expected service life of assets.
3. Funding is provided for near future stormwater pond cleaning.
4. Sarnia implement additional service level metrics using Sarnia's CityWorks software when it is available organization wide.
5. Sarnia work towards developing a formal risk management process to inform project prioritization.

Road Network

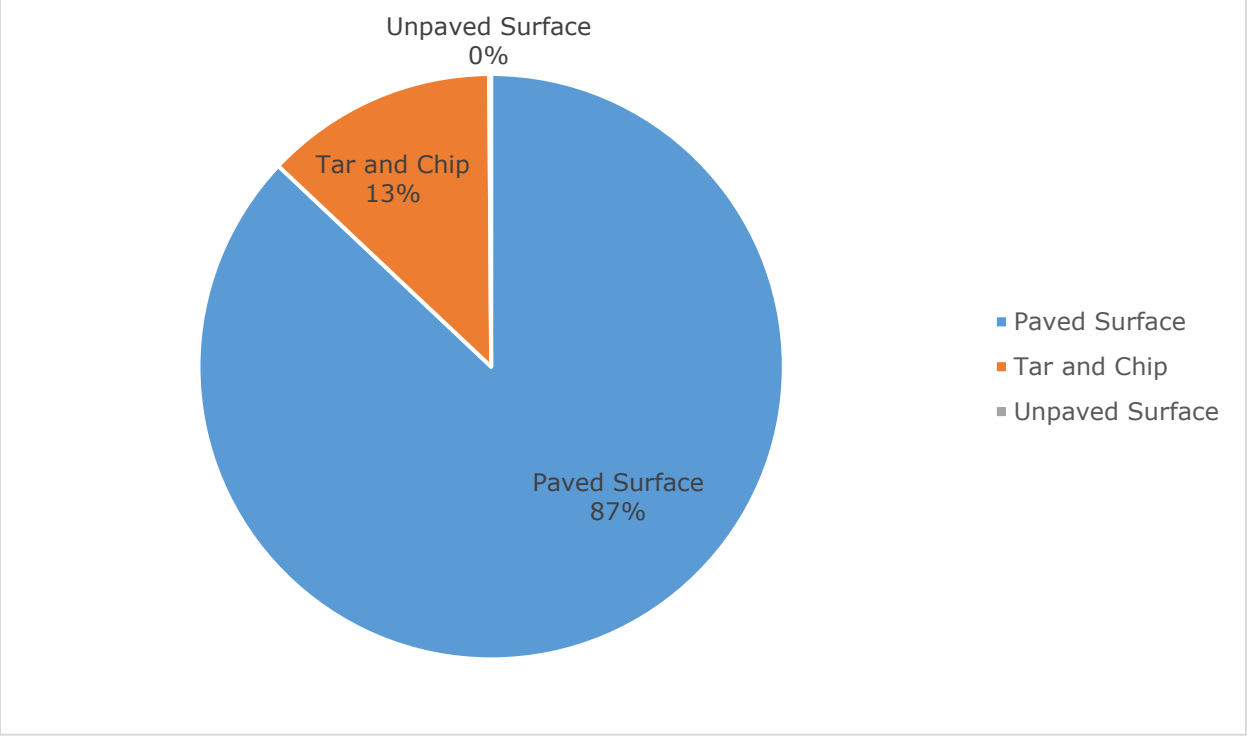
Road assets allow Sarnia residents and external users to travel through the City. Roadways must be well managed as unchecked deterioration can correlate with increasing risk to user safety.

Inventory

Table 19 Road network inventory

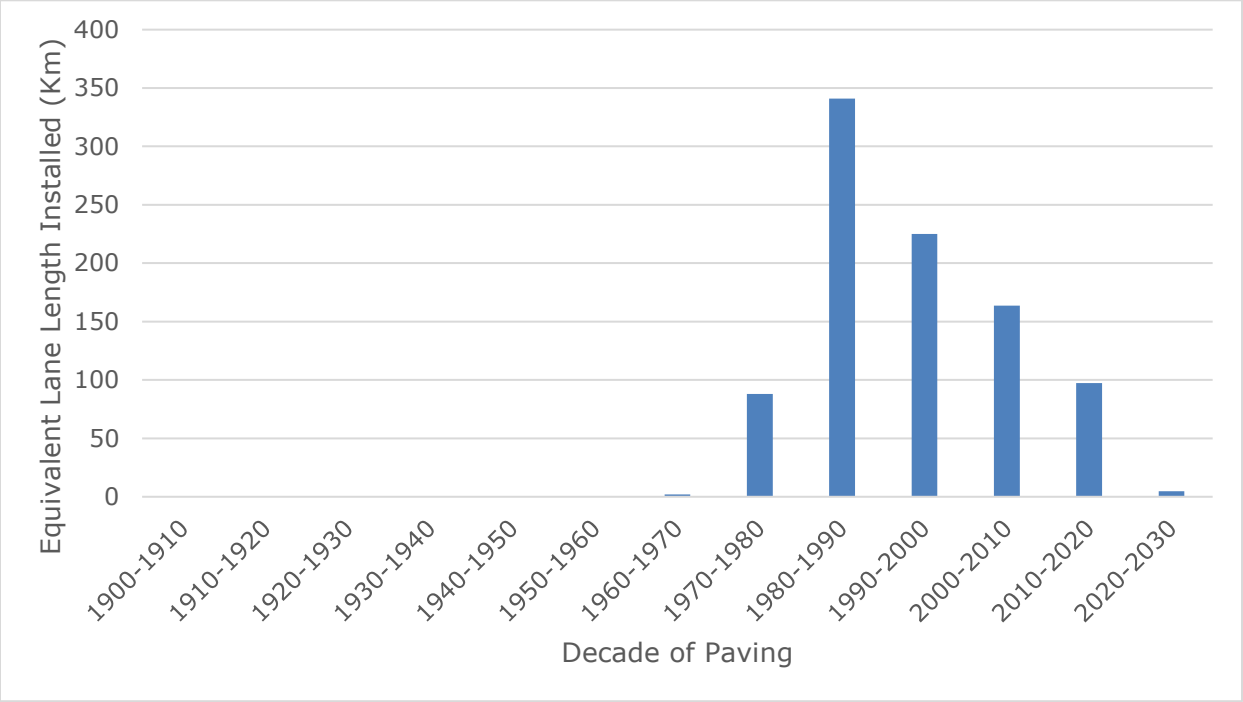
Asset Type	Quantity (Lane Kilometers)	Average Age	Replacement Cost
Paved	802 km	29 Years	$687,000,000
Unpaved	1 km	43 Years	$1,000,000
Tar and Chip	119 km	19 Years	$135,000,000
Total	922 km	29 Years	$823,000,000

Figure 17 Road network by surface material



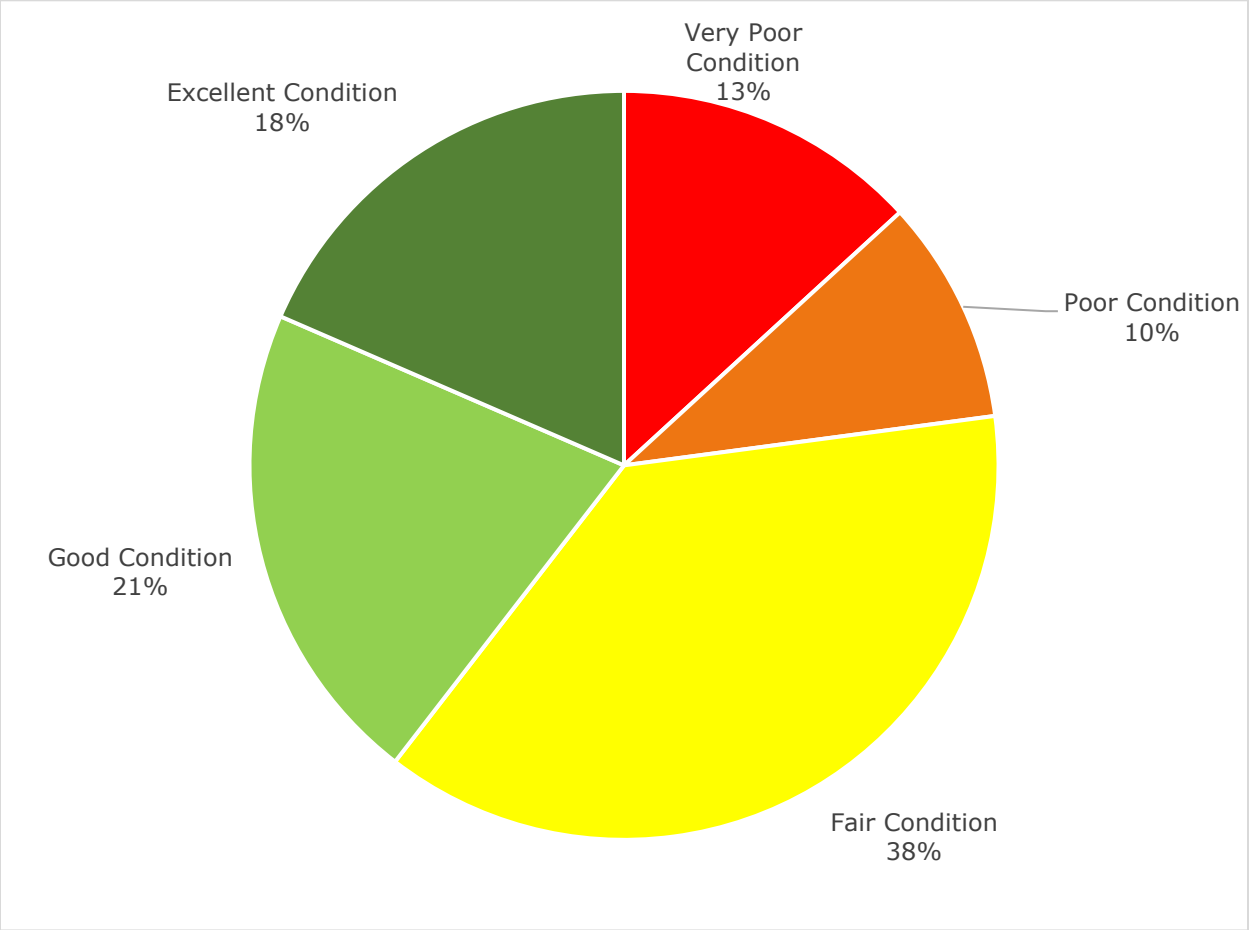
Condition and Age

Figure 18 Roadways installed lane length per decade



In 2018, IMS Infrastructure Management Services (IMS) carried-out a detailed pavement condition assessment and road need analysis using their IMS pavement management program. The analysis provided information regarding measured road conditions, road classifications, construction cost estimates, construction needs, and critical road deficiencies. IMS compiled a list of the City roads in order of their priority rating with respect to reconstruction and/or rehabilitation. The approach used by IMS was fully automated and consistent as the detailed distress and roughness survey used was consistent with the Ministry of Transportation and Ontario Good Road Association's methodologies. The City completes detailed pavement condition index inspections periodically to confirm the age-based deterioration estimations.

Figure 19 Road distribution condition rating



Lifecycle Management Strategy

Operations and Maintenance

- The Public Works Department currently undertakes both pothole repair and other common road maintenance activities
- More significant asphalt patching is sometimes required after excavation has taken place to repair other assets within the right of way.
- Snow clearing and other associated winter storm maintenance occurs when required.

Rehabilitation and Replacement

- Sarnia currently rehabilitates roadways through resurfacing in order to match their estimated useful service life with other assets within the right of way. Resurfacing takes place on an "as needed" basis and is often guided by the condition of assets buried within the right of way.

- Road replacement generally occurs when a window of opportunity arises where both the roadway and other assets within the right of way can be replaced as part of a single project.

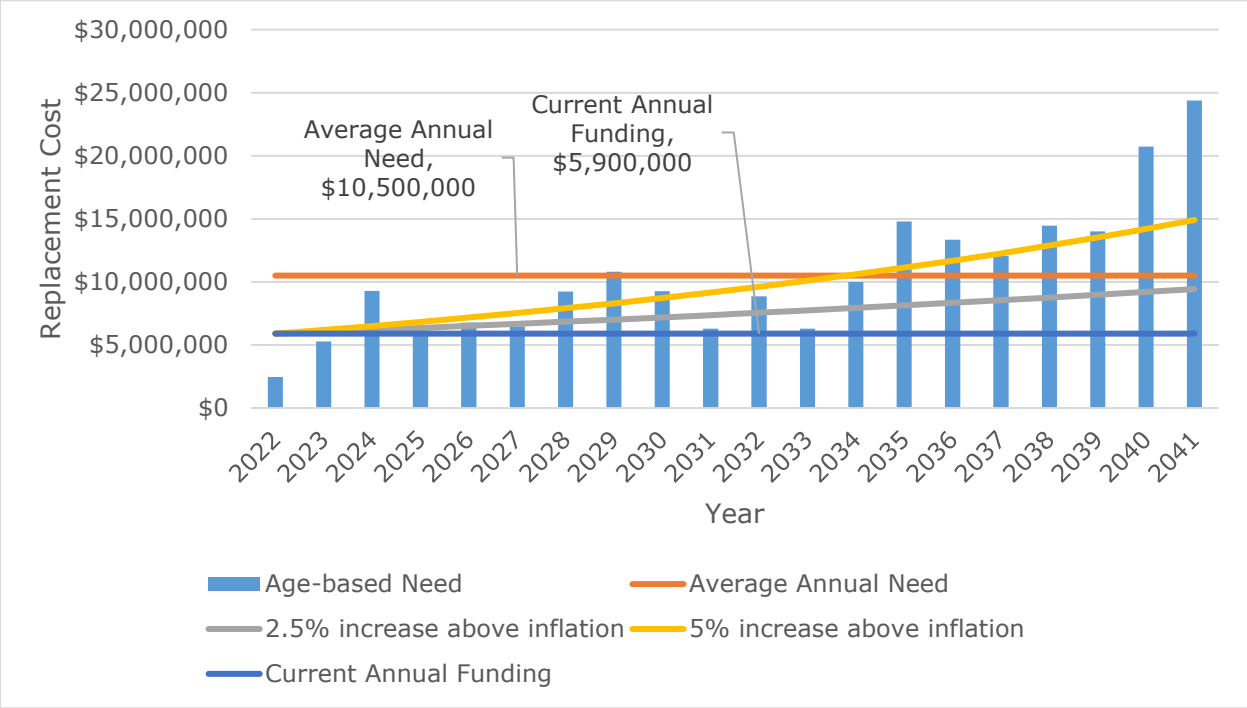
Financial and Sustainability Analysis

Multiple high level financial scenarios are outlined in **Table 20**. Each scenario highlights the average annual funding, average annual cost increase per residential user, and the projected backlog at the end of the 20-year window. The current road network backlog is $107,000,000 and there is approximately a $4,600,000 annual gap between actual funding and the funding required to reach sustainability. This gap is added to the backlog at the end of each year. Note that the average annual funding below does not match the annual funding in the capital budget as a portion of the road restoration costs are covered through other capital budgets when completing integrated projects. The second scenario displays the average cost per user required to become immediately sustainable. This would be a one-time permanent user rate increase to ensure that the current level of service is maintained.

Table 20 Road network financial scenarios

Scenario	Average Annual Funding	Average Annual User Increase	2041 Backlog
Maintain Current Funding	$5,900,000	$-	$199,000,000
Reach Sustainability in 2022	$10,500,000	$184 *Permanent one time increase per user	$107,000,000
2.5% Annual Capital Funding Increase Above Inflation	$7,500,000	$7.06	$167,000,000
5% Annual Capital Funding Increase Above Inflation	$9,800,000	$18.02	$121,000,000

Figure 20 Road network sustainability analysis



Levels of Service

Community Levels of Service

Table 21 Community levels of service

Service Attribute	Community Levels of Service	Current levels of service (2021)
Scope	Description, which may include maps, of the road network in the municipality and its level of connectivity.	See Appendix A
Quality	Description or images that illustrate the different levels of road class pavement condition.	See Appendix B

Technical Levels of Service

Table 22 Technical levels of service

Service Attribute	Technical levels of service	Current levels of service (2021)
Scope	Number of lane-kilometres of each of arterial roads, collector roads, and local roads as a proportion of square kilometres of land area index value	Arterial Roads: 1.73 km/km^2 Collector Roads: 0.77 km/km^2 Local Roads: 3.05 km/km^2
Quality	For paved roads in the municipality, the average pavement condition index value	The average pavement condition index for paved roads is 66.
	For unpaved roads in the municipality, the average surface condition (e.g. excellent, good, fair or poor)	On average the unpaved roads in Sarnia are in fair condition.

Conclusion

While roadways are the most expensive group of linear assets owned by Sarnia, they are not the sole factor in project selection. If the buried assets in the right of way are not in need of replacement the City resurfaces roadways instead of replacing them. On average the City's roadways are in fair condition and have a projected annual need of $10,500,000.

The gap between the City's age-based need funding and the average annual funding available is significant. With the overall system in fair condition it is important that the current service level is maintained. To accomplish this, additional funding will need to be allocated to the road network both internally and through external funding opportunities.

Recommendations

It is recommended that:

1. Sarnia continues to select road resurfacing projects to ensure replacement windows line-up with the needs of buried infrastructure.
2. Sarnia implement additional service level metrics using CityWorks software when it is available organization wide.
3. Sarnia work towards developing a formal rehabilitation program to ensure roadways reach the end of their useful service life.
4. Sarnia incorporates the rehabilitation schedule within its GIS system.

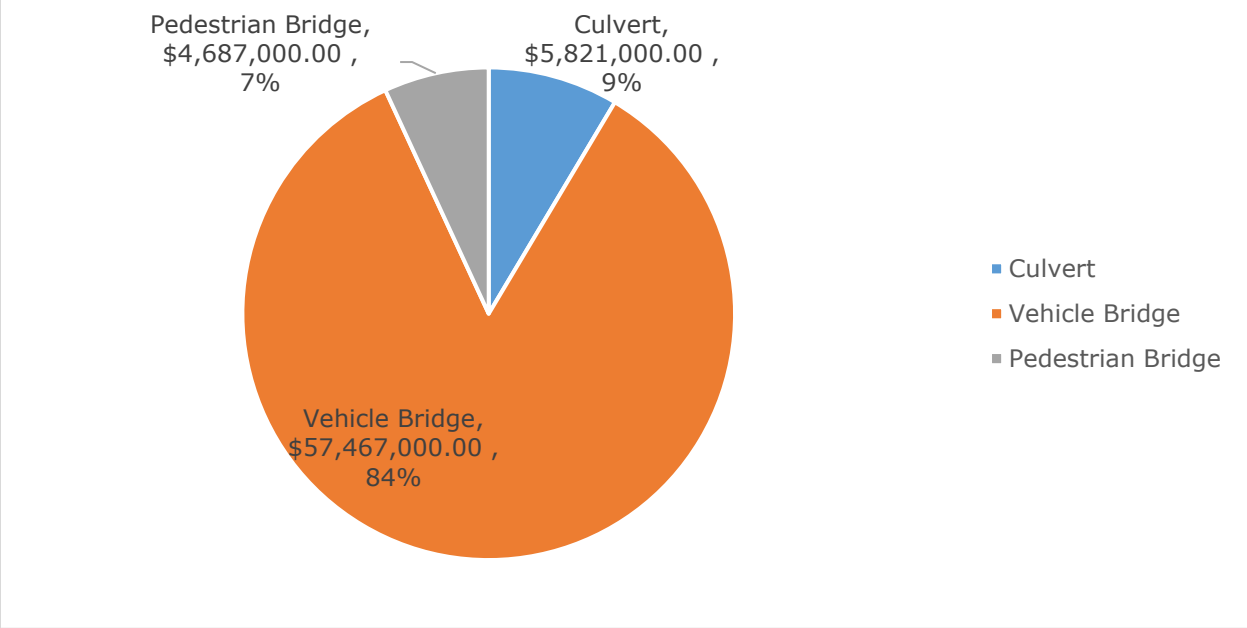
Bridges and Culverts

Inventory

Table 23 Bridge and major culvert age and inventory

Asset Type	Quantity	Average Age	Replacement Cost
Vehicle Bridges	16	47 Years	$57,500,000
Pedestrian Bridges	4	26 Years	$4,700,000
Major Culverts	12	27 Years	$5,800,000

Figure 21 Breakdown of bridges and culverts by class



Condition and Age

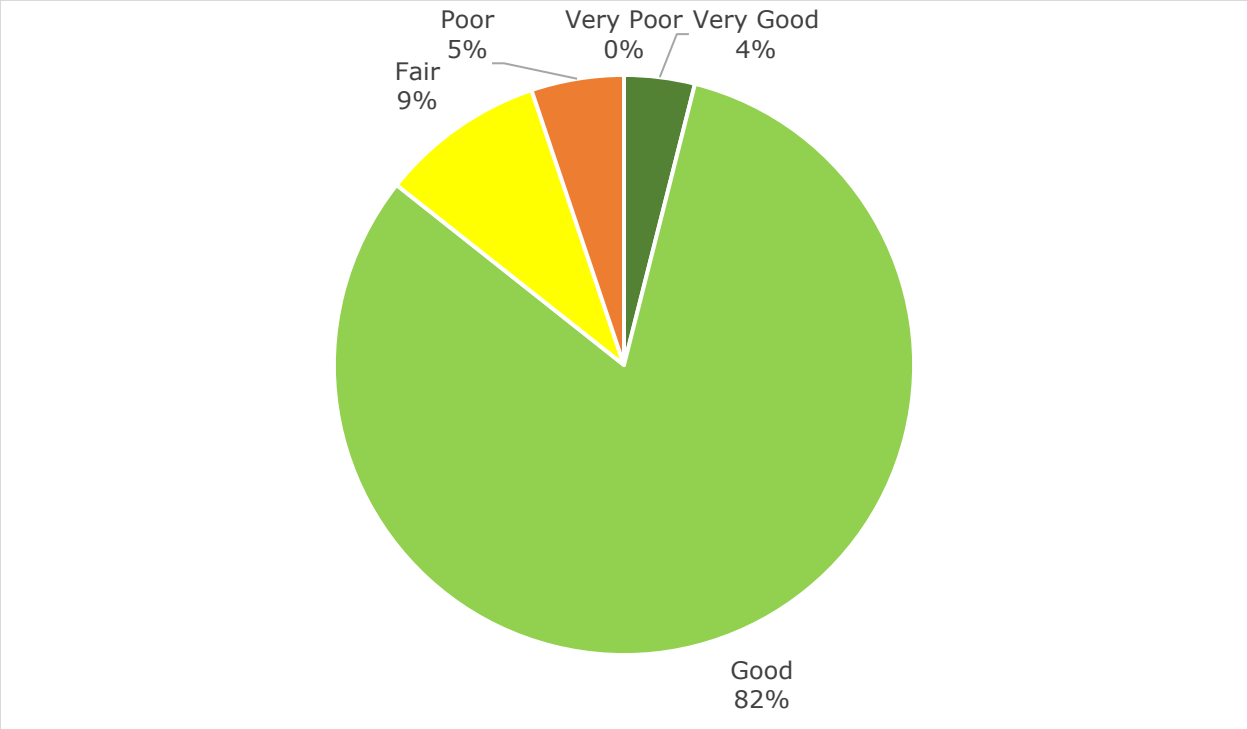
Conservatively, it can be expected that the bridge and culvert inventory will require complete renewal every 75 years assuming that proper management and maintenance has occurred during the asset's lifecycle. The current average age of Sarnia's assets is 45 years. This indicates that the majority

of the infrastructure is entering the second half of its useful service life with renewal costs due sooner rather than later.

While the Figure 22 demonstrates that a majority of the bridges and culverts are in good or very good condition, Sarnia is projecting significant spending in 2022 and 2023. This funding will be used to replace and rehabilitate bridges in the area to address concerns identified in recent OSIM inspections.

Figure 22 summarizes the condition ratings of the inspected bridges and culverts based on the Ministry of Transportation's (MTO) Bridge Condition Index (BCI) value ranges.

Figure 22 Condition of bridge and culvert assets



Lifecycle Management Strategy

Operations and Maintenance

- Biennial OSIM reports recommend maintenance programs for each structure. These activities can include further investigation, general cleaning, loose concrete removal, etc.
- The Public Works Department undertakes limited bridge maintenance work including pressure washing, minor concrete maintenance, loose concrete removal and pothole repair.

- Additional investigations and more complex bridge maintenance is outsourced.

Rehabilitation and Replacement

- Sarnia rehabilitates bridges based on recommendations made through the biennial OSIM reporting. Often further testing will be required after receiving the report to help determine the extent of rehabilitation needed.
- Replacement projects are undertaken when a structure has reached the end of its useful service life and rehabilitation is prohibitively expensive when compared to a full replacement.
- While most structures can be replaced by utilizing the current yearly funding there are a few larger structures within the City that require funding well in advance of replacement due to their high cost.

Financial and Sustainability Analysis

Multiple high level financial scenarios are outlined in Table 24. Each scenario highlights the average annual funding, average annual cost increase per residential user, and the projected backlog at the end of the 20-year window. The current bridge and culvert backlog is $8,700,000 and there is approximately a $300,000 annual gap between actual funding and the funding required to reach sustainability. This gap is added to the backlog at the end of each year. The 10-year capital plan completed in 2020 recommends that an average of $2,000,000 annually would be sufficient to sustainably maintain Sarnia's major bridge and culvert infrastructure. This was calculated by considering larger spending needs on the horizon outside of the 10-year forecast. The second scenario displays the average cost per user required to become immediately sustainable. This would be a one-time permanent user rate increase to ensure that the current level of service is maintained.

Table 24 Major bridge and culvert financial scenarios

Scenario	Average Annual Funding Required	Average Annual User Increase	2041 Backlog
Maintain Current Funding	$1,700,000	$0	$14,700,000

Scenario	Average Annual Funding Required	Average Annual User Increase	2041 Backlog
Reach Sustainability in 2022	$2,000,000	$12 *Permanent one time increase per user in 2022	$8,700,000
2.5% Annual Capital Funding Increase Above Inflation	$2,170,000	$2.04	$5,300,000
5% Annual Capital Funding Increase Above Inflation	$2,810,000	$5.19	-$7,500,000

Figure 23 Major bridges and culverts sustainability analysis

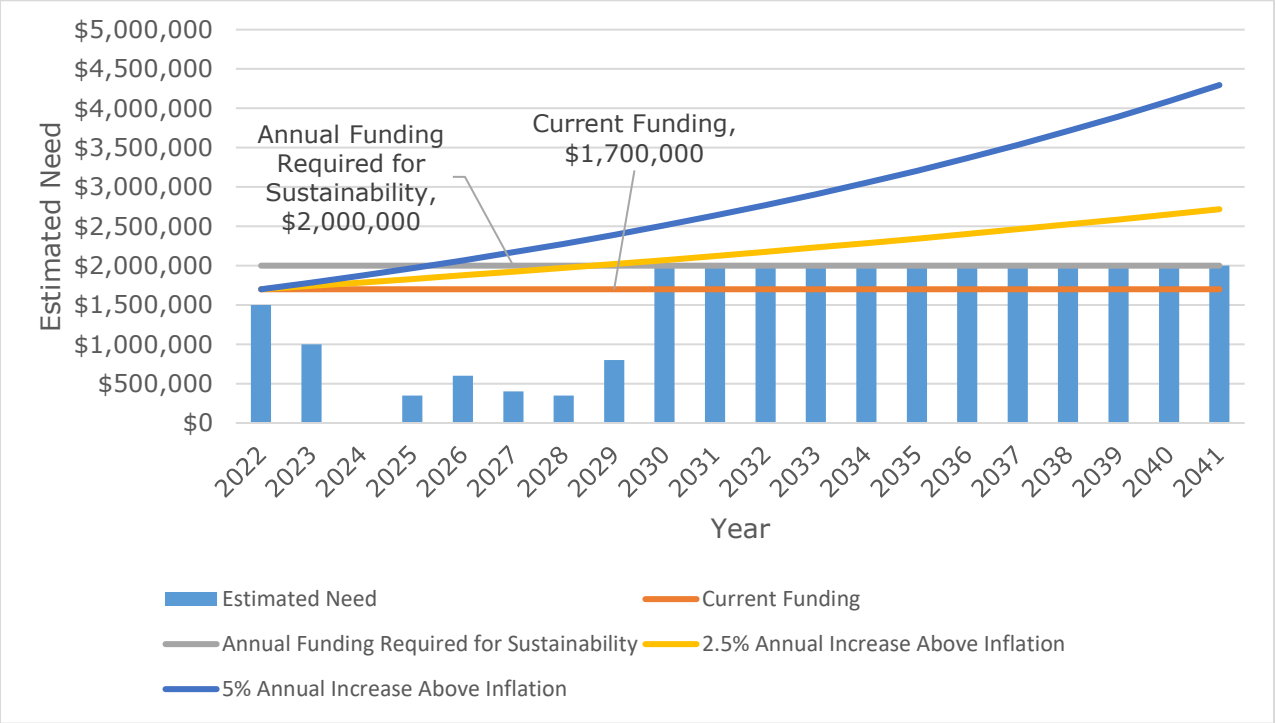


Table 24 represents the four different financial scenarios outlined in Figure 23. It is projected that the current funding level is insufficient to maintain the major bridge and culvert network without the $300,000 gap being bridged with external funding. To bridge this gap internally funding towards bridges and culverts must be increased above inflation. With a 2.5% increase above inflation sustainability will be reached by 2029.

Levels of Service

Community Levels of Service

Table 25 Community levels of service

Service Attribute	Community Levels of Service	Current levels of service (2021)
Scope	Description of traffic that is supported by municipal bridges (e.g., heavy transport vehicles, motor vehicles, emergency vehicles, pedestrians, cyclists)	None of the municipality's bridges have loading or dimensional restrictions.

Service Attribute	Community Levels of Service	Current levels of service (2021)
Reliability	Description or images of the condition of bridges/culverts and how this would affect the use of the bridges	Biennial inspections of all bridge/culvert structures are completed according to the definition of these structures within the OSIM. Each structure is inspected by a licensed engineer and maintenance, rehabilitation, and replacement requirements are provided within these reports. 13 rehabilitation or replacement projects have been identified by the City's 10-year plan that is built on the OSIM inspections. At the time of writing six of these projects have either been awarded for design or completed. If these structures continue to deteriorate, uncontrolled closures may be required to ensure safety. These service interruptions can have a significant impact on the transportation network as detours may be required.

Technical Levels of Service

Table 26 Technical levels of service

Service Attribute	Technical levels of service	Current levels of service (2021)
Scope	Percentage of bridges in the municipality with loading or dimensional restrictions	0%

Service Attribute	Technical levels of service	Current levels of service (2021)
Reliability	For bridges in the municipality, the average bridge condition index value.	Average BCI of bridges calculated from 2020 OSIM Reports: 68%
	For structural culverts in the municipality, the average bridge condition index value	Average BCI of culverts calculated from 2020 OSIM Reports: 72%

Conclusion

On average, the City's Major Bridges and Culverts are in good condition, but with a projected annual need of $2,000,000 it is important to continue funding bridge and culvert efforts to maintain the current level of service both now and into the future.

The current annual gap between the recommended capital reinvestment rate and current funding level is $300,000. It must be understood that a couple of high value assets make up over half of the entire inventory's replacement value. Even though these projects fall outside of short term forecasts, efforts should be made to budget for the eventuality. With the overall the system in good condition there is an opportunity to both maintain the current level of service while also bolstering reserve funds for the highlighted future needs.

Recommendations

It is recommended that:

1. Sarnia continues to modify the 10-year plan based on biennial recommendations made through the OSIM reporting.
2. Sarnia work towards building the capital reserve to fund higher value bridge projects requiring replacement in the future.

Impact of Growth

O. Reg. 588/17 states that core asset management plans for lower-tier municipalities include the population and employment forecasts set out in the official plan of the upper-tier municipality of which it is a part of. Sarnia is a lower-tier municipality and is part of the upper-tier municipality of Lambton County. Lambton County's Official Plan was last updated in 2020 and contains population forecast for Sarnia.

Table 27 Lambton County population projection

Municipality	Dwellings Located Annually	Project 2031 Population
Sarnia	230	66,005 to 74,045

As the population is forecasted to grow by 2031 the existing infrastructure and services will require expansion to provide the expected level of service to the community. Growth related infrastructure must be integrated into the municipality's asset management plan when it is acquired. This includes considering long-term lifecycle costs of the growth related infrastructure. Funding strategies must be adapted to maintain the current level of service. Included in the Official Plan, Lambton County estimates a workforce of 55,000 people in 2031.

References

1. Dillon Consulting Limited. *Inventory Assessment and Identification of Capital Needs for the City of Sarnia – Sanitary Sewerage, Water Distribution and Road Network Infrastructure.* Sarnia: City of Sarnia, 2006.
2. *Building Together: Guide for Municipal Asset Management Plans*, Ministry of Infrastructure ISBN 9878-1-4435-9990-0. http://www.moi.gov.on.ca/pdf/en/Municipal%20Strategy_English_Web.pdf
3. Bryan Wouters. *Current Condition and Financial Assessment of the City of Sarnia's Linear Asset*. Sarnia: city of Sarnia, 2012.
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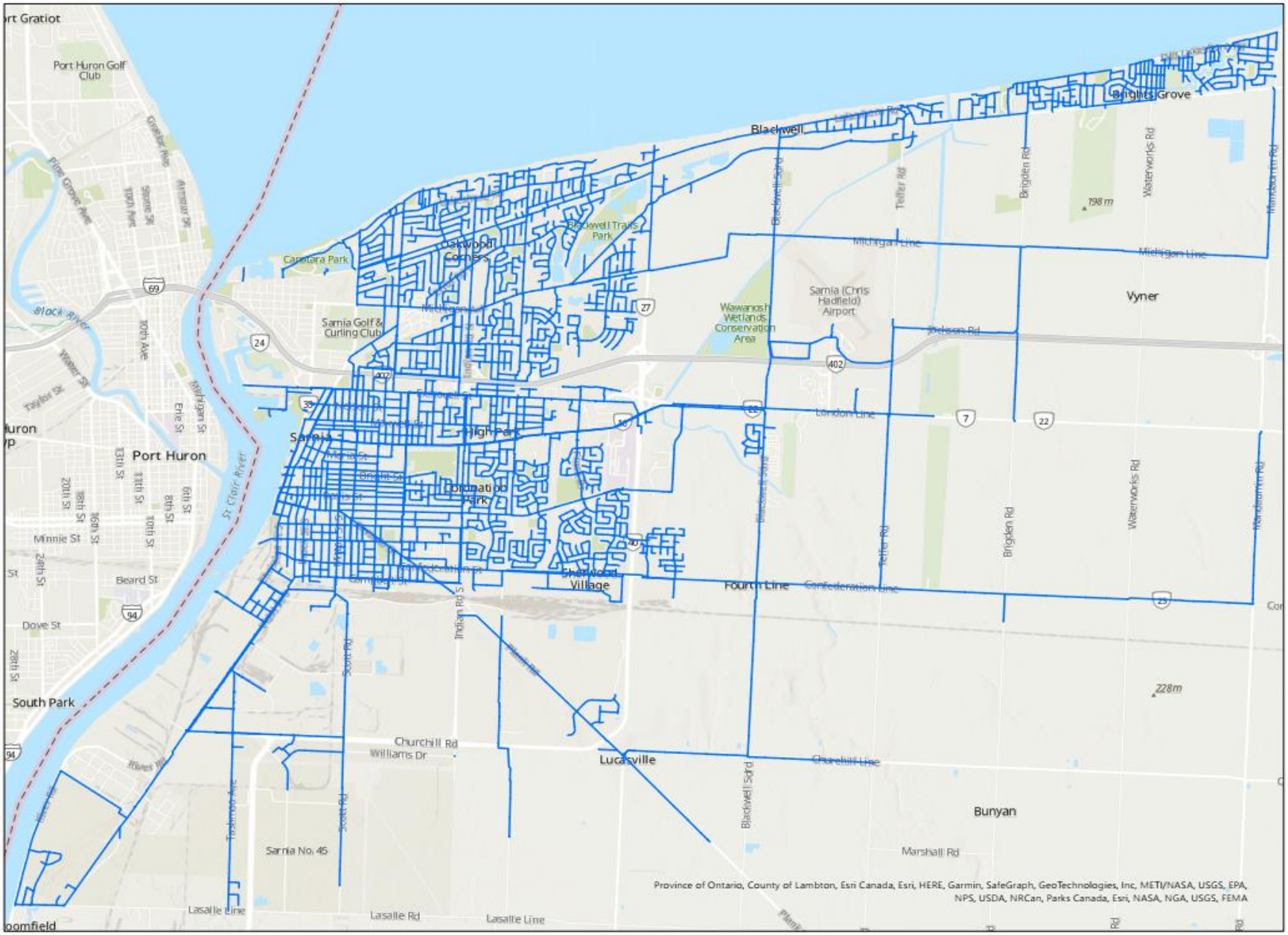
8. Engineered Management System Inc. *2020 Bridge and Culvert Assessment and 10-Year Capital Plan*. Sarnia: City of Sarnia, 2020.
9. City of Sarnia. *Official Plan*. Sarnia: City of Sarnia, 2014
10. Street Scan. *Pavement Assessment and Field Data Collection Analysis and Results*. Sarnia: City of Sarnia, 2018.
11. R.V. Anderson Associates. *Pump Station Assessment*. Sarnia: City of Sarnia, 2009.
12. Watson & Associates. *Water and Sewer User Rate Study*. Sarnia: City of Sarnia, 2021.
13. O. Reg. 588/17: Asset Management Planning For Municipal Infrastructure. https://www.ontario.ca/laws/regulation/r17588
14. *Canadian Infrastructure Report Card*, 2016 http://canadianinfrastructure.ca/downloads/Canadian_Infrastructure_Report_2016.pdf

Appendices

Appendix A – Core Asset Management Maps



Sarnia Water Distribution Network

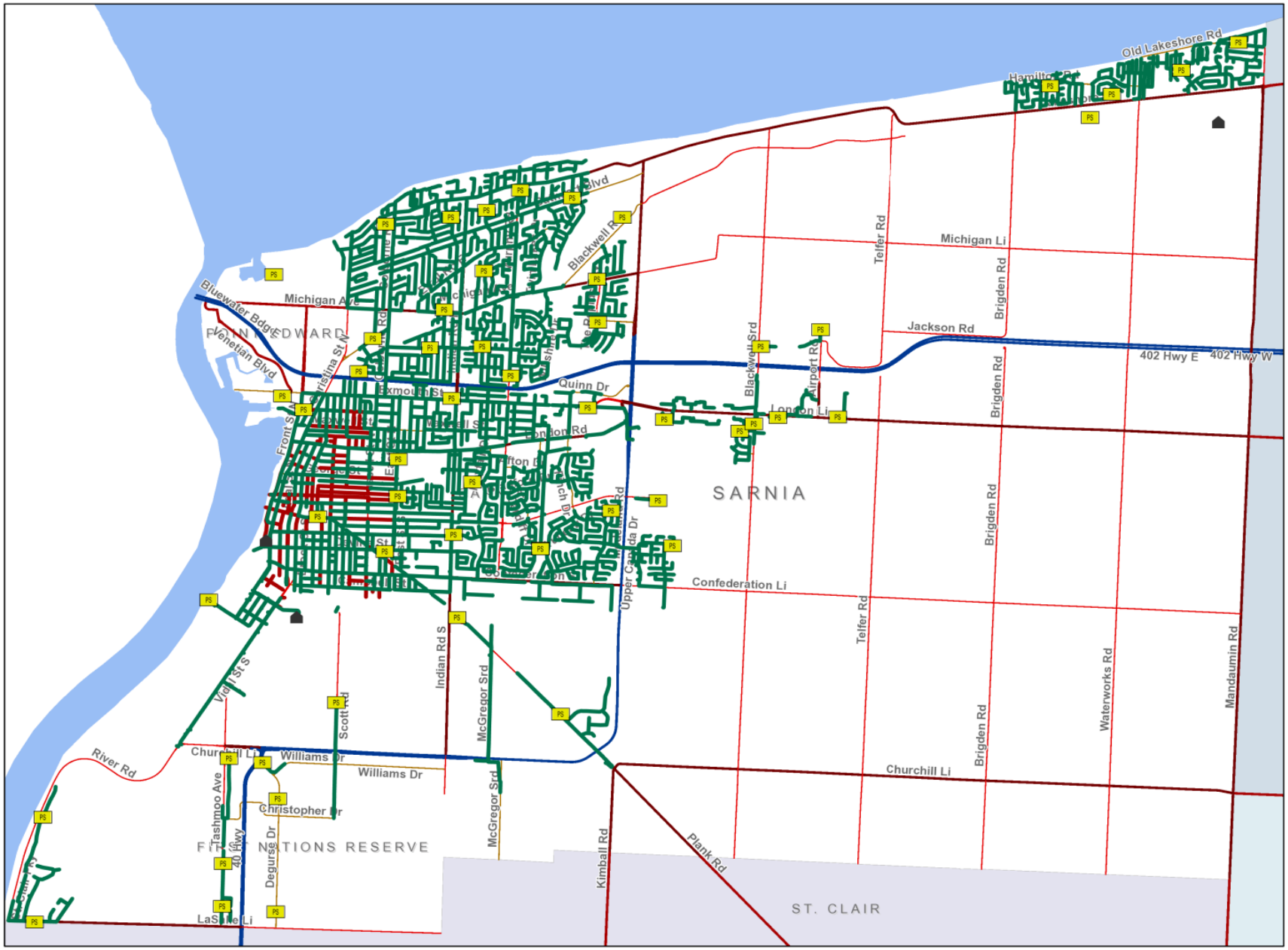
Legend

— Watermain

N

0 0.5 1 2 Kilometers

Prepared by the City of Sarnia Engineering Department, June 2022

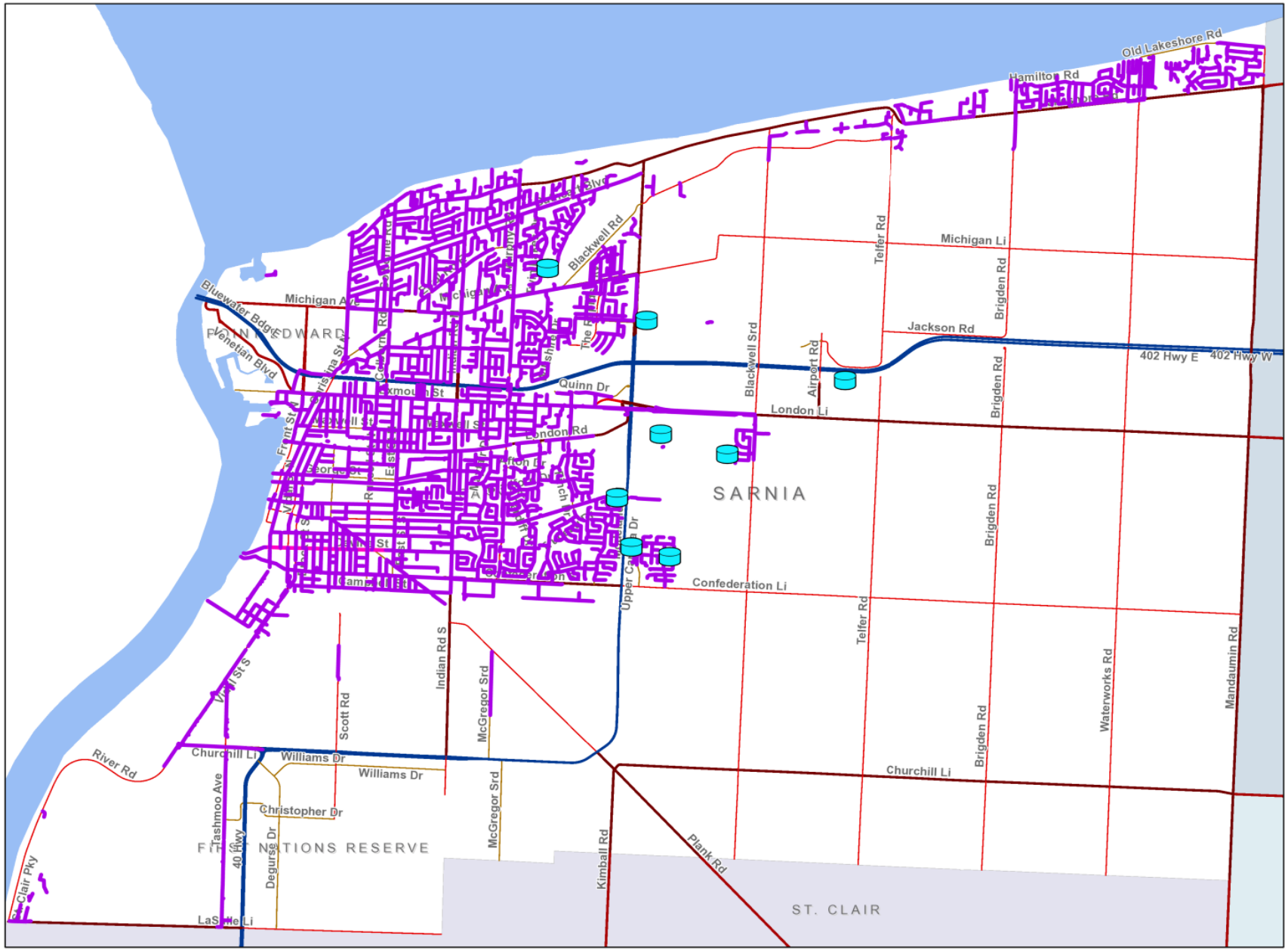


Sarnia Sewer Network

Legend

- Sewer Facility
- Sanitary Pumping Station
- Sanitary Sewer
- Combined Sewer

Prepared by the City of Sarnia
Engineering Department, February 2022



Sarnia Stormwater Sewer Network

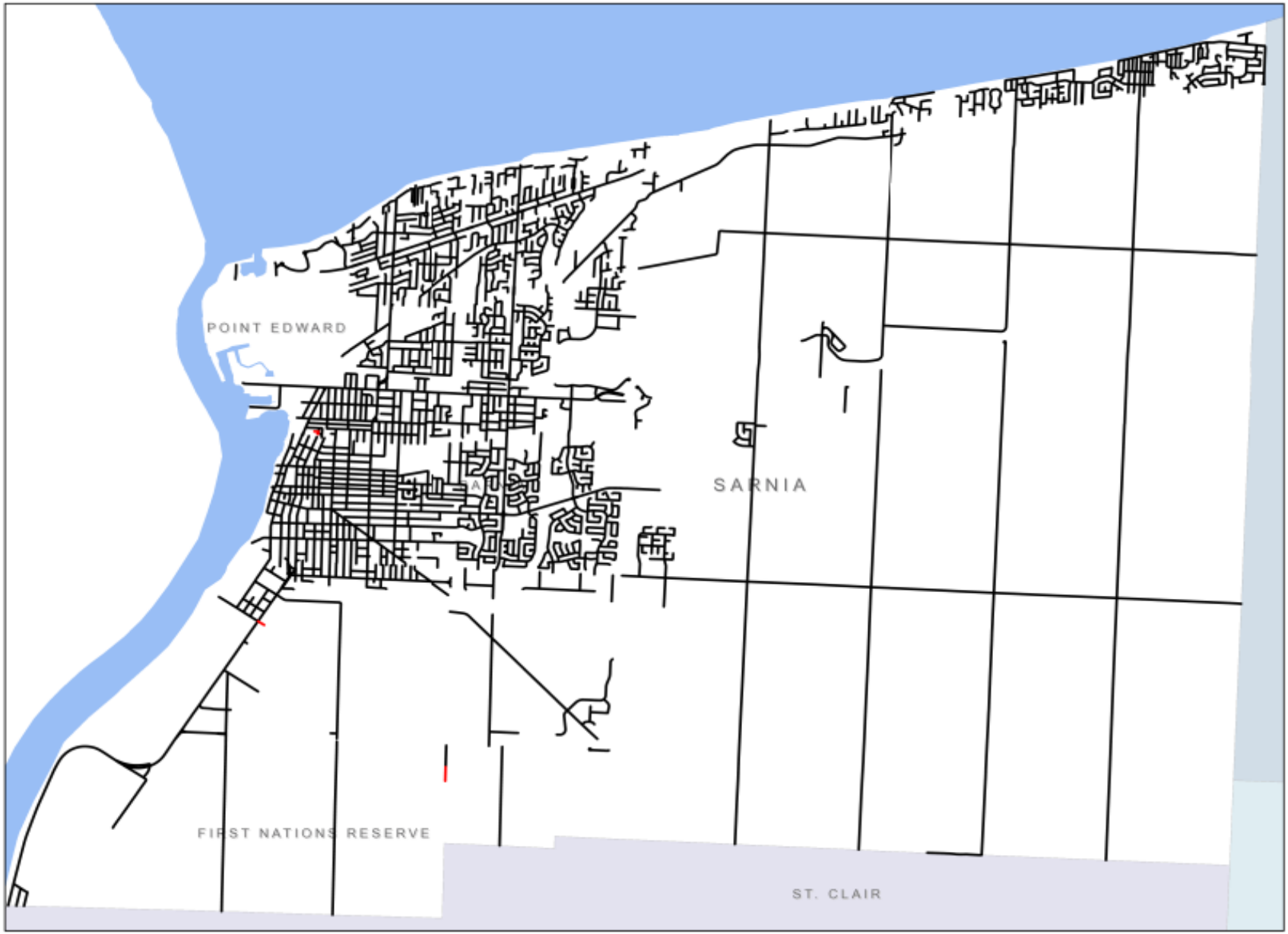
Legend

- Stormwater Management Facility
- Storm Sewer
- Future Storm Sewer

N

0 0.5 1 2 Kilometers

Prepared by the City of Sarnia
Engineering Department, February 2022



Sarnia Road Network

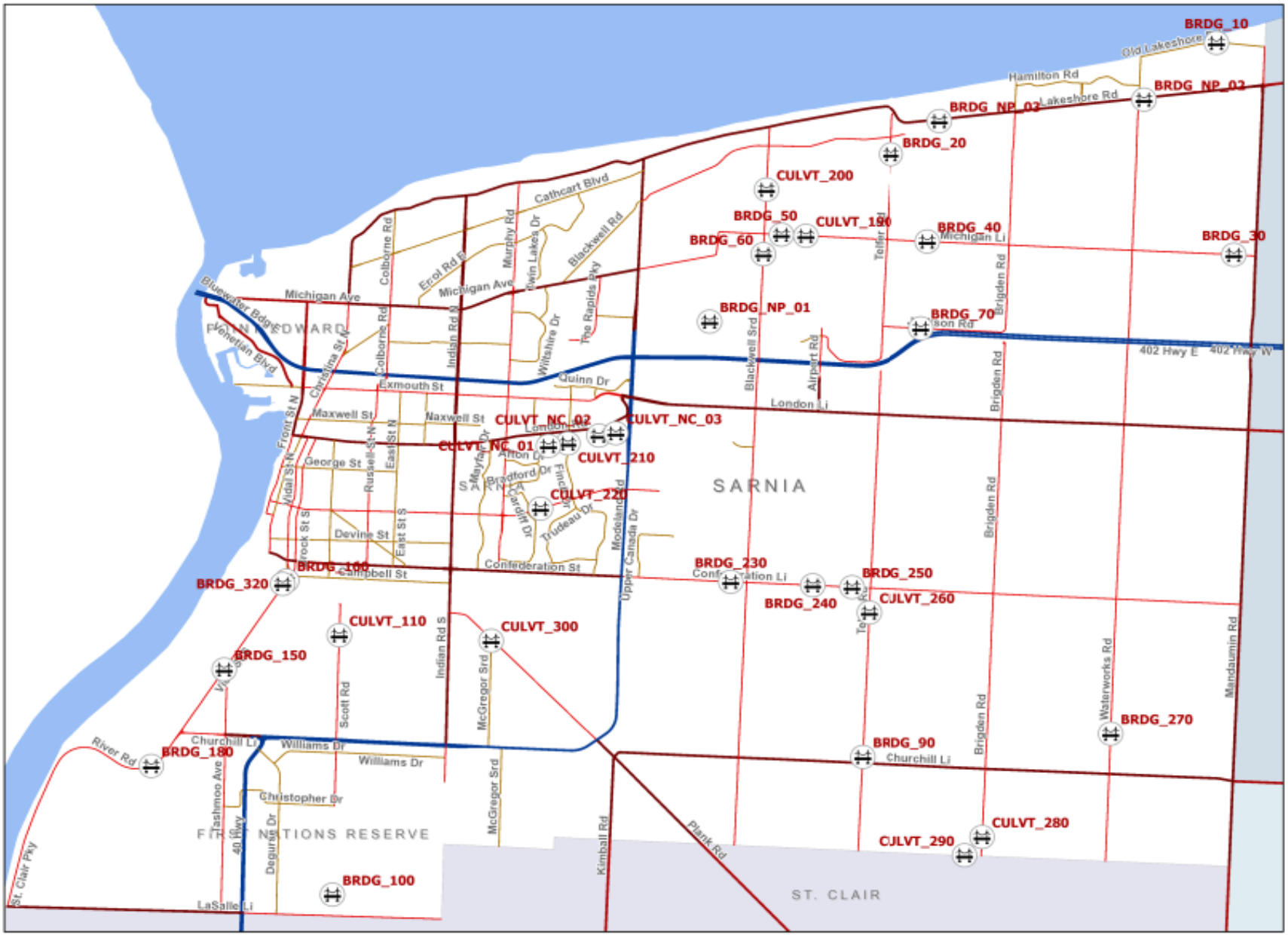
Legend

- Unpaved Road
- Paved Road

N

0 0.5 1 2 Kilometers

Prepared by the City of Sarnia
Engineering Department, February 2022



City of Sarnia Bridge and Culvert Map for OSIM Inspections

Legend

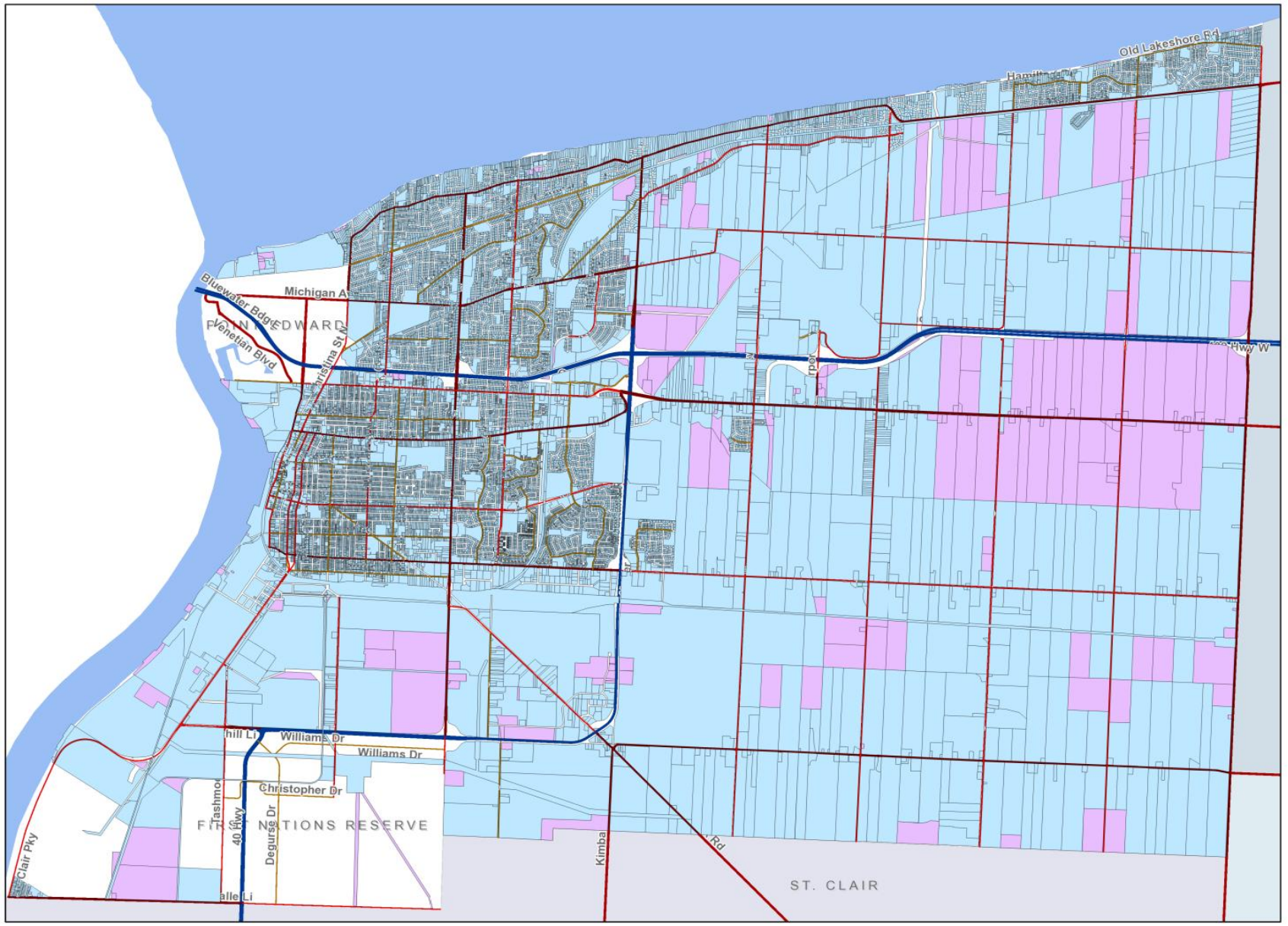
Bridges

N

0 0.5 1 2 Kilometers

Prepared by the City of Sarnia
Engineering Department, February 2022

Appendix B – O.Reg. 588/17 Level of Service Tables



Properties with Fronting Watermain

Legend

- Parcels without fronting watermain
- Parcels with fronting watermain

N

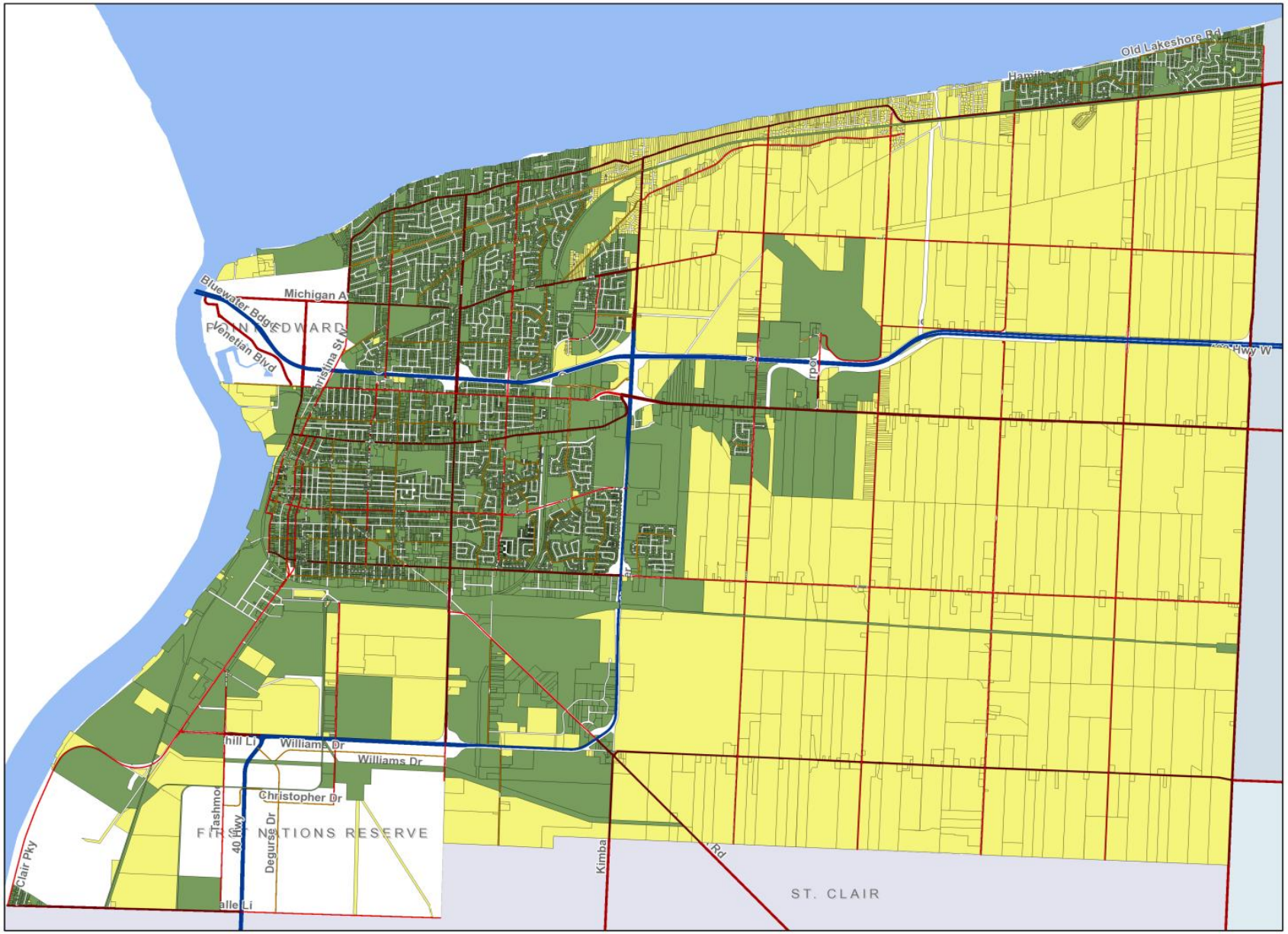
0 0.5 1 2 Kilometers

Summary	Number
All Parcels	28,578
Parcels with fronting watermain	28,139
Parcels without fronting watermain	439
Watermain Coverage (%)	98%

Methodology: Parcel is considered connected to water distribution network if within 40 meters of municipal watermain

Prepared by the City of Sarnia Engineering Department, February 2022

*This estimate is an approximation using available data



Properties with Fronting Sanitary Sewer

Legend

- Parcels without fronting sewer
- Parcels with fronting sewer

N

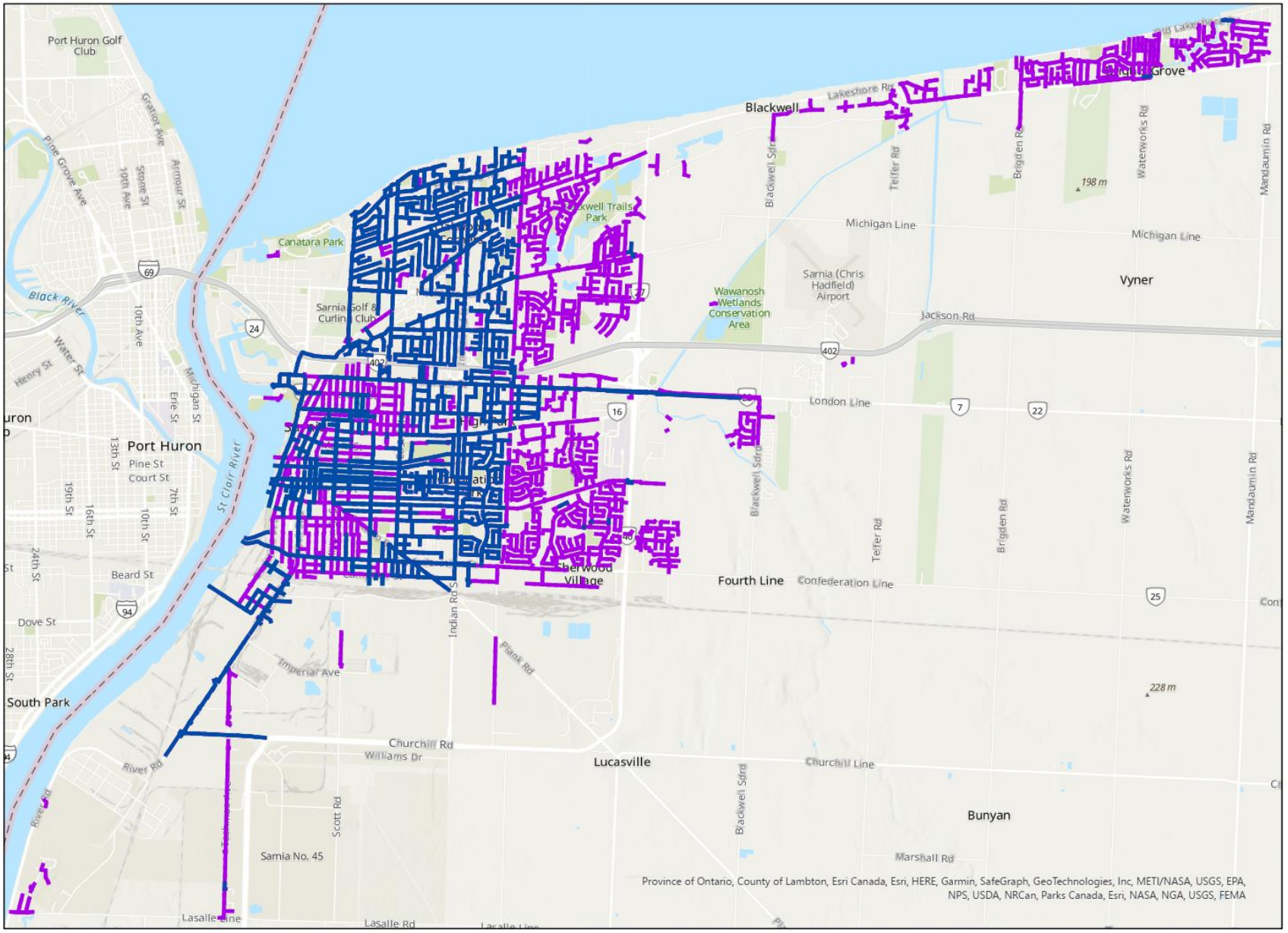
0 0.5 1 2 Kilometers

Summary	Number
All Parcels	28,578
Parcels with fronting sewer	25,846
Parcels without fronting sewer	2732
Sanitary Sewer Coverage (%)	90%

Methodology: Parcel is considered connected to sanitary sewer network if within 40 meters of a municipal sewer

Prepared by the City of Sarnia Engineering Department, February 2022

*This estimate is an approximation using available data



City of Sarnia - Stormwater Management System Resilient to 5-year Storm

Legend

- Sewer Storm
- Storm Sewer Pre 1970

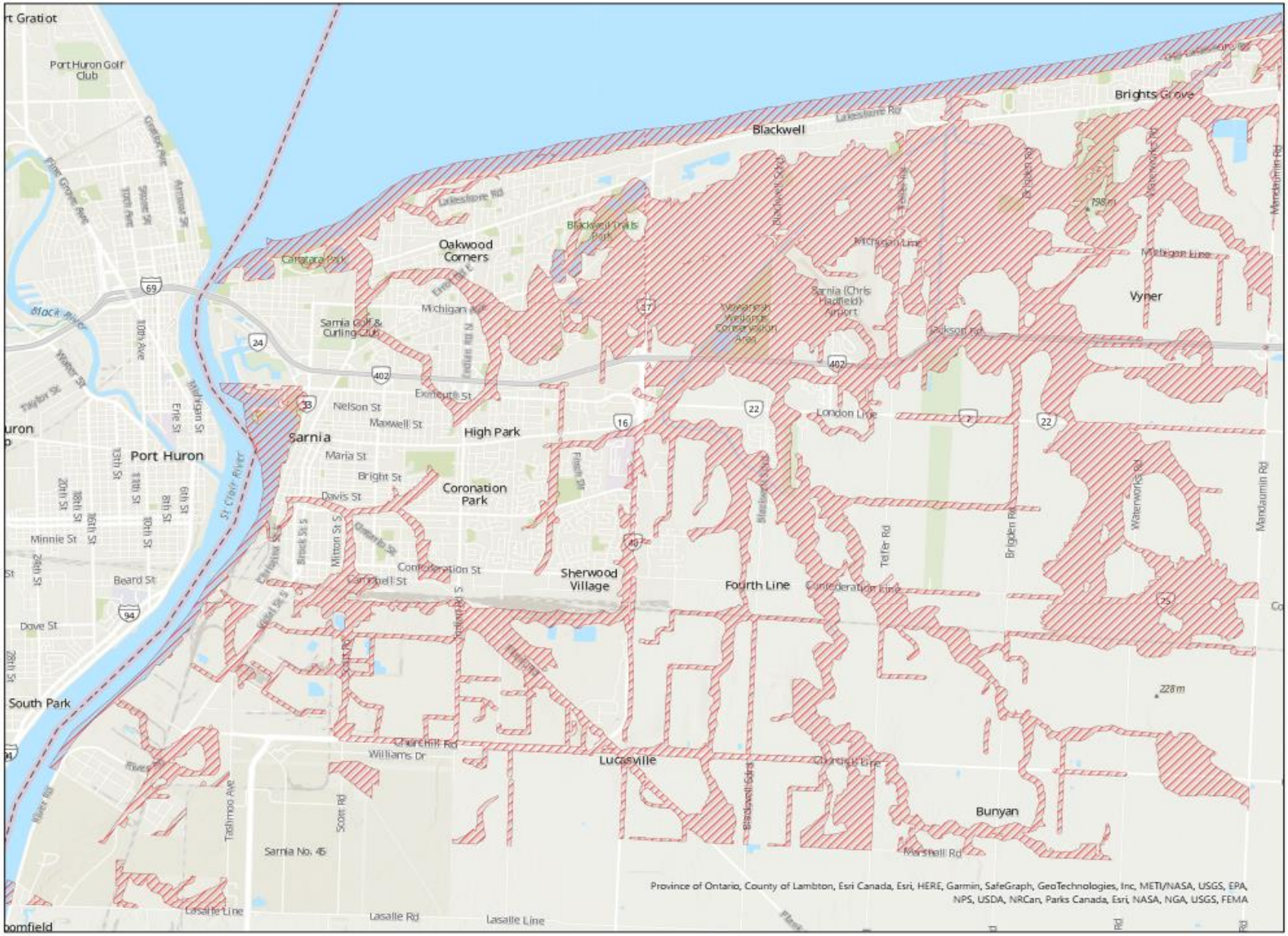
Asset Category	Length (km)	Percentage
Storm and Combined Sewer	343	100%
Storm and Combined Sewer Pre 1970	162	47%

N

0 0.5 1 2 Kilometers

Prepared by the City of Sarnia Engineering Department, June 2022

*Storm sewers built before 1970 are assumed to not be resilient to a 5-year storm



*This estimate is an approximation using available data

Road Network Condition Data Examples	
Condition	**Example Photo**
Very Poor	
Poor	

Fair	
Good	

Very Good	

Appendix C – Supplementary Data

History of the Asset Management Plan

In July 2005, the City retained Dillon Consulting Limited to aid in the implementation of an asset management system (AMS). The AMS included the creation of a linear infrastructure asset inventory and the identification of their associated needs of capital needs. The City's core linear infrastructure assets include watermains, roads, sanitary sewers, storm sewers, and combined sewers. Due to budget limitations and data availability constraints, a sampling approach was adopted to carry out the AMS assessments.

The City's AMS progressed as follows:

1. Under the direction of the City, Dillon Consulting Limited completed an initial inventory assessment and identification of capital needs for linear infrastructure assets in 2005.
2. The City acquired the Autodesk Map Guide "Mi-Town GIS Application" in 2006 and upgraded to the ESRI Enterprise Geo Cortex GIS system in 2010.
3. The City initiated data collection programs, which included hydrant flushing, water valve turning, and sewer flushing programs in 2004 which continue to operate.
4. R.V. Anderson Associates completed a pumping station condition assessment for the City in 2009.
5. In 2012, Stantec Consulting Limited completed a sewer collection system model and a sewer master plan study for City of Sarnia.
6. In 2013, Stantec Consulting Limited also completed a water distribution system model and a water distribution system master plan for the City.
7. IMS Infrastructure Management Services completed a road condition assessment in 2018.
8. The City bridges and applicable culverts are inspected every two years as per provincial regulation. The last inspection of City bridges/culverts was completed in 2020.
9. CityWorks software implementation commenced in 2021 and is ongoing.
10. Sewer condition assessments are being completed in phases and is currently ongoing. The sewer condition assessment is a challenging task for the City as there is uncertainty as to the extent of sewer cleaning required.
11. The infrastructure asset data in the GIS system is being updated on a regular basis.

The information required for this AMP was obtained from a number of sources, which include as-built construction drawings, reports, GIS inventories, GIS maps, capacity assessments, condition assessments, and infrastructure master plans.

Figure 24 Asset management workflow

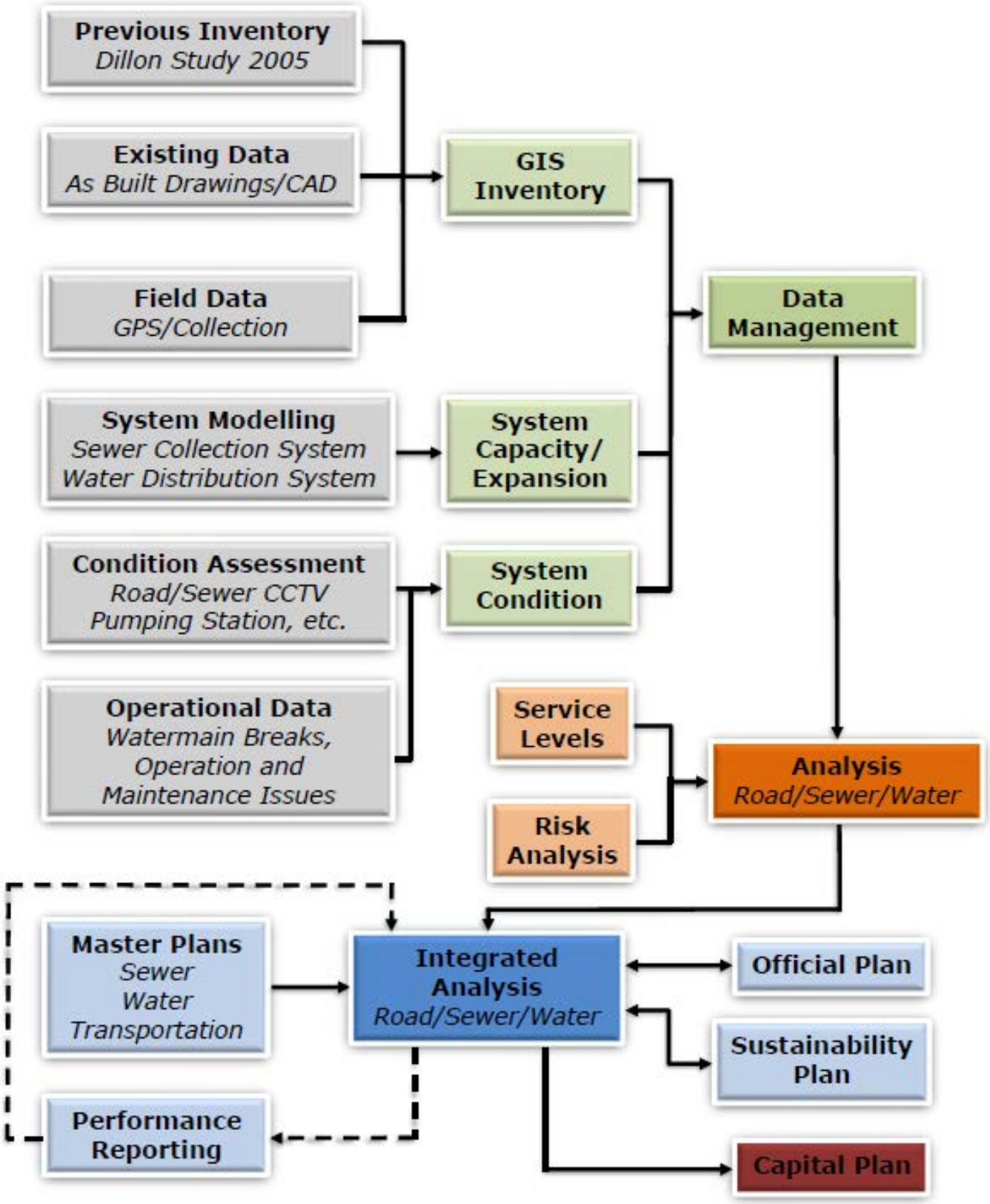


Table 28 Sanitary Pumping Stations

Pump Station No.	Name	Condition Score	Comments
1	Holland Street	0	
2	Briarfield	0	
3	Clifford	10	
4	ARI	56	
5	East St at Huey's	N/A	Out of Service
6	East St at Maple	N/A	Out of Service
7	Elrick at Vye	73	
8	Errol Road	7	
9	Exmouth West of Indian	79	
10	Forsyth	13	
11	Lasalle	86	
12	Lecaron	81	
13	McCaw	5	
14	Rosedale	0	
15	Scott Road	9	
16	Talfourd Street	65	
17	Mayfair	67	
18	Giffel Road	0	
19	Degurse(Ain-Ki-Jig)	N/A	Out of Service
20	Tashmoo Ave (North)	33	
21	Plain Lane	39	

Pump Station No.	Name	Condition Score	Comments
22	Berkshire Road	38	
23	Sandy Lane	45	
24	River Road	27	
25	161 Nelson Street	38	
26	1350 Plank	51	
27	1569 London Line(Lou's)	69	
28	1801 London at Blackwell	N/A	Out of Service
29	London Line at Briarwood	18	
30	Blackwell at Sim's	N/A	Out of Service
31	Airport Road North of 402	24	
32	Exmouth St. (Lambton Mall)	13	
33	CNR Tracks at Bedford	71	
34	Plank Road at Indian Road	69	
35	Murphy Road at 402	14	Does this still have operation issues?
36	1642 Murphy Road	51	
37	Cathcart at Rutherglen	21	

Pump Station No.	Name	Condition Score	Comments
38	Penhuron Lane (Hamilton)	76	
39	Kaymar	73	
40	Huronview (Lakeshore)	64	
41	Green Street	87	
42	Research Park	80	
43	1264 Tashmoo (South)	56	
44	Chippewa Park	19	
45	Augusta Drive	60	
46	Rapids Parkway	53	
47	Devine Street	80	
48	CNR Tracks at St.Clair	N/A	Out of Service
49	5960 Blackwell Side Road	68	
50	Michigan Avenue	64	
51	Heritage Park	64	
52	Stone Hedge Park	74	
53	London Rd Industrial Park	69	
54	5759 Blackwell Side Road	85	
55	Waterworks	95	
56	Compost Site	N/A	Out of Service
57	Indian Road	98	

Pump Station No.	Name	Condition Score	Comments
58	Sarnia Bay Marina	24	
59	Fuel Dock	24	

Financial Strategy

Table 29 Average unit price for financial analysis

Asset Category	Unit Price
Watermain	$807/m
Sanitary Sewer	$980/m
Storm Sewer	$1336/m
Roadway	$173/$m^2$

Financial Forecast Assumptions

- Unit prices are calculated using recent capital project rates and are an average of multiple pipe diameters
- All projects are uninflated. It is assumed that City funding will keep pace with inflation
- Future needs are determined through age-based deterioration with comparison to the recommended reinvestment rate stated in the Canadian Infrastructure Report Card.
- Unit prices for underground infrastructure include road repair costs due to trench excavation