Municipality of North Middlesex

Asset Management Plan

Final Report

Submitted By:

DILLON CONSULTING

www.Dillon.ca

Dillon Consulting Limited
130 Dufferin Avenue
Suite 1400
London, ON N6A 5R2
Tel.: 519-438-6192
Fax: 519-627-8209

March, 2014

EXECUTIVE SUMMARY

Public infrastructure is central to our prosperity and our quality of life. The majority of public infrastructure in Canada is the responsibility of the municipal government, and most people take for granted the important role of these assets. Adequate municipal infrastructure such as roads, bridges, and underground water and sewage pipes are essential to economic development, citizen safety, and quality of life. Well maintained infrastructure is critical in sustaining a municipality as an attractive place to live and do business.

The recent *Canadian Infrastructure Report Card* (2012), which addresses municipal roads and water systems, stated that approximately 30% of municipal infrastructure is in "fair" to "very poor" condition across Canada. The replacement value of these assets alone totals over $170 billion. This illustrates the importance of municipalities protecting their investment in infrastructure and finding creative financial solutions to keep infrastructure in good operating condition. One of the solutions to Canada's infrastructure issues is improved asset management practices.

The Municipality of North Middlesex (Municipality) has placed asset management as a strategic priority. The present AMP report, along with the asset management tools delivered to the Municipality, will assist staff in making the most cost-effective decisions with regards to rehabilitation or replacement of their infrastructure. It will also ensure that the limited funds made available for infrastructure renewal are spent wisely, and that staff decisions are supported by sound technical data and analysis.

State of Local Infrastructure

It is often suggested in literature that 2% to 4% of the value of an asset should be spent yearly to ensure sustainability of the assets. Without asset management tools, it is almost impossible to determine the long term effect of inadequate budget allocations. Yet, it is important for a municipality to determine if the current level of funding is appropriate to continue to provide an adequate level of service to its residents. It is also essential to allocate adequate funding to ensure sustainability of the assets in the future. For the Municipality, the estimated value of the assets included in this project was estimated at almost $311 million. The following table shows the distribution of that asset value.

Asset Value		
Infrastructure Network	**Quantity**	**Replacement Cost**
Paved Roads	99.6 km	$16,596,740
Water	467 km	$188,390,170
Sanitary Sewer	22.5 km	$11,479,930
Storm Sewer	23.4 km	$18,552,616
Bridges and Culverts	35 Bridges 19 Culverts	$75,890,036
Total Asset Value		**$310,909,493**

Current Needs Summary

An analysis scenario assuming an unlimited annual budget is utilized to gain insight on the state of local infrastructure. Although an unlimited budget is not a reality for any municipality, the scenario demonstrates the backlog of repairs that have been neglected over the years due to a lack of funding. The results define the extent of the infrastructure needs that currently exist in the Municipality, indicating that there is a backlog of needs.

Analysis was completed on the municipality networks and assets to determine the current needs of the system. The current needs summary was completed to understand the needs within the upcoming year for the municipal infrastructure.

Through the analysis current needs were not identified for the road, sanitary sewer or storm sewer networks. Needs were, however, identified for the water network, bridges and culverts. The following tables present a summary of the current needs.

Summary of Current Needs – Linear Network				
Network	**Sections in Need**	**Total Current Needs (km)**	**% of Network in Need**	**Estimated Expenditure**
Road Network	0	0	-	-
Water Network	4	0.520	0.1%	$207,834
Sanitary Sewer Network	0	0	-	-
Storm Sewer Network	0	0	-	-

Summary of Current Needs – Point Assets		
Asset Type	**Structures in Need**	**Estimated Expenditure**
Bridges & Culverts	13	$2,848,627

Asset Management Strategy

Using the DPSS asset management tool described in **Section 2.5**, it is possible to analyze the effect of different budget scenarios on the linear infrastructure networks. Depending on the allocated annual budget, the level of service may decrease, remain constant, or increase over time.

The scenarios and plan developed below are produced based on the analysis conducted considering condition of the network infrastructure.

Current Funding Level

Road Network

The condition of the road network is such that there are no current needs identified on the network within a ten year timeframe, as determined through DPSS analysis.

Water, Sanitary Sewer and Storm Sewer Networks

The condition of the sanitary sewer network is such that there are no current needs identified on the network within a ten year timeframe, as determined through DPSS analysis.

The analysis on the water and storm sewer networks returned needs for both networks. The needs identified for the water network included works only in 2014, with an anticipated cost of $207,834. The needs identified for the storm sewer network include only one year of needs in 2016, at an anticipated expenditure of $329,060.

Bridge and Culvert Assets

Approximations for timing for rehabilitation and replacement of point assets, and corresponding costs were developed using the OSIM condition survey reports and PSAB database which contained information on year of construction, service lives and replacement costs.

Financing Strategy

Financing infrastructure needs has become a very serious issue. Asset managers need to identify better practices and innovations in infrastructure financing if municipalities and other levels of government want to continue to provide an adequate level of service to tax payers in an affordable manner. Asset managers need to come up with innovative solutions to address that infrastructure deficit. Asset management systems are part of the solutions but innovative financing and finding alternate revenue sources are an even bigger part of the solution.

Through this assignment we have worked with Municipality staff to develop an Asset Management (AM) Strategy, including funding requirements that would ensure sustainability of the assets to continue to provide an adequate level of service to the residents of the Municipality. The strategy developed is realistic and affordable. The following approach will be followed by the Municipality to pay for the current and future needs in the infrastructure networks. The primary funding source in the Municipality is tax dollars, supplemented by reserve funds, and period federal or provincial funding. These financing sources will address a significant portion of the infrastructure needs identified in this report but additional external financing may be required to ensure sustainability of the assets to continue to provide an adequate level of service to the residents of the Municipality in the future.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

1.1. SIGNIFICANCE OF MUNICIPAL INFRASTRUCTURE

Public infrastructure is central to our prosperity and our quality of life. The majority of public infrastructure in Canada is the responsibility of the municipal government, and most people take for granted the important role of these assets. Adequate municipal infrastructure such as roads, bridges, and underground water and sewage pipes are essential to economic development, citizen safety, and quality of life. Well maintained infrastructure is critical in sustaining a municipality as an attractive place to live and do business.

The recent *Canadian Infrastructure Report Card* (2012), which addresses municipal roads and water systems, stated that approximately 30% of municipal infrastructure is in “fair” to “very poor” condition across Canada. The replacement value of these assets alone totals over $170 billion. This illustrates the importance of municipalities protecting their investment in infrastructure and finding creative financial solutions to keep infrastructure in good operating condition. One of the solutions to Canada’s infrastructure issues is improved asset management practices.

The Municipality of North Middlesex (Municipality) has placed asset management as a strategic priority. The present AMP report, along with the asset management tools delivered to the Municipality, will assist staff in making the most cost-effective decisions with regards to rehabilitation or replacement of their infrastructure. It will also ensure that the limited funds made available for infrastructure renewal are spent wisely, and that staff decisions are supported by sound technical data and analysis.

1.2. PURPOSE OF THE AMP

Dillon Consulting Limited (Dillon) was retained by the Municipality to develop an Asset Management Plan (AMP), which will contribute to North Middlesex’s eligibility for provincial funding under the Municipal Infrastructure Investment Initiative (MIII) program. Eligibility rules for MIII funding indicate that municipalities must prepare an AMP to ensure that the funds provided by the Province are spent in a cost-effective manner. Municipalities must also prove in their submission that they have acquired suitable asset management tools that will assist staff in managing its infrastructure assets in the future. These tools and systems will ensure that municipalities continue to provide an adequate level of service to their residents and create a solid foundation for economic prosperity.

The Ministry of Infrastructure of Ontario recognized that public infrastructure is central to prosperity and quality of life, as municipalities deliver many services that are critical to the public. Many of these services rely on well planned and maintained infrastructure. All levels of government understand also that they have an obligation to address the ever increasing infrastructure challenges, to ensure that they can continue providing and adequate level of service to tax payers. In an effort to commence addressing these challenges, the Ministry has initiated a program and plan called *Building Together*: *Guide for Municipal Asset Management Plans* (2012). This program is meant to assist municipalities in developing a municipal infrastructure strategy. This strategy provides an opportunity for municipalities to address current and emerging infrastructure challenges. One of the main components of the strategy is to improve the current municipal infrastructure asset management practices. The first step for municipalities is to develop an AMP.

The province has indicated that any municipalities seeking provincial infrastructure funding must demonstrate that they have or are in the process of developing an AMP and how its proposed project funding requests fit within a detailed AMP. The AMP should not only address the current needs in infrastructure, it should also identify future needs and a financing short and long-term strategy to funds those needs.

The AMP will assist municipalities in making the best possible decisions regarding the building, operating, maintaining, renewing, replacing and disposing of infrastructure assets. The intent of the plan is to make the best use of the funds available while managing risk and continuing to provide adequate levels of service to the public.

1.3. MUNICIPALITY OF NORTH MIDDLESEX

The municipality of North Middlesex is located in Southwestern Ontario, and is a division of Middlesex County. The municipality is situated north-west of the City of London, and is bounded by five different municipalities. The total land area occupied by the Municipality is just under 600 square kilometers. In 2011, the Municipality had a population of approximately 6,700 people. ***Figure 1*** illustrates the location of the Municipality.

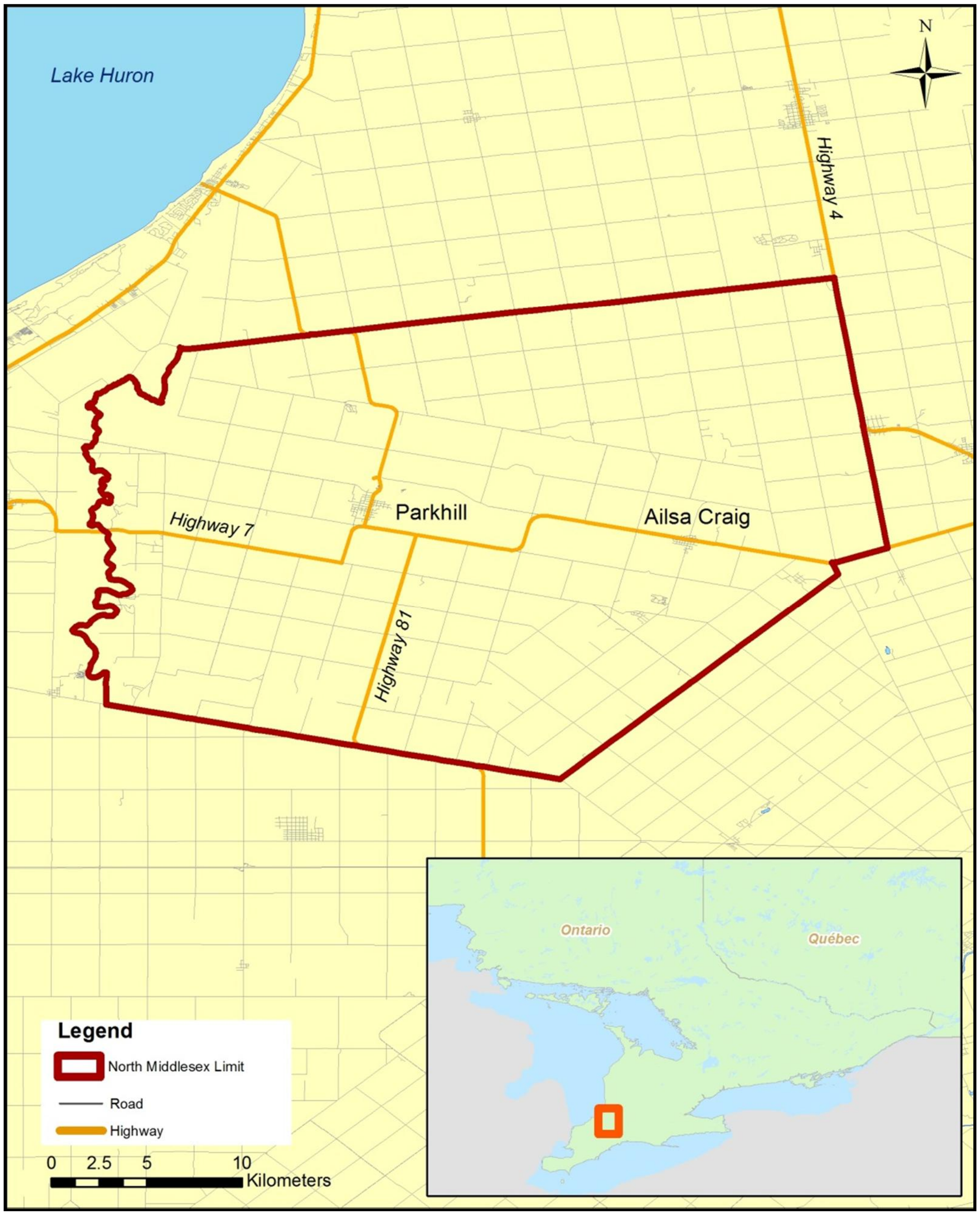


Figure 1: Municipality of North Middlesex – Location Map

1.4. PROJECT TEAM

To ensure that all technical and financial aspects of the plan were addressed, the Municipality included representatives from all relevant departments in the project. Their involvement will continue in the future to ensure that the plan remains relevant and useful in properly managing the Municipality's infrastructure assets.

1.5. ASSETS INCLUDED IN THE AMP

Ideally, municipalities should include all the capital assets owned and maintained by the municipality. However, the funds made available by the province were mostly for infrastructure assets such as roads, bridges, water and wastewater assets, and social housing. As recommended in the Guide for Municipal Asset Management Plans, the Municipality opted to develop a plan that includes all the primary assets. These infrastructure assets are considered essential to continue to provide an acceptable level of service to the public. The assets included in the AMP are:

- 99.6 kilometers of paved roads
- 365 kilometers of unpaved roads
- 465 kilometers of water network
- 22.5 kilometers of sanitary sewer network
- 23.4 kilometers of storm sewer network
- 19 culvert and 35 bridge structures

Detailed information of the road, water main, sanitary and storm sewer networks can be found in the digital database delivered to the Municipality. The information included in the asset management tools delivered to the Municipality will assist in updating the AMP in the future. However, it is important to note that the AMP is not a static plan, and it will need to be updated as infrastructure is maintained and rehabilitated. The condition of the assets will also need to be reviewed as the assets continue to deteriorate over time.

The information provided to the Dillon team originated from various existing Municipality databases, including CAD, MS Excel and GIS system from the County. Less significant assets such as street signs and street lights were not included in this project. The maintenance of these assets is funded primarily through the operating budget on an as-needed basis, rather than being planned strategically in advance.

1.6. AMP LIMITATIONS

The AMP is a tool which is meant to be used to inform decision making. Other political, social, and environmental considerations should also be taken into account in planning capital investments. However, the AMP should provide a foundation on which those decisions are made.

In addition, the usefulness of the AMP is directly related to the quality of data used in its analysis. While both the Municipality Staff and Dillon team involved in the project were committed to data accuracy, some assumptions had to be made in extenuating circumstances. Yet, as a whole the AMP provides an accurate approximation of the Municipality's current and future infrastructure needs.

2.0 PROJECT METHODOLOGY

The general methodology we have adopted has been to follow the best practices from the *National Guide to Sustainable Municipal Infrastructure (2002)*, also known as the *InfraGuide*. The approach is described in five steps and was designed to help asset managers assess the level of service currently provided by their tangible assets. It allows asset managers to make fact-supported infrastructure investment decisions, while maximizing the effectiveness of available funds. Each of the five steps and their key elements, presented below, were addressed in developing the AMP for the Municipality. Each step is described in detail in the sections below.

1. **Infrastructure Data Inventory -** ***What infrastructure do you own?***
   - Analysis of existing data and optimization of data sources
   - Transfer of physical characteristic information into databases
   - Document inventory of all assets
   - Upload of information in graphical interface such as a Geographic Information System (GIS)
2. **Replacement Costs -** ***What is it worth?***
   - Define bench-marking unit prices for replacement
   - Calculate replacement costs of all assets
   - Input information in analytical tools
3. **Condition Assessment -** ***What is its condition and remaining service life?***
   - Review of condition assessment data
   - Transfer of condition data to analytical tools
   - Computing condition assessment indices where appropriate
   - Statistical analysis of defects to assess life expectancy
   - Determination of service life of all infrastructure assets
   - Comparison with industry standards and definition of acceptable level of service
4. **State of Local Infrastructure Analysis-** ***What needs to be done to rehabilitate, replace, operate and maintain these assets?***
   - Upload condition data in asset management tools and process information
   - Review the effect of different repair alternatives
   - Consideration of lifecycle costs and extension of service life
   - Determine financial requirements to address needs identified
5. **Asset Management Strategy -** ***What should be done first and how much will it cost?***
   - Consideration of selected "what if" expenditure scenarios; and
   - Production of a prioritized short and long term AMP.

The final part of this report, which could be incorporated as an additional question to the list above, is "How will you finance your plan?". To answer that question we have reviewed a variety of financing strategies which could be implemented to address the needs of all assets while maintaining an acceptable level of service to the residents.

2.1. INFRASTRUCTURE DATA INVENTORY

The Municipality possesses a large amount of inventory data in a variety of formats; therefore, no field data collection was required on this project. We worked closely with the Municipality staff to make best use of the valuable information they had. To facilitate access to the information, we made sure that all asset elements were properly digitized and georeferenced in the database with unique ID numbers. The final datasets were delivered in ArcGIS geodatabase format.

It is recommended in the development of an AMP not to collect and store data just because the data is available. If the data does not add any value to the business processes, it should not be incorporated in the system. Usually, the financial investment and time spent keeping that information current could be better used elsewhere in the development of an AMP.

2.1.1. Linear Infrastructure Inventory – Road, Sewer and Water Networks

The Municipality staff had existing road, sewer, and water database information available in a variety of formats, including spreadsheets, CADD files and detailed on historical drawings and documentation. The files were digitized in formats compatible with the GIS system. The roads database was created using a combination of the County's GIS information and the road information contained in the Municipality's PSAB database. The Dillon team reviewed all the linear infrastructure information and identified data gaps that needed to be addressed before processing data for the development of the AMP. Information such as year of construction, pipe diameter, material type, and pavement widths were some of the attribute information that was required in the development of the AMP. The project team worked closely with staff to address missing data or to make educated assumptions where the information was not available.

2.1.2. Point Asset Inventory – Bridge and Culvert Assets

Existing information pertaining to the point asset inventory within the Municipality, including bridge and culvert assets were obtained for the AMP. The main source of information for the bridges and culverts were survey reports developed to meet the requirements of OSIM. Municipalities are required to undertake OSIM surveys every two years, which report data on each bridge and culvert structure including type, dimensions, year of construction, anticipated service life, condition and rehabilitation required. The OSIM information was very valuable in the initiation of the development of the asset management system, and the Dillon team took full advantage of it.

The Dillon team, in collaboration with Municipality staff, reviewed all available data and made appropriate adjustments to parameters such as service life and replacement cost of an asset. The goal was to tailor the existing information on current infrastructure conditions to the AMP development process.

2.2. REPLACEMENT COSTS

Calculating the replacement costs of infrastructure assets provides insight on the existing financial investments on municipal infrastructure networks. To calculate overall replacement costs, each type of linear infrastructure was assigned an average unit cost per meter or square meter of construction. Unit construction costs were developed in collaboration with Municipality staff based on recent construction activities in the area. For the point assets, the main source of information was the PSAB database. The values provided in the PSAB were inflated where required to obtain an approximation of the current replacement cost of the assets.

2.3. CONDITION ASSESSMENT

The generation of condition indices, using consistent and repeatable techniques, is essential in comparing assets and identifying needs in all types of infrastructure. These indices are used to track improvements to the level of service in the condition of the asset network in the form of financial investment. All condition indices for linear assets ranged from 0 to 1, with 1 representing an asset in perfect condition. Once all assets were assigned a condition rating, knowledge of assets and technical expertise were used to determine rating level which represented the minimal level of service that can be provided to the residents. This was determined in consultation with Municipality staff. Any components of infrastructure rated below the minimal rating are to be repaired to improve the level of service. The minimum rating, or level of service, is called the "Threshold of Acceptability" of an asset.

The following ***Figure 2*** illustrates graphically an example of a deterioration model and performance threshold used for a road network.

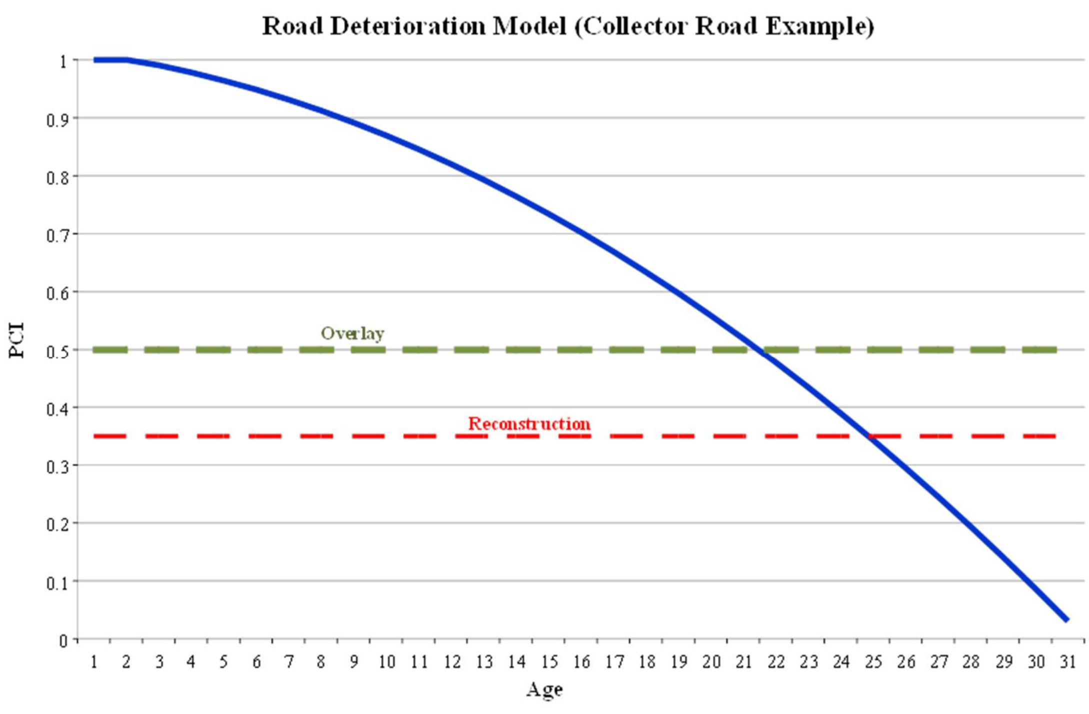


Figure 2: Deterioration Model and Threshold of Acceptability (Collector Roads)

2.3.1. Road Network Condition Assessment Process

The condition of the road network was determined through statistically developed deterioration trends, and road attributes as provided by the Municipality. It is recommended that the Municipality conduct road condition surveys on a regular basis (3 to 5 years) following the PCI method recommended by the Ministry of Transportation. The results of such a survey provides a much better indication of the current condition of the road network and provides a better base of information to predict the deterioration of road sections over time.

2.3.2. Water and Sewer Networks Condition Assessment Process

Budgetary constraints prohibited the possibility of conducting a condition assessment survey of the sewer and water networks. To overcome this limitation, statistically developed deterioration trends were used to approximate pipe condition based on the pipe's age and material type.

The approach used to approximate the condition of these assets is illustrated on ***Figure 3***. It involves using deterioration trends to estimate the condition of "families" or "asset classes" of infrastructure components with similar physical and functional characteristics. It is based on age and material type of the assets. Using the age and statistical deterioration trend of a particular material type, it is possible to approximate its current condition. For high level financial analyses focused on asset sustainability of an infrastructure network, this approach is quite adequate.

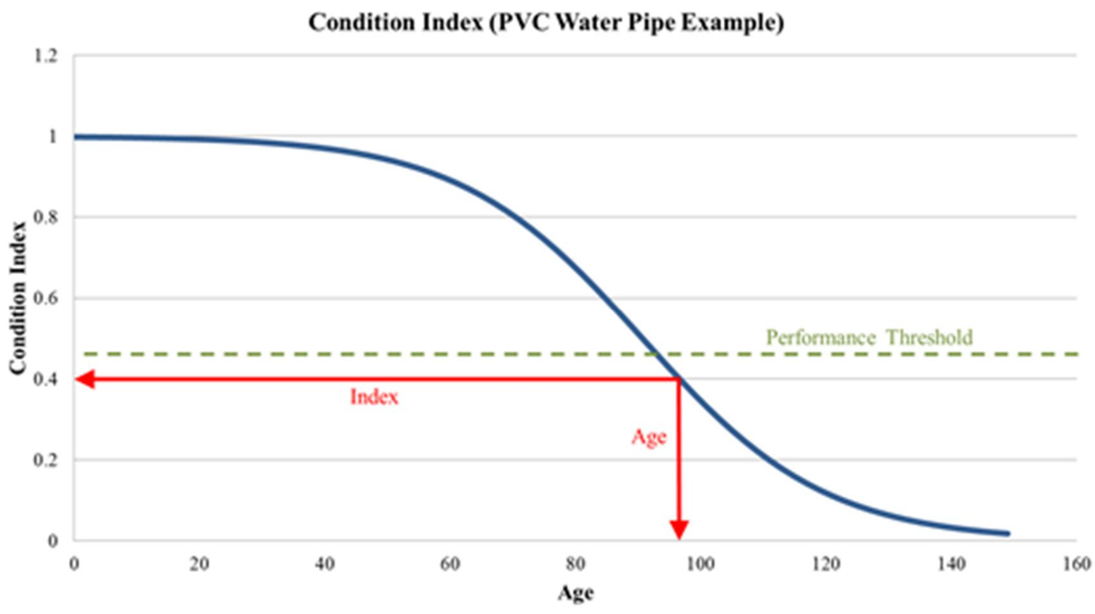


Figure 3: Determination of Condition Index

Where pertinent information relevant to network analysis was unable to be located, assumptions were made based on the age and material of surrounding pipes. All the assumptions made as part of the condition assessment process have been documented in the database.

2.3.3. Point Asset Condition Assessment Process

OSIM surveys were recently completed for bridge and culvert assets. The OSIM and PSAB databases contained information on year of construction, service lives, construction and rehabilitation costs, which was used to approximate timing for rehabilitation and replacement of those assets. The approximations and final results were reviewed and endorsed by staff.

2.4. STATE OF LOCAL INFRASTRUCTURE ANALYSIS

For linear assets, the Dillon Predictive Scenario Software (DPSS) was used in preparing the capital investment analysis of the AMP. The tool is a Microsoft Access application that relies on an overall assessment of the infrastructure condition to produce investment scripts based on degradation curves, which are adjusted to the Municipality's particular operations and thresholds of acceptability.

The DPSS tool assesses the condition, and puts the Asset Manager in control of the life cycle of assets. It also allows for planning as to where, when, how, and how much to invest in the renewal and replacement of infrastructures for the coming year, or for the next 5, 10, 20 or 50 years.

We used the DPSS application to develop the Municipality's short and long term prioritized renewal plans. ***Figure 4*** provides a view of a screen capture of the DPSS analytical tool. Based on unit costs for rehabilitation of roadways provided by the Municipality, AMPs were developed using the tool.

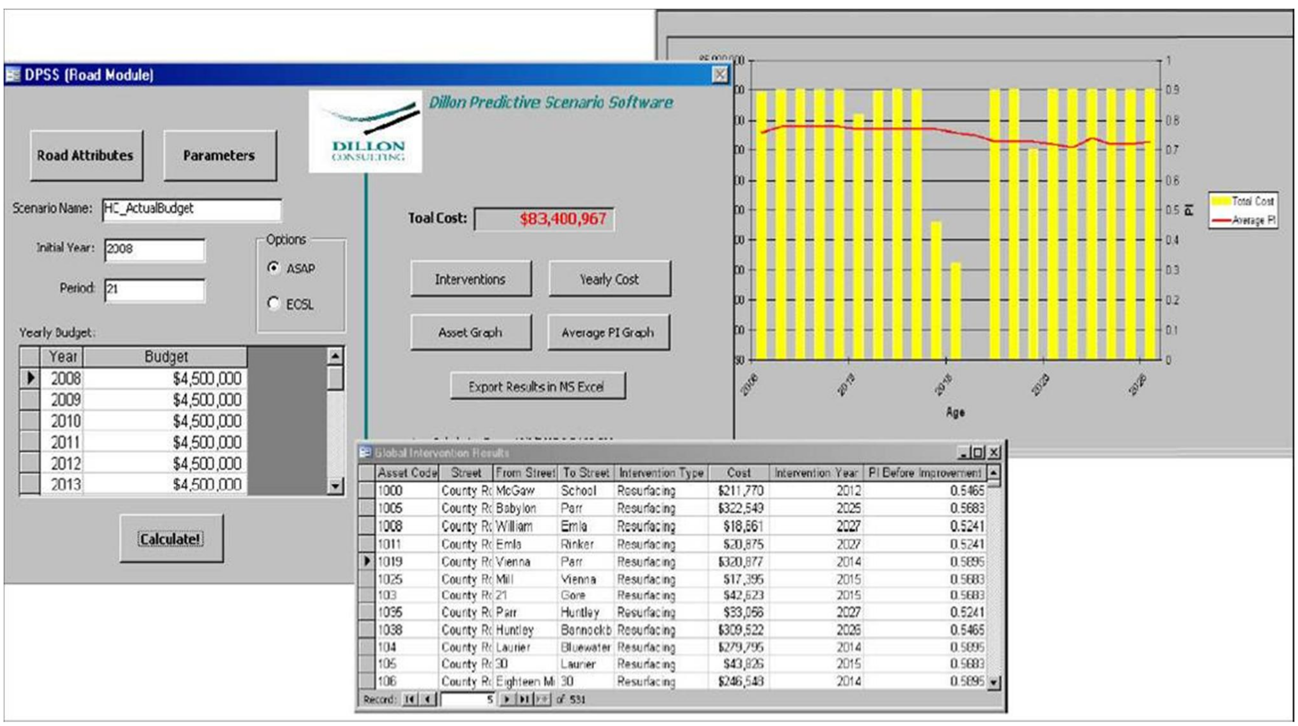


Figure 4: Dillon Predictive Scenario Software (DPSS)

For point assets, Dillon also developed a simple and practical tool to manage point assets. Point assets are assets which include bridges and culverts. These assets usually behave differently than linear assets because they are composed of many different components that have variable service lives. The service lives of these components can usually be obtained from sources such as:

- The supplier's suggested service life
- The experience of the technical expert performing condition assessment
- Published industry guides on service life and maintenance requirements

The AMP tool developed by Dillon has been designed to summarize in tabular and chart forms the maintenance and renewal costs of the components of the assets. The tool considers factors such as year of construction, expected service life, infrastructure needs, maintenance and replacement costs, and year of intervention. It has been successfully implemented in a many communities in across Canada. ***Figure 5*** illustrates the AMP tool interface.

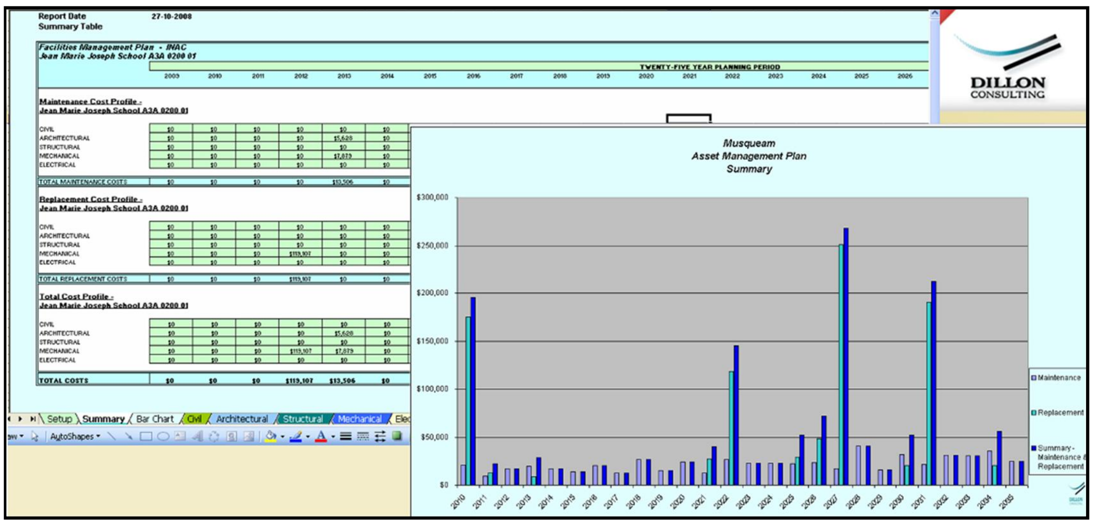


Figure 5: Condition Assessment Tool

This tool was used to develop the multi-year AMP for the point assets included in this project. The results were delivered in digital form in MS Excel format. Municipality staff will continue to use the applications described above to assist them in managing their infrastructure assets.

3.0 DESIRED LEVELS OF SERVICE

As described in the best practice document in the *National Guide to Sustainable Municipal Infrastructure* (2003), also known as *InfraGuide*, levels of service fall into two broad categories: those that are mandated by regulations (codes, standards, etc.); and those that result from community plans or objectives.

In general, mandated levels of service are very specific in their description of the measures to be used. This can take the form of, for example, the number of a type of bacteria per unit volume in drinking water. Community objectives tend to be less defined measurement in terms of schemes. They are future oriented, and focus less on technical measures and more on social, cultural and environmental concerns.

3.1. MANDATED LEVELS OF SERVICE

Regulations exist to ensure the health and safety of the users of public facilities or the products delivered by a utility to the public. These regulations are enforced through codes, standards, or guidelines adopted government authorities.

The most common regulations that apply to infrastructure include:

- Minimum Maintenance Standards for Municipal Highways
- National Drinking Water Guidelines
- National Building Code of Canada
- National Fire Code of Canada

This list is not comprehensive and the owners and managers of infrastructure need to be fully familiar with the regulations that apply to their facilities.

3.2. COMMUNITY OBJECTIVES

Every community has developed objectives on the expected quality of life in their community and a vision for the future. These are established either through a structured process (such as a comprehensive community plan) or by other means. The objectives and vision usually include elements of health and safety, social wellbeing, economic and cultural development, and other factors. Community objectives rely heavily on the ability of the existing infrastructure to support such plans. In many instances, the objectives call for new infrastructure that the community will have to operate and maintain for generations.

The *InfraGuide* describes the steps required to successfully establish a community's levels of service. The key elements that relate to the development of levels of service as described in the *InfraGuide* best practice are illustrated in ***Figure 6.***

Figure 6: Levels of Service (*InfraGuide* 2002)

Asset understanding refers to the knowledge about the inventory, condition and performance of infrastructure that provide the community its services: potable water, wastewater collection and treatment, solid waste management, roads and bridges, community buildings, etc. This information is provided by the AMP and is used to ensure existing and planned infrastructure can support the levels of service established.

Consultation and communication are important elements of developing community levels of service. Key stakeholders must be involved; including community leaders, operators of the assets, education and health professionals, and other levels of government officials. The consultations should be properly managed to avoid creating a "wish list", as consultations have a tendency to raise expectations amongst those involved. Instead, the consultation process should provide adequate background material, and the context and constraints (e.g., financial, environmental, material and human resources, etc.) which face the municipality. This will help generate realistic levels of services that the community can achieve and afford.

Levels of service have to be aligned to the *strategic direction* of the community. Appropriate levels of service must consider the community's ability and willingness to *tolerate risk*. The costs associated with the levels of service need to be established and evaluated in view of the capacity of the community to support them.

Ideally, each community should use this process to define their acceptable level of service. Once determined, all assets would need to be reviewed and compared to the community's expectations. Action plans on remedial measures would have to be developed to close the gap between expectations and reality, if physically and financially possible.

3.3. DETERMINING APPROPRIATE LEVELS OF SERVICE FOR NORTH MIDDLESEX

For this project, due to time constraint and budget limitations, a full community consultation process for establishing levels of service was not conducted. The process followed was mostly based on the *Asset Understanding* component of the process, which considered the physical and functional characteristics of an asset to define a measurable index that can be monitored over time.

Condition indices were determined as described in **Section 2.3: Condition Assessment.** The Municipality's current levels of service, measured in terms of condition index, were determined in consultation with the Municipality's project team. By combining that information with staff knowledge, it was possible to determine if the current levels of service provided to the residents were appropriate. Once acceptable levels of service were established, the information was used to identify current and future infrastructure investment requirements. The asset management tools described previously were provided to staff to monitor the levels of service over time, and to assess the effect of different budget scenarios on the current and future levels of service. The results of our analysis are presented in **Section 5.0: Asset Management Strategy**.

4.0 STATE OF LOCAL INFRASTRUCTURE

4.1. EXISTING INFRASTRUCTURE AND CONDITION

4.1.1. Road Network

The Municipal road network is made up of a total length of over 460 kilometers of road, varying in widths from 3 to 8 meters. The roads in the network are both unpaved and paved; unpaved surfaces including gravel and grass, and accounting for approximately 365 kilometers of the network. The remaining length, approximately 100 kilometers, has paved surfaces. The distribution of surface types within the network is illustrated in ***Figure 7***. The network is of fairly recent construction, with the earliest segment construction having been noted as 1949, and the most recent as 2013. The distribution of dates of construction are noted in ***Figure 7***. Further to this, it is noted that the paved road segments were all constructed in 1995 or more recently; the older construction corresponds to unpaved roads.

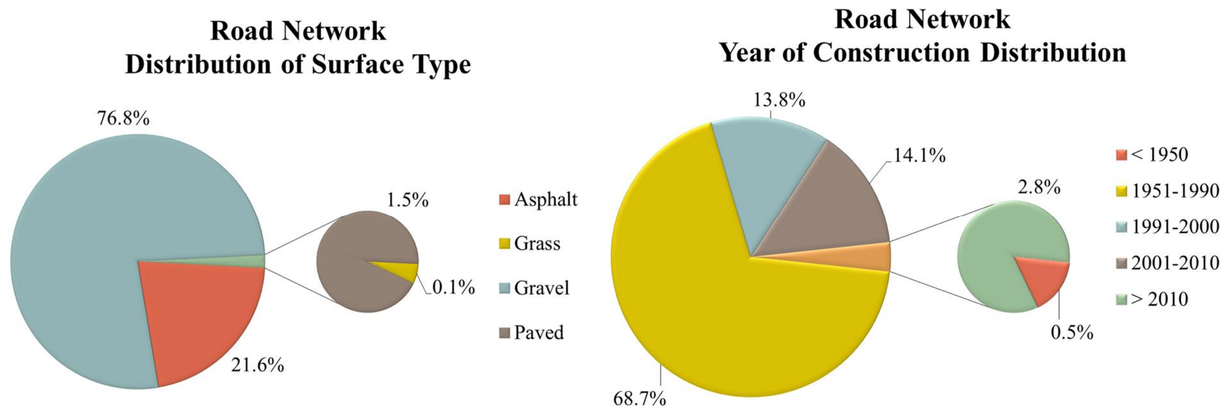


Figure 7: Distribution of Surface Type and Year of Construction of Road Network

Unpaved roads are generally maintained continuously, while paved roads require periodic rehabilitation, based on their condition. The anticipated service life attributed by the Municipality to the paved road surfaces was set at 35 years. The network is noted to generally be in good condition based on the service life and age.

4.1.2. Water Network

The water network is constructed with primairly PVC piping, smaller or equal to 250 millimeters in diameter. The remainder of the pipes within the network are constructed of larger diameter PVC, ductile and cast iron materials. The distribution of pipe materials is shown in ***Figure 8***. The current network ranges in year of construction from 1954 to the present day, the majority being constructed between 1971 and 1990. ***Figure 8*** illustrates the distribution of pipe ages within the network and material types.

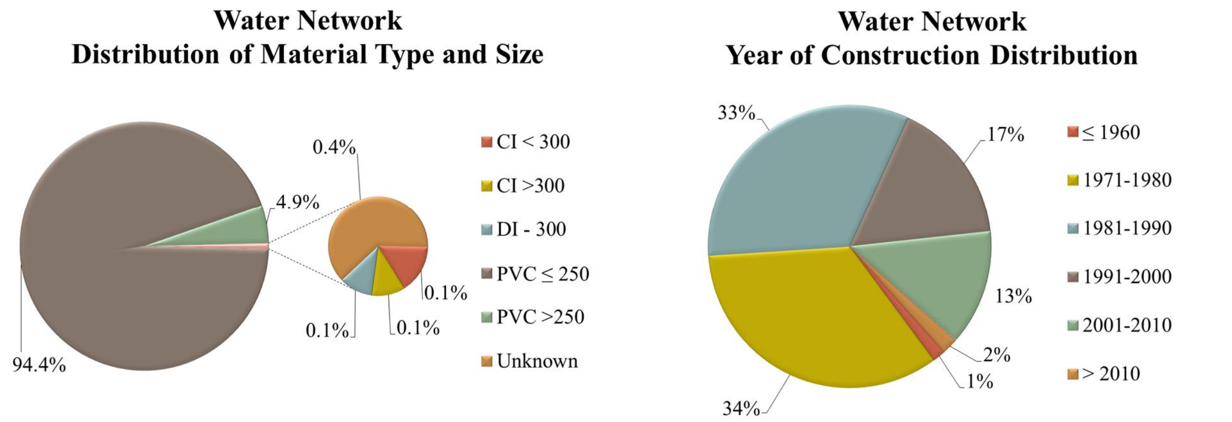


Figure 8: Distribution of Material Type and Size and Year of Construction for Water Network

The average age of the water network is 30 years. The life expectancy values attributed to PVC pipes is 100 years, ductile iron is 60 years, and cast iron pipes are 50 years. The ages of the pipes considered with their service lives indicates a water network in very good condition. Due to the nature of the deterioration curves, the network currently has an average condition rating of approximately a 0.97, and 70% of its anticipated service life remaining.

4.1.3. Sanitary Sewer Network

The sanitary sewer network is constructed primarily with PVC pipe materials, but also includes concrete, HDPE and steel materials. The network is recorded to have been constructed during four years, including 1980, 1986 1996 and 2007, with the majority of the pipe system having been constructed in 1980. ***Figure 9*** illustrates the distribution of pipe ages within the network, and the material types.

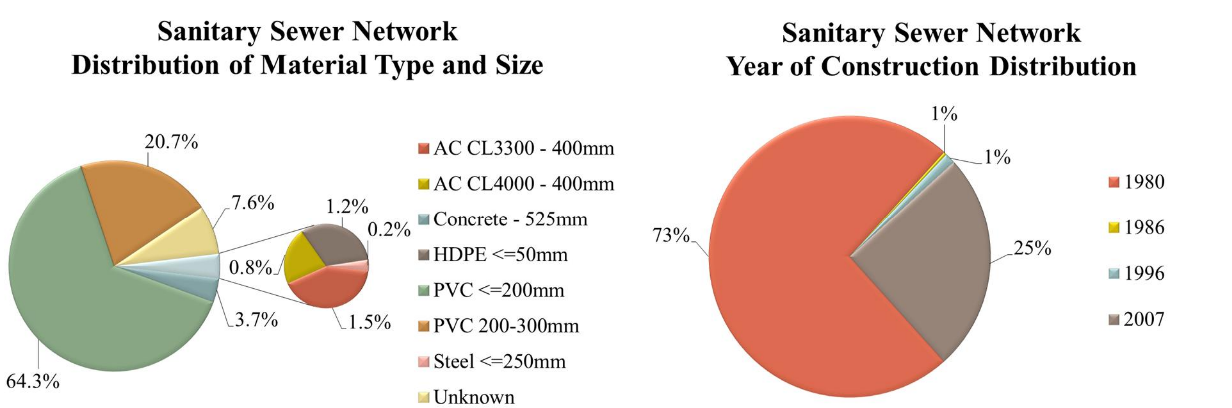


Figure 9: Distribution of Material Type, Size and Year of Construction for Sanitary Sewer Network

The average age of the network is 26 years. The pipe materials within the network have been attributed anticipated service lives of 100 years for PVC and HDPE, 60 years for concrete, and 55 years for steel. This results in a sewer network in very good condition. The average condition index of the network is 0.98, and the network has on average 80 years remaining of service.

4.1.4. Storm Sewer Network

The storm sewer network is constructed of PVC, concrete and CSP pipe materials, with a range in pipe diameter from 150 to 1350 millimeters. It is noted that assumptions were made regarding pipe materials within the network due to incomplete data. It was assumed that pipe sections with a diameter of less than 450 mm were constructed of PVC pipe, and pipes with diameter 450 mm or larger were constructed of concrete. The majority of the storm sewer network was constructed in 1950, accounting for approximately 44% of the network. The earliest noted construction of segments of the storm sewer network was in 1940, with additional segments being constructed up until, and including present day. ***Figure 10*** illustrates the distribution of year of construction and pipe diameters for the storm sewer network.

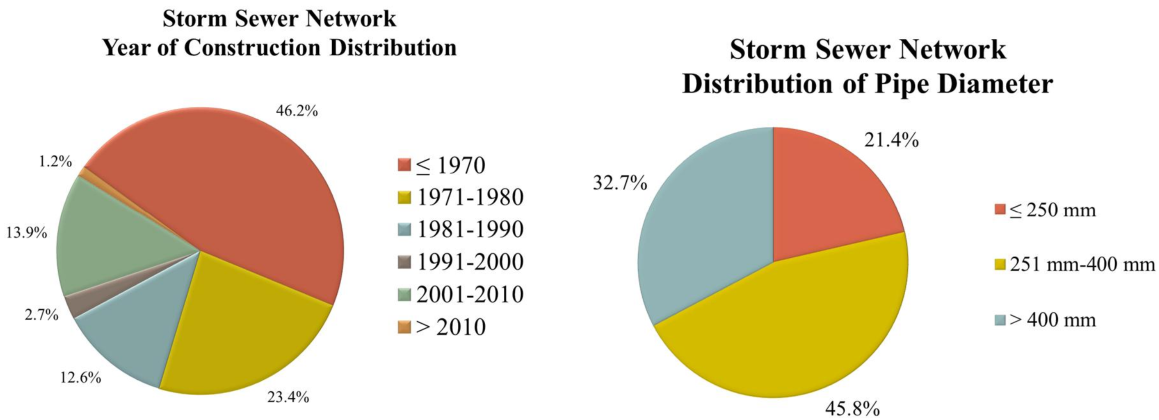


Figure 10: Distribution of Year of Construction and Material Type for Storm Sewer Network

The average age of the network is 42 years. All materials used within the network have been attributed an anticipated service life of 75 years. This results in a network which is within the second half of its service life, however is in good condition. Due to the nature of the degradation of pipe materials, the average condition index of the system is 0.83 out of 1, indicating a system in good condition.

4.1.5. Bridge & Culvert Assets

Included in the AMP are 35 bridge and 19 culvert structures. The majority of the bridge structures are of concrete rigid frame construction, but the network also includes steel I-beam and truss structures. The culverts within the network are primarily corrugated steel pipe, but also include concrete culverts. The life expectancy attributed to the concrete structures is 75 years, 50 years for the steel structures, and 40 years for corrugated steel pipe. The years of construction of the projects range vastly, the earliest structure construction noted to have been in 1870, while the most recent was constructed in 2008. The distribution of construction years is shown in ***Figure 11***.

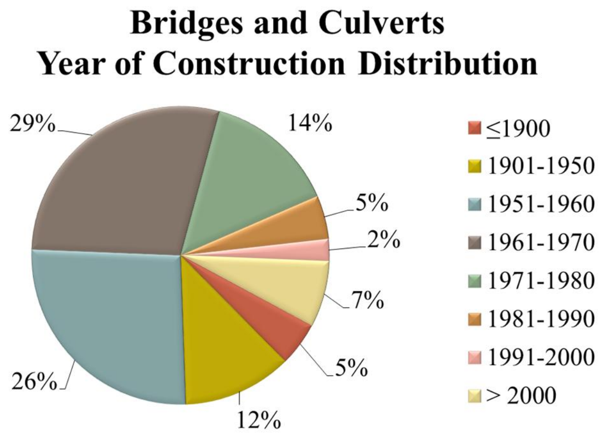


Figure 11: Distribution of Year of Construction for Bridges and Culverts

It is noted that the distribution does not include the majority of the culvert structures, for which dates of construction were assumed due to lack of data.

4.2. ESTIMATED CURRENT ASSET VALUE

It is often suggested in literature that 2% to 4% of the value of an asset should be spent yearly to ensure sustainability of the assets. Without asset management tools, it is almost impossible to determine the long term effect of inadequate budget allocations. Yet, it is important for a municipality to determine if the current level of funding is appropriate to continue to provide an adequate level of service to its residents. It is also essential to allocate adequate funding to ensure sustainability of the assets in the future. For the Municipality, the estimated value of the assets included in this project was estimated at almost $311 million. ***Table 1*** and ***Figure 12*** show the distribution of that asset value.

Table 1: Asset Value

Infrastructure Network	Quantity	Replacement Cost
Paved Roads	99.6 km	$16,596,740
Water	467 km	$188,390,170
Sanitary Sewer	22.5 km	$11,479,930
Storm Sewer	23.4 km	$18,552,616
Bridges and Culverts	35 Bridges 19 Culverts	$75,890,036
Total Asset Value		**$310,909,493**

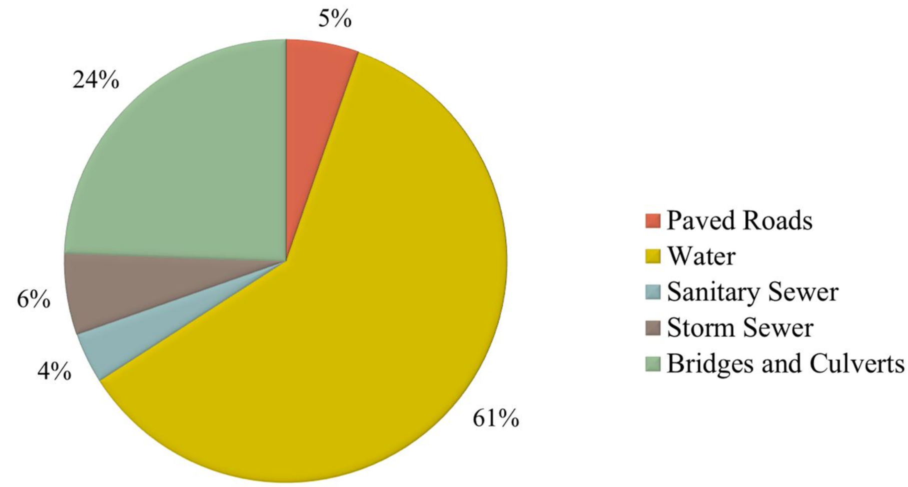


Figure 12: Current Estimated Asset Value

Based on these results and the recommended 2% yearly investment in maintenance, theoretically the Municipality should allocate around $6.2 M per year to ensure future sustainability of its assets.

4.3. CURRENT NEEDS SUMMARY

4.3.1. Unlimited Budget Scenario

An analysis scenario assuming an unlimited annual budget is utilized to gain insight on the state of local infrastructure. Although an unlimited budget is not a reality for any municipality, the scenario demonstrates the backlog of repairs that have been neglected over the years due to a lack of funding. The results define the extent of the infrastructure needs that currently exist in the Municipality. The following sections discuss the results of our analysis for the linear networks based on the deterioration models described above and service life from installation year of a pipe or condition assessment survey results.

Most municipalities in Canada experience infrastructure repair backlogs. They are aware of the problem but are unable to properly assess the long term effect of current funding levels on the sustainability of their infrastructure. The only way for a municipality to take control and properly manage its backlog, in a realistic manner, is through the implementation of asset management tools. These tools enable asset managers to assess the long term effect of different levels of funding.

4.3.2. Current Needs

An analysis was completed on the infrastructure networks and point assets to determine the current needs of the assets using an unlimited budget. Current needs refers to the needs identified in 2014. The threshold of acceptability used to qualify the condition of the asset was based on the experience of the project team and in consultation with staff, as discussed in **Section 2.3**. The current needs summary was completed to understand the needs within the upcoming year for the Municipality infrastructure, and to identify the existence of any backlog.

Through the analysis current needs were not identified for the road, sanitary sewer or storm sewer networks. Needs were, however, identified for the water network. ***Table 2*** presents a summary of the current needs on the linear networks.

Table 2: Summary of Current Needs – Linear Network

Network	Sections in Need	Total Current Needs (km)	% of Network in Need	Estimated Expenditure
Road Network	0	0	-	-
Water Network	4	0.520	0.1%	$207,834
Sanitary Sewer Network	0	0	-	-
Storm Sewer Network	0	0	-	-

The needs for the water network represent only a small portion of the network.

The point assets were analyzed to determine current needs, and it was found that bridges and culverts experienced needs in 2014. ***Table 3*** presents a summary of the current needs with point assets.

Table 3: Summary of Current Needs – Point Assets

Asset Type	Structures in Need	Estimated Expenditure
Bridges & Culverts	13	$2,848,627

The needs identified for bridges and culverts are significant in expenditure. This total cost represents one full structure replacement, and 12 incidences of repair work, as recommended through bridge condition, identified by the Municipality or through OSIM survey.

5.0 ASSET MANAGEMENT STRATEGY

Using the DPSS asset management tool described in **Section 2.4**, it is possible to analyze the effect of different budget scenarios on the linear infrastructure networks. Depending on the allocated annual budget, the level of service may decrease, remain constant, or increase over time.

The scenarios and plan developed below are produced based on the analysis conducted considering condition of the network infrastructure.

5.1. CURRENT FUNDING LEVELS

5.1.1. Road Network

The condition of the road network is such that there are no current needs experienced on the network within a ten year timeframe, as determined through DPSS analysis. It is anticipated that monitoring and routine maintenance on the road network will suffice for some time to continue to provide an adequate level of service to the residents of the Municipality.

5.1.2. Water, Sanitary Sewer and Storm Sewer Networks

Analysis for long-term needs for the water, sanitary sewer and storm networks was conducted using DPSS, and resulted in identification and summarization of anticipated projects and associated yearly expenditures.

5.1.2.1. Water Network

The condition of the water network is such that the current needs previously presented in **Section 4.3.2** are the only needs experienced on the network within a ten year timeframe. This includes water works identified in 2014, with an anticipated cost of $207,834. Considering the good condition of the water network, it is recommended that in addition to the identified rehabilitation costs, monitoring and regular routine maintenance be carried out to maintain the current condition of the water network. Details for the anticipated projects can be found on thematic maps within **Appendix A**, and a detailed list within **Appendix B**.

5.1.2.2. Sanitary Sewer Network

The condition of the sanitary sewer network is such that there are no current needs experienced on the network within a ten year timeframe through DPSS analysis. It is anticipated that monitoring and routine maintenance on the sanitary sewer systems will suffice for some time to continue to provide an adequate level of service to the residents of the Municipality.

5.1.2.3. Storm Sewer Network

The results of the analysis indicated only one year incurring needs within a ten year timeframe for the storm sewer network. Needs are identified in 2016, at an anticipated expenditure of $329,062. The needs encompass rehabilitation of three sections of storm sewer, with a total length of 470 m, approximately 2% of the network.

Previous to the initiation of this report, the Municipality had defined a five-year budget for expenditures within the Water/Sewer Department. The results of the unlimited-budget analysis of the networks indicated that expenditures required include work on the water and storm sewer networks, with a total expenditure of $207,834 in 2014, and $329,062 in 2016. The estimated values within the budget are within the same magnitude of the analyzed expenditure.

The following graphic, ***Figure 13***, demonstrates the magnitudes of the results of DPSS analysis for network rehabilitation and resulting average condition, compared to the estimated cost budgeted provided by the Municipality.

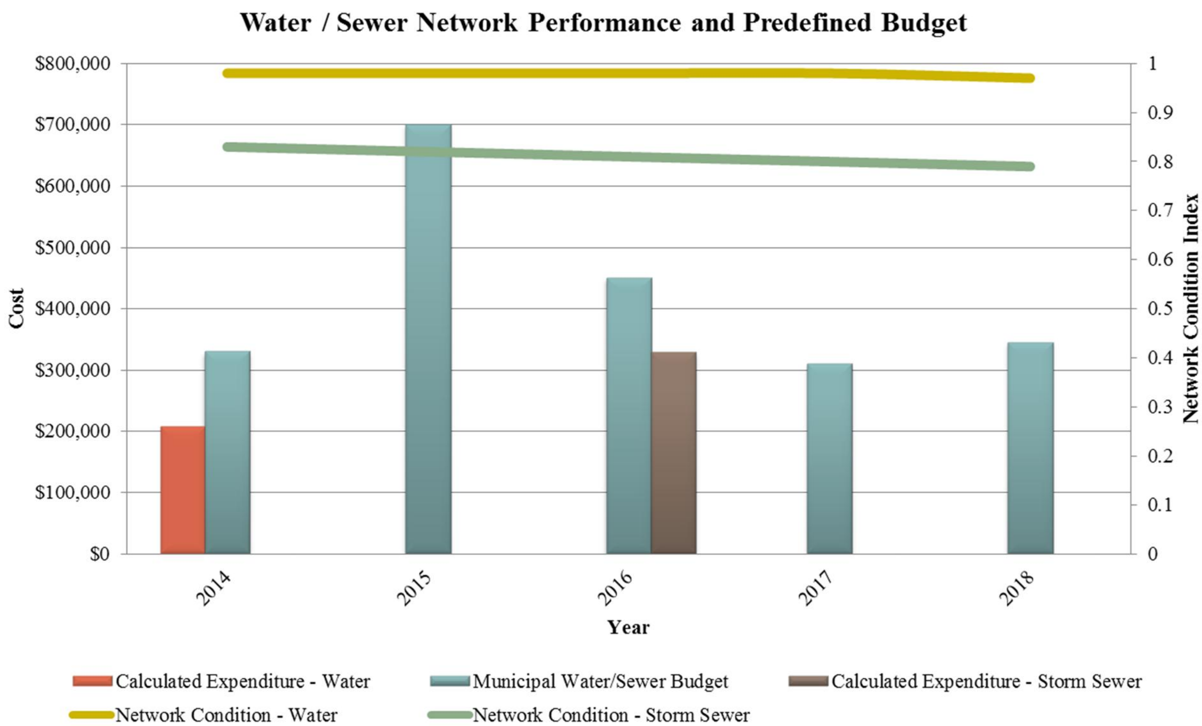


Figure 13: Storm Sewer, Water Network Expenditure, Network Performance and Municipal Budget

It is noted that the network condition shown in the above figure is based on the expenditures also noted, which are sufficient to maintain a high asset condition for both the water and storm sewer networks. It is noted that the expenditures identified as a result of DPSS analysis are below the average budget allocated across the five years by the Municipality.

5.1.3. Bridge and Culvert Assets

As indicated previously, no detailed condition assessment survey was carried out on the point assets. To develop a capital program, we have used the OSIM condition survey reports and PSAB database which contained information on year of construction, service lives and replacement costs. Using that information, we have approximated timing for rehabilitation and replacement of those point assets and corresponding costs. Detailed rehabilitation and replacement profiles recommended for the point assets are included in **Appendix C.**

5.2. LONG TERM MAINTENANCE OF LEVEL OF SERVICE

A scenario was run to determine the long-term needs of the linear networks for a duration of 25 years. Although there are no, or minimal, needs on the road, water, sanitary sewer and storm sewer networks within a ten year timeframe, needs will be incurred within the additional fifteen on the road and storm sewer networks. Expenditures were incurred during the initial ten-year timeframe for bridges and culverts, and similarly are anticipated to be incurred into the balance of a 25-year timeframe. This scenario is included to bring awareness to the upcoming projects to provide a sufficient basis for long-term budgeting purposes.

It is noted that no work was incurred for the sanitary sewer network, and no additional work was incurred for the water network within the analyzed 25-year timeline. It is not recommended in this case that a yearly capital works budget be allocated, but instead a yearly contribution to reserve fund in anticipation of network maintenance beyond the analyzed period.

The networks identified as requiring significant costs into the future are the storm sewer network, road network, bridges and culverts, as shown in ***Figure 14***.

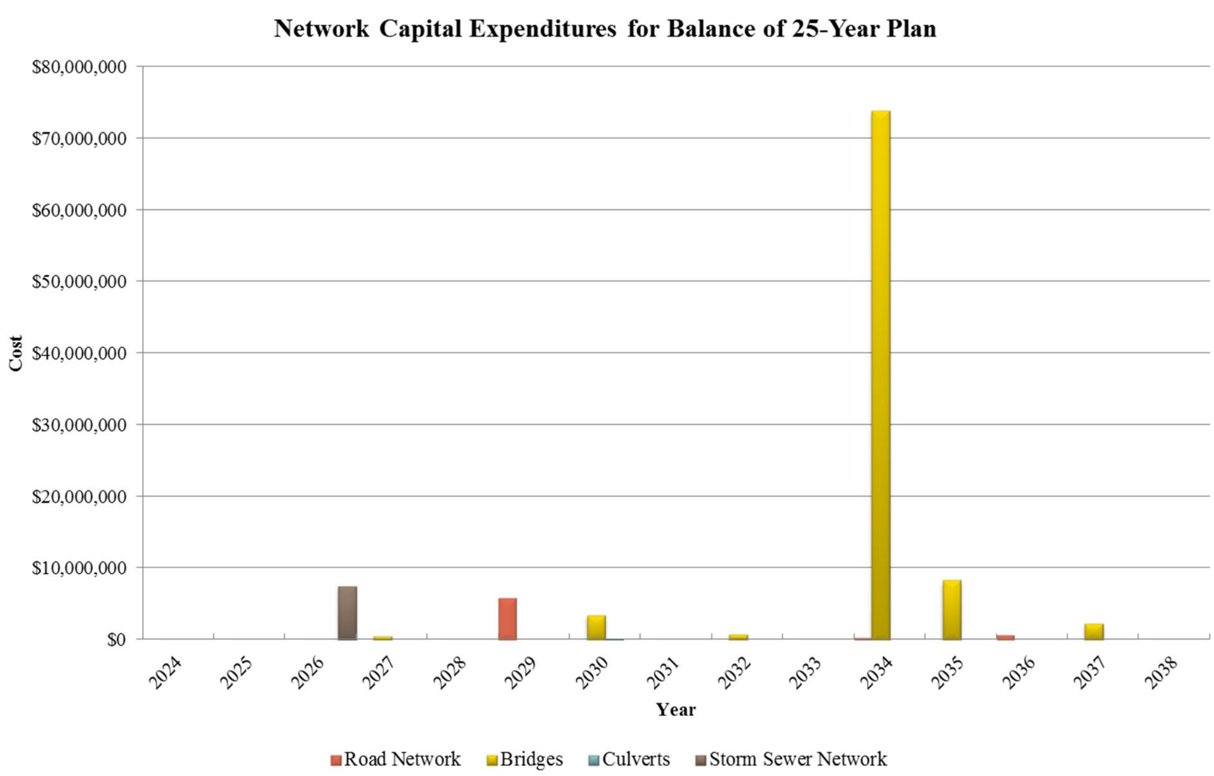


Figure 14: Expenditures Anticipated Across Networks for Balance of 25-Year Plan

The needs incurred on the storm sewer and road networks both include one year with significant expenditures. In both cases, this is due to a large proportion of each of the networks being constructed within the same year. The deterioration of the assets dictates that they will similarly require replacing during the same year. It may not be common practice to allocate a significant budget value during one year for expenditures as noted. In anticipation of the expenditure on the networks, appropriate reserve and financial planning must be undertaken. It is noted that the expenditure presented is based on a calculated degradation of the asset. To better characterize the condition of the assets, and thereby refine the replacement profile presented, infrastructure condition surveys should be conducted on a regular basis. The bridge and culvert expenditures are noted to include both full structure replacements and repairs identified within OSIM surveys. Consistent undertaking of OSIM surveys to repair and re-evaluate condition of structures may serve to mitigate the extensive yearly expenditures.

5.3. SUMMARY

As evidenced through the results of the DPSS budget scenarios, the Municipality may experience a funding shortfall in the storm sewer network, road network, and bridge and culvert funding in order to maintain the existing level of service for 25 years.

5.4. ASSET MANAGEMENT POLICIES

5.4.1. Approach to Data Assembly

The Municipality currently manages a large amount of data in a multitude of formats and sources. It is recommended to develop a corporate environment which will use GIS as a platform as a method to store information moving forward. It is also recommended to incorporate additional information related to all other assets and create what is referred to as an enterprise database. This is critical for on-going infrastructure management activities within the Municipality's organization. The database used in preparation of the AMP encompasses asset information that can support multiple business functions. ***Figure 17*** and ***Figure 18*** illustrate the concept of going from an ad-hoc data environment to a structured enterprise database.

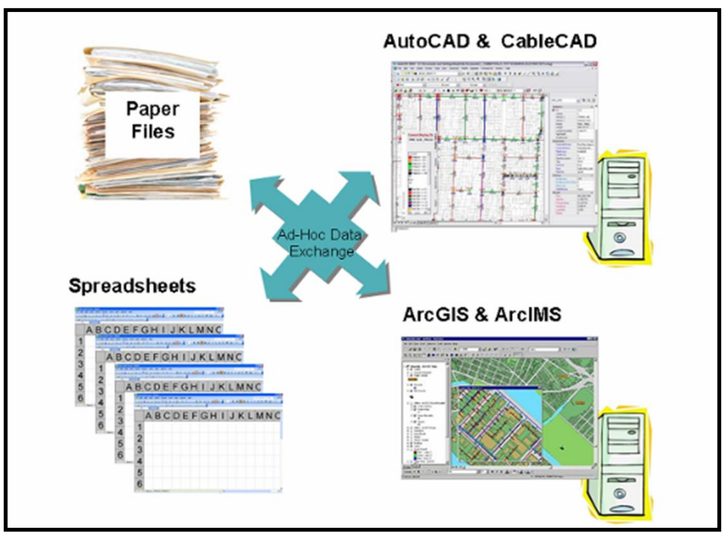


Figure 15: Ad Hoc Environment

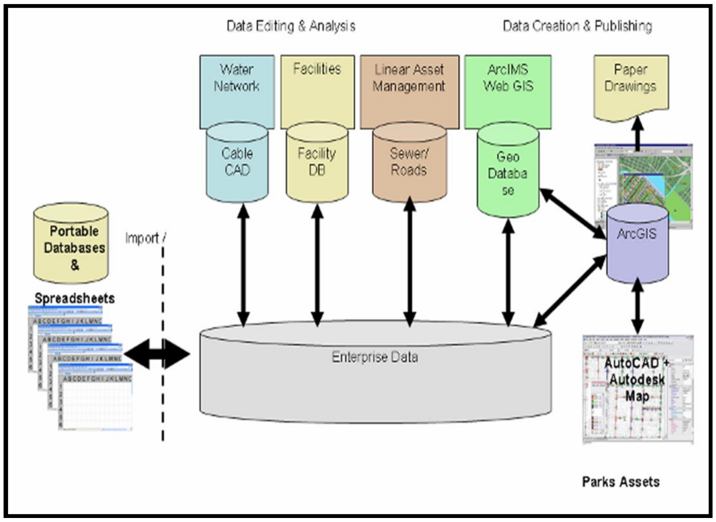


Figure 16: Recommended "Enterprise" Environment

The recommendation to use the Corporate GIS as the enterprise database is common practice in many municipalities across Canada. Data is maintained in one environment, and accessible by many users. Relevant information can be exported in external applications for processing of data. The results can then be imported back in the GIS database and accessed/displayed graphically which add value to the information stored in databases. An enterprise database system reduces data redundancy and increases access to information across the organization.

5.4.2. Condition Assessment Strategy

In continuing to maintain a detailed AMP over time, it is highly recommended that the municipality acquire detailed condition assessment data on all components of their infrastructure assets. It is critical to ensure the data is current and accurate, in order to maintain a useful AMP.

Roads should undergo a full condition assessment every 3-5 years. Given the shorter lifespan of road structures, and high variability in road construction and environment, pavement condition indices are more difficult to estimate over time. Therefore, their condition should be evaluated on a more frequent basis.

Underground pipe assets historically undergo far fewer condition assessments. A sampling approach for collecting condition data and extrapolating the results to assets with similar physical and operational characteristics is a viable option when funding is limited. For example, in this approach Closed Circuit Television (CCTV) inspection survey might be conducted for a sample of pipes, and results can be extrapolated to pipes with similar physical characteristics. This approach is commonly used for long term financial planning. Another approach is to use the results of the DPSS to identify pipes that are or could be in needs of rehabilitation now or in the next few years, and generate a CCTV program to only investigate these critical pipes. This approach is commonly used when funding is limited.

The approach for condition assessment of point assets, including bridges and culverts, should consist of the completion of inspections, which are mandated to be done every 2 years. This overall detailed inspection should be carried out, but asset management tools should also be used to frequently visit and monitor assets that are approaching the end of their service lives.

5.4.3. Maintenance Activities

It should be understood that most infrastructure assets will usually reach their expected service lives if routine maintenance is carried out on those assets while in service. As specified in the literature, 2% to 4% of the value of an asset should be spent on a yearly basis to ensure it reaches the end of its service life. Most municipalities will spent less than 2% a year of the value of the asset in maintenance. Maintenance activities such as crack sealing or slurry sealing a roadway or flushing and cleaning a sewer pipe should be carried out on a regular basis depending on the condition and age of the assets. There are many very good Computerized Maintenance Management System (CMMS) in the market that are very helpful and efficient in ensuring sustainability of infrastructure assets. Some types of CMMS could be very beneficial to the Municipality.

5.4.4. Integrated Rehabilitation

In order to make cost-effective decisions with regard to rehabilitation of infrastructure assets, it is recommended (as suggested in the Asset Management Best Practice published by the Infraguide), that an integrated approach be used to acknowledge the close proximity and high level of interaction between the infrastructure networks. Knowledge of the integrated condition of these networks provides a clear advantage to municipal administrators by giving a global view of the infrastructure networks.

The spatial proximity consideration of that approach allows for a more accurate set of interventions by using the concept of "windows of opportunity". This enables analysis of assets, not only based on actual condition, but also on a predictive condition in time. This is made possible by defining windows of opportunity along the deterioration curves, as shown on ***Figure 19***.

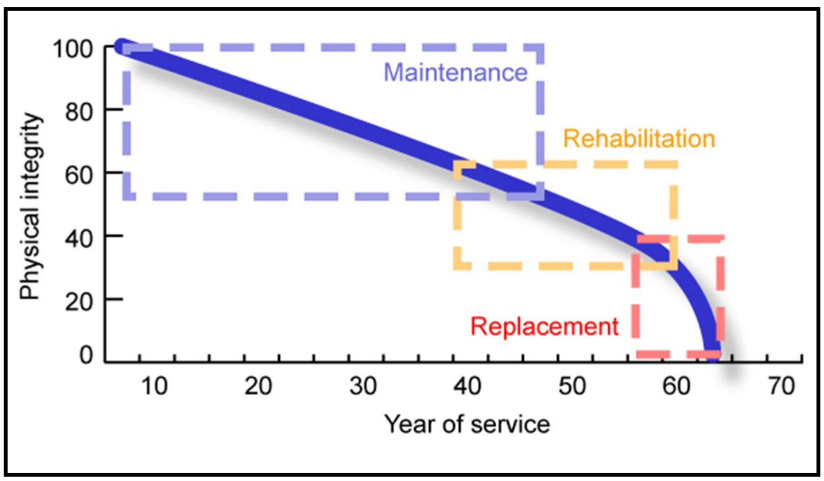


Figure 17: Windows of Opportunity

This approach relates to economics and cost-effectiveness. Priority is assigned by reviewing all locations in the network identified for repair and assigning a higher priority to locations where more than one component of the asset network requires rehabilitation. This approach provides for a reduction in replacement costs per meter of a pipe by carrying out the repair of more than one pipe within the same excavation. The "window" concept allows delaying a rehabilitation activity as long as it stays within that window, to combine it with another piece of infrastructure in the vicinity of the pipe.

5.5. AMP UPDATE AND EVALUATION

The present AMP has been designed for a time span of 10 years. However, as previously mentioned it should be treated as a living document, which is regularly updated to reflect changes in infrastructure condition. It is, therefore, recommended that the AMP be updated every year. This will include incorporating rehabilitations and their associated condition changes, adding newly constructed infrastructure, removing decommissioned infrastructure from the analysis, and updating unit prices for rehabilitation or reconstruction.

The AMP should also be continuously evaluated and improved through clearly defined actions. It is recommended that the Municipality generate short-term action plan every 2 to 3 years including a timetable for implementation. These actions should include measures to insure data quality, and improve the AMP process.

5.6. CRITICALITY OF INFRASTRUCTURE AND RISK

The criticality of infrastructure and consequences of failure of that infrastructure were not really addressed in this project. However some general guidelines could be provided to assess criticality and identify high level consequences of failure. The results of this high level assessment should be used to assigned priorities to infrastructure repair and minimize disruption to the general public. Some criteria that should be looked at when assigning priorities could be are listed below.

1. Road classification – Arterial and collector roadways carry more traffic than local roads and defects on these roadways should be addressed first.
2. Pipe sizes: Large pipes service more people that local small pipes therefore should be prioritized for repair or replacement when identified as network need.
3. Bridge access to a community: In some cases, a municipality may only have one or two accesses that are serviced by a bridge structure. These should be fixed first when defect are identified.

These are examples of common sense factors that should be used to define criticality and assign a risk factor. But if a community decides to conduct a detailed study to identify Critical Assets and Risk associated with them, they should think of using the following framework that was developed by individuals from Australia and New Zealand.

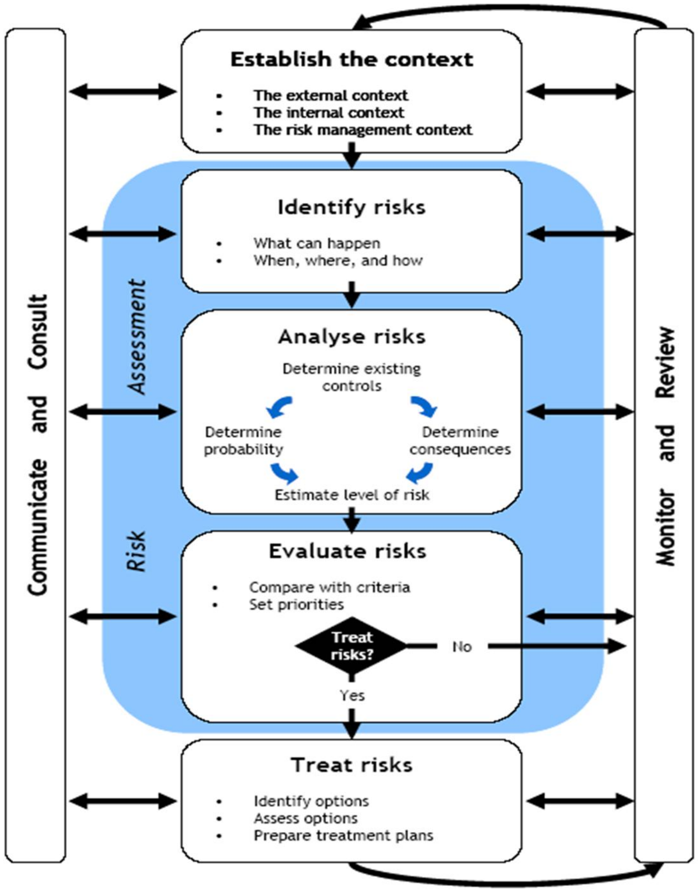


Figure 18: Framework for Identification of Critical Assets

Source: Australian and New Zealand AS/NZS 4360 (1999) '*Risk Management'* and Emergency Management Ontario (2004) '*Emergency Management Doctrine for Ontario*.'

By following this approach, the municipality would have a much better understanding of its infrastructure assets and be in much better position to prioritize repair or replacement of critical assets.

6.0 FINANCING STRATEGY

Financing infrastructure needs has become a very serious issue. We need to identify better practices and innovations in infrastructure financing if municipalities and other levels of government want to continue to provide an adequate level of service to tax payers in an affordable manner. It seems to make sense that municipal infrastructure should be financed, as far as possible, by the residents who benefit from it but, how do you determine who should pay for the rehabilitation of an arterial or collector road going from point A to point B in large cities throughout Canada. In addition, for the past many years, municipal accounting practices have failed to include replacement costs for depreciating assets, thereby assuring a fiscal shock when replacement time arrives. The Public Sector Accounting Board (PSAB) has changed that practice which has made municipalities realize the extent and magnitude of the infrastructure deficit. Asset managers need to come up with innovative solutions to address that infrastructure deficit. Asset management systems are part of the solutions but innovative financing and finding alternate revenue sources are an even bigger part of the solution.

Most municipalities are familiar with a variety internal and some external revenue sources. The following describes a few of those revenue sources currently used by municipalities.

- **Internal Revenue Sources:**
    - ***General Operating Revenues****:* Rural municipalities, towns and smaller cities tend to rely more on local taxes, user fees and grants than on borrowing, partly because borrowers view them as higher risk than larger cities, thus raising their borrowing costs.
    - ***Earmarked User Fees****:* An earmarked user fee is dedicated to a specific project; for example, water and sewer charges for water infrastructure, disposal fees for solid waste facilities, and admission charges for recreational complexes.
    - ***Reserves****:* Financing capital projects through funds set aside for capital spending is the reverse of financing through borrowing. A "capital levy" — usually a few percentage points of the local property tax — is set aside and accumulates in interest earning accounts segregated from general revenues.
    - ***Special Assessments and Local Improvement Charges****:* A special assessment is a specific charge added to the existing property tax to pay for improved capital facilities that border them. The charge is based on a specific capital expenditure in a particular year, but may be spread over a number of years.
    - ***Development Charges***: Most large municipalities and many smaller ones impose a specific dollar value per lot on developers to finance the off-site capital costs of new development. Developers are generally responsible for on-site services, such as local roads, sidewalks, and street lighting. Historically, development charges have financed "hard" services, such as water supply, sewage treatment, trunk mains and roads.

- **External Revenue Sources:**
  - ***Grants****:* Municipalities sometimes rely on provincial and federal government grants for infrastructure. Program such as the MIII is a good example. In the past capital assistance has also been made available for water, sewer, and transportation projects with all three levels of government participating.
  - ***Borrowing****:* Municipalities engage in both short-term and long-term borrowing. Short-term borrowing may be used to finance capital expenditures or to finance an unexpected deficit in the operating budget. For infrastructure whose benefits accrue to future residents, fairness, efficiency and accountability is enhanced if these projects are financed by borrowing with repayment coming from property tax revenues and user fees paid by future beneficiaries.

There are also a few new financing instruments that have been made available to municipalities. The federal government's initiative to provide grants to municipalities from federal gas tax revenue is one example of new financing instrument. The Public-Private Partnership (P3) is also a new financing instrument that may be considered by municipalities. It involves the direct participation of the private sector in a venture controlled by the public sector. The public sector's role is to facilitate, regulate, and guarantee provision of an asset and the private sector's role is to design, finance, build and operate the asset in a formalized partnership agreement.

6.1. NORTH MIDDLESEX FINANCING STRATEGY

In **Section 5.0** of this report we have worked with Municipality staff to develop an Asset Management (AM) Strategy, including funding requirements that would ensure sustainability of the assets to continue to provide an adequate level of service to the residents of the Municipality. The strategy developed is realistic and affordable. The following approach will be followed by the Municipality to pay for the current and future needs in the infrastructure networks.

6.1.1. Road Network

In 2013, nearly two million dollars were spent on capital works within the Roads Department. The expenditure directly incurred by the Municipality was diminished due to trade-in values and reserves established in past budgets. The remainder of the expenditure was addressed using tax dollars from the Municipality. Each fiscal year money is allocated to the reserve fund. Usage of the reserve fund, although spent through the Roads Department, is generally used for capital equipment costs. The network rehabilitation and improvement capital works are otherwise addressed using tax dollars. No expenditures were identified in analysis for the ten year period, and it is therefore recommended that a reserve fund be maintained with surplus roads department budget each year in anticipation of future requirements.

6.1.2. Water and Sewer Networks

The municipality has defined a water and sewer budget, which plans for a five-year timeframe. The budget combines needs attributed to the water, sanitary and sewer networks. The anticipated expenditure defined within the Municipal budget ranges from $300,000 annually to $700,000, and encompasses capital project, equipment and maintenance costs. The anticipated expenditures are noted to be paid for through trade-in value where applicable through equipment trade-in, reserves, and tax dollars. The Municipality allocates funding to a reserve each year, as well as an emergency reserve.

The sanitary sewer network is in such condition that no expenditures were identified in analysis for the ten year period, and it is therefore recommended that the reserve fund be maintained in anticipation of future requirements.

Needs were identified on both the water and storm sewer networks. The water network incurred a total anticipated expenditure of nearly $210,000 in 2014, and the storm network incurring a total expenditure of approximately $330,000 in 2016. Both of these expenditure values are within the range of the Municipally allocated annual budget, both tending towards the low end. It is reasonable then that these expenditures can be funded using the reserve fund and tax dollar approach, which the Municipality currently employs.

6.1.3. Bridges and Culverts

Bridge and culvert repairs are ongoing, and have been considered by the municipality when formulating their capital budget. The bridge and culvert replacements and repairs are funded through tax dollars, reserves funds and external funding resources where available. The bridge and culvert capital works are combined with other transportation network assets within the capital plan for road works. Although the Municipality maintains a reserve fund, it is primarily used for equipment expenditures, although has periodically been accessed for road works expenditures. Through analysis, it was determined that a expenditure will be required for bridge and culvert assets in 2014, at nearly $3,000,000, and yearly expenditures ranging to nearly $2,000,000 within the ten year timeframe. The budgeted costs within the projected budget ranged from over $800,000 to $3,150,000 to address all facets of the road department. Although the magnitude of anticipated expenditure defined through analysis are generally consistent with the budgeted values, the budget also considers road and equipment costs, and therefore may not be sufficient to cover bridge and culvert infrastructure costs. It is recommended that the reserve funds and tax dollars be employed to address costs associated with point assets, and also that external funding be sourced where possible to supplement Municipal funding.

7.0 REFERENCES

Canadian Federation of Municipalities. (2012). *Canadian Infrastructure Report Card*. Volume 1. <http://www.canadainfrastructure.ca/downloads/Canadian_Infrastructure_Report_Card_EN.pdf>

Canadian Federation of Municipalities and Infrastructure Canada. (2002). *National Guide to Sustainable Municipal Infrastructure [InfraGuide]*.

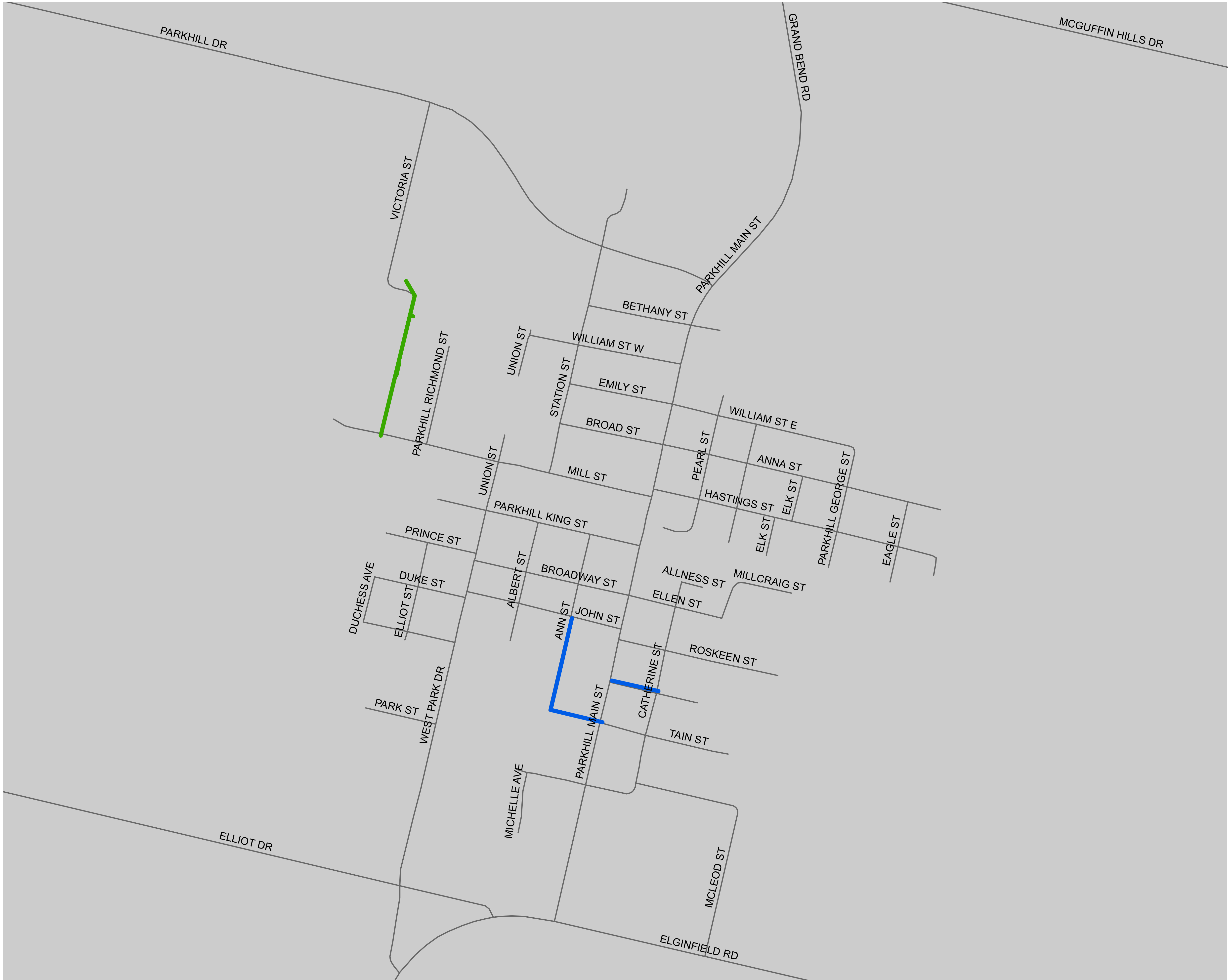
Ministry of Infrastructure of Ontario. (2012). *Building Together: Guide for Municipal Asset Management Plans*. http://www.moi.gov.on.ca/pdf/en/Municipal%20Strategy_English_Web.pdf

Department of Economics, Trent University (2006): *A State of Disrepair: How to Fix the Financing of Municipal Infrastructure in Canada,* No. 241 ISSN 0824 – 8001

APPENDIX A

Infrastructure Needs for Linear Assets

- Thematic Maps



NORTH MIDDLESEX
ASSET MANAGEMENT PLAN

10 YEAR CAPITAL PLAN
STORM AND WATER NETWORK

Legend

- Storm_Intervention Year 2016
- Water_Intervention Year 2014
- Roads

MAP CREATED BY: LFY
MAP CHECKED BY: LB
MAP PROJECTION: NAD 1983 UTM Zone 17N

FILE LOCATION: Path:
G:\CAD\2013\138390\Design_GIS\MXDs\Storm_Water_Intervention Years.mxd

DILLON CONSULTING

PROJECT: 13-8390
STATUS: FINAL
DATE: 21 FEB 2014

APPENDIX B

10-Year AMP for Linear Assets

Water Network

Intervention Year	ID	Street	From Street	To Street	Estimated Cost
2014	Watermains-389	LEONARD AVE	J-32	J-458	$56,745
2014	P-343	ANN ST	J-458	J-863	$53,016
2014	Watermains-396	ARDROSS ST	J-382	J-401	$50,889
2014	P-344	ANN ST	J-863	J-455	$47,183

Storm Sewer Network

Intervention Year	ID	Street	From Street	To Street	Estimated Cost
2016	39	VICTORIA ST	Mill St	S bend	$299,570
2016	41	VICTORIA ST	Mill St	S bend	$23,154
2016	40	VICTORIA ST	Mill St	S bend	$6,338

APPENDIX C

10-Year AMP for Point Assets

Last Update to Report **3-Mar-14**

Table 1 - Component Inventory and Condition Report - Maintenance and Replacement Data

Facilities Management Plan - Bridges							Replacement Profile									
ID	Bridge Name	Road Name	Location	Year of Construction / Year of Inspection	2012 Survey	Type	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
0001	Bridge No. 1	Hagmier Road	0.60 km S of County Rd 5	1962		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0001	Bridge No. 1	Hagmier Road	0.60 km S of County Rd 5	2012		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0002	Bridge No. 2	Hagmier Drain	1.60 km S of County Rd 5	1962		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0002	Bridge No. 2	Hagmier Drain	1.60 km S of County Rd 5	2012		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0003	Bridge No. 3	Hutchinson Road	0.80 km S of County Rd 5	1959		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0003	Bridge No. 3	Hutchinson Road	0.80 km S of County Rd 5	2012	1) Approaches - Install End Treatments	Concrete Rigid Frame	---	---	---	---	---	$40,575	---	---	---	---
0003	Bridge No. 3	Hutchinson Road	0.80 km S of County Rd 5	2012	2) Approaches - Install 4 signs	Concrete Rigid Frame	$1,000	---	---	---	---	---	---	---	---	---
0004	Bridge No. 4	Prance Road	South of Mark Settlement Drive	1972		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0004	Bridge No. 4	Prance Road	South of Mark Settlement Drive	2012	1) Approaches - Install End Treatments	Concrete Rigid Frame	---	---	---	---	---	$40,575	---	---	---	---
0004	Bridge No. 4	Prance Road	South of Mark Settlement Drive	2012	2) Embankments - Brushing around Bridge	Concrete Rigid Frame	---	---	$2,122	---	---	---	---	---	---	---
0005	Bridge No. 5	Prance Road	North of Parkhill Drive on Parkhill Creek	1955		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0005	Bridge No. 5	Prance Road	North of Parkhill Drive on Parkhill Creek	2012	1) Approaches - Install End Treatments	Concrete Rigid Frame	---	---	---	---	---	$40,575	---	---	---	---
0005	Bridge No. 5	Prance Road	North of Parkhill Drive on Parkhill Creek	2012	2) Embankments - Remove Debris on Upstream and Downstream Ends	Concrete Rigid Frame	---	---	$1,061	---	---	---	---	---	---	---
0006	Bridge No. 6	McInnis Road	South of Mark Settlement Drive	1952		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0006	Bridge No. 6	McInnis Road	South of Mark Settlement Drive	2012	1) Approaches - Install End Treatments	Concrete Rigid Frame	---	---	---	---	---	$40,575	---	---	---	---
0006	Bridge No. 6	McInnis Road	South of Mark Settlement Drive	2012	2) Approaches - Install 4 End Marker signs	Concrete Rigid Frame	$1,000	---	---	---	---	---	---	---	---	---
0007	Bridge No. 7	West Corner Drive	South of Mark Settlement Drive	1952		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0007	Bridge No. 7	West Corner Drive	South of Mark Settlement Drive	2012	1) Approaches - Install 4 End Marker signs	Concrete Rigid Frame	$1,000	---	---	---	---	---	---	---	---	---
0008	Bridge No. 8	McInnis Drive	North of Parkhill Drive on Parkhill Creek	1968		Precast Concrete - I-Beams	---	---	---	---	---	---	---	---	---	---
0008	Bridge No. 8	McInnis Drive	North of Parkhill Drive on Parkhill Creek	2012	1) Approaches - Install End Treatments	Precast Concrete - I-Beams	---	---	---	---	---	$40,575	---	---	---	---
0009	Bridge No. 9	Cedar Swamp Road	1.52 km N of McGillivray Road	1962		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0009	Bridge No. 9	Cedar Swamp Road	1.52 km N of McGillivray Road	2012	1) Approaches - Install End Treatments	Concrete Rigid Frame	---	---	$37,132	---	---	---	---	---	---	---
0009	Bridge No. 9	Cedar Swamp Road	1.52 km N of McGillivray Road	2012	2) Deck Drains need to be cleared	Concrete Rigid Frame	---	---	$1,591	---	---	---	---	---	---	---
0010	Bridge No. 10	Adare Drive	0.5 km W of Creamery Road	1979		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0010	Bridge No. 10	Adare Drive	0.5 km W of Creamery Road	2012	1) Approaches - Install End Treatments	Concrete Rigid Frame	---	---	---	---	---	$40,575	---	---	---	---
0011	Bridge No. 11	Mooresville Drive	Crossing Mud Creek, 1.0 km E of Lieury Road	2007		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0011	Bridge No. 11	Mooresville Drive	Crossing Mud Creek, 1.0 km E of Lieury Road	2012	1) Approaches - Install End Treatments	Concrete Rigid Frame	---	---	---	---	---	$40,575	---	---	---	---
0012	Bridge No. 12	Ausable Drive	0.65 km E of Lieury Road	1966		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0012	Bridge No. 12	Ausable Drive	0.65 km E of Lieury Road	2012	1) Approaches - Install End Treatments	Concrete Rigid Frame	---	---	---	---	---	$40,575	---	---	---	---
0013	Bridge No. 13	Adare Drive	0.4 km E of Neil Road	1959		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0013	Bridge No. 13	Adare Drive	0.4 km E of Neil Road	2012	1) Approaches - Install End Treatments	Concrete Rigid Frame	---	---	---	---	---	$40,575	---	---	---	---
0013	Bridge No. 13	Adare Drive	0.4 km E of Neil Road	2012	2) Approaches - Install 4 End Marker signs	Concrete Rigid Frame	$1,000	---	---	---	---	---	---	---	---	---
0013	Bridge No. 13	Adare Drive	0.4 km E of Neil Road	2012	3) Embankments - Brushing needs to be done on the North Side	Concrete Rigid Frame	---	---	$2,122	---	---	---	---	---	---	---
0015	Bridge No. 15	Adare Drive	Crossing Ausable River, 3.2 km W of Maguire Road	1890		Steet Truss	---	---	---	---	---	---	---	---	---	---
0015	Bridge No. 15	Adare Drive	Crossing Ausable River, 3.2 km W of Maguire Road	2012	1) Truss - Powerwash Annually	Steet Truss	---	---	$5,305	---	---	---	---	---	---	---
0015	Bridge No. 15	Adare Drive	Crossing Ausable River, 3.2 km W of Maguire Road	2012	2) Approaches - Upgrade End Treatments	Steet Truss	---	---	---	---	---	$40,575	---	---	---	---
0015	Bridge No. 15	Adare Drive	Crossing Ausable River, 3.2 km W of Maguire Road	2012	3) Approaches - Install Load Bearing Signs at Intersections	Steet Truss	---	---	---	---	---	$580	---	---	---	---
0016	Bridge No. 16	Maguire Road	Intersection of Maguire Road and Moorseville Drive	1975		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0016	Bridge No. 16	Maguire Road	Intersection of Maguire Road and Moorseville Drive	2012	1) Approaches - Install End Treatments	Concrete Rigid Frame	---	---	---	---	---	$40,575	---	---	---	---
0017	Bridge No. 17	Moorseville Drive	Crossing Ausable River, 1.2 km W of Maguire Road	1870	**Note: Repairs undertaken in 2009, at $170,601.*	Steet Truss	---	---	---	---	---	---	---	---	---	---
0017	Bridge No. 17	Moorseville Drive	Crossing Ausable River, 1.2 km W of Maguire Road	2012	1) Truss - Powerwash Annually	Steet Truss	---	---	$5,305	---	---	---	---	---	---	---
0017	Bridge No. 17	Moorseville Drive	Crossing Ausable River, 1.2 km W of Maguire Road	2012	2) Approaches - Install End Treatments	Steet Truss	---	---	---	---	---	$40,575	---	---	---	---
0018	Bridge No. 18	Maguire Road	3.1 km S of McGillivray Drive	2008		Pre-Stressed Conc Beam Bridge	---	---	---	---	---	---	---	---	---	---
0018	Bridge No. 18	Maguire Road	3.1 km S of McGillivray Drive	2012	1) Approaches - Install End Treatments	Pre-Stressed Conc Beam Bridge	---	---	---	---	---	$40,575	---	---	---	---
0019	Bridge No. 19	Maguire Road	1.20 km S of Clandeboye Drive	1955		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0019	Bridge No. 19	Maguire Road	1.20 km S of Clandeboye Drive	2012	1) Approaches - Install End Treatments	Concrete Rigid Frame	---	---	---	---	---	$40,575	---	---	---	---
0020	Bridge No. 20	Ausable Drive	Intersection of Ausable Drive and Brinsley Road	1970	**Note: Repairs and engineering undertaken in 2010, at $27,354.52*	3-span I Beams	---	---	---	---	---	---	---	---	---	---
0020	Bridge No. 20	Ausable Drive	Intersection of Ausable Drive and Brinsley Road	2012	1) Approaches - Install End Treatments	3-span I Beams	---	---	$37,132	---	---	---	---	---	---	---
0020	Bridge No. 20	Ausable Drive	Intersection of Ausable Drive and Brinsley Road	2012	2) Approaches - Install 4 End Marker signs	3-span I Beams	$1,000	---	---	---	---	---	---	---	---	---
0024	Bridge No. 24	West Corner Drive	0.3 km W of Charlton Road	1959		3-span Steel Beam Bridge	---	---	---	---	---	---	---	---	---	---
0024	Bridge No. 24	West Corner Drive	0.3 km W of Charlton Road	2012	1) Bearings - Need to be Cleaned	3-span Steel Beam Bridge	---	---	$5,305	---	---	---	---	---	---	---
0024	Bridge No. 24	West Corner Drive	0.3 km W of Charlton Road	2012	2) Embankments - Remove trees on North Side	3-span Steel Beam Bridge	---	---	$1,591	---	---	---	---	---	---	---
0024	Bridge No. 24	West Corner Drive	0.3 km W of Charlton Road	2012	3) Approaches - Install End Treatments	3-span Steel Beam Bridge	---	---	$37,132	---	---	---	---	---	---	---
0025	Bridge No. 25	Fernhill Drive	0.5 km W of Bear Creek Road	1962		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0025	Bridge No. 25	Fernhill Drive	0.5 km W of Bear Creek Road	2012	1) Approaches - Install End Treatments	Concrete Rigid Frame	---	---	---	---	---	$40,575	---	---	---	---
0025	Bridge No. 25	Fernhill Drive	0.5 km W of Bear Creek Road	2012	2) Approaches - Install 4 End Marker signs	Concrete Rigid Frame	$1,000	---	---	---	---	---	---	---	---	---
0026	Bridge No. 26	Carlisle	North of Fernhill Drive on King Street in Carlisle	1990		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0026	Bridge No. 26	Carlisle	North of Fernhill Drive on King Street in Carlisle	2012		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0027	Bridge No. 27	Argyle Street	Lot 27 Con. 2 and 19	1992		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0027	Bridge No. 27	Argyle Street	Lot 27 Con. 2 and 19	2012	1) Approaches - Add Eccentric Loaders	Concrete Rigid Frame	---	---	---	---	---	$11,593	---	---	---	---
0027	Bridge No. 27	Argyle Street	Lot 27 Con. 2 and 19	2012	2) Approaches - Install 4 End Marker signs	Concrete Rigid Frame	$1,000	---	---	---	---	---	---	---	---	---
0028	Bridge No. 28	Argyle Street	0.5 km E of County Road No. 7	1975		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0028	Bridge No. 28	Argyle Street	0.5 km E of County Road No. 7	2012	1) Deck Rehabilitation	Concrete Rigid Frame	---	---	$31,827	---	---	---	---	---	---	---
0028	Bridge No. 28	Argyle Street	0.5 km E of County Road No. 7	2012	3) Approaches - Install End Treatments	Concrete Rigid Frame	---	---	---	---	---	$40,575	---	---	---	---
0029	Bridge No. 29	Wyatt Road	South of Glascow Road	1973		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0029	Bridge No. 29	Wyatt Road	South of Glascow Road	2012	1) Approaches - Install End Treatments	Concrete Rigid Frame	---	---	---	---	---	$40,575	---	---	---	---
0030	Bridge No. 30	Poplar Hill Road	0.6 km N of Petty Road (County Road 19)	1960		3-span Steel I-Beam Bridge	---	---	---	---	---	---	---	---	---	---
0030	Bridge No. 30	Poplar Hill Road	0.6 km N of Petty Road (County Road 19)	2014	Allocation for Repairs - Indicated by Municipality	3-span Steel I-Beam Bridge	---	---	$1,591,350	---	---	---	---	---	---	---
0030	Bridge No. 30	Poplar Hill Road	0.6 km N of Petty Road (County Road 19)	2012	1) Approaches - Install End Treatments	3-span Steel I-Beam Bridge	---	---	---	---	---	$40,575	---	---	---	---
0031	Bridge No. 31	Coldstream Road	0.7 km N of Petty Road (County Road 19)	1960		3-span Concrete I-Beam Bridge	---	---	---	---	---	---	---	---	---	---
0031	Bridge No. 31	Coldstream Road	0.7 km N of Petty Road (County Road 19)	2012	1) Approaches - Install End Treatments	3-span Concrete I-Beam Bridge	---	---	---	---	---	$40,575	---	---	---	---
0032	Bridge No. 32	Bear Creek Road	North of County Road No. 19	1920		Steel I-Beam	---	---	---	---	---	---	---	---	---	---

Last Update to Report **3-Mar-14**

Table 1 - Component Inventory and Condition Report - Maintenance and Replacement Data

Facilities Management Plan - Bridges							Replacement Profile									
ID	Bridge Name	Road Name	Location	Year of Construction / Year of Inspection	2012 Survey	Type	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
0032	Bridge No. 32	Bear Creek Road	North of County Road No. 19	2012	1) Remove Structure	Steel I-Beam	$5,000	---	---	---	---	---	---	---	---	---
0032	Bridge No. 32	Bear Creek Road	North of County Road No. 19	2012	1) Perform Class E.A. for Closure	Steel I-Beam	$10,000	---	---	---	---	---	---	---	---	---
0033	Bridge No. 33	New Ontario Road	Intersection of Brook Road and New Ontario	1964		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0033	Bridge No. 33	New Ontario Road	Intersection of Brook Road and New Ontario	2012	1) Approaches - Install End Treatments	Concrete Rigid Frame	---	---	---	---	---	$40,575	---	---	---	---
0034	Bridge No. 34	New Ontario Road		1920		Steel Truss - 1 end spans	---	---	---	---	---	---	---	---	---	---
0034	Bridge No. 34	New Ontario Road		2012	1) Truss - Powerwash Annually	Steel Truss - 1 end spans	---	---	$5,305	---	---	---	---	---	---	---
0034	Bridge No. 34	New Ontario Road		2012	2) Approaches - Upgrade End Treatments	Steel Truss - 1 end spans	---	---	---	---	---	$40,575	---	---	---	---
0034	Bridge No. 34	New Ontario Road		2012	3) Approaches - Install 4 End Marker signs	Steel Truss - 1 end spans	---	---	---	---	---	$1,159	---	---	---	---
0034	Bridge No. 34	New Ontario Road		2012	4) Structure Evaluation for Triple Load Posting	Steel Truss - 1 end spans	---	---	---	---	---	$5,217	---	---	---	---
0035	Bridge No. 35	Spring Bank Road	North of Glascow Street	1920		Steel Truss - 2 end spans	---	---	---	---	---	---	---	---	---	---
0035	Bridge No. 35	Spring Bank Road	North of Glascow Street	2012	1) Truss - Powerwash Annually	Steel Truss - 2 end spans	---	---	$5,305	---	---	---	---	---	---	---
0035	Bridge No. 35	Spring Bank Road	North of Glascow Street	2012	2) Approaches - Upgrade End Treatments	Steel Truss - 2 end spans	---	---	---	---	---	$40,575	---	---	---	---
0035	Bridge No. 35	Spring Bank Road	North of Glascow Street	2012	3) Approaches - Install 4 End Marker signs	Steel Truss - 2 end spans	---	---	$1,061	---	---	---	---	---	---	---
0035	Bridge No. 35	Spring Bank Road	North of Glascow Street	2012	4) Tar and Chip Approaches	Steel Truss - 2 end spans	---	---	$10,609	---	---	---	---	---	---	---
0036	Bridge No. 36	Spring Bank Road	South of Glascow Street	1957		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0036	Bridge No. 36	Spring Bank Road	South of Glascow Street	2012	2) Approaches - Install End Treatments	Concrete Rigid Frame	---	---	---	---	---	$40,575	---	---	---	---
0037	Bridge No. 37	Ausable Road	0.1 km W of County Road 6	1920		Steel Truss	$2,817,627	---	---	---	---	---	---	---	---	---
0037	Bridge No. 37	Ausable Road	0.1 km W of County Road 6	2012	1) Truss - Powerwash Annually	Steel Truss	$5,000	---	---	---	---	---	---	---	---	---
0037	Bridge No. 37	Ausable Road	0.1 km W of County Road 6	2012	2) Deck - Replace Poor Timbers	Steel Truss	$1,500	---	---	---	---	---	---	---	---	---
0037	Bridge No. 37	Ausable Road	0.1 km W of County Road 6	2012	3) Place 5"x5" Timbers on Side to Secure Deck	Steel Truss	$2,500	---	---	---	---	---	---	---	---	---
0038	Bridge No. 38	Elliot Drive	East of Roddick Road	1962		Concrete Rigid Frame	---	---	---	---	---	---	---	---	---	---
0038	Bridge No. 38	Elliot Drive	East of Roddick Road	2012	2) Approaches - Install End Treatments	Concrete Rigid Frame	---	---	---	---	---	$40,575	---	---	---	---
						TOTAL REPLACEMENT & REPAIR COSTS	**$2,848,627**	**$0**	**$1,781,251**	**$0**	**$0**	**$992,339**	**$0**	**$0**	**$0**	**$0**

Notes: Adjusted replacement year assumed to be 2034 for structures 15, 17, 24, 30, 32, 34, 35, 37 due to recent repairs done to structures.

Last Update to Report **3-Mar-14**

Table 1 - Component Inventory and Condition Report - Maintenance and Replacement Data

Facilities Management Plan - Culverts							***Replacement Profile***									
ID	Culvert Name	Road Name	Location	Year of Construction / Year of Inspection	2012 Survey	Type	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
0001	Culvert No. 1	Fernhill Drive	1.3 km East of Bear Creek Road on Fernhill Drive on the Watson Drain	2000		Concrete Culvert - Open Footings	---	---	---	---	---	---	---	---	---	---
0001	Culvert No. 1	Fernhill Drive	1.3 km East of Bear Creek Road on Fernhill Drive on the Watson Drain	2012		Concrete Culvert - Open Footings	---	---	---	---	---	---	---	---	---	---
0002	Culvert No. 2	Fernhill Drive	0.1 km West of Siddal Road on Nairn Creek	2004		Round Corrugated Steel Pipe	---	---	---	---	---	---	---	---	---	---
0002	Culvert No. 2	Fernhill Drive	0.1 km West of Siddal Road on Nairn Creek	2012	1) Approaches - Install Triple Cable Guardrail	Round Corrugated Steel Pipe	---	---	$15,914	---	---	---	---	---	---	---
0003	Culvert No. 3	Argyle Street	0.5 km West of New Ontario Road on Stewart-Siddall Drain	2000		Corrugated Steel Pipe Arch	---	---	---	---	---	---	---	---	---	---
0003	Culvert No. 3	Argyle Street	0.5 km West of New Ontario Road on Stewart-Siddall Drain	2012	1) Approaches - Install End Marker signs	Corrugated Steel Pipe Arch	---	---	$1,061	---	---	---	---	---	---	---
0004	Culvert No. 4	Argyle Street	0.5 km East of Bear Creek Road	2000		Corrugated Steel Pipe Arch	---	---	---	---	---	---	---	---	---	---
0004	Culvert No. 4	Argyle Street	0.5 km East of Bear Creek Road	2012		Corrugated Steel Pipe Arch	---	---	---	---	---	---	---	---	---	---
0005	Culvert No. 5	Bear Creek Road	0.2 km North of Argyle Street	2000		Corrugated Steel Pipe Twin Arch	---	---	---	---	---	---	---	---	---	---
0005	Culvert No. 5	Bear Creek Road	0.2 km North of Argyle Street	2012		Corrugated Steel Pipe Twin Arch	---	---	---	---	---	---	---	---	---	---
0006	Culvert No. 6	Argyle Street	0.7 km West of Bear Creek Road	2000		Corrugated Steel Pipe Twin Arch	---	---	---	---	---	---	---	---	---	---
0006	Culvert No. 6	Argyle Street	0.7 km West of Bear Creek Road	2012	1) Approaches - Install 4 End Marker signs	Corrugated Steel Pipe Twin Arch	---	---	$1,061	---	---	---	---	---	---	---
0007	Culvert No. 7	Argyle Street	1 km West of Cold Stream Road	2000		Corrugated Steel Pipe Arch	---	---	---	---	---	---	---	---	---	---
0007	Culvert No. 7	Argyle Street	1 km West of Cold Stream Road	2012	1) Approaches - Install 4 End Marker signs	Corrugated Steel Pipe Arch	---	---	$1,061	---	---	---	---	---	---	---
0008	Culvert No. 8	Argyle Street	0.6 km East of Poplar Hill Road on Currie - McLachlan Drain	2000		Corrugated Steel Pipe Twin Arch	---	---	---	---	---	---	---	---	---	---
0008	Culvert No. 8	Argyle Street	0.6 km East of Poplar Hill Road on Currie - McLachlan Drain	2012	1) Approaches - Install 4 End Marker signs	Corrugated Steel Pipe Twin Arch	---	---	---	---	---	$1,159	---	---	---	---
0008	Culvert No. 8	Argyle Street	0.6 km East of Poplar Hill Road on Currie - McLachlan Drain	2012	2) Barrel - East Pipe needs to be Cleaned out	Corrugated Steel Pipe Twin Arch	---	---	$1,061	---	---	---	---	---	---	---
0009	Culvert No. 9	Argyle Street	1.5 km West of Poplar Hill Road	2000		Concrete Box with Open Footings	---	---	---	---	---	---	---	---	---	---
0009	Culvert No. 9	Argyle Street	1.5 km West of Poplar Hill Road	2012		Concrete Box with Open Footings	---	---	---	---	---	---	---	---	---	---
0010	Culvert No. 10	Argyle Street	1.3 km West of McCubbin Road	2000		Concrete Box	---	---	---	---	---	---	---	---	---	---
0010	Culvert No. 10	Argyle Street	1.3 km West of McCubbin Road	2012	1) Approaches - Install 4 End Marker signs	Concrete Box	---	---	$1,061	---	---	---	---	---	---	---
0011	Culvert No. 11	Argyle Street	0.7 km East of McCubbin Road	2000		Corrugated Steel Pipe Arch	---	---	---	---	---	---	---	---	---	---
0011	Culvert No. 11	Argyle Street	0.7 km East of McCubbin Road	2012	1) Approaches - Install 4 End Marker signs	Corrugated Steel Pipe Arch	---	---	$1,061	---	---	---	---	---	---	---
0012	Culvert No. 12	Fort Road	0.1 km North of Bornish Drive	2000		Rigid Frame Box Culvert	---	---	---	---	---	---	---	---	---	---
0012	Culvert No. 12	Fort Road	0.1 km North of Bornish Drive	2012	1) Approaches - Install Triple Cable Guardrail	Rigid Frame Box Culvert	---	---	$15,914	---	---	---	---	---	---	---
0013	Culvert No. 13	Bornish Drive	0.3 km South of Fort Rose Road	1982		C.S.P. Structural Plate Pipe	---	---	---	---	---	---	---	---	$424,368	---
0013	Culvert No. 13	Bornish Drive	0.3 km South of Fort Rose Road	2012	1) Barrel - North Barrel Needs to be Cleaned out	C.S.P. Structural Plate Pipe	---	---	$2,652	---	---	---	---	---	---	---
0013	Culvert No. 13	Bornish Drive	0.3 km South of Fort Rose Road	2012	2) Approaches - Install Triple Cable Guardrail	C.S.P. Structural Plate Pipe	---	---	$26,523	---	---	---	---	---	---	---
0014	Culvert No. 14	Cold Stream Road	0.8 km North of Bornish Drive on the Big Swamp Drain	2000		2 - C.S.P. Arch Culverts	---	---	---	---	---	---	---	---	---	---
0014	Culvert No. 14	Cold Stream Road	0.8 km North of Bornish Drive on the Big Swamp Drain	2012	1) Approaches - Install 4 End Marker signs	2 - C.S.P. Arch Culverts	---	---	$1,061	---	---	---	---	---	---	---
0015	Culvert No. 15	Queen Street	1.1 km West of Maguire on the Vanneste Drain	1966		Concrete Box with Open Footings	---	---	---	---	---	---	---	---	---	---
0015	Culvert No. 15	Queen Street	1.1 km West of Maguire on the Vanneste Drain	2012	1) Approaches - Install End Markers	Concrete Box with Open Footings	---	---	$1,061	---	---	---	---	---	---	---
0016	Culvert No. 16	Moorseville Drive	0.5 km East of Maguire	1955		Concrete Box with Open Footings	---	---	---	---	---	---	---	---	---	---
0016	Culvert No. 16	Moorseville Drive	0.5 km East of Maguire	2012	1) Approaches - Install 4 End Marker signs	Concrete Box with Open Footings	---	---	$1,061	---	---	---	---	---	---	---
0017	Culvert No. 17	Neil Road	0.5 km South of Moorseville Drive	2000		Corrugated Steel Pipe Arch	---	---	---	---	---	---	---	---	---	---
0017	Culvert No. 17	Neil Road	0.5 km South of Moorseville Drive	2012	1) Embankments - Brushing	Corrugated Steel Pipe Arch	---	---	$2,122	---	---	---	---	---	---	---
0017	Culvert No. 17	Neil Road	0.5 km South of Moorseville Drive	2012	2) Approaches - Install Triple Cable Guardrail	Corrugated Steel Pipe Arch	---	---	$15,914	---	---	---	---	---	---	---
0018	Culvert No. 18	Neil Road	0.4 km South of Adare Drive	1971		Rigid Frame Concrete	---	---	---	---	---	---	---	---	---	---
0018	Culvert No. 18	Neil Road	0.4 km South of Adare Drive	2012	1) Embankments - Remove Tree on Downstream End	Rigid Frame Concrete	---	---	$1,591	---	---	---	---	---	---	---
0018	Culvert No. 18	Neil Road	0.4 km South of Adare Drive	2012	2) Approaches - Install Triple Cable Guardrail	Rigid Frame Concrete	---	---	---	---	---	$17,389	---	---	---	---
0020	Culvert No. 20	Adare Drive	0.4 km East of Cassidy Road on the Lewis Drain	2000		Concrete Culvert	---	---	---	---	---	---	---	---	---	---
0020	Culvert No. 20	Adare Drive	0.4 km East of Cassidy Road on the Lewis Drain	2012	1) Approaches - Install 4 End Marker signs	Concrete Culvert	---	---	$1,061	---	---	---	---	---	---	---
0021	Culvert No. 21	Cassidy Road	0.7 km North of Adare Drive on the Lewis Drain	2000		Concrete Culvert	---	---	---	---	---	---	---	---	---	---
0021	Culvert No. 21	Cassidy Road	0.7 km North of Adare Drive on the Lewis Drain	2012	1) Culvert - Needs to be extended	Concrete Culvert	---	---	$79,568	---	---	---	---	---	---	---
0021	Culvert No. 21	Cassidy Road	0.7 km North of Adare Drive on the Lewis Drain	2012	2) Approaches - Install Triple Cable Guardrail	Concrete Culvert	---	---	$15,914	---	---	---	---	---	---	---
0022	Culvert No. 22	Cassidy Road	1.1 km South of Mount Carmel Drive on the Ryan Drain	1988		Rigid Frame Concrete	---	---	---	---	---	---	---	---	---	---
0022	Culvert No. 22	Cassidy Road	1.1 km South of Mount Carmel Drive on the Ryan Drain	2012		Rigid Frame Concrete	---	---	---	---	---	---	---	---	---	---
0023	Culvert No. 23	Creamery Road	0.4 km South of Mount Carmel Road on the Lewis Drain	2000		Concrete Culvert	---	---	---	---	---	---	---	---	---	---
0023	Culvert No. 23	Creamery Road	0.4 km South of Mount Carmel Road on the Lewis Drain	2012	1) Culvert - Needs to be extended	Concrete Culvert	---	---	$79,568	---	---	---	---	---	---	---
0023	Culvert No. 23	Creamery Road	0.4 km South of Mount Carmel Road on the Lewis Drain	2012	2) Approaches - Install 4 End Markers	Concrete Culvert	---	---	$1,061	---	---	---	---	---	---	---
0024	Culvert No. 24	Creamery Road	0.5 km North of McGillivray Drive on Parkhill Creek	2000		Concrete Culvert	---	---	---	---	---	---	---	---	---	---
0024	Culvert No. 24	Creamery Road	0.5 km North of McGillivray Drive on Parkhill Creek	2012	1) Approaches - Install Triple Cable Guardrail	Concrete Culvert	---	---	$15,914	---	---	---	---	---	---	---
0025	Culvert No. 25	Creamery Road	0.7 km North of Ausable Drive on the Gilbert Windsor Drain	2000		Corrugated Steel Pipe Arch	---	---	---	---	---	---	---	---	---	---
0025	Culvert No. 25	Creamery Road	0.7 km North of Ausable Drive on the Gilbert Windsor Drain	2012		Corrugated Steel Pipe Arch	---	---	---	---	---	---	---	---	---	---
0026	Culvert No. 26	Ausable Road	0.65 km West of Cassidy Road on the Gilbert Windsor Drain	2000		Corrugated Steel Pipe Arch	---	---	---	---	---	---	---	---	---	---
0026	Culvert No. 26	Ausable Road	0.65 km West of Cassidy Road on the Gilbert Windsor Drain	2012		Corrugated Steel Pipe Arch	---	---	---	---	---	---	---	---	---	---
0027	Culvert No. 27	McLean Road	0.6 km North of West Corner Drive	2000		Corrugated Steel Pipe Arch	---	---	---	---	---	---	---	---	---	---
0027	Culvert No. 27	McLean Road	0.6 km North of West Corner Drive	2012	1) Approaches - Install Triple Cable Guardrail	Corrugated Steel Pipe Arch	---	---	$15,914	---	---	---	---	---	---	---
0028	Culvert No. 28	West Corner Drive	0.05 km East of McLean on the McLean Drive	2000		Concrete Box Culvert	---	---	---	---	---	---	---	---	---	---
0028	Culvert No. 28	West Corner Drive	0.05 km East of McLean on the McLean Drive	2012	1) Approaches - Install Triple Cable Guardrail	Concrete Box Culvert	---	---	$15,914	---	---	---	---	---	---	---
0029	Culvert No. 29	West Corner Drive	0.9 km East of Charlton Road	2000		Corrugated Steel Pipe Arch	---	---	---	---	---	---	---	---	---	---
0029	Culvert No. 29	West Corner Drive	0.9 km East of Charlton Road	2012	1) Barrel - Weld Cracks on South End	Corrugated Steel Pipe Arch	---	---	$5,305	---	---	---	---	---	---	---
0029	Culvert No. 29	West Corner Drive	0.9 km East of Charlton Road	2012	2) Approaches - Install Triple Cable Guardrail	Corrugated Steel Pipe Arch	---	---	$15,914	---	---	---	---	---	---	---
0030	Culvert No. 30	West Corner Drive	3.6 km West of Cassidy Road	1970		Rigid Frame Concrete	---	---	---	---	---	---	---	---	---	---
0030	Culvert No. 30	West Corner Drive	3.6 km West of Cassidy Road	2012		Rigid Frame Concrete	---	---	---	---	---	---	---	---	---	---
0031	Culvert No. 31	Grieves Road	0.5 km South of Mount Carmel Road on the Prance Drain	2000		Concrete Culvert	---	---	---	---	---	---	---	---	---	---
0031	Culvert No. 31	Grieves Road	0.5 km South of Mount Carmel Road on the Prance Drain	2012	1) Approaches - Install End Marker signs	Concrete Culvert	---	---	$1,061	---	---	---	---	---	---	---
0032	Culvert No. 32	Salem Road	1.1 km South of Mount Carmel Road on the Carey Drain	2000		Concrete Culvert	---	---	---	---	---	---	---	---	---	---
0032	Culvert No. 32	Salem Road	1.1 km South of Mount Carmel Road on the Carey Drain	2012	1) Culvert - Needs to be extended	Concrete Culvert	---	---	$79,568	---	---	---	---	---	---	---
0032	Culvert No. 32	Salem Road	1.1 km South of Mount Carmel Road on the Carey Drain	2012	2) Approaches - Install End Markers	Concrete Culvert	---	---	---	---	---	$1,159	---	---	---	---
0033	Culvert No. 33	Cedar Swamp Road	0.5 km South of Mount Carmel Road on the Mcgregor Young Drain	2000		steel I-Beams with Concrete Deck	---	---	---	---	---	---	---	---	---	---
0033	Culvert No. 33	Cedar Swamp Road	0.5 km South of Mount Carmel Road on the Mcgregor Young Drain	2012	1) Culvert - Replace	steel I-Beams with Concrete Deck	---	---	---	---	---	---	---	---	---	---

Last Update to Report **3-Mar-14**

Table 1 - Component Inventory and Condition Report - Maintenance and Replacement Data

Facilities Management Plan - Culverts							***Replacement Profile***									
ID	Culvert Name	Road Name	Location	Year of Construction / Year of Inspection	2012 Survey	Type	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
0034	Culvert No. 34	Cedar Swamp Road	0.9 km South of Adare on the Arnold - McCann Drain	2000		Concrete Culvert - Open Footings	---	---	---	---	---	---	---	---	---	---
0034	Culvert No. 34	Cedar Swamp Road	0.9 km South of Adare on the Arnold - McCann Drain	2012	1) Culvert - Needs to be extended	Concrete Culvert - Open Footings	---	---	$79,568	---	---	---	---	---	---	---
0034	Culvert No. 34	Cedar Swamp Road	0.9 km South of Adare on the Arnold - McCann Drain	2012	2) Approaches - Install Triple Cable Guardrail	Concrete Culvert - Open Footings	---	---	$15,914	---	---	---	---	---	---	---
0035	Culvert No. 35	Harmony Road	0.1 km South of Mark Settlement Drive on the Worrall Drain	2000		Concrete Culvert	---	---	---	---	---	---	---	---	---	---
0035	Culvert No. 35	Harmony Road	0.1 km South of Mark Settlement Drive on the Worrall Drain	2012	1) Approaches - Install End Markers	Concrete Culvert	---	---	$1,061	---	---	---	---	---	---	---
0036	Culvert No. 36	Bullock Road	0.1 km North of Adare Drive on the Hutchinson - Eagleson Drain	2000		Concrete Culvert - Open Footings	---	---	---	---	---	---	---	---	---	---
0036	Culvert No. 36	Bullock Road	0.1 km North of Adare Drive on the Hutchinson - Eagleson Drain	2012	1) Culvert - Needs to be extended	Concrete Culvert - Open Footings	---	---	$90,177	---	---	---	---	---	---	---
0036	Culvert No. 36	Bullock Road	0.1 km North of Adare Drive on the Hutchinson - Eagleson Drain	2012	2) Approaches - Install Triple Cable Guardrail	Concrete Culvert - Open Footings	---	---	$15,914	---	---	---	---	---	---	---
0037	Culvert No. 37	Bullock Road	0.9 km South of Greenway Drive on the Hutchinson Drain	2000		Concrete Culvert - Open Footings	---	---	---	---	---	---	---	---	---	---
0037	Culvert No. 37	Bullock Road	0.9 km South of Greenway Drive on the Hutchinson Drain	2012	1) Culvert - Needs to be extended	Concrete Culvert - Open Footings	---	---	$106,090	---	---	---	---	---	---	---
0037	Culvert No. 37	Bullock Road	0.9 km South of Greenway Drive on the Hutchinson Drain	2012	2) Approaches - Install Triple Cable Guardrail	Concrete Culvert - Open Footings	---	---	$15,914	---	---	---	---	---	---	---
0038	Culvert No. 38	Prance Road	1.2 km North of West Corner Drive on the Bullock Drain	2000		Corrugated Steel Pipe Arch	---	---	---	---	---	---	---	---	---	---
0038	Culvert No. 38	Prance Road	1.2 km North of West Corner Drive on the Bullock Drain	2012		Corrugated Steel Pipe Arch	---	---	---	---	---	---	---	---	---	---
0039	Culvert No. 39	Elliot Drive	West of Roddick Road	1966		Rigid Frame Concrete	---	---	---	---	---	---	---	---	---	---
0039	Culvert No. 39	Elliot Drive	West of Roddick Road	2012		Rigid Frame Concrete	---	---	---	---	---	---	---	---	---	---
0040	Culvert No. 40	Centre Road	0.4 km North of Elginfield Road	2000		Corrugated Steel Pipe Arch	---	---	---	---	---	---	---	---	---	---
0040	Culvert No. 40	Centre Road	0.4 km North of Elginfield Road	2012	1) Approaches - Install End Markers Signs	Corrugated Steel Pipe Arch	---	---	$1,061	---	---	---	---	---	---	---
0041	Culvert No. 41	Haskett Road	0.6 km South of Narin Road	2000		Corrugated Steel Pipe Arch	---	---	---	---	---	---	---	---	---	---
0041	Culvert No. 41	Haskett Road	0.6 km South of Narin Road	2012	1) Approaches - Install End Markers	Corrugated Steel Pipe Arch	---	---	$1,061	---	---	---	---	---	---	---
						TOTAL REPLACEMENT & REPAIR COSTS	**$0**	**$0**	**$743,691**	**$0**	**$0**	**$19,708**	**$0**	**$0**	**$424,368**	**$0**

Notes: Adjusted replacement year assumed to be 2063 for structure 33 due to recent repair done to structure.