Town of Gananoque

2009 Road Needs Study

Prepared by:

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Project Number:

60146997

Date: March 2011

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March 2011

Ryan C. Morton MPM, CIPM
Director of Public Works
Town of Gananoque
30 King St. East, Box 100
Gananoque, Ontario
K7G 2T6

Dear Mr. Morton

Project No: 60146997

Regarding: Town of Gananoque 2009 Road Needs Study

AECOM is pleased to submit this report with respect to the results of the 2009 Road Needs Study for review and comment.

This study was completed for the road appraisals using WorkTech's Asset Foundation Software and following the methodology of the Inventory Manual, 1991.

With this report, all road related data has been updated to present day values and the content of the report reflects road system conditions as of the time of the field data collection, in the fall of 2009.

We trust that this report will be beneficial to the Town of Gananoque in developing their asset management plans and wish to express appreciation for the opportunity for AECOM to participate in the work.

Sincerely,
AECOM Canada Ltd.

David Anderson, CET
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DA:da
Encl.
cc: Guy LaPorte, P.Eng

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Revision Log

Revision #	Revised By	Date	Issue / Revision Description
1	DA	January 2010	First Draft
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3	DA	February 2011	Client Comments and QA

AECOM Signatures

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Executive Summary

The Town of Gananoque 2009 Road Needs Study summarizes road system surveys conducted during the fall of 2009. The surveys identify the condition of each road section by its time of need and rehabilitation strategy. The surveys identify the condition of each road section by its time of need and rehabilitation strategy. All of the roads under the Town of Gananoque's jurisdiction were included in this survey.

Gravel roads are best reviewed during the spring breakup period in order to observe the extent of the frost susceptible materials. However, it should be noted that the Town of Gananoque roads were not reviewed during spring break up, which may result in a system adequacy rating indicated in this report being higher than it should be.

The purpose of a Road Needs Study is to provide an overview of the overall condition of the road system. The study provides a rating of the general condition of the road system, by road section, including such factors as structural adequacy, drainage, and surface condition. The study also provides an indication of apparent deficiencies in horizontal and vertical alignment elements as per the Ministry of Transportation's manual, "Geometric Design Standards for Ontario Highways". The study information can be used for programming and budgeting, however, once a road section reaches the project design stage, further detailed review, investigation and design will be required to address the specific requirements of the project. The Road Needs Study is *not* a road safety audit.

The study utilized the traffic count information that was provided by the Town of Gananoque. Traffic counts are important in establishing road maintenance classifications for Minimum Maintenance Standards purposes as per Regulation 239/02, as well as determining appropriate geometry, structure and cross-section when the road is rehabilitated or reconstructed.

The Town of Gananoque traffic information that was provided generally dealt with only major roads over a number of years. For roads that did not have traffic counts AECOM estimated the traffic counts. The estimated counts are suitable for the purposes of this report; however they should not be used to establish road classes per Regulation 239/02. AECOM would recommend that the Town of Gananoque continue with their existing traffic counting program and expand the number of roads that are counted. A traffic counting program should be conducted on a regular cycle, completing the entire system over a three to five year period.

As a component of this project AECOM created a road section database/network. Road sections were created and classified such that were consistent throughout their length according to roadside environment, surface type, condition, cross section, speed limit or a combination of these factors. For instance, a road section with a hot mix surface that changes from being in good condition to poor condition would require that road section to be split, thus adding an additional section to the database. Another example would be a road where speed limit changes as it enters a school zone; a new section would be created to reflect that change even if no other element had changed. It should be noted that during the course of the review it appeared that there may be conflicting information with respect to speed zone limits (Charles Street), which should be reviewed by the Town.

Data collection and road ratings were completed generally in accordance with the *MTO Inventory Manual for Municipal Roads (1991)*—hereafter referred to as the Inventory Manual or the Manual.

Road conditions are rated during a field review and a score is calculated which then categorizes the road section as a 'Now', '1 to 5' or '6 to 10' year need for reconstruction or resurfacing. Priority ratings are established through a further calculation involving the traffic count and the condition rating. Using the priority rating, data is further sorted by time of need and rehabilitation strategy. This report summarizes the results of the study through a number of tabular appendices and mapping.

Generally, every road system has some deficiencies with the existing horizontal and vertical alignment; typically more so in a lower tier municipality where the roads have a lesser traffic volume. These deficiencies are noted within the database. As the Town of Gananoque develops its asset management plan, which may include rehabilitations in lieu of full reconstructions as interim measures, consideration should be given to those vertical and horizontal elements that may not be corrected through rehabilitation, and should be addressed by other means such as improved signage. These elements should be reviewed on an ongoing basis.

Historically, when the Province provided funding for municipal road systems, road systems were measured by their system adequacy. The system adequacy is the percentage of the road system that is not a “NOW” need. (The “NOW” needs inventory represents the backlog of work that is required on the road system.)

The Inventory Manual provides direction that roads with a traffic volume of less than 50 vehicles per day are deemed to be adequate even if they have structural, geometric or drainage deficiencies that would otherwise rate them as having a need. Deficiencies in roads with traffic volumes less than 50 vehicles per day are to be corrected within the maintenance budget, as per the manual. With respect to the Town of Gananoque’s road system, there are a number of road sections that are classified as alleys. Whereas it would appear that a number of the alleys may have traffic counts of less than 50,as they service local residential areas, there a number that service the central commercial area that may have a traffic count of over 50 vehicles per day. The Town should include the alleys in the traffic counting program in order to determine the appropriate service level and to better manage the risk.

Roads with less than 50 vehicles per day and a speed limit of less than 80 km/hr are classified as Class 6 roads under Regulation 239/02, Minimum Maintenance Standards, and such roads do not have a standard for repair. The Town of Gananoque has 5.4 km of road sections with an estimated or actual traffic count of less than 50 vehicles per day.

The current system adequacy measure for Town of Gananoque road system is 73.8% when using the Inventory Manual methodology, or restated, 26.2% of the road system is deficient in the NOW time period. When considering this measure of adequacy it must also be considered that 5.4 km (or 13.6%) of the system is deemed adequate by virtue of a low traffic count and a further 6.1 km (or 15.2%) of the road system are represented by the King Street and Stone Street, which are arterial and do not have any sections evaluated as NOW needs. Therefore the calculated system adequacy level may not be the level perceived by the driving public.

This report indicates the estimated total cost of improvements for the road system as **$41,411,247** based on calculations using the benchmark costs that were developed based on AECOM’s recent experience in the area, for those roads with a traffic count of greater than 50 vehicles per day. Of those needs, **$20,744,684** is for those roads that are already deficient (NOW needs). The remaining **$20,666,563** is for roadworks that are required in the '1-10' year time period. (These values include maintenance work such as crack sealing)

Gananoque staff have advised that there are also significant improvements required for the sanitary sewer collection and water distribution systems. This is estimated to be **$7,053,750** in addition to the improvements required on the road system

Based on an analysis of the composition of the Town of Gananoque’s road system, minimum annual capital expenditure levels in the different roads programming areas are recommended as follows:

- **$1,109,800** for the roads capital, excluding resurfacing and structures, based upon a 50-year life cycle
- **$701,200** for annual hot mix resurfacing based upon an 18 -year cycle.

The above noted program values for the road system do not include any replacement costs for sidewalks, street lighting etc. It should be further distinguished that the above-noted capital recommendations do not include programming that is required due to development growth.

Major maintenance for roads and structures is also often an area of concern for municipalities, particularly for surface-treated roads. Typically, expenditures in this area are funded from the operating budget. Recommended expenditure levels in these program areas are as follows:

- **$29,100** annually for resurfacing gravel roads on a 3 year cycle (This does not include any gravel road conversion costs; those costs would be additional; also does not include ditching, re-grading, dust control, etc.).

Careful consideration should be given to the pavement management strategy (PMS), especially where funding is limited. Where there are funding constraints, higher priority should be given to those programs that extend the life cycle of the road by providing the correct strategy at the optimum time. For example, resurfacing, rehabilitation, and preservation projects should be a higher priority than reconstruction projects. Many studies have proven that it is far less expensive to keep a good road in good condition than it is to reconstruct a road. Re-stated, where funding is limited, reconstruction projects should be deferred and available funding should be directed to the roads requiring preservation or rehabilitation such as resurfacing.

The prime goal of any pavement management strategy should be, as an absolute minimum, to maintain overall system adequacy. The funding level for road-related programming should be set at a sufficient level so as to ensure that overall system adequacy does not decrease over time.

AECOM makes the following recommendations for management of the Town of Gananoque's road inventory:

1. The opportunity to develop a sustainable asset management/financial plan should be reviewed for implementation over a five to ten year period.

2. The condition of the road system should be reviewed on a regular basis to measure the effectiveness of strategies and/or sufficiency of funding levels.

3. The regular traffic counting program should be continued and expanded, completing the entire system on a three to five year cycle on a continuing basis.

4. The asset management strategy for the foreseeable future should be developed along the following lines
   - The reconstruction program should be deferred over the next few years in favour of ensuring that activities that extend the life of the existing good road sections have been satisfied. Given the existing funding level for roads, the basic strategy should be one of preservation; the top priority is to 'keep the good roads good'
   - Optimize the hot mix overlay program, preservation program and the surface treatment program.

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1. Background and Introduction

The Town of Gananoque 2009 Road Needs Study provides a summary of road condition ratings identified during rating surveys conducted by AECOM during the fall of 2009. All of the Town of Gananoque's roads were rated and are included in this report.

The purpose of the report is to clearly identify the current and future construction and financial needs of the Town of Gananoque with respect to its road system. It does not include costing for appurtenant devices or infrastructure such as sidewalks and street lighting. The Road Needs Study provides an overview of the overall condition of the road system. The study provides a rating of the general condition of the road system, by road section, including such factors as structural adequacy, drainage, and surface condition, as well as providing an indication of apparent deficiencies in horizontal and vertical alignment elements as per the Ministry of Transportation's manual, "Geometric Design Standards for Ontario Highways". The Road Needs Study is *not* a road safety audit. The study information can be used for programming and budgeting, however, once a road section reaches the project design stage, further detailed review, investigation and design will be required to address the specific requirements of the project.

The study utilized the traffic count information that was provided by the Town of Gananoque. Accurate traffic counts are important in establishing road maintenance classifications for Minimum Maintenance Standards purposes as per Regulation 239/02, as well as determining appropriate geometric design, cross-section and structure when the road is rehabilitated. When traffic data is collected, the percentage of truck traffic is very critical to the structural design.

The Town of Gananoque traffic information that was provided generally just dealt with the major roads over a number of years. For roads that did not have traffic counts AECOM estimated the traffic counts. The estimated counts are suitable for the purposes of this report, however should not be used to establish road classes per Regulation 239/02. AECOM would recommend that the Town of Gananoque continue with their existing traffic counting program and expand the number of roads that are counted. A traffic counting program should be conducted on a regular cycle, completing the entire system over a three to five year period.

Within the body of this report, the following information is provided:

- A summary of the road condition ratings, reporting on the results in a tabular format by Road Section, Priority Rating, Time of Need and Rehabilitation Strategy (with associated mapping).
- An overview of the report methodology and evaluation system.
- A valuation of the road inventory.
- Recommendations for pavement management strategies.
- Recommendations for program funding levels.

The Roads Needs Study is an important tool for municipalities as it allows them to benchmark against themselves and to provide an overview from programming and financial perspectives.

With respect to structures, the Province of Ontario passed amendments in 1997 to existing legislation in the *Highway Traffic Act* (HTA), *The Bridges Act* (BA) and the *Public Transportation and Highway Improvement Act* (PTHIA) that required all bridge and culvert structures with a span greater than 3m to be inspected under the direction of a Professional Engineer at no greater than two year intervals. The inspection methodology and reporting must be in accordance with the Ontario Structure Inspection Manual (or equivalent). The overview of the structures inventory was at the same level as the road inventory overview.

2. Report Content and Scope

The report was prepared by AECOM for the Town of Gananoque using the roads condition rating methodology previously prescribed by the Ministry of Transportation (MTO) in the *Inventory Manual for Municipal Roads (1991)*.

The scope of the report includes summaries of collected data, with discussion and analysis regarding same.

3. Report Methodology

3.1 Road Condition Ratings

Road section ratings were completed in accordance with the MTO's *Inventory Manual for Municipal Roads (1991).* The resultant data was entered into WorkTech's Asset Foundation software. The Condition Ratings, Priority Ratings, and associated costs were then calculated by the software in accordance with the Inventory Manual. Benchmark construction costs were developed by AECOM based on local experience.

The road network is composed of road sections that are reasonably consistent throughout their length according to the following factors: roadside environment, surface type, condition, cross section, speed limit or a combination of these factors. For example, a road section with a hot mix surface that changes from good condition to poor condition would require an additional section to be added to the database. Another example would be a road where speed limit changes on the section of the road found in a school zone; a new section would be created to reflect that change even if no other element had changed.

The Condition Ratings developed through the scoring in the Inventory Manual classify roads as 'NOW', '1 to 5', or '6 to 10' year needs for reconstruction or resurfacing. Field data is obtained through a visual examination of the road system and includes: structural adequacy, level of service, maintenance demand, horizontal and vertical alignment, surface and shoulder width, surface condition, and drainage. The Condition Rating is calculated based upon a combination of other calculations and data. In the WorkTech Asset Foundation Software, further calculations are also made to determine the Priority Rating which is a function of the Condition Rating and the Average Annual Daily Traffic (AADT). The Priority Rating may be used as a sorting tool within program areas albeit with some caveats.

Notwithstanding the Priority Rating results, from an asset management perspective it may be better to sort projects based solely on the structural adequacy rating or condition of the pavement. The Priority Rating is/was a typical sorting parameter that was a function of the traffic count and the overall condition rating of the road section. This approach added weight to the traffic count of the section. From a more current asset management perspective, this approach may lead to work being undertaken on a higher volume road section at the expense of a lower volume section that was in poorer condition. If appropriate strategies are not undertaken at the correct time, there is a less effective usage of the available funding.

The Time of Need and the 'ADEQ' ratings are defined as follows:

3.2 'NOW' Needs

The Now needs inventory generally represents the backlog of work required on the road system. Construction improvements identified within this time period should be undertaken immediately (notwithstanding funding levels and pavement management strategy). It should be noted that a resurfacing strategy is never a 'NOW' need. The exception is when the surface type is inadequate for the traffic volume.

Figure 1 'NOW' Need Road

If a road with a rehabilitation strategy of "resurface" deteriorates too far, it becomes a 'NOW' construction need. A 'NOW' need rating may be triggered by substandard ratings in any of the Structural Adequacy, Surface Type, Surface Width, Capacity, Drainage, or Geometrics data fields.

3.3 '1 to 5' Year Need

'1 to 5' Identifies road sections where construction and resurfacing improvements are anticipated within the next 5 years, based upon a review of their current condition.

Figure 2 "1 to 5" Year Need Road (Resurfacing)

3.4 '6 to 10' Year Need Road (Resurfacing)

'6 to 10' Identifies road sections where construction and resurfacing improvements are anticipated within the 6 to 10 years, based upon a review of their current condition

Figure 3 '6-10' Year Need Road (Resurfacing)

3.5 'ADEQ'

A road section is categorized as adequate pursuant to the Inventory Manual rating system.

It should be noted that an 'ADEQ' rating encompasses a wide range of conditions that include the following:

- Roads with a traffic volume of less than 50 vehicles per day will be deemed adequate and deficiencies on those roads are to be corrected with the maintenance budgets
- Gravel Roads with a surface condition that is not a "NOW" need (More than 25% distress) is adequate; there is no further differentiation by time period.

Figure 4 'ADEQ' Road (approx. 7 Years old)

3.6 Types of Improvements—Roads

Deficient sections and structures each have an identified improvement type as part of the rating that is conducted.

Generally, one of the key factors in making a decision with respect to an improvement type, and in making a determination of whether the appearance and performance of a road relates to an underlying structural problem or simply to aged surface materials, is the visual survey. A road's structural or drainage problem would tend to lead toward a reconstruction/replacement type of treatment; whereas, aged surface materials would tend toward a resurfacing type of treatment. A determination of the root cause of the problem or the condition is critical. Reconstructing a road that should have had some type of resurfacing treatment, would be an ineffective use of available resources.

Improvement types include the following:

- R1 - Basic Resurfacing
- R2 - Basic Resurfacing—double lift

- RM - Major Resurfacing
- PR1 - Pulverizing and Resurfacing
- PR2 - Pulverizing and Resurfacing—Double lift
- BS - Tolerable standard for lower volume roads—Rural and Semi-Urban Cross sections only
- RW - Resurface and widen
- REC - Reconstruction
- RNS - Reconstruction Nominal Storm Sewers (Urban: no new sewer, adjust Manholes, catchbasins, add sub-drain, remove and replace curb and gutter, granular and hot mix)
- RSS - Reconstruction including installation of Storm Sewers (New storm sewers and manholes in addition to the above)
- NC - Proposed road Construction
- SRR - Storm Sewer Installation and Road reinstatement.

Appendix 1 includes a listing, sorted by priority number, of all the Town of Gananoque road sections that have a need. They are further sorted into sections by Time of Need and general strategy; construction or resurfacing. Pavement management will be discussed later in this report, however, generally, if a municipality's programs are underfunded the priority on spending should be on the 1 to 5 and 6 to 10 year needs to ensure that preservation and resurfacing needs have been satisfied.

Appendix 2 includes a listing of all of the roads with needs and their critical deficiencies. This table is useful when preparing the rehabilitation or reconstruction treatment. For example, a road may have a treatment of R1 to resurface with a single lift of asphalt which will be indicated by a strategy of R1. However, the section my also indicate a 6 to 10 year drainage need which would typically be triggered by a drainage score of 12 to 14, indicating that there also some drainage improvement required also.

Appendix 3 includes a listing of all rural roads and the number of substandard vertical and horizontal curves. This appendix is useful in creating a list of sections that should be reviewed for additional signage, or if in the instance where a road is recommended for reconstruction but the municipality elects to defer that by undertaking some type of rehabilitation strategy instead, the curves should be reviewed for spot improvement, additional signage, or speed reduction.

3.7 Bridge and Culvert Ratings

Bridge and culvert inspections were not completed by AECOM staff on the Town of Gananoque's structure inventory as part of this study. However, structures are an important integral part of the road system infrastructure and the management of the structures within the inventory is critical to the overall function of the road system.

Provincial legislation requires that inspections be undertaken on all structures that have a span greater than three metres, in accordance with the Ontario Structure Inspection Manual (OSIM) or Municipal Bridge Appraisal Manual (MBADES), every two years. AECOM recommends that these inspections be undertaken by a qualified consultant to demonstrate the Town of Gananoque's due diligence in the management of the structure inventory.

Bridges and culverts are defined as follows:

- Bridge: transfers all live loads through a superstructure to a substructure and to the foundations
- Culvert: transfers all live loads through fill.

Structures are rated as deficient or become 'NOW' needs due to:

- Insufficient width of structure (six metre minimum)
- Vertical clearance
- Level of Service (cannot accommodate peak hour traffic)
- Structural Capacity.

Figure 5 'NOW' Need Bridge

4. Road Structure

To better understand the content and methodology of this report, an overview of how a pavement structure is designed and functions is provided. The majority of municipal roads are a pavement structure referred to as flexible pavement. As such, the following discussion focuses on flexible pavements. Other pavement structure types include rigid and composite and are more typically found on 400 series highways or on arterial roads of larger urban centres.

4.1 Overview of Typical Flexible Pavement Road Structure

The pavement/road structure transmits the wheel loads of vehicles from the road surface to the road sub-grade (or native soil). The pavement structure has to be designed such that the load that is transmitted to the sub-grade, is not greater than the sub-grade's ability to support the load. The following figure and table show a typical flexible pavement structure.

Figure 6 **Typical Wheel Load Stress Illustration for Flexible Pavement. Source; MTO Soils Manual circa mid 1960's**

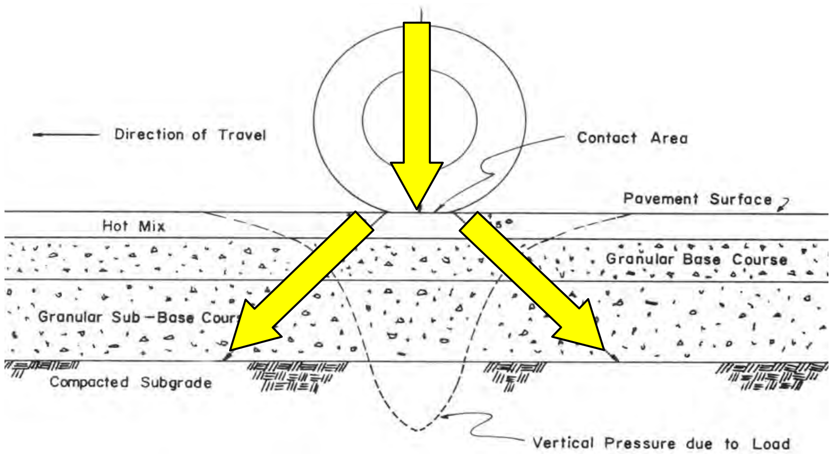


Table 1 **Typical Wheel Load Stress Illustration for Flexible Pavement.**

Depth Below Surface	Stress (psi)	Stress (Kpa)
At surface	90	620.5
8" (200mm) Below	11	75.84
11"(275mm) Below	7	48.26
16"(400mm) Below	4	27.58

Source; MTO Soils Manual circa mid 1960's

The highest loading is experienced at the point of contact with the vehicle's tire. With modern radial truck tires that run inflated to 110 psi, the loads at the road surface can be over 20 times higher than at the compacted sub-grade. **Figure 6** is a profile view of the way in which the load is distributed through the pavement structure. The loading actually occurs in a conical fashion, dissipating both vertically and horizontally as it passes through the pavement structure, with the highest loading occurring at the point of contact. Loading decreases exponentially as it passes through the road structure. Therefore, materials of lesser strength or lesser quality can be used deeper in the road structure. Restated, the closer the road building materials are placed to the surface of the road, the higher the quality of road building materials required. Similarly, the poorer the sub-grade or native material, the deeper/stronger the road structure has to be to carry the same loads. Part of understanding road structure is understanding the materials used in that construction, both native soil and manufactured/or mined.

Traffic counts are important to adequate and appropriate structural design of the pavement structure. *Accurate truck counts are critical*. Dependant upon the source, the effect of a single truck on the pavement structure is equivalent to 2,000 to 10,000 passenger cars.

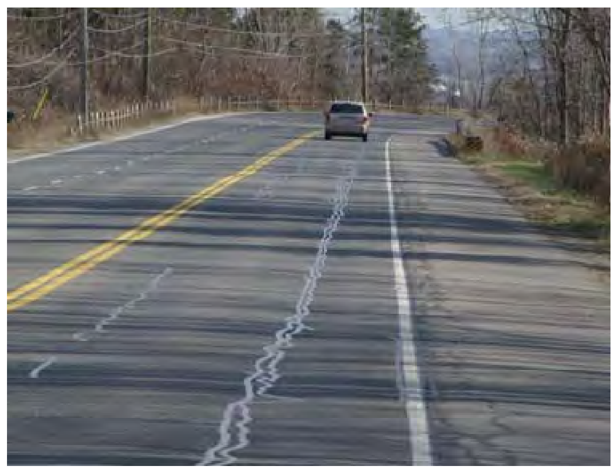
The Town of Gananoque is largely urban and residential, however there are major arterial roads through the town that would experience a significant percentage of truck traffic. Therefore, that type of traffic loading also has to be a consideration in the design of road improvements.

Pavement evaluation involves a review of each road section and an assessment of not only the extent of distress that is being observed, but also the type(s) of distress(es) being observed. The recommended treatment of the road section is dependent on whether the cause of the major distress(es) are structural or non-structural.

Flexible pavement will have age related distresses and wearing that will occur on all functional classes of flexible pavement such as thermal cracking and oxidation. These distresses are non-structural, however, once a crack develops and water enters the pavement structure, deterioration will accelerate. Poor construction practices, quality control or materials may produce other non structural surface defects such as segregation and ravelling which will also provide a reduced life expectancy of the surface asphalt.

Fatigue cracking is indicative of a structural failure and can manifest itself in many forms such as wheelpath, alligator and edge cracking. It can be localized or throughout a road section. When roads that have exhibited fatigue cracking throughout a road section are rehabilitated, particular attention should be placed on the rehabilitation treatment to ensure that the upgraded facility has sufficient structure.

Figure 7 Fatigue Cracking



4.2 Flexible Pavement Structural Design

There are a number of flexible pavement structural design methodologies and associated software. In Ontario, road structure/strength is frequently expressed as a Granular Base Equivalent (GBE).

The measurement is unit-less and relates to the structural value of 1 millimetre of Granular A material. The relationship of the typical road building materials is expressed in either of the two following ways;

1mm of HMA = 2mm of Granular A = 3mm of Granular B

Or

HMA =2, Granular A = 1, Granular B=0.67

The typical subdivision road has the following pavement structure and associated Granular Base Equivalency.

Table 2 Granular Base Equivalency comparison

Material	Example 1 Depth	Granular Base Equivalency	Example 2 Depth	Granular Base Equivalency
Hot Mix Asphalt (HMA)	100	200	150	300
Granular A	150	150	300	300
Granular B	300	200	0	0
TOTAL	**550**	**550**	**450**	**600**

The GBE concept is important to bear in mind when reconstruction and rehabilitation projects are undertaken. Other products used such as Expanded Asphalt and Cold in Place recycling also have a structural value. For design purposes it may be prudent to use a conservative equivalency of 1.5 for these products. (Although some sources indicate GBE's of up to 1.8)

As an example, if a 200mm pavement is replaced with 150mm of Expanded Asphalt or Cold in Place Recycling, with a 50mm overlay of Hot Mix asphalt, a pavement structure with a GBE of 400 is replaced by a pavement structure with a GBE of 325; a significant difference.

Under-design of a replacement pavement structure will result in premature pavement failure and waste of available funding. The purpose of this example is to illustrate the different structural values that products have. Expanded Asphalt and Cold in Place recycling are both excellent products to rehabilitate pavement structures.

The Ministry of Transportation of Ontario's Pavement Design and Rehabilitation Manual is an excellent resource for use in pavement structure design and rehabilitation.

4.3 Flexible Pavement Construction – Thin Lift Pavements

Hot mix asphalt mixes are designed in Ontario either by the Marshall Method or the Superpave Method. Through time, this has resulted in a number of commonly used mixes that are typically sorted by size, to some extent. One of the parameters used to describe that sizing is the Nominal Maximum Aggregate Size (NMAS)

Table 3 Lift Thicknesses

Mix Type	NMAS (mm)	Lift Thickness Range (mm)
SP 9.5	9.5	30 to 40
SP 12.5	12.5	40 to 50
SP 19	19	60 to 80
HL3	13.2	40 to 55
HL4	16	50 to 65
HL8	19	60 to 80

In the Marshall Mix Method, the mix designations are HL1, HL2, HL3, HL4, HL8 etc. In Superpave mix design methodology, mixes are designated by the NMAS. The following table identifies the NMAS for the more commonly used mixes.

4.4 Overview of a Typical Rigid Pavement Structure

Rigid Pavements are typically constructed of concrete. The fundamental difference between a flexible pavement and a rigid pavement is the method in which the load is transferred. Whereas, the flexible pavement disperses load through the pavement structure in a conical fashion, with a higher point load directly beneath where the load is applied, the rigid pavement structure distributes that load in a beam like fashion more evenly across the pavement structure. Rigid pavements may have an exposed concrete wearing surface or they may be covered with an asphaltic concrete wearing surface. The Town of Gananoque does not appear to have any road sections that are rigid pavements. However, the former highways may be composite pavement and have a layer of asphalt over a concrete base.

Figure 8 Rigid Pavement Structure(s)

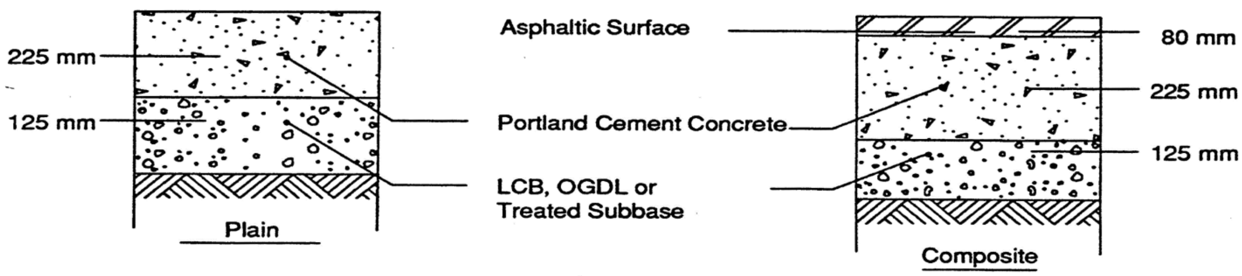
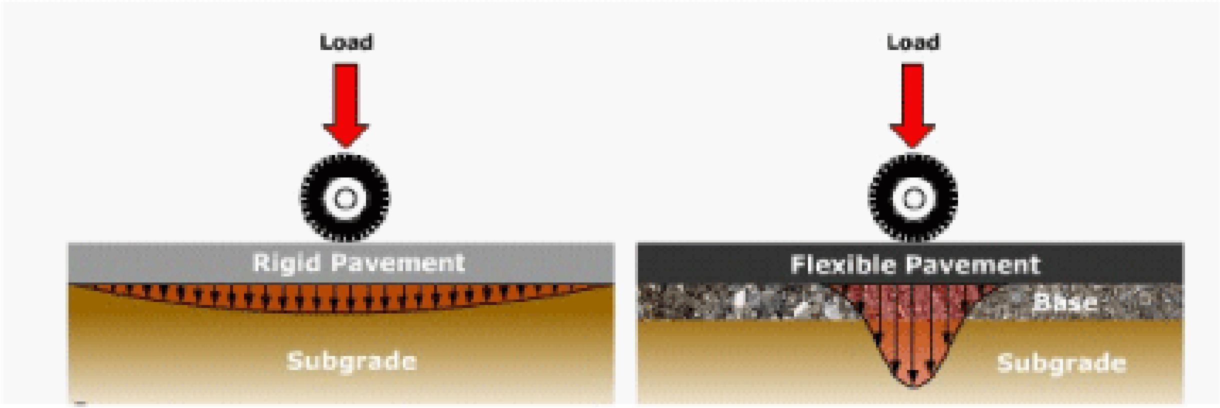


Figure 9 Rigid vs Flexible Pavement Load Distribution

Source Texas DOT



The resulting pavement structure is usually thinner overall when compared to a flexible pavement designed to accommodate the same traffic loading. This does not necessarily translate into a reduced cost of construction. Any comparison of costs between flexible and rigid pavements should be on a lifecycle basis for the most accurate assessment.

Older concrete pavements were prone to failure at joints as load transfer caused a slight movement in the concrete slab and with the intrusion of water, a structural failure. Newer concrete pavements are designed with improved load transfer technology.

4.5 Gravel Road Structure and Maintenance

Gravel roads are also a flexible pavement. Gravel roads function and distribute load as described in the previous section of the report. The principle difference is that the riding or wearing surface and the pavement structure for gravel roads are one and the same.

As with hard surfaced roads, the surface of a gravel road must also be renewed. The wearing surface in this case also forms part of the road structure, so as it diminishes and disappears though the normal wear and tear or grading and winter control, so does it's ability to carry loads.

Gravel roads are deceptively expensive. Once the true costs of the addition of appropriate amounts of gravel, grading, and dust control are considered there is typically a cost benefit justification to convert the gravel road to a hard surface; typically low cost bituminous (surface treatment). Other agencies have determined that the trigger for conversion to a hard surface is between 100 and 150 AADT. However, simply hard topping a gravel road that does not have an adequate structure and drainage will result in failure.

Figure 10 Float on Gravel Roads

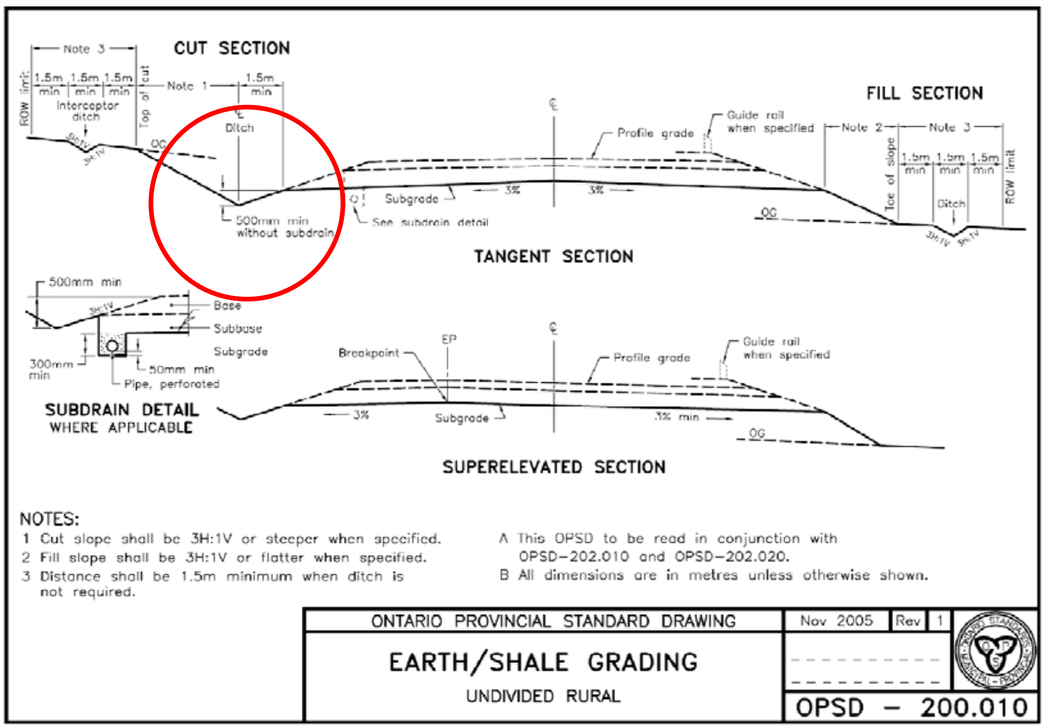
The gradation of Granular A material is such that up to 15% of the particles could be greater than 19mm; up to approximately 35% of the aggregate could be between 13.2mm and 26.5mm. Placing the material in too thin a lift will result in excessive float on the road. Additional gravel should be added to gravel roads in a minimum 75mm (3 in) lift thickness. **Figure 10** illustrates a gravel road with too much float.

4.6 Drainage

It has often been stated that the three most important elements of road building are drainage, drainage and drainage. Proper drainage is imperative in order to maximize the long-term performance of the road structure. Roads are designed, constructed and maintained in order to minimize the amount of water that may enter, or flow over, the road structure. In the case of water flowing over the road, assessments must be made on a site specific basis and factors that should be considered include the traffic volumes of the road section, economic impacts to the loss of the use of the road, upgrade costs and risk.

When water enters a road pavement structure, a number of reactions can occur. In summer, the granular road base can become saturated and when too much water displaces the granular material it removes the material's ability to support the loads it was designed for. Too much water in the granular material actually acts like a lubricant and facilitates the displacement of the material under load. In winter, water in the road structure can cause frost heave, potholes and pavement break-up as the water freezes and expands. Generally, a saturated granular road base results in structural failure of the road.

Figure 11 OPSS 200.10



Rural road drainage is typically achieved through roadside ditches. Rural road ditches should be a minimum of 500mm below the granular road base to ensure that the road base remains free from moisture and maintains its ability to carry loads. For the Town of Gananoque's road system, approximately 50% of the length of the road system has a drainage need of some description ranging from simple maintenance to spot drainage to the wholesale construction of a ditch or construction of a storm sewer system.

The side slopes of the ditches are also critical to the stability of the road platform. The drawing above indicates a 3:1 side slope which is ideal. In most cases, a 2:1 slope would also be satisfactory. When slopes are too steep, the soil will move over time and find its natural angle of repose. The movement of the soil will contribute to an early failure of the pavement structure. Inadequate compaction will also be a contributing factor to early failure. The following pictures illustrating the steep side slope were not taken in the Town of Gananoque, but illustrate the longer term effect of a road structure with side slopes that are too steep.

Figure 12 Steep Side Slopes

Figure 13 Inadequate Roadside Drainage

Urban roads typically have a storm sewer pipe network that carries the minor storm event. The roadway itself is often part of the overland flow route for the major event. The drainage of the granular road base is accomplished through sub-drains installed below the curb and gutter, lower than the lowest elevation of the granular base.

Figure 14 Shoulder Berm Contributing to Edge Failure

There are some areas of Gananoque where the majority of the roads within the area have a recommended treatment of reconstruction with storm sewers. Prior to reconstruction of the area, a stormwater management plan should be developed through a Class Environmental process.

Maintenance of the drainage system(s) is also critical to the long term performance of the road system. Low volume rural roads tend to have a winter maintenance program that includes the application of sand to improve traction. Over time that sand builds up on the edge of the pavement to a point where it effectively blocks the runoff from getting to the ditch. The runoff is trapped at the edge of pavement where it saturates that area of the road bed contributing to the early failure of the edge of the pavement.

4.7 Horizontal and Vertical Alignments

Horizontal and vertical alignments are the changes in direction and elevation of the road. A large number of roads in rural Ontario, more so in the north, were originally constructed along the alignments of the trails from the original settlements of the area. As a result they tend to closely follow (or avoid) the existing contours of the land. In southern Ontario there was a greater tendency to follow the alignments of the original Township surveys due largely to the much flatter landscape, however adjacent to larger streams and rivers there was still that tendency to follow the topography. The result is a road alignment that tends to change vertical and horizontal direction frequently. Those changes generally do not provide sufficient visibility for Safe Stopping Distance (SSD) from the posted speed limit as per the manual entitled Geometric Design Standards for Ontario Highways.

The following table is an excerpt from the Geometric Design Standards for Ontario Highways and indicates the SSD's required for various design speeds.

Table 4 **Minimum Stopping Sight Distance on Wet Pavement**

Table C2-1
MINIMUM STOPPING SIGHT DISTANCE ON WET PAVEMENTS

Speed *v*		Perception and Brake Reaction		Coefficient of friction wet pav't	Braking distance on level	S-Min. Stopping sight distance	
Design	Assumed condition	Time	Distance			calculated	rounded
km/h	km/h	s	m	*f*	m	m	m
40	40	2.5	28	0.380	17	45	45
50	50	2.5	35	0.358	27	62	65
60	60	2.5	42	0.337	42	84	85
70	70	2.5	49	0.323	60	109	110
80	79	2.5	55	0.312	79	134	135
90	87	2.5	60	0.304	98	158	160
100	95	2.5	66	0.296	120	186	185
110	102	2.5	71	0.290	141	212	215
120	109	2.5	76	0.283	165	241	245
130*	116	2.5	81	0.279	190	271	275
140*	122	2.5	85	0.277	211	296	300
150*	127	2.5	88	0.273	232	320	320
160*	131	2.5	91	0.269	251	342	345

**Design Speeds above 120 km/h are beyond the normal range of application*

It would be unrealistic to expect that all substandard alignments could be removed from all roads in a road system, particularly those with lower traffic volumes. However, in order to reduce the exposure to risk for the municipal corporation, those road sections with substandard alignments should be reviewed for erection of additional advisory signage.

Figure 15 **Substandard Vertical Alignment**

Figure 16 **Substandard Horizontal Alignment**

Appendix 3 of this report includes a list of all rural roads with vertical and horizontal curves that may be substandard and should be further reviewed by the municipality for additional signage, spot improvement or speed reduction.

One of the criteria analysed by the software based on the data input is the Geometry. Two of the input fields are the posted speed and the average operating speed. The purpose of this is to measure the effects of the geometry on the travelling speed on the road section. For example, a road section with a posted speed limit of 80 km/hr with an average operating speed of less than 65 km/hr would be a 'NOW' need. If the growth factors data fields are populated then the software would also calculate the potential 1 to 5 and 6 to 10 year needs. The following table, from the Inventory Manual indicates the trigger points for geometric needs.

Table 5 **Minimum Tolerable Operating Speed (km/hr) (Table 91 IM Manual)**

ITEM	SPEED					
Legal Speed Limit	40	50	60	70	80	90
Minimum Tolerable Operating Speed	35	45	50	60	65	75

The Town of Gananoque does not have any road sections that have an indicated NOW need for geometry. This was based on the assumption that all roads within the Town were a 50 km/hr speed limit.

4.8 Pavement Maintenance and Life Cycle

Pavement structure life expectancy will vary dependant on a number of factors including the following:

- adequacy of initial design
- adequate maintenance programming
- adequate drainage
- traffic volumes
- traffic type

A conventionally designed and constructed flexible road pavement structure for an arterial road should last at least 40 years before it needs to be reconstructed. During that 40-year life span two or three hot mix overlays will be required. A local road, carrying less traffic volume and substantially less truck loads, should last at least 50 years before full reconstruction is required. Again, two or three overlays will be required within this life span. Proper maintenance programming will maximize these life expectancies.

Maintenance programs should include the following components:

- Spot improvements to the asphalt surface
- Spot improvements to the road drainage system
- Crack sealing
- Resurfacing/overlays at the appropriate time
- Pavement preservation strategies if appropriate, including:
  - o Microsurfacing

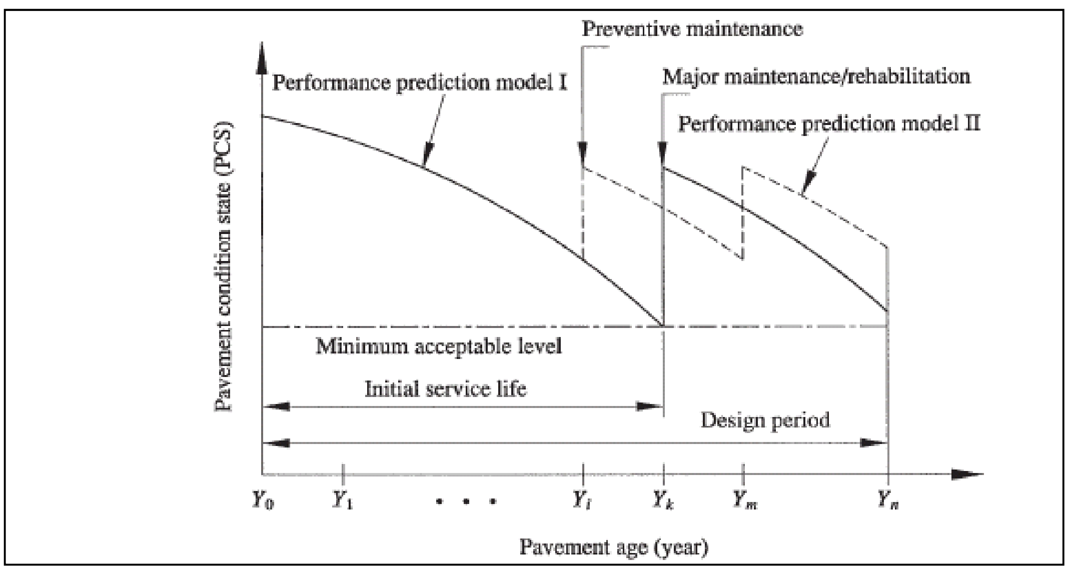
- o Crack sealing
- o Surface Treatment
- o Slurry Seals
- o Reclamite.

Each one of the above-noted treatments represents an extension to the pavement's life at relatively lesser cost than full reconstruction. For example, it is generally accepted that crack sealing will extend the pavement life by two years; slurry seals, microsurfacing and surface treatment for four to seven years. However, preservation-type treatments do have a functional limit for usage and cannot be the exclusive technique used for pavement management as these treatments generally do not have a structural value. Hot Mix Asphalt Overlay treatments will add structure and extend the pavement life from 12 to 25 years depending on traffic volumes.

More recently, the concept of perpetual pavements has been the topic of discussion at conferences and seminars. The pavement structure design is different from a conventional flexible pavement design in that it generally requires a greater depth of asphalt. The greater depth of asphalt results in a road structure that is less susceptible to fatigue failure.

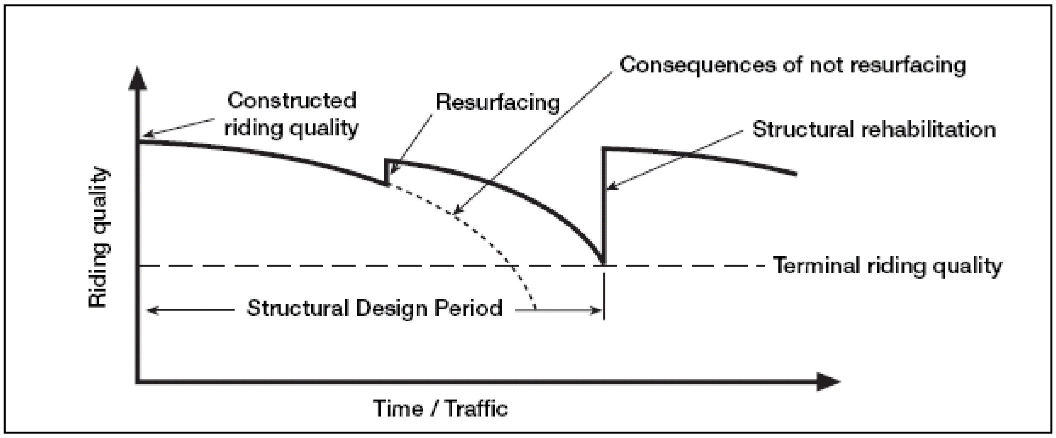
The goal of perpetual pavement is to provide a pavement structure that is designed and maintained over a longer life cycle period, such that only the top layer of the existing asphalt would ever be replaced/rehabilitated. The top layer of asphalt acts as a 'replaceable' wearing surface that protects the underlying road structure, maintaining its structure in perpetuity. An award winning example of perpetual pavement in Ontario is the Don Valley Parkway, constructed in the 1950s and 1960s, with only resurfacing being done since its construction. Although originally not constructed for that purpose, the road structure was sufficiently built to allow it to perform in this way.

Figure 17 Impact of Different Maintenance Strategies on Pavement Performance



Source: Development of a new asphalt pavement performance prediction model; Ningyuan Li, Ralph Haas and Wei-Chau Xie

Figure 18 Alternative Maintenance Strategies



Source: *Wirtgen Cold Recycling Manual*

Given the nature of urban roads and the number of other utilities occupying the road allowance, the perpetual pavement concept may lend itself more easily to rural cross-sections (Urban roads tend to have an increased number of utility cuts and repairs). Initial construction costs of perpetual pavements will be higher; however, they will be more cost effective on a life cycle basis.

Optimal timing of maintenance and rehabilitation efforts is the key to maximizing life expectancy of existing pavement structures. A number of road agencies and institutions have developed deterioration curves and/or graphical depictions that illustrate the life cycle of a pavement structure.

The message, consistent with all of the graphs in **Figures 17** and **18**, is that timely, appropriate maintenance and rehabilitation extends the life expectancy of the pavement structure.

Timing of major maintenance, such as an overlay, is dependent upon the purpose of the road and can vary from 12 to 25 years. However, on average, an arterial road requires resurfacing at an age of 16 to 20 years. Other studies have indicated that 17 years is the optimal time interval for resurfacing.

5. Regulatory and Advisory Signage

Most municipal road systems have a significant number of signs advising the road user of various aspects of the road section.

Regulatory signage provides advice to the motoring public on regulatory requirements such as speed zones, and stop, and yield requirements. Provincial legislation such as the *Highway Traffic Act* provides municipalities with the authority to create speed zones as well as and stop and yield requirements. A municipal by-law must be passed by the Council of the municipality to create and authorize enforcement of such regulations.

Warning or Advisory signage provides advice to the motoring public on recommended speeds for substandard corners, hazards, areas or reduced visibility etc.

The following are excerpts from the Ontario Traffic Manual (OTM) which further explain signage:

"*The Highway Traffic Act Section 182 (R.S.O 1990), provides for the regulation of various signs, their type and location on the roadway. The criteria and specifications for application, dimensions, location and orientation are prescribed and illustrated under Regulations 615,608, 581 and 599 (R.R.O. 1990) and are indicated as such in this manual. Signs erected in accordance with the Regulations, and pursuant to the Highway Traffic Act, are enforceable under various provisions of the Act. Enforcement is permitted under the particular section under the authority of which a prescribed sign may be erected to indicate a traffic regulation or HTA Section 182 (R.S.O. 1990), which requires obedience to prescribed signs."*

"Regulatory signs are signs which inform the driver/road user as to things they should or must do (or not do) under a given set of circumstances. They often indicate traffic regulations which apply at any time (or at times specified) or place upon a street or highway, disregard of which may constitute a violation. They may be supported (1) by the Highway Traffic Act or its regulations, (2) by municipal by-law or (3) not at all. In the first two cases the signs are enforceable; in the third case, although the signs advise road users as to what they should do, they are not enforceable"

The foregoing is a very brief overview of signage and how it is used by a municipality. For more detailed information and guidance, the municipality should obtain copies of the manuals and/or seek advice from an appropriately qualified consulting firm.

Figure 19 – Obscured Regulatory Signage

To paraphrase the *Highway Traffic Act*, where regulatory speed signs have not been placed in a rural setting, the speed limit shall be assumed to be 80km/hr. Where regulatory speed signs have not been placed in an urban area, the speed limit shall be assumed to be 50km/hr. This is significant in that, if the roads are not appropriately signed or if there is not an appropriate by-law in place, the speed limits are not enforceable and the roadway classifications for purposes of Regulation 239/02 will be inaccurate, creating additional exposure to risk for the municipality.

Regulatory signage that is installed but not visible or obscured also poses a liability to the municipality. As part of the road inspection process, signage should be reviewed for visibility during the maintenance inspections.

6. Town of Gananoque Road System Inventory and Classification

6.1 Surface Type and Roadside Environment

The Town of Gananoque is classified as an Urban Single Tier road system. **Tables 6 & 7** provide information of the composition of the road system by surface type and by roadside environment. **Maps 1 & 2** of this report provide a graphical representation of the information in the tables.

Table 6 indicates that the road surface types throughout the Town of Gananoque are composed primarily of high cost bituminous pavements with short lengths of intermediate cost pavement and gravel. **Map 1** shows the road network by road surface type.

Table 7 shows that the Town of Gananoque has a road system that is split between urban and semi-urban roadside environments with about 47.33% of the road sections having an urban roadside environment and 46.46% having a semi urban roadside environment. The remaining 6.21% is rural. **Map 2** shows the Town of Gananoque Road System by roadside environment.

Table 6 **System Breakdown by Surface Type *(unadjusted for boundary roads)***

Surface Type	Length (km)	Length (%)
Gravel	6.09	15.18
Intermediate Cost Bituminous (LCB)	0.30	0.75
High Cost Bituminous (HCB) (Hot Mix Asphalt)	33.73	84.07
Totals	**40.12**	**100**

Table 7 **System Breakdown by Roadside Environment *(unadjusted for boundary roads)***

Roadside Environment	Length (km)	Length (%)
Rural (R)	2.49	6.21
Semi-urban (S)	18.64	46.46
Urban (U)	18.99	47.33

<u>Rural Roads</u>—within areas of sparse development or where development is less than 50% of the frontage, including developed areas extending less than 300m on one side or 200m on both sides, with no curbs and gutters.

<u>Semi-Urban Roads</u>—within areas where development exceeds 50% of the frontage for a minimum of 300m on one side or 200m on both sides, with no curbs and gutters, with or without storm/combination sewers, or for subdivisions where the lot frontages are 30m or greater.

Urban Roads – within areas where there is curb and gutter on both sides, served with storm or combination sewers, or curb and gutter on one side served with storm or combination sewers, or reversed paved shoulders with, or served by, storm or combination sewers, or for subdivisions with frontages less than 30m.

Roads are further classified within the database by classes such as Local, Collector, Arterial and Residential or Industrial.

6.2 Boundary Roads

Boundary roads, by definition, are roads that a municipality would have in common with the abutting municipality and typically involve a Boundary Road Agreement that identifies the responsibilities of both agencies. The agreements are usually in writing; however, some are informal.

Boundary Road Agreements are useful when costs are identified for maintenance or capital works on the road section. From a risk management perspective they reduce the risk for one of the parties in the event of a claim, depending upon the content of the agreement.

The Town of Gananoque does not appear to have any boundary roads with the adjacent municipalities.

6.3 Road System Value

Section 6 of this report identifies the road system breakdown by surface type and by roadside environment. **Table 8** (below) provides a conservative estimate of road replacement costs by those parameters on a per kilometre basis. The costs have been prepared from the municipal database and are based on weighted average widths of each surface type. The values shown in **Table 8** include the construction costs based AECOM's recent experience with construction costs from recent contracts and adjustment factors including: basic construction, contingency, engineering, and terrain type.

Table 8 Road Replacement Costs per Kilometre

Surface Type and Roadside Environment	Replacement Cost per Kilometre
Hot Mix (High Cost Bituminous) – Semi- Urban	663,726 – 878,729
Hot Mix (High Cost Bituminous) - Urban	1,958,353 – 2,892,026

Based on the above-noted per kilometre costs, the estimated replacement cost of the Town of Gananoque's road system is **$55,491,400,222 as it exists today** (This estimate includes contingencies and engineering, but does not include removals). **Appendix 5** of this report includes the parameters used to develop the value of the Town of Gananoque's road system. The road replacement costs noted in **Table 8** are estimated generally in accordance with the Inventory Manual and include adjustment factors for basic construction, contingency, engineering, terrain, and roadside environment. The adjustment factors can add from 18% to over 50% to the construction costs based on the site specific circumstances.

7. Road System Time of Need and Adequacy

This section of the report will provide two key pieces of information that have been extracted and/or calculated from the information collected: Time of Need and System Adequacy.

The tabular information provided in the Time of Need section indicates the dollar value of the backlog of work that should be undertaken and provides an estimate of the work that remains to be undertaken within the typical capital planning horizon for most municipalities. Cost estimates for the work required are generated by the pavement management software based on road type, class, and current unit costs, and as such will vary considerably on a section-by-section basis.

The System Adequacy calculation will provide a report card on the adequacy or appropriateness of the road programming since the last Road Needs Study. A decrease in the system adequacy reflects inadequate funding or an inappropriate pavement management strategy. This measurement alone is reason to continue road network evaluations on a regular ongoing basis.

Map 3 of this report shows the road system by time of need. The costs shown in **Table 7** include adjustment factors for basic construction terrain, roadside environment and engineering.

As indicated earlier in the report, the Inventory Manual provides direction that: roads with a traffic volume of less than 50 vehicles per day are deemed to be adequate even if they have structural, geometric or drainage deficiencies that would otherwise rate them as having a need. Deficiencies in roads with low traffic values are to be corrected within the maintenance budget.

7.1 Time of Need

Appendix 1 includes a summary of deficiencies for all of the Town of Gananoque's roads. The Town of Gananoque should review the list to determine where improved or increased signage could be utilized and where there are deficient/substandard geometric needs, such as horizontal and vertical curves and road widths.

Table 9 **Summary of Costs by Time of Need as per the Inventory Manual (Including Contingencies and Engineering, not including maintenance needs)**

Item	NOW	1 to 5	6 to 10	Total
Construction Needs	20,744,684	6,138,334	10,450,755	37,333,773
Resurfacing Needs		1,308,826	733,748	2,042,574
Road System Total Needs	**20,744,684**	**7,447,161**	**11,184,502**	**39,376,347**
Water	3,960,000			3,960,000
Sanitary	3,093,750			3,093,750
Grand Total	**27,798,434**	**7,447,161**	**11,184,502**	**46,430,097**

It should be noted that all roads with a traffic count of less than 50 AADT and a speed limit of less than 80 km/hr are Class 6 roads per Regulation 239/02, meaning that there isn't a Minimum Maintenance Standard and the Inventory Manual deems all roads with less than 50 AADT as being adequate.

7.2 System Adequacy

The system adequacy is a measure of that portion of the system that is not categorized as a need in the "NOW" time period. The total road system adequacy is calculated as follows:

$$System\ Adequacy = \frac{Total\ System\,(km) - NOW\ Deficiencies\,(km)}{Total\ System\,(km)} \times 100$$

The system adequacy calculation provides a report card on the adequacy or appropriateness of the road programming since the last Road Needs Study. A decrease in the system adequacy reflects inadequate funding or an inappropriate pavement management strategy.

Consequently, measuring and reviewing the trend in the system adequacy calculations over time is one of the most effective measures of the performance of the overall roads program.

The Town of Gananoque currently has a road system adequacy measure of 73.8%. From a road system of kilometres, (unadjusted) 40.12 kilometres 10.51 km are rated as deficient in the 'NOW' time period. The traditional target adequacy for upper tier road systems (Regions and Counties) was 75% and a lower tier's target adequacy is 60%. Based on these former MTO targets, which were in effect when the municipal grant system was in place, the target adequacy for the Town of Gananoque should be 60%, as a minimum. The minimum target adequacies were established by MTO to reflect the nature and purpose of the road system.

When considering this measure of adequacy it must also be considered that 5.4 km (or 13.6%) of the system is deemed adequate by virtue of a low traffic count and a further 6.11km (or 15.2%) of the road system are represented by the King Street and Stone Street, which do not have any sections evaluated as NOW needs. Therefore the calculated system adequacy level may not be the level perceived by the driving public.

From a different perspective, the driving public may perceive that 47% of the road system, other than King and Stone Streets, were in poor condition.

8. Recommended Program Funding Levels

Recommended program funding level calculations are typically based on the length of or number of the infrastructure types and average widths of same within the database.

It should be noted that the budgetary recommendations in this report do not include items in the budget related to development and growth. Those items are in addition to the recommendations in this report and should require another funding source.

8.1 Capital Replacement – Roads

Recommended funding for the road system should include sufficient capital expenditures that would allow the replacement of infrastructure as the end of design life is approached.

For example, a typical road structure is expected to last approximately 50 years before it has to be reconstructed/replaced provided that the roads were maintained and resurfaced at appropriate intervals. If the life span is 50 years, then 2% of the replacement cost should be the annual contribution to the capital reserve to ensure that it can be reconstructed in that time frame. From a slightly different perspective, the annual capital program should be reflective of the life span of the item being considered.

The estimated replacement/depreciation is based upon the replacement value of the Town of Gananoque's road system, including adjustment factors, over a 50 year life cycle, to the current design standard. The estimated replacement/depreciation value of the Town of Gananoque's road system, to the current standard is **$55,491,400.** This translates into an annual capital depreciation of **$1,109,800**. This would best be described as an *'Accountaneering'* estimate which is based on the replacement value of the asset to the current design standard and its design life. The annual dollar value is the annual straight line capital depreciation over the lifespan. If all recommended maintenance was undertaken, then the lifespan may well exceed 50 years, which would be recognized in a reduction of the annual capital depreciation. This estimate does not include bridges, culverts, cross culverts less than 3m, sidewalks or street lighting.

Perhaps a simpler explanation would be an analogy to a car. A car is purchased and payments are made throughout the life of the car, which equates to the annual contribution. Throughout that life of the car, maintenance is required such as oil changes, brake and strut replacements and perhaps painting. This would parallel the need on a road to crack seal and overlay during the life cycle. These activities can extend the useful life of the pavement, thereby reducing lifecycle costs.

The calculations provided in this report are based on the dimensional information in the database of the road system. Accordingly, this represents an opportunity to develop a financial plan to increase the capital and resurfacing budgets in conjunction with longer term program development.

8.2 Hot Mix Resurfacing (Major Maintenance)

Both roads and bridges require major maintenance activities throughout their life cycle in order to reach their design life spans. Roads require resurfacing and bridges require replacement of waterproofing and/or bridge deck rehabilitations at the correct interval. Some municipalities include these activities in the operating budget, whereas others include them in the capital budget, due to the dollar value involved.

The time interval between hot mix resurfacing cycles is dependent upon traffic loading and, more particularly, truck loading. Roads with a higher percentage of truck traffic have a shorter anticipated life span than local residential roads. Studies have shown that the optimal timing for a hot mix overlay on a road is between 10 and 20 years, depending on the road type. MTO 400 series roads would tend toward the 10-year cycle, while lower volume roads tend toward the 20-year replacement cycle.

Table 10 Hot Mix Asphalt Road Classes for Budget Development

Asset Class	Subtype	Material	Resurfacing Interval	Roadside Environment	AADT Low	AADT High
HCB1-R	All	HCB	10	Rural	20,000	100,000
HCB1-S	All	HCB	10	Semi-Urban	20,000	100,000
HCB1-U	All	HCB	10	Urban	20,000	100,000
HCB2-R	All	HCB	12	Rural	10,000	20,000
HCB2-S	All	HCB	12	Semi-Urban	10,000	20,000
HCB2-U	All	HCB	12	Urban	10,000	20,000
HCB3-R	All	HCB	15	Rural	1,000	10,000
HCB3-S	All	HCB	15	Semi-Urban	1,000	10,000
HCB3-U	All	HCB	15	Urban	1,000	10,000
HCB4-R	All	HCB	20	Rural	1	1,000
HCB4-S	All	HCB	20	Semi-Urban	1	1,000
HCB4-U	All	HCB	20	Urban	1	1,000

Most municipalities resurface their local residential roads less frequently than they would resurface an arterial road - generally every 20 to 25 years. However, deferral of resurfacing past the ideal time interval incurs risk of greater expenditure. At 25 years the pavement surface may require additional rehabilitative effort beyond resurfacing.

AECOM Hot Mix Asphalt Resurfacing recommendation is based upon the distribution of the Town of Gananoque's hot mix asphalt component of the road system in following the parameters outlined in **Table 10**: As such, the optimal budget calculation will focus on the 18-year interval for hot mix roads.

Given the aforementioned, and the information with respect to surface type contained in **Table 6**, the funding for the annual resurfacing program size should be **$701,200** per year in order to maintain the system at its current adequacy level. This estimate is for the major resurfacing work only and does not include any estimated costs for other pavement preservation activities or programs.

8.3 Gravel Surface Roads

The standard practice for gravel road maintenance when MTO was providing maintenance subsidy was to place approximately 75 mm of gravel on each gravel road section every three years.

Since the conditional grant system was discontinued, a large number of municipalities have reduced the amount of gravel that has been placed on gravel roads to the point where the gravel roads in the system are a major maintenance problem, particularly in the latter part of the winter and early spring. If the granular base is not replenished the road structure will disappear through normal usage and the remaining gravel typically becomes contaminated other materials such as the native soil, and winter sand.

The Town of Gananoque has 6.09 kilometres of gravel surfaced roads as per **Table 6** of this report. Using the municipality's benchmark costing, the annual gravel resurfacing program size should be **$29,100** per year, based on adding 75mm of gravel every three years. This estimate does not include costs for re-grading, dust control, or gravel road conversion.

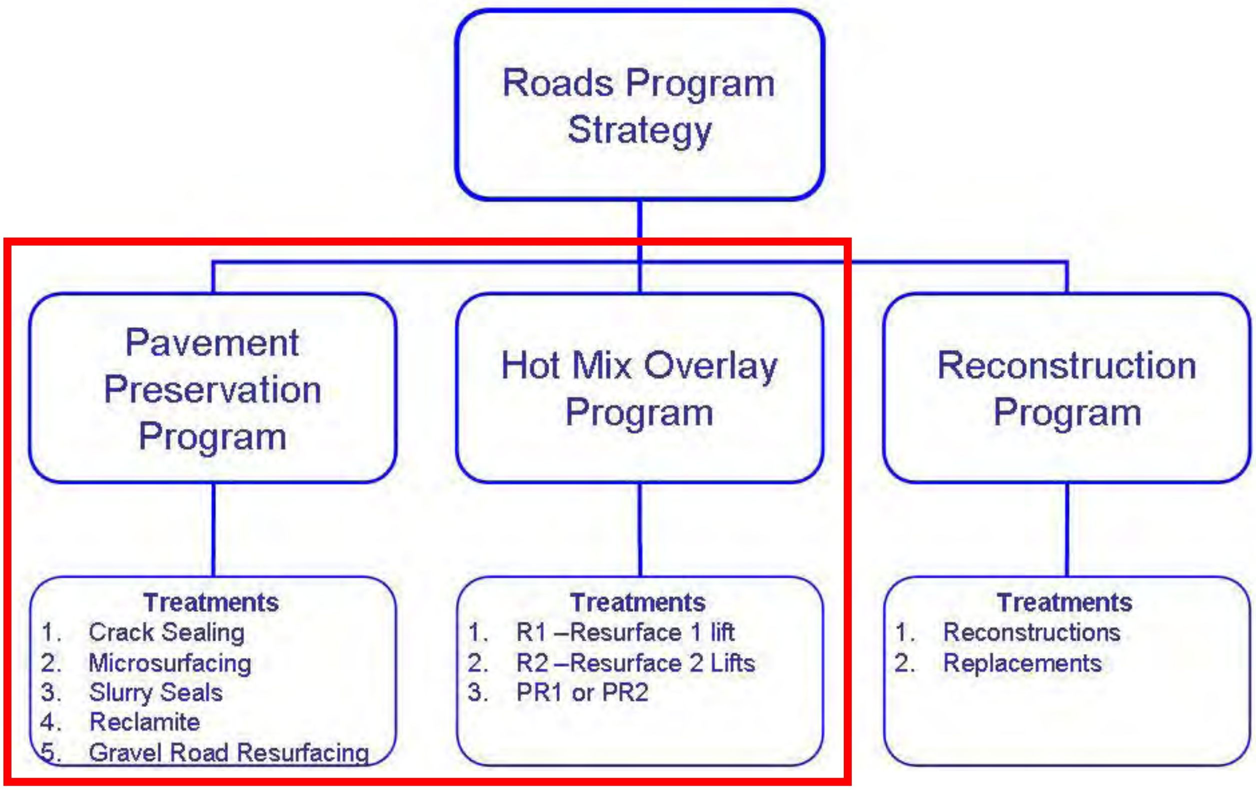
9. Pavement and Structure Management Systems and Strategies

The American Association of State Highway and Transportation Officials (AASHTO) defines asset management as "... a strategic approach to managing transportation infrastructure. It focuses on business processes for resource allocation and utilization with the objective of better decision-making based upon quality information and well-defined objectives."

The document entitled *Managing Public Infrastructure Assets 2001* prepared by AMSA, AMWA, WEF, and AWWA, defines asset management as "managing infrastructure assets to minimize the total cost of owning and operating them, while continuously delivering the service levels customers' desire, at an acceptable level of risk."

The absolute minimum objective of any pavement management strategy should be to ensure that the overall system adequacy does not decrease over time.

Figure 20 Strategy-Program-Treatment Relationships and Priorities



Sections 9 and 10 of this report include discussion on strategies, programs and treatments. For clarification, the terminology is defined as follows;

Strategy - The strategy is the overall theme of the approach to managing the road system and is usually dictated by the funding level.

Program - A program is a group of treatments with a similar purpose.

Treatment – A treatment is a specific process.

The strategy for any given agency will be dependent upon funding available. Generally, most agencies are not fully funded, therefore the pavement management strategy should be one that utilizes available funding first on preservation and resurfacing programs, to the greatest extent possible, and then on reconstruction and replacement. The following chart depicts the inter-relationship between strategies, programs and treatments.

9.1 Overview of Pavement Management Systems (PMS)

Generally, for any municipality, the road related infrastructure represents their largest asset or asset group. Efficient and effective management of the road system involves complex decision-making processes. Collecting, maintaining and analyzing pavement condition data are the objectives of a Pavement Management System ("PMS") in maximizing the performance of the municipal road network.

In practice today, a large amount of decision making with respect to the maintenance of the road system still occurs at the road supervisor level and is based on the supervisor's detailed knowledge of the roads system. Funding levels rarely match the demands.

The PMS is another tool in the municipal toolbox to assist council and staff in making better decisions and maximize available funding. A PMS is a valuable decision-making tool in an organization that includes staff at a number of levels—from technical and management to financial departments and the political representatives — who are ultimately responsible for the continued performance of the road system.

Table 11 Benefits of a Pavement Management System

	Political	Programming	Budgeting & Financial	Engineering
System composition	✓			✓
Detailed Physical inventory				✓
Overall System Adequacy	✓			✓
Condition Ratings		✓		✓
Rehabilitation options/costs		✓	✓	✓
Budget Limitation Implications	✓	✓	✓	✓
Strategy	✓	✓		✓
Project Coordination/ utilities		✓		✓
Priorities	✓	✓		✓
Deterioration prediction	✓	✓	✓	✓
Managing Cash Flow			✓	✓
Fiscal Policy development	✓	✓	✓	✓

The PMS is useful in providing analysis of strategies, programs and treatments, calculation of funding levels and projection of the long-term effect of wear on the road system. The PMS provides the means to develop effective pavement management strategies for any agency.

Table 11 identifies how a PMS benefits its many potential user groups and their differing needs and perspectives.

9.2 Hot Mix Roads Pavement Management Strategy

One of the difficulties that road agencies encounter is the parochial nature of direction that can be provided. This direction is often counter to effective pavement management decision making.

There is a strong tendency to adopt a ‘worst first’ approach to project selection and unless the entire program is adequately funded the ‘worst first’ approach will lead to a further deterioration of the overall adequacy of the road system. Given the information with respect to system adequacies and the effect programming may have on the system adequacy, the ‘worst first’ approach and its long-term consequences should be carefully considered/reconsidered by the Town of Gananoque before acting on it.

Of course there are other considerations and driving forces in capital programming decision making that are unavoidable, such as development demands. However, to address these demands an alternate funding source could be used rather than the road's capital reserve. Some municipalities address this through a development reserve that may be funded through development charges. Other infrastructure types within the road allowance and their respective needs and priorities will also influence programming.

As indicated earlier in this report, the minimum objective of any pavement management strategy should be to ensure that the overall system adequacy does not decrease over time. Given that most road agencies are inadequately funded, the majority of the discussion in the hot mix roads pavement management strategies section will focus on a road system where there is less than optimal funding.

9.3 Hot Mix Pavement Management with Limited Resources

The prime goal of any pavement management strategy should be, at an absolute minimum, to maintain overall system adequacy. The funding level for road-related programming should be set at a sufficient level so as to ensure that overall system adequacy does not decrease over time. Adequate funding is not always available. As such, the available funds should be expended on maintaining the adequacy of the system. More simply stated, the Town of Gananoque should ‘right size’ the hot mix resurfacing program, the surface treatment program and other pavement preservation or pavement life extending programs.

If the funding for preservation and resurfacing programs are inadequate then, by default, some of the **roads that could have been resurfaced, will become reconstruction projects at three to four times the cost for a rural road and up to seven times as much for an urban section**. Therefore, it is critical that preservation and resurfacing occurs in the optimal timeline or there will be deterioration in the overall system adequacy, and, with that, increased long-term costs.

Deferral of a road project that is already categorized as a ‘NOW’ need will not result in further deterioration of a road system’s adequacy; however, there will be increased maintenance costs for the road section and potentially more public complaint. Deferral of a hot mix resurfacing project will result in major cost implications for the road agency and may reduce overall system adequacy while increasing public concern and maintenance costs.

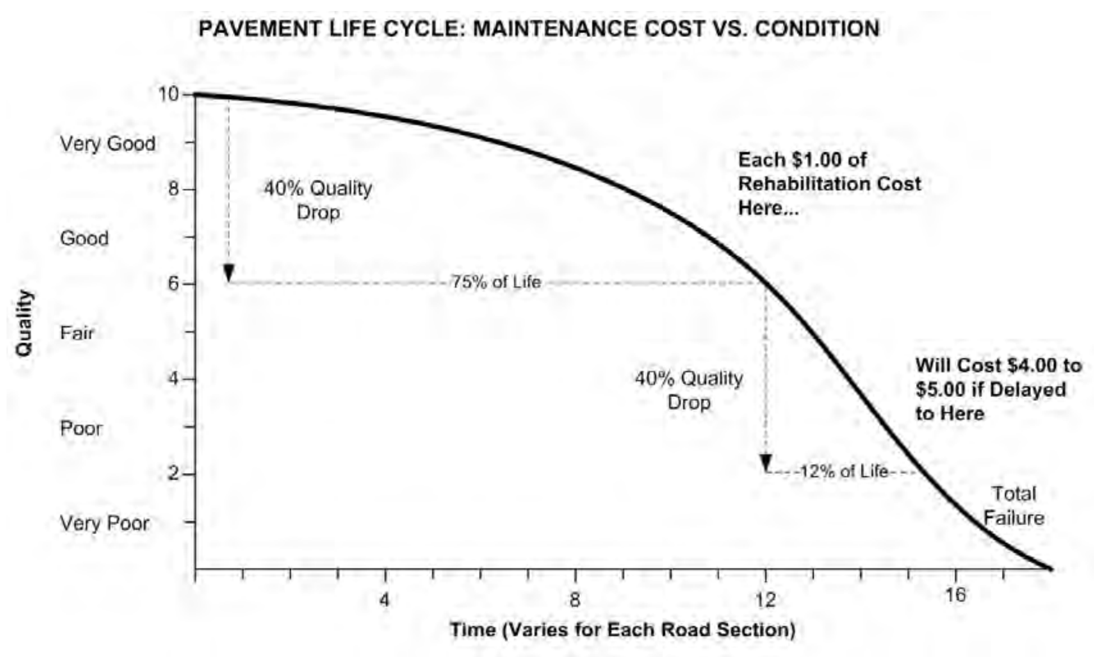
A hot mix overlay, or application of the appropriate preservation treatment, at the optimal point in the deterioration curve is the most cost effective use of available funding. Adequate funding should be provided for the hot mix resurfacing program to cover the cost of resurfacing a set length of roads in order to ensure the continued adequacy of the existing road system and to prevent further deterioration.

The Town of Gananoque is advanced in its usage of pavement preservations materials and processes, although an ongoing annual crack sealing program should be added to the maintenance program.

The following graph from an American Public Works Association (APWA) publication provides a representation of the foregoing discussion.

The Inventory Manual has six areas of evaluation that can trigger a need: Geometrics, Surface Type, Surface Width, Drainage, Structural Adequacy, and Capacity. Generally most municipalities wait until the road structure is a problem and the reconstruction or rehabilitation is such that it addresses the other deficiencies.

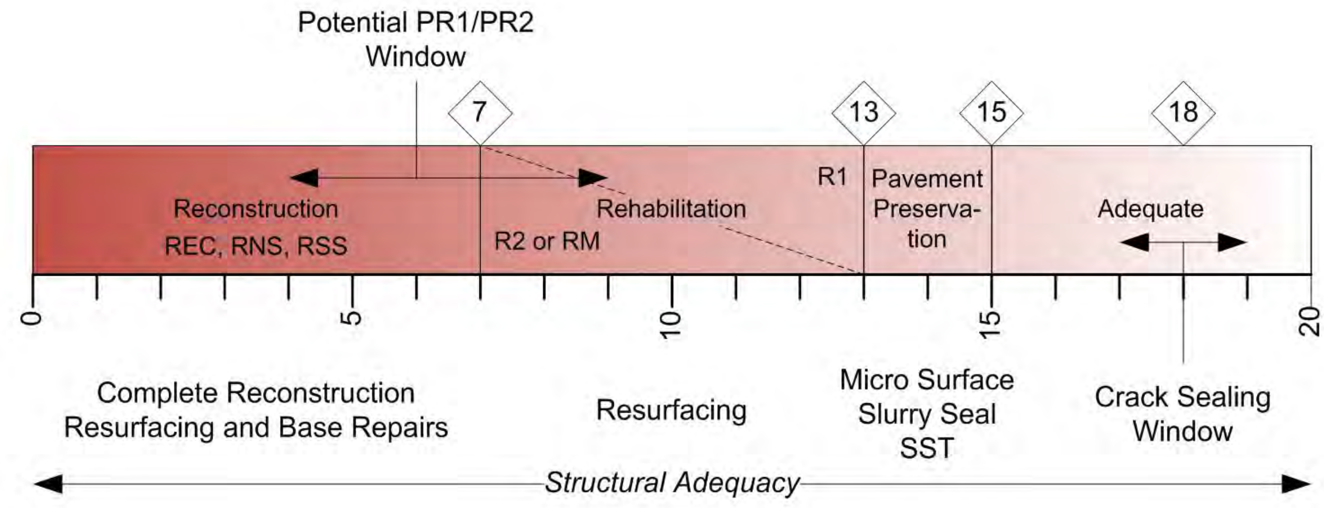
Figure 21 Pavement Condition versus Rehabilitation Cost



Adapted From: American Public Works Association, 1983
The Hole Story: Facts and Fallacies of Potholes

The pavement management treatment is designed around the structural adequacy of the road section. **Figure 22** is a bar graph of the entire range of scores for structural adequacy. Along the bar are *'trigger points'* and ranges where certain activities should occur and are appropriate.

Figure 22 Pavement Management Strategy Bar Graph



In terms of the structural adequacy scoring**,** those roads with a structural adequacy of 7 or less should be deferred as those roads are typically reconstructions or replacements. The exception being some of the PR2 Treatments (Pulverize and resurface with 2 lifts of asphalt);those roads could be included as part of the hot mix resurfacing program.

The treatment for roads with a structural adequacy between 8 and 10 is a double lift of asphalt and the treatment for roads with a structural adequacy score of 11 to 14 is a single lift of asphalt. Roads with a score of 13 to 15 may be appropriate for pavement preservation treatments such as microsurfacing and slurry seals. Roads with a score of 17 to 19 may benefit from crack sealing.

In trying to assess the adequacy and appropriateness of the programs, the Town of Gananoque may wish to consider the literature available from the National Centre for Pavement Preservation (NCPP, U.S. based).

In summary, the NCPP's programs measurement methodology indicate they in order to maintain the current system adequacy, 1 kilometre-year of work per kilometre of road system must be undertaken each year. In the Town of Gananoque's case, with an approximate 40 km road system, 40 km-yr of work would have to be completed each year. Different treatments have different values. For example, crack sealing is worth two years. If 100 km of road were crack sealed, then 200 km-yrs of work would have been undertaken.

9.4 Project Prioritization

With full funding available, projects should be undertaken in order of priority and by program. The highest priority is to ensure that the hot mix resurfacing program is adequately funded. If funding is limited, resurfacing and preservation programs should be prioritized over the construction program.

Projects should generally be undertaken in order of priority ranking by program; however, the scoring system utilized in the PMS only rates/ranks more tangible criteria that exist in the database. There may be other criteria that are specific to the Town of Gananoque that are less tangible, but are important considerations in project prioritization.

For example, the Town of Gananoque may want to advance projects that also include bike lanes ahead of those roads that do not have, or will not have, bike lanes.

The Road Needs Study provides ratings that deal strictly with the condition of the roads and those indications have to be considered in conjunction with needs that may exist for other utilities or pending development. For example, a road that is rated as a resurfacing candidate may have deficient sewers and watermains. The reality is that a significant percentage of the road would be excavated as utilities are replaced - it would be appropriate then to re-rate the road as a reconstruction project.

The condition of other infrastructure within the road allowance may be the key element in the prioritization. For example, a road rated as a reconstruction project may have a relatively low priority rating but a trunk watermain in the street may require immediate replacement. It would be pragmatic then to advance that road reconstruction project ahead of other road projects.

Frequently, a higher priority project may be undertaken adjacent to a much lower priority project that may not be scheduled to occur for years based on its own priority rating. If the lower priority project were to be advanced as a stand-alone project the unit costs may tend to make it disproportionately expensive due to the small quantities and location. Those circumstances may present an opportunity to advance the lower priority project to capture economies of scale that may not exist otherwise.

To summarize - road projects should generally be undertaken in order of priority; however, in developing the capital program, other factors should also be taken into consideration such as:

- Other ranking criteria that may be specific to the Town of Gananoque
- The condition of other infrastructure within the road
- Other infrastructure replacements may have a higher priority
- Realize opportunities of proximity and bulk purchasing

9.5 Gravel Roads Management Strategy

AECOM has recommended a gravel road budget of $29,100 annually just for the material component of the gravel road system. **Section 4.2** of this report provides a technical explanation of the current gravel resurfacing program and impacts.

Proper maintenance of a gravel road surface is deceptively expensive. Once the costs of gravel, dust control and grading are considered, often the cost per kilometre of gravel road maintenance is increased to the point where it is greater than the cost to maintain a hard-topped road section. At that point it may be cost effective to convert/upgrade the gravel road to a surface treated road.

Studies from various agencies, both in Canada and the United States, have shown that, dependent upon local unit costs for materials and machinery, conversion of a structurally sound gravel road to a surface treated road can be a cost effective strategy for roads with traffic volumes as low as 100 AADT. Net Present Value and Payback period analysis of this option can be developed that are specific to local material costs.

Once the above noted analysis has been completed and proves viable, candidate project selection could include roads with the following characteristics:

- adequate existing granular base structure (typically a minimum of 450 mm of material in southern Ontario, 550 in northern Ontario; 150 mm of Granular A and 300 of Granular B; 400 mm of Granular B in Northern Ontario);
- adequate drainage;
- high maintenance costs (frequent complaints and calls);
- isolation from other gravel roads (high deadheading costs);
- sections that would provide continuity in a hard top network; and,
- proximity to work that is being done in other programs, for example asphalt millings to supplement gravel program.

Conversion of a gravel road to a surface treated road may not necessarily raise the road out of the 'NOW' needs category as the inherent geometric and surface width deficiencies would remain. However, over time, converting gravel surfaced roads to surface treated roads will generally reduce overall operating costs.

Benefits to converting a gravel road include the following:

- customer satisfaction
- reduced maintenance costs for routine maintenance
- reduced maintenance costs for winter maintenance
- reduced complaints

Another option that the municipality may wish to consider is providing additional funding to add additional gravel to those roads that are not structurally adequate with the intention of surface treating the road in a subsequent year.

9.6 Subdivision/ Development Roads Management Strategy

As development occurs, new roads and widenings are added to the road network and thus present a future financial liability for the Town of Gananoque.

The capital and operating budgets should be adjusted annually to reflect the increased road network. Some municipalities deal with this issue as a system size adjustment, or a base adjustment, over and above any inflationary increases that may be required to manage the road system. For example, if the system size grows by two per cent year over year then the related roads budget items should increase by that same proportion over and above all other increases, in order that the same service level is maintained.

9.7 Annual Budget Adjustment

Typically municipal budgets are adjusted on an annual basis and the average Consumer Price Index is usually the targeted amount. Adopting this practice for public works and particularly road infrastructures ensures a continual downward spiral in overall condition of the road system and service levels. Given the increasing litigious nature of our society, decreased and/or inadequate funding increases the exposure to risk for the Town of Gananoque.

Given the disproportionate increases that have occurred in fuel, asphalt and salt over the last few years, consideration should be given annual to increases in road funding over and above the CPI in order that service levels may be maintained. Making specific increases to allow for exceptional product price increases will assist in ensuring that adequate and appropriate service levels are maintained.

10. Recommendations

AECOM makes the following recommendations for management of the Town of Gananoque's road inventory:

1. The opportunity to develop a sustainable asset management/financial plan should be reviewed for implementation over a five to ten year period.

2. The condition of the road system should be reviewed on a regular basis to measure the effectiveness of strategies and/or sufficiency of funding levels.

3. The regular traffic counting program should be continued and expanded, completing the entire system on a three to five year cycle on a continuing basis.

4. The asset management strategy for the foreseeable future should be developed along the following lines

    a. The reconstruction program should be deferred over the next few years in favour of ensuring that activities that extend the life of the existing good road sections have been satisfied. Given the existing funding level for roads, the basic strategy should be one of preservation; the top priority is to 'keep the good roads good'
    b. Optimize the hot mix overlay program, and preservation programs

Appendix 1

Reconstruction and Rehabilitation Needs by Time of Need

Inventory Manual Treatments

R1	Basic Resurfacing – Single Lift
R2	Basic Resurfacing – Double Lift
RM	Major Resurfacing
PR1	Pulverizing and Resurfacing- Single Lift
PR2	Pulverizing and Resurfacing—Double lift
BS	Base and Surface Tolerable -Tolerable standard for lower volume roads—Rural and Semi-Urban Cross sections only
RW	Resurface and widen
REC	Reconstruction
RNS	Reconstruction Nominal Storm Sewers (Urban: no new sewer, adjust Manholes, catchbasins, add sub-drain, remove and replace curb and gutter, granular and hot mix)
RSS	Reconstruction including installation of Storm Sewers (New storm sewers and manholes in addition to the above)
NC	Proposed New Road Construction
SRR	Storm Sewer Installation and Road reinstatement

TYPES OF IMPROVEMENTS

For each Type of Improvement **(Item 104)**, there are a number of specific road improvements that are included in the total cost relative to the Roadside Environment **(Item 32)** and the Design Class **(Item 105)**. The computer will check a number of Items on the appraisal sheet in order to select the appropriate factors and cross section standards and then calculate the Bench Mark Cost. For example, a Resurfacing and Widening improvement coded under Item 104 is a significantly different road cross section and cost when applied to a rural road vs. an urban arterial. The computer will make all of the necessary checks to arrive at the recommended improvement cost.

Described below are the road improvements and associated construction activities costed for each Type of Improvement listed under Item 104. Please note, that the Codes **(CO)** – Carry Over, **(SR)** – Spot Road, **(SI)** – Spot Intersection and **(SD)** – Spot Drainage are direct cost inputs and **are not** included in the Bench Mark Cost system.

(R1) - BASIC RESURFACING (Single Lift of Hot Mix – 50 mm)

RURAL AND SEMI-URBAN ROADS (Cross Section A)

(a) Hot mix padding for 20% of area to be resurfaced
(b) Single life of hot mix (50 mm)
(c) Granular material to raise shoulders to new surface grade

URBAN ROADS – Granular Base (Cross Section B-1)
– Concrete Base (Cross Section C-1)

(a) Minor base repairs for 10% of area to be resurfaced
(b) Hot mix padding for 20% of area to be resurfaced
(c) Curb removal and replacement on both sides for 50% of section length
(d) Planning 1.0m of existing pavement along both curbs
(e) Adjust manholes and catch basins to new surface grade
(f) Single lift of hot mix (50 mm)

(R2) - BASIC RESURFACING (Double Lift of Hot Mix – 100 mm)

RURAL AND SEMI-URBAN ROADS (Cross Section A)

(a) Hot mix padding for 20% of area to be resurfaced
(b) Double lift of hot mix (100 mm)
(c) Granular materials to raise shoulder to new surface grade

URBAN ROADS – Granular Base (Cross Section B-1)
– Concrete Base (Cross Section C-1)

(a) Minor base repairs for 10% of area to be resurfaced
(b) Hot mix padding for 20% of area to be resurfaced

(c) Curb removal and replacement on both sides for 50% of section length
(d) Planning 1.0 m of existing pavement along both curbs
(e) Adjust manholes and catch basins to new surface grade
(f) Double lift of hot mix (100 mm)

(RM) - MAJOR RESURFACING
(Double Lift of Hot Mix – 100 mm)

URBAN ROADS (Arterials and Collectors)
– Granular Base (Cross Section B-1)
– Concrete Base (Cross Section C-1)

(a) Base repairs for 50% of area to be resurfaced
(b) Planning for 50% of area to be resurfaced
(c) Curb removal and replacement on both sides for 50% of section length
(d) Adjust manholes and catch basins to new surface grade
(e) Double lift of hot mix (100 mm)

PR1) - PULVERIZING AND RESURFACING
(Single lift of Hot Mix – 50 mm)

RURAL ROADS (Cross Section A)

(a) Pulverize existing hard top surface
(b) Single lift of hot mix (50 mm)
(c) Granular material to raise shoulders to new surface grade

(PR2) - PULVERIZING AND RESURFACING
(Double Lift of Hot Mix – 100 mm)

RURAL ROADS (Cross Section A)

(a) Pulverize existing hard top surface
(b) Double lift of hot mix (100 mm)
(c) Granular material to raise shoulders to new surface grade

(BS) - BASE AND SURFACE

RURAL ROADS – TOLERABLE STANDARD (50 to 100 AADT) (Cross Section D)

(a) Granular material for base
(b) Granular material for loose top surface
(c) Minimal shoulder widening
(d) Minor ditching

RURAL ROADS – DESIGN STANDARD (200 to 399 AADT) (Cross Section D)

(a) Placing granular material
(b) Minimal shoulder widening
(c) Double surface treatment
(d) Minor ditching

RURAL ROADS – DESIGN STANDARD (400 plus AADT) (Cross Section D)
and
SEMI- URBAN ROADS – DESIGN STANDARD (Cross Section D)

(a) Placing granular material
(b) Minimal shoulder widening
(c) Hot mix (50/100 mm, see table F-1)
(d) Minor ditching

(RW) - RESURFACE AND WIDEN

RURAL ROADS – TOLERABLE STANDARD (50 to 199 AADT) (Cross Section E)

(a) Excavating for widening
(b) Ditching and side culvert replacement
(c) Granular material for widening base
(d) Granular material for loose top surface

RURAL ROADS – DESIGN STANDARD (200 to 399 AADT) (Cross Section E)

(a) Excavating for widening
(b) Ditching and side culvert replacement
(c) Granular material for widening base
(d) Double surface treatment

RURAL ROAD – DESIGN STANDARD (400 plus AADT) (Cross Section E)
and
SEMI-URBAN ROADS – DESIGN STANDARD (Cross Section E)

(a) Excavating for widening
(b) Ditching and side culvert replacement
(c) Granular material for widening base
(d) Base Course of hot mix for widening
(e) Hot mix Padding for 20% of existing surface area
(f) Single life of hot mix (50 mm)

URBAN ROADS – DESIGN STANDARD – Granular Base (Cross Section F)

(a) Excavating for widening
(b) Curb and Gutter removal
(c) Catch Basin removal
(d) Base repair 10% of existing surface area
(e) Granular material for widening
(f) Place catch basins and leads
(g) New curb and gutter

(h) New sub-drains
(i) Base course of hot mix for widening
(j) Hot mix padding for 20% of existing surface area
(k) Adjust manholes to new surface grade
(l) Single lift of hot mix (50 mm) curb to curb

URBAN ROADS – DESIGN STANDARD – Concrete Base (Cross section G)

(a) Excavating for widening
(b) Curb and gutter removal
(c) Catch basin removal
(d) Base repair for 10% of existing surface area
(e) Place new catch basins and leads
(f) Granular material for widening
(g) Concrete base for widening
(h) New curb and gutter
(i) New subdrains
(j) Base course of hot mix for widening
(k) Hot mix padding for 20% of existing surface area
(l) Adjust manholes to new surface grade
(m) Single lift of hot mix (50 mm) curb to curb

(REC) - RECONSTRUCTION (RURAL and SEMI-URBAN)

RURAL ROADS – DESIGN STANDAR (200 to 399 AADT) (Cross Section H)

(a) Excavate base material
(b) Ditching and side culvert replacement
(c) Grading
(d) Granular material
(e) Double surface treatment

RURAL ROADS – DESIGN STANDARD (400 plus AADT) Cross Section H)
and
SEMI-URBAN ROADS – DESIGN STANDARD (Cross Section H)

(a) Excavate base material
(b) Ditching and side culvert replacement
(c) Grading
(d) Granular material
(e) Hot mix (50/100 mm, see Table F-1)

RURAL and SEMI-URBAN ROADS – DESIGN STANDARD (Concrete Surface)
(Cross Section P)

(a) Excavate base material
(b) Ditching and side culvert replacement
(c) Grading
(d) Granular Material
(e) Concrete base and surface

(RNS) - RECONSTRUCTION NOMINAL STORM SEWERS (URBAN)

URBAN ROADS – DESIGN STANDARD – Granular Base (Cross Section I)

(a) Excavate base material
(b) Curb and gutter removal
(c) Granular base
(d) New curb and gutter
(e) New sub-drains
(f) Adjust manholes and catch basins
(g) Hot mix (50/100 mm, see Table F-1)

URBAN ROADS – DESIGN STANDARD – Concrete Base (Cross Section J)

(a) Excavate base material
(b) Curb and gutter removal
(c) Granular base
(d) Concrete base
(e) New curb and gutter
(f) New sub-drains
(g) Adjust manholes and catch basins
(h) Hot mix (50/100 mm, see Table H-5)

URBAN ROADS – DESIGN STANDARD – Concrete Surface (Cross Section O)

(a) Excavate base material
(b) Curb and gutter removal
(c) Granular base
(d) Concrete base and surface
(e) New curb and gutter
(f) New sub-drains
(g) Adjust manholes and catch basins

(RSS) - RECONSTRUCTION INCLUDING INSTALLATION OF STORM SEWERS

URBAN ROADS – DESIGN STANDARD – Granular Base (Cross Section K)

(a) Excavate base material
(b) Curb and gutter removal
(c) Storm sewer removal
(d) Manhole and Catch Basin removal including leads
(e) New storm sewers
(f) New manhole and catch basins including leads
(g) New curb and gutter
(h) New sub-drains
(i) Granular base
(j) Hot mix (100/150 mm, see Table F-1)

URBAN ROADS – DESIGN STANDARD – Concrete Base (Cross Section L)

(a) Excavate base material
(b) Curb and gutter removal
(c) Storm sewer removal
(d) Manhole and Catch Basin removal including leads
(e) New storm sewers
(f) New manhole and catch basins including leads
(g) New curb and gutter
(h) New sub-drains
(i) Granular base
(j) Concrete base
(k) Hot mix (50/100 mm, see Table F-1)

URBAN ROADS – DESIGN STANDARD – Concrete Surface (Cross Section Q)

(a) Excavate base material
(b) Curb and gutter removal
(c) Storm sewer removal
(d) Manhole and Catch Basin removal including leads
(e) New storm sewers
(f) New manhole and catch basins including leads
(g) New curb and gutter
(h) New sub-drains
(i) Granular base
(j) Concrete base and surface

(NC) - PROPOSED ROAD CONSTRUCTION

RURAL ROADS – DESIGN STANDARD (200 – 399 AADT) (Cross Section H)

(a) Grading
(b) Ditching and cross culverts
(c) Granular base
(d) Double surface treatment

RURAL ROADS – DESIGN STANDARD (400 plus AADT) (Cross Section H)

(a) Grading
(b) Ditching and cross culverts
(c) Granular base
(d) Hot mix (50.100 mm, see Table F-1)

SEMI-URBAN ROADS

- New Construction does not apply to semi-urban roads as there is no existing frontage development.

URBAN ROADS – DESIGN STANDARD – Granular Base (Cross Section K)

(a) Grading
(b) Storm Sewers
(c) Manholes and catch basins including leads
(d) Curb and gutter
(e) Sub-drains
(f) Granular base
(g) Hot mix (100 mm/150 mm, see Table F-1)

URBAN ROADS – DESIGN STANDARD – Concrete Base (Cross Section L)

(a) Grading
(b) Storm Sewers
(c) Manholes and catch basins including leads
(d) Curb and gutter
(e) Sub-drains
(f) Granular base
(g) Concrete base
(h) Hot mix (50 mm/100 mm , see Table F-1)

(SRR) - STORM SEWER INSTALLATION AND ROAD REINSTATEMENT (URBAN AND SEMI-URBAN)

URBAN AND SEMI-URBAN ROADS – Granular Base (Cross Section M)

(a) Trenching and removal of existing storm sewers
(b) New manholes and adjust catch basin leads
(c) New storm sewer including bedding
(d) Granular materials in trench
(e) Hot mix to restore surface grade (100/150 mm, see Table F-1)

URBAN and SEMI-URBAN ROADS – Concrete Base (Cross Section N)

(a) Trenching and removal of existing storm sewers
(b) New manholes and adjust catch basin leads
(c) New storm sewers including bedding
(d) Granular material in trench
(e) Concrete base for trenched area
(f) Hot mix to restore surface grade (50/100 mm, See Table F-1)

URBAN and SEMI-URBAN ROADS – Concrete Surface (Cross Section R)

(a) Trenching and removal of existing storm sewers
(b) New manholes and adjust catch basin leads
(c) New storm sewers including bedding
(d) Granular material in trench
(e) Concrete base and surface for trenched area

Town of Gananoque
Improvement Needs

Data Last Refreshed March 02, 2011 4:33:41PM

NOW Const

Priority	Section No.	Road Name	From/ To	AADT	Length (km)	Improv. Time	Improv. Type	Improv. Cost ($)
46	910	ALBERTA STREET	QUEEN STREET STONE STREET NORTH	1,099	0.09	NOW	RSS	362,568
43	1400	MACDONALD DRIVE	ELMWOOD DRIVE 175M EAST OF ELMWOOD DRIVE	500	0.18	NOW	RSS	383,307
42	850	CHARLES STREET NORTH	GARDEN STREET NORTH STREET	5,070	0.19	NOW	RNS	278,601
41	680	NORTH STREET	WILLIAM STREET NORTH INTERSECTION	1,026	0.20	NOW	RSS	453,673
40	1580	BEAVER ROAD	WEST END CROSBY ROAD	50	0.79	NOW	REC	412,869
39	1430	CHURCHILL DRIVE	20M EAST OF ELMWOOD DRIVE ELIZABETH DRIVE	450	0.09	NOW	RSS	204,153
39	2210	MAPLE STREET SOUTH	WINDSOR STREET KING STREET WEST	900	0.30	NOW	RSS	819,389
39	400	COWANS ALLEY	KING STREET EAST GARDEN STREET	200	0.10	NOW	RSS	146,296
38	470	WILSON DRIVE	TALBOT PLACE 60M NORTH OF TALBOT PLACE	500	0.06	NOW	REC	44,460
37	1790	VICTORIA AVENUE	FIRST STREET KING STREET WEST	1,500	0.19	NOW	RNS	189,296
36	2220	MAPLE STREET SOUTH	KING STREET WEST WINDSOR STREET	270	0.18	NOW	RSS	716,106
35	2180	OSBORNE STREET	KING STREET WEST WINDSOR STREET	350	0.29	NOW	RSS	792,076
35	1460	ELIZABETH DRIVE	CHURCHILL DRIVE PINE STREET EAST	800	0.23	NOW	RSS	521,724
35	860	CHARLES STREET NORTH	NORTH STREET GEORGIANA STREET	4,200	0.20	NOW	RNS	321,262
34	480	WILSON DRIVE	60M NORTH OF TALBOT PLACE 230M NORTH OF TALBOT PLACE	500	0.18	NOW	REC	122,819

NOW Const

Priority	Section No.	Road Name	From/ To	AADT	Length (km)	Improv. Time	Improv. Type	Improv. Cost ($)
34	1250	WILLIAM STREET SOUTH	COOPERS ALLEY THOMAS STREET	1,883	0.04	NOW	RNS	56,653
34	2190	WINDSOR STREET	OSBORNE STREET EAST END	52	0.05	NOW	REC	34,116
34	2250	STEEL STREET	DEMPSTER LANE MAPLE STREET SOUTH	350	0.18	NOW	RSS	716,106
33	1630	FOURTH STREET	CROSBY ROAD GANANOQUE TRAIL CROSSING	200	0.21	NOW	REC	173,901
33	410	COOPERS ALLEY	COWANS ALLEY STONE STREET NORTH	200	0.10	NOW	RSS	144,509
33	610	BROCK STREET	WILLIAM STREET NORTH JAMES STREET NORTH	850	0.20	NOW	RSS	469,104
32	800	CHARLES STREET SOUTH	SOUTH END SOUTH STREET	50	0.05	NOW	REC	44,611
32	2240	DEMPSTER LANE	STEEL STREET WEST END	217	0.22	NOW	RSS	499,040
31	1140	JAMES STREET NORTH	GEORGIANA STREET FORSYTH STREET	400	0.10	NOW	RSS	226,836
31	1410	ELMWOOD DRIVE	PINE STREET MACDONALD DRIVE	350	0.13	NOW	RSS	294,887
31	440	COOPERS ALLEY	WILLIAM STREET NORTH JAMES STREET NORTH	100	0.20	NOW	RSS	281,273
31	250	ARTHUR STREET	60M EAST OF WILLIAM STREET SOUTH EAST END	60	0.08	NOW	RSS	181,469
30	290	WELLINGTON STREET	CHARLES STREET SOUTH WILLIAM STREET SOUTH	404	0.20	NOW	RSS	795,673
30	620	BROCK STREET	CHARLES STREET NORTH WILLIAM STREET NORTH	850	0.20	NOW	RNS	283,265
30	1130	GEORGIANA STREET	WILLIAM STREET NORTH JAMES STREET NORTH	400	0.20	NOW	RSS	453,673
29	1310	PINE STREET	WEST END CULDESAC JAMES STREET SOUTH	106	0.11	NOW	RSS	249,520
29	600	BROCK STREET	JAMES STREET NORTH HERBERT STREET	202	0.20	NOW	RSS	453,673

Priority	Section No.	Road Name	From/ To	AADT	Length (km)	Improv. Time	Improv. Type	Improv. Cost ($)
29	160	JOHN STREET	STONE STREET SOUTH CHARLES STREET SOUTH	570	0.20	NOW	RSS	903,690
29	1690	FOURTH STREET	GANANOQUE TRAIL CROSSING FIRST STREET	600	0.14	NOW	RNS	198,285
29	1330	PINE STREET	ELIZABETH DRIVE WILMER AVENUE	500	0.11	NOW	RSS	249,520
28	1820	MAPLE STREET NORTH	SECOND AVENUE NORTH END	50	0.23	NOW	REC	572,408
28	2230	ONTARIO STREET	HILLSIDE DRIVE STEEL STREET	270	0.09	NOW	RSS	358,053
27	2070	CLARENCE STREET	MAIN STREET MARKET STREET	1,000	0.09	NOW	RNS	127,469
27	1780	VICTORIA AVENUE	SECOND AVENUE FIRST STREET	1,286	0.20	NOW	RNS	625,265
27	1650	FOURTH STREET	OAK STREET RIVER STREET	250	0.09	NOW	RSS	204,153
27	170	JOHN STREET	CHARLES STREET SOUTH WILLIAM STREET SOUTH	404	0.20	NOW	RSS	811,104
27	1210	WILLIAM STREET SOUTH	ARTHUR STREET WELLINGTON STREET	850	0.10	NOW	RNS	141,632
26	450	COOPERS ALLEY	JAMES STREET NORTH HERBERT STREET	100	0.20	NOW	RSS	266,041
26	430	COOPERS ALLEY	CHARLES STREET NORTH WILLIAM STREET NORTH	100	0.20	NOW	RSS	285,443
26	2080	CLARENCE STREET	MARKET STREET BAY ROAD	1,000	0.05	NOW	RNS	70,816
26	1850	SECOND AVENUE	ELM STREET VICTORIA AVENUE	150	0.10	NOW	RSS	226,836
25	2020	BAY ROAD	600M NORTH OF CLARENCE KING STREET WEST	50	0.10	NOW	REC	67,133
25	1600	NALON ROAD	CROSBY ROAD QUARRY ENTRANCE	100	0.08	NOW	REC	66,248
25	390	OAK ALLEY	STONE STREET SOUTH CHARLES STREET SOUTH	50	0.21	NOW	RSS	299,715

NOW Const

Priority	Section No.	Road Name	From/ To	AADT	Length (km)	Improv. Time	Improv. Type	Improv. Cost ($)
25	420	COOPERS ALLEY	STONE STREET NORTH CHARLES STREET NORTH	200	0.20	NOW	RNS	107,786
24	380	OAK ALLEY	CHARLES STREET SOUTH WILLIAM STREET SOUTH	50	0.20	NOW	RSS	285,443
24	1610	CROSBY ROAD	NALON ROAD FOURTH STREET	100	0.26	NOW	REC	215,306
24	1880	FIRST STREET	BIRCH STREET VICTORIA AVENUE	180	0.19	NOW	RSS	430,989
24	1830	SECOND AVENUE	MAPLE STREET NORTH BIRCH STREET	150	0.09	NOW	RSS	204,153
24	1750	OAK STREET	THIRD STREET 80M SOUTH OF THIRD STREET	50	0.08	NOW	RSS	181,469
22	2200	WINDSOR STREET	MAPLE STREET SOUTH OSBORNE STREET	62	0.06	NOW	REC	40,940
22	370	PINE STREET	CHARLES STREET SOUTH WILLIAM STREET SOUTH	405	0.20	NOW	RNS	283,265
22	690	NORTH STREET	JAMES STREET NORTH HERBERT STREET	203	0.20	NOW	RSS	453,673
22	320	SYDENHAM STREET	STONE STREET SOUTH CHARLES STREET SOUTH	403	0.20	NOW	RNS	625,265
21	360	PINE STREET	STONE STREET SOUTH CHARLES STREET SOUTH	405	0.20	NOW	RNS	283,265
21	1010	EMMA STREET	EMMA INTERSECTION SOUTH END	73	0.07	NOW	RSS	158,786
20	230	ARTHUR STREET	CHARLES STREET SOUTH WILLIAM STREET SOUTH	404	0.20	NOW	RNS	283,265
20	1730	THIRD STREET	WEST END VICTORIA AVENUE	50	0.10	NOW	RSS	226,836
19	1900	FIRST STREET	HICKORY STREET TANNER STREET	309	0.08	NOW	RNS	250,106
19	180	JOHN STREET	WILLIAM STREET SOUTH 50 M EAST OF WILLIAM STREET SOUTH	50	0.05	NOW	RSS	113,418
Totals:	**NOW Const**				**10.51**			**20,744,684**

Priority	Section No.	Road Name	From/ To	AADT	Length (km)	Improv. Time	Improv. Type	Improv. Cost ($)
37	1450	ELIZABETH DRIVE	WILLIAM STREET SOUTH CHURCHILL DRIVE	800	0.32	1-5	RSS	725,877
28	1950	ELM STREET	FIRST STREET SECOND AVENUE	385	0.20	1-5	RSS	453,673
25	1800	BIRCH STREET	KING STREET WEST SECOND AVENUE	379	0.38	1-5	RSS	1,687,692
25	330	SYDENHAM STREET	CHARLES STREET SOUTH WILLIAM STREET SOUTH	403	0.20	1-5	RNS	520,163
24	900	JAMES A BRENNAN ROAD	CHARLES STREET NORTH NORTH END	494	0.41	1-5	RSS	930,029
22	1270	WILLIAM STREET SOUTH	BROCK STREET NORTH STREET	1,200	0.10	1-5	RNS	169,586
21	1440	CHURCHILL DRIVE	ELIZABETH DRIVE PINE STREET EAST	400	0.20	1-5	RSS	453,673
20	1810	MAPLE STREET NORTH	SECOND AVENUE SOUTH END	50	0.07	1-5	REC	177,438
20	630	BROCK STREET	STONE STREET NORTH CHARLES STREET NORTH	850	0.20	1-5	RNS	283,265
19	220	ARTHUR STREET	STONE STREET SOUTH CHARLES STREET SOUTH	404	0.20	1-5	RNS	283,265
18	1050	HENRIETTA STREET	EMMA STREET GEORGIANA STREET	201	0.20	1-5	RSS	453,673
Totals:	**1-5**	**Const**			**2.48**			**6,138,334**

Priority	Section No.	Road Name	From/ To	AADT	Length (km)	Improv. Time	Improv. Type	Improv. Cost ($)
33	880	CHARLES STREET NORTH	120M E OF JAMES A BRENNAN ROAD/ PW YARD ENT. JAMES A BRENNAN ROAD	3,403	0.12	6-10	RSS	335,005
28	1180	HERBERT STREET	GARDEN STREET NORTH STREET	1,400	0.20	6-10	RSS	546,259
28	1670	RIVER STREET	FOURTH STREET THIRD STREET	700	0.21	6-10	RNS	640,313
26	950	BOOTH STREET	QUEEN STREET STONE STREET NORTH	400	0.09	6-10	RSS	204,153
25	1280	WILLIAM STREET SOUTH	NORTH STREET GEORGIANA STREET	600	0.19	6-10	RSS	430,989
24	1760	VICTORIA AVENUE	FOURTH STREET THIRD STREET	1,200	0.21	6-10	RSS	476,357
23	930	QUEEN STREET	NORTH END ALBERTA STREET	500	0.26	6-10	RSS	589,775
22	1710	MACHAR STREET	BRIDGE ADELAIDE STREET	1,791	0.09	6-10	RSS	204,153
22	1770	VICTORIA AVENUE	THIRD STREET SECOND AVENUE	1,210	0.20	6-10	RSS	453,673
22	1720	THIRD STREET	VICTORIA AVENUE RIVER STREET	200	0.20	6-10	RSS	453,673
21	2000	BAY ROAD	CLARENCE STREET 170M NORTH OF CLARENCE STREET	1,000	0.17	6-10	RSS	385,622
21	940	QUEEN STREET	ALBERTA STREET BOOTH STREET	284	0.12	6-10	RSS	272,204
21	970	QUEEN STREET	BOOTH STREET ANN STREET	284	0.17	6-10	RSS	385,622
20	1740	OAK STREET	FOURTH STREET THIRD STREET	200	0.20	6-10	RNS	205,852
19	1470	ELIZABETH DRIVE	PINE STREET EAST KING STREET EAST	800	0.09	6-10	RSS	204,153
18	1150	JAMES STREET NORTH	FORSYTH STREET GARDEN STREET	800	0.29	6-10	RSS	657,826
18	240	ARTHUR STREET	WILLIAM STREET SOUTH 60M EAST OF WILLIAM STREET SOUTH	60	0.06	6-10	RSS	136,102

6-10 Const

Priority	Section No.	Road Name	From/ To	AADT	Length (km)	Improv. Time	Improv. Type	Improv. Cost ($)
16	740	ADELAIDE STREET	BROCK STREET NORTH STREET	1,540	0.09	6-10	RSS	204,153
16	750	ADELAIDE STREET	GARDEN STREET BROCK STREET	820	0.13	6-10	RSS	294,887
16	1300	JAMES STREET SOUTH	KING STREET EAST PINE STREET	500	0.09	6-10	RSS	204,153
16	1420	ELMWOOD DRIVE	MACDONALD DRIVE CHURCHILL DRIVE	350	0.17	6-10	RSS	385,622
16	980	QUEEN STREET	ANN STREET SOUTH END	91	0.09	6-10	RSS	204,153
15	280	WELLINGTON STREET	STONE STREET SOUTH CHARLES STREET SOUTH	404	0.20	6-10	RNS	625,265
15	1640	FOURTH STREET	GANANOQUE TRAIL CROSSING OAK STREET	250	0.16	6-10	RSS	362,938
14	1840	SECOND AVENUE	BIRCH STREET ELM STREET	150	0.09	6-10	RSS	204,153
14	1320	PINE STREET	JAMES STREET SOUTH ELIZABETH DRIVE	201	0.20	6-10	RSS	453,673
14	1290	FORSYTH STREET	WILLIAM STREET NORTH JAMES STREET NORTH	200	0.20	6-10	RSS	453,673
12	920	ALBERTA STREET	WEST END QUEEN STREET	125	0.12	6-10	RSS	272,204
6	990	ANN STREET	QUEEN STREET STONE STREET NORTH	280	0.09	6-10	RSS	204,153
Totals:	**6-10**	**Const**			**4.50**			**10,450,755**

1-5 Rehab

Priority	Section No.	Road Name	From/ To	AADT	Length (km)	Improv. Time	Improv. Type	Improv. Cost ($)
42	1560	KING STREET EAST	HERBERT STREET WILSON DRIVE	14,948	0.24	1-5	R2	214,912
41	1510	KING STREET WEST	GARFIELD STREET BAY ROAD	6,800	0.50	1-5	R2	364,177
26	2140	WATER STREET WEST	MARKET STREET MAIN STREET	1,500	0.09	1-5	R2	80,393
22	1200	WILLIAM STREET SOUTH	SOUTH STREET ARTHUR STREET	850	0.22	1-5	R2	143,236
18	650	NORTH STREET	ADELAIDE STREET STONE STREET NORTH	1,026	0.13	1-5	R1	54,914
16	130	SOUTH STREET	CHARLES STREET SOUTH WILLIAM STREET SOUTH	404	0.20	1-5	R1	87,672
16	10	STONE STREET NORTH	401 EXIT RAMP ALBERTA STREET	7,984	0.41	1-5	R1	269,204
16	1890	FIRST STREET	VICTORIA AVENUE HICKORY STREET	353	0.17	1-5	R1	68,015
14	490	TALBOT PLACE	GARDEN STREET WILSON DRIVE	281	0.06	1-5	R1	26,302
Totals:	**1-5**	**Rehab**			**2.02**			**1,308,826**

6-10 Rehab

Priority	Section No.	Road Name	From/ To	AADT	Length (km)	Improv. Time	Improv. Type	Improv. Cost ($)
32	20	STONE STREET NORTH	ALBERTA STREET CULVERT	8,764	0.51	6-10	R1	263,810
29	30	STONE STREET NORTH	CULVERT NORTH STREET	5,400	0.44	6-10	R1	224,591
20	80	STONE STREET SOUTH	SYDENHAM STREET WELLINGTON STREET	2,329	0.10	6-10	R1	50,116
20	1160	JAMES STREET NORTH	GARDEN STREET KING STREET EAST	1,200	0.10	6-10	R1	45,112
16	1110	GEORGIANA STREET	STONE STREET NORTH HENRIETTA STREET	700	0.10	6-10	R1	45,431
12	500	GARDEN STREET	HERBERT STREET TALBOT PLACE	281	0.22	6-10	R1	96,440
8	110	STONE STREET SOUTH	SOUTH STREET STONE STREET SOUTH	50	0.02	6-10	R1	8,248
Totals: 6-10 Rehab					**1.49**			**733,748**

6-10 Maintenance

Priority	Section No.	Road Name	From/ To	AADT	Length (km)	Improv. Time	Improv. Type	Improv. Cost ($)
13	960	BOOTH STREET	WEST END / QUEEN STREET	172	0.08	6-10	SD	0
Totals:	**6-10**	**Maintenance**			**0.08**			**0**
Grand Total:					**21.08**			**39,376,347**

Appendix 2

Critical Deficiencies and Recommended Improvements Summary for Roads

Town of Gananoque
Critical Deficiencies and Recommended Improvements

Data Last Refreshed March 02, 2011 4:27:45PM

Section No.	Road Name	From/ To	Length (km)	AADT	Critical Deficiency: Geo-metrics	Surf. Type	Surf. Width	Capacity	Struct. Adeq.	Drainage	Improv. Type	Improv. Cost ($)
740	ADELAIDE STREET	BROCK STREET NORTH STREET	0.09	1,540	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	6-10	RSS	204,153
750	ADELAIDE STREET	GARDEN STREET BROCK STREET	0.13	820	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	6-10	RSS	294,887
910	ALBERTA STREET	QUEEN STREET STONE STREET NORTH	0.09	1,099	ADEQ	ADEQ	ADEQ	ADEQ	NOW	1-5	RSS	362,568
920	ALBERTA STREET	WEST END QUEEN STREET	0.12	125	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	6-10	RSS	272,204
990	ANN STREET	QUEEN STREET STONE STREET NORTH	0.09	280	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	6-10	RSS	204,153
1380	ARTHUR STREET	20M EAST OF CONNOR DRIVE 210M WEST OF CONNOR DRIVE	0.23	228	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
220	ARTHUR STREET	STONE STREET SOUTH CHARLES STREET SOUTH	0.20	404	ADEQ	ADEQ	ADEQ	ADEQ	1-5	ADEQ	RNS	283,265
230	ARTHUR STREET	CHARLES STREET SOUTH WILLIAM STREET SOUTH	0.20	404	ADEQ	ADEQ	ADEQ	ADEQ	NOW	ADEQ	RNS	283,265
240	ARTHUR STREET	WILLIAM STREET SOUTH 60M EAST OF WILLIAM STREET SOUTH	0.06	60	ADEQ	ADEQ	ADEQ	ADEQ	6-10	6-10	RSS	136,102
250	ARTHUR STREET	60M EAST OF WILLIAM STREET SOUTH EAST END	0.08	60	ADEQ	NOW	NOW	ADEQ	NOW	1-5	RSS	181,469
260	ASH ALLEY	CHARLES STREET SOUTH WILLIAM STREET SOUTH	0.20	45	ADEQ	NOW	NOW	ADEQ	NOW	6-10	NONE	0
270	ASH ALLEY	STONE STREET SOUTH CHARLES STREET SOUTH	0.20	45	ADEQ	NOW	NOW	ADEQ	NOW	6-10	NONE	0

Section No.	Road Name	From/ To	Length (km)	AADT	Critical Deficiency Geo-metrics	Surf. Type	Surf. Width	Capacity	Struct. Adeq.	Drainage	Improv. Type	Improv. Cost ($)
2000	BAY ROAD	CLARENCE STREET 170M NORTH OF CLARENCE STREET	0.17	1,000	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	6-10	RSS	385,622
2010	BAY ROAD	170M NORTH OF CLARENCE STREET 600M NORTH OF CLARENCE	0.43	20	ADEQ	NOW	ADEQ	ADEQ	NOW	6-10	NONE	0
2020	BAY ROAD	600M NORTH OF CLARENCE KING STREET WEST	0.10	50	ADEQ	ADEQ	ADEQ	ADEQ	NOW	6-10	REC	67,133
1580	BEAVER ROAD	WEST END CROSBY ROAD	0.79	50	ADEQ	ADEQ	NOW	ADEQ	NOW	NOW	REC	412,869
1800	BIRCH STREET	KING STREET WEST SECOND AVENUE	0.38	379	ADEQ	ADEQ	ADEQ	ADEQ	1-5	6-10	RSS	1,687,692
950	BOOTH STREET	QUEEN STREET STONE STREET NORTH	0.09	400	ADEQ	ADEQ	ADEQ	ADEQ	6-10	6-10	RSS	204,153
960	BOOTH STREET	WEST END QUEEN STREET	0.08	172	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	6-10	SD	0
760	BROCK STREET	ADELAIDE STREET PARK ENTRANCE	0.13	490	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
770	BROCK STREET	PARK ENTRANCE PARK STREET	0.07	490	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
780	BROCK STREET	PARK STREET KING STREET EAST	0.12	490	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
600	BROCK STREET	JAMES STREET NORTH HERBERT STREET	0.20	202	ADEQ	ADEQ	ADEQ	ADEQ	NOW	6-10	RSS	453,673
610	BROCK STREET	WILLIAM STREET NORTH JAMES STREET NORTH	0.20	850	ADEQ	ADEQ	ADEQ	ADEQ	NOW	6-10	RSS	469,104
620	BROCK STREET	CHARLES STREET NORTH WILLIAM STREET NORTH	0.20	850	ADEQ	ADEQ	ADEQ	ADEQ	NOW	ADEQ	RNS	283,265
630	BROCK STREET	STONE STREET NORTH CHARLES STREET NORTH	0.20	850	ADEQ	ADEQ	ADEQ	ADEQ	1-5	ADEQ	RNS	283,265

Section No.	Road Name	From/ To	Length (km)	AADT	Critical Deficiency Geo-metrics	Surf. Type	Surf. Width	Capacity	Struct. Adeq.	Drainage	Improv. Type	Improv. Cost ($)
640	BROCK STREET	CHARLES STREET NORTH STONE STREET NORTH	0.13	1,140	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
300	CEDAR ALLEY	WILLIAM STREET SOUTH CHARLES STREET SOUTH	0.20	45	ADEQ	NOW	NOW	ADEQ	NOW	6-10	NONE	0
310	CEDAR ALLEY	STONE STREET SOUTH CHARLES STREET SOUTH	0.20	45	ADEQ	NOW	NOW	ADEQ	NOW	6-10	NONE	0
1920	CENTRE STREET	KING STREET WEST TANNER STREET	0.13	50	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
850	CHARLES STREET NORTH	GARDEN STREET NORTH STREET	0.19	5,070	ADEQ	ADEQ	ADEQ	ADEQ	NOW	ADEQ	RNS	278,601
860	CHARLES STREET NORTH	NORTH STREET GEORGIANA STREET	0.20	4,200	ADEQ	ADEQ	ADEQ	ADEQ	NOW	ADEQ	RNS	321,262
870	CHARLES STREET NORTH	GEORGIANA STREET 120M E OF JAMES A BRENNAN ROAD/ PW YARD ENT.	0.59	3,800	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
880	CHARLES STREET NORTH	120M E OF JAMES A BRENNAN ROAD/ PW YARD ENT. JAMES A BRENNAN ROAD	0.12	3,403	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	6-10	RSS	335,005
890	CHARLES STREET NORTH	JAMES A BRENNAN ROAD STONE STREET NORTH	0.05	4,000	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
800	CHARLES STREET SOUTH	SOUTH END SOUTH STREET	0.05	50	ADEQ	ADEQ	NOW	ADEQ	NOW	6-10	REC	44,611
810	CHARLES STREET SOUTH	SOUTH STREET ARTHUR STREET	0.22	800	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
820	CHARLES STREET SOUTH	ARTHUR STREET PINE STREET	0.30	1,250	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
830	CHARLES STREET SOUTH	PINE STREET KING STREET EAST	0.10	2,571	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
840	CHARLES STREET SOUTH	KING STREET EAST GARDEN STREET	0.10	5,070	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0

Section No.	Road Name	From/ To	Length (km)	AADT	Critical Deficiency Geo-metrics	Surf. Type	Surf. Width	Capacity	Struct. Adeq.	Drainage	Improv. Type	Improv. Cost ($)
1480	CHARMICHAEL DRIVE	KING STREET EAST SOUTH END	0.15	3,000	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
2040	CHURCH STREET	KING STREET WEST SOUTH END	0.19	187	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
1430	CHURCHILL DRIVE	20M EAST OF ELMWOOD DRIVE ELIZABETH DRIVE	0.09	450	ADEQ	ADEQ	ADEQ	ADEQ	NOW	1-5	RSS	204,153
1440	CHURCHILL DRIVE	ELIZABETH DRIVE PINE STREET EAST	0.20	400	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	1-5	RSS	453,673
2060	CLARENCE STREET	MILL STREET MAIN STREET	0.08	832	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
2070	CLARENCE STREET	MAIN STREET MARKET STREET	0.09	1,000	ADEQ	ADEQ	ADEQ	ADEQ	NOW	ADEQ	RNS	127,469
2080	CLARENCE STREET	MARKET STREET BAY ROAD	0.05	1,000	ADEQ	ADEQ	ADEQ	ADEQ	NOW	ADEQ	RNS	70,816
1370	CONNER DRIVE	MACDONALD DRIVE ARTHUR STREET	0.07	300	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
410	COOPERS ALLEY	COWANS ALLEY STONE STREET NORTH	0.10	200	ADEQ	ADEQ	ADEQ	ADEQ	NOW	1-5	RSS	144,509
420	COOPERS ALLEY	STONE STREET NORTH CHARLES STREET NORTH	0.20	200	ADEQ	ADEQ	ADEQ	ADEQ	NOW	ADEQ	RNS	107,786
430	COOPERS ALLEY	CHARLES STREET NORTH WILLIAM STREET NORTH	0.20	100	ADEQ	ADEQ	ADEQ	ADEQ	NOW	1-5	RSS	285,443
440	COOPERS ALLEY	WILLIAM STREET NORTH JAMES STREET NORTH	0.20	100	ADEQ	ADEQ	ADEQ	ADEQ	NOW	1-5	RSS	281,273
450	COOPERS ALLEY	JAMES STREET NORTH HERBERT STREET	0.20	100	ADEQ	NOW	ADEQ	ADEQ	NOW	1-5	RSS	266,041
400	COWANS ALLEY	KING STREET EAST GARDEN STREET	0.10	200	ADEQ	ADEQ	NOW	ADEQ	NOW	1-5	RSS	146,296

Section No.	Road Name	From/ To	Length (km)	AADT	Critical Deficiency Geo-metrics	Surf. Type	Surf. Width	Capacity	Struct. Adeq.	Drainage	Improv. Type	Improv. Cost ($)
1610	CROSBY ROAD	NALON ROAD FOURTH STREET	0.26	100	ADEQ	ADEQ	ADEQ	ADEQ	NOW	6-10	REC	215,306
1620	CROSBY ROAD	FOURTH STREET 30M SOTH OF FOURTH STREET	0.05	20	ADEQ	ADEQ	ADEQ	ADEQ	NOW	NOW	NONE	0
2240	DEMPSTER LANE	STEEL STREET WEST END	0.22	217	ADEQ	ADEQ	ADEQ	ADEQ	NOW	1-5	RSS	499,040
1450	ELIZABETH DRIVE	WILLIAM STREET SOUTH CHURCHILL DRIVE	0.32	800	ADEQ	ADEQ	ADEQ	ADEQ	1-5	1-5	RSS	725,877
1460	ELIZABETH DRIVE	CHURCHILL DRIVE PINE STREET EAST	0.23	800	ADEQ	ADEQ	ADEQ	ADEQ	NOW	1-5	RSS	521,724
1470	ELIZABETH DRIVE	PINE STREET EAST KING STREET EAST	0.09	800	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	6-10	RSS	204,153
1940	ELM STREET	KING STREET WEST FIRST STREET	0.18	385	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
1950	ELM STREET	FIRST STREET SECOND AVENUE	0.20	385	ADEQ	ADEQ	ADEQ	ADEQ	1-5	6-10	RSS	453,673
1410	ELMWOOD DRIVE	PINE STREET MACDONALD DRIVE	0.13	350	ADEQ	ADEQ	ADEQ	ADEQ	NOW	1-5	RSS	294,887
1420	ELMWOOD DRIVE	MACDONALD DRIVE CHURCHILL DRIVE	0.17	350	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	6-10	RSS	385,622
1000	EMMA STREET	CHARLES STREET NORTH EMMA INTERSECTION	0.06	250	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
1010	EMMA STREET	EMMA INTERSECTION SOUTH END	0.07	73	ADEQ	ADEQ	ADEQ	ADEQ	NOW	6-10	RSS	158,786
1020	EMMA STREET	EMMA INTERSECTION EMMA BEND	0.07	160	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
1030	EMMA STREET	EMMA BEND HENRIETTA STREET	0.09	100	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0

Section No.	Road Name	From/ To	Length (km)	AADT	Critical Deficiency Geo-metrics	Surf. Type	Surf. Width	Capacity	Struct. Adeq.	Drainage	Improv. Type	Improv. Cost ($)
1040	EMMA STREET	HENRIETTA STREET WEST END	0.02	40	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	6-10	NONE	0
1880	FIRST STREET	BIRCH STREET VICTORIA AVENUE	0.19	180	ADEQ	ADEQ	NOW	ADEQ	6-10	6-10	RSS	430,989
1890	FIRST STREET	VICTORIA AVENUE HICKORY STREET	0.17	353	ADEQ	ADEQ	ADEQ	ADEQ	1-5	ADEQ	R1	68,015
1900	FIRST STREET	HICKORY STREET TANNER STREET	0.08	309	ADEQ	ADEQ	ADEQ	ADEQ	NOW	ADEQ	RNS	250,106
1910	FIRST STREET	TANNER STREET BEND	0.23	309	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	393,300
1290	FORSYTH STREET	WILLIAM STREET NORTH JAMES STREET NORTH	0.20	200	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	6-10	RSS	453,673
1630	FOURTH STREET	CROSBY ROAD GANANOQUE TRAIL CROSSING	0.21	200	ADEQ	ADEQ	ADEQ	ADEQ	NOW	NOW	REC	173,901
1640	FOURTH STREET	GANANOQUE TRAIL CROSSING OAK STREET	0.16	250	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	6-10	RSS	362,938
1650	FOURTH STREET	OAK STREET RIVER STREET	0.09	250	ADEQ	ADEQ	ADEQ	ADEQ	NOW	6-10	RSS	204,153
1680	FOURTH STREET	THIRD STREET GANANOQUE TRAIL CROSSING	0.26	1,800	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	444,600
1690	FOURTH STREET	GANANOQUE TRAIL CROSSING FIRST STREET	0.14	600	ADEQ	ADEQ	ADEQ	ADEQ	NOW	ADEQ	RNS	198,285
560	GARDEN ALLEY	ADELAIDE STREET STONE STREET NORTH	0.13	45	ADEQ	ADEQ	NOW	ADEQ	NOW	1-5	NONE	0
570	GARDEN ALLEY	STONE STREET NORTH CHARLES STREET NORTH	0.20	45	ADEQ	ADEQ	ADEQ	ADEQ	NOW	1-5	NONE	0
580	GARDEN ALLEY	CHARLES STREET NORTH WILLIAM STREET NORTH	0.20	45	ADEQ	NOW	NOW	ADEQ	NOW	1-5	NONE	0

Section No.	Road Name	From/ To	Length (km)	AADT	Critical Deficiency Geo-metrics	Surf. Type	Surf. Width	Capacity	Struct. Adeq.	Drainage	Improv. Type	Improv. Cost ($)
590	GARDEN ALLEY	WILLIAM STREET NORTH JAMES STREET NORTH	0.20	45	ADEQ	NOW	ADEQ	ADEQ	NOW	1-5	NONE	0
510	GARDEN STREET	JAMES STREET NORTH HERBERT STREET	0.20	202	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
520	GARDEN STREET	WILLIAM STREET NORTH JAMES STREET NORTH	0.20	850	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
530	GARDEN STREET	CHARLES STREET NORTH WILLIAM STREET NORTH	0.20	850	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
540	GARDEN STREET	STONE STREET NORTH CHARLES STREET NORTH	0.21	850	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
550	GARDEN STREET	ADELAIDE STREET STONE STREET NORTH	0.10	800	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
500	GARDEN STREET	HERBERT STREET TALBOT PLACE	0.22	281	ADEQ	ADEQ	ADEQ	ADEQ	6-10	ADEQ	R1	96,440
2260	GARFIELD STREET	KING STREET WEST WEST END	0.40	200	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
1110	GEORGIANA STREET	STONE STREET NORTH HENRIETTA STREET	0.10	700	ADEQ	ADEQ	ADEQ	ADEQ	6-10	ADEQ	R1	45,431
1120	GEORGIANA STREET	HENRIETTA STREET WILLIAM STREET NORTH	0.29	700	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
1130	GEORGIANA STREET	WILLIAM STREET NORTH JAMES STREET NORTH	0.20	400	ADEQ	ADEQ	ADEQ	ADEQ	NOW	6-10	RSS	453,673
1070	HAVELOCK ALLEY	NORTH STREET GEORGIANA STREET	0.22	45	ADEQ	NOW	NOW	ADEQ	NOW	6-10	NONE	0
1080	HAVELOCK ALLEY	GEORGIANA STREET NORTH END	0.12	45	ADEQ	NOW	NOW	ADEQ	NOW	6-10	NONE	0
1050	HENRIETTA STREET	EMMA STREET GEORGIANA STREET	0.20	201	ADEQ	ADEQ	ADEQ	ADEQ	1-5	6-10	RSS	453,673

Section No.	Road Name	From/ To	Length (km)	AADT	Critical Deficiency Geo-metrics	Surf. Type	Surf. Width	Capacity	Struct. Adeq.	Drainage	Improv. Type	Improv. Cost ($)
1060	HENRIETTA STREET	GEORGIANA STREET NORTH STREET	0.21	210	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	359,100
1170	HERBERT STREET	KING STREET EAST GARDEN STREET	0.10	1,835	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
1180	HERBERT STREET	GARDEN STREET NORTH STREET	0.20	1,400	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	6-10	RSS	546,259
1190	HERBERT STREET	NORTH STREET NORTH END	0.29	1,000	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	SD	0
1930	HICKORY STREET	KING STREET WEST FIRST STREET	0.19	194	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
900	JAMES A BRENNAN ROAD	CHARLES STREET NORTH NORTH END	0.41	494	ADEQ	ADEQ	ADEQ	ADEQ	1-5	6-10	RSS	930,029
1140	JAMES STREET NORTH	GEORGIANA STREET FORSYTH STREET	0.10	400	ADEQ	ADEQ	ADEQ	ADEQ	NOW	1-5	RSS	226,836
1150	JAMES STREET NORTH	FORSYTH STREET GARDEN STREET	0.29	800	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	6-10	RSS	657,826
1160	JAMES STREET NORTH	GARDEN STREET KING STREET EAST	0.10	1,200	ADEQ	ADEQ	ADEQ	ADEQ	6-10	ADEQ	R1	45,112
1300	JAMES STREET SOUTH	KING STREET EAST PINE STREET	0.09	500	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	6-10	RSS	204,153
1090	JANE ALLEY	EMMA STREET GEORGIANA STREET	0.20	45	ADEQ	NOW	NOW	ADEQ	NOW	6-10	NONE	0
1100	JANE ALLEY	GEORGIANA STREET NORTH STREET	0.21	45	ADEQ	NOW	NOW	ADEQ	NOW	6-10	NONE	0
160	JOHN STREET	STONE STREET SOUTH CHARLES STREET SOUTH	0.20	570	ADEQ	ADEQ	ADEQ	ADEQ	NOW	ADEQ	RSS	903,690
170	JOHN STREET	CHARLES STREET SOUTH WILLIAM STREET SOUTH	0.20	404	ADEQ	ADEQ	ADEQ	ADEQ	NOW	6-10	RSS	811,104

Section No.	Road Name	From/ To	Length (km)	AADT	Critical Deficiency Geo-metrics	Surf. Type	Surf. Width	Capacity	Struct. Adeq.	Drainage	Improv. Type	Improv. Cost ($)
180	JOHN STREET	WILLIAM STREET SOUTH 50 M EAST OF WILLIAM STREET SOUTH	0.05	50	ADEQ	NOW	ADEQ	ADEQ	ADEQ	1-5	RSS	113,418
190	JOHN STREET	50 M EAST OF WILLIAM STREET SOUTH EAST END	0.18	30	ADEQ	NOW	NOW	ADEQ	NOW	NOW	NONE	0
2120	KATE STREET	WATER STREET WEST ST. LAWRENCE	0.08	500	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
1540	KING STREET EAST	STONE STREET NORTH CHARLES STREET NORTH	0.20	11,458	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
1550	KING STREET EAST	CHARLES STREET NORTH HERBERT STREET	0.61	14,065	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
1560	KING STREET EAST	HERBERT STREET WILSON DRIVE	0.24	14,948	ADEQ	ADEQ	ADEQ	ADEQ	1-5	ADEQ	R2	214,912
1570	KING STREET EAST	WILSON DRIVE GANANOQUE GATE	0.72	15,393	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
1490	KING STREET WEST	GANANOQUE WEST LIMIT GANANOQUE GATE	0.32	5,026	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
1500	KING STREET WEST	GANANOQUE GATE GARFIELD STREET	0.31	1,500	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
1510	KING STREET WEST	GARFIELD STREET BAY ROAD	0.50	6,800	ADEQ	ADEQ	ADEQ	ADEQ	1-5	ADEQ	R2	364,177
1520	KING STREET WEST	BAY ROAD MAIN STREET	0.48	8,499	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
1530	KING STREET WEST	MAIN STREET STONE STREET NORTH	0.42	8,938	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
1390	MACDONALD DRIVE	175M EAST OF ELMWOOD DRIVE CONNER DRIVE	0.21	430	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
1400	MACDONALD DRIVE	ELMWOOD DRIVE 175M EAST OF ELMWOOD DRIVE	0.18	500	ADEQ	ADEQ	ADEQ	ADEQ	NOW	ADEQ	RSS	383,307

Section No.	Road Name	From/ To	Length (km)	AADT	Critical Deficiency: Geo-metrics	Surf. Type	Surf. Width	Capacity	Struct. Adeq.	Drainage	Improv. Type	Improv. Cost ($)
1700	MACHAR STREET	RIVER STREET BRIDGE	0.08	1,791	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
1710	MACHAR STREET	BRIDGE ADELAIDE STREET	0.09	1,791	ADEQ	ADEQ	ADEQ	ADEQ	6-10	6-10	RSS	204,153
1960	MAIN STREET	KING STREET WEST WATER STREET WEST	0.34	2,019	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	581,400
200	MANSE ALLEY	CHARLES STREET SOUTH WILLIAM STREET SOUTH	0.21	45	ADEQ	NOW	ADEQ	ADEQ	NOW	6-10	NONE	0
210	MANSE ALLEY	STONE STREET SOUTH CHARLES STREET SOUTH	0.20	45	ADEQ	NOW	ADEQ	ADEQ	NOW	6-10	NONE	0
1810	MAPLE STREET NORTH	SECOND AVENUE SOUTH END	0.07	50	ADEQ	ADEQ	ADEQ	ADEQ	1-5	6-10	REC	177,438
1820	MAPLE STREET NORTH	SECOND AVENUE NORTH END	0.23	50	ADEQ	ADEQ	NOW	ADEQ	1-5	6-10	REC	572,408
2210	MAPLE STREET SOUTH	WINDSOR STREET KING STREET WEST	0.30	900	ADEQ	ADEQ	ADEQ	ADEQ	NOW	1-5	RSS	819,389
2220	MAPLE STREET SOUTH	KING STREET WEST WINDSOR STREET	0.18	270	ADEQ	ADEQ	ADEQ	ADEQ	NOW	NOW	RSS	716,106
1970	MARKET STREET	WATER STREET WEST ST. LAWRENCE	0.08	413	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
1980	MARKET STREET	ST. LAWRENCE CLARENCE STREET	0.09	413	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
1990	MARKET STREET	CLARENCE STREET KING STREET WEST	0.22	413	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
2050	MILL STREET	MAIN STREET CLARENCE STREET	0.19	832	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
1590	NALON ROAD	QUARRY ENTRANCE NORTH END CULDESAC	0.24	100	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0

Section No.	Road Name	From/ To	Length (km)	AADT	Critical Deficiency: Geo-metrics	Surf. Type	Surf. Width	Capacity	Struct. Adeq.	Drainage	Improv. Type	Improv. Cost ($)
1600	NALON ROAD	CROSBY ROAD QUARRY ENTRANCE	0.08	100	ADEQ	ADEQ	ADEQ	ADEQ	NOW	6-10	REC	66,248
700	NORTH ALLEY	WILLIAM STREET NORTH JAMES STREET NORTH	0.20	45	ADEQ	NOW	NOW	ADEQ	NOW	6-10	NONE	0
710	NORTH ALLEY	CHARLES STREET NORTH WILLIAM STREET NORTH	0.20	45	ADEQ	NOW	ADEQ	ADEQ	NOW	6-10	NONE	0
720	NORTH ALLEY	STONE STREET NORTH CHARLES STREET NORTH	0.20	45	ADEQ	ADEQ	NOW	ADEQ	NOW	6-10	NONE	0
730	NORTH ALLEY	STONE STREET NORTH ADELAIDE STREET	0.12	45	ADEQ	ADEQ	ADEQ	ADEQ	NOW	6-10	NONE	0
650	NORTH STREET	ADELAIDE STREET STONE STREET NORTH	0.13	1,026	ADEQ	ADEQ	ADEQ	ADEQ	1-5	ADEQ	R1	54,914
660	NORTH STREET	STONE STREET NORTH CHARLES STREET NORTH	0.20	1,026	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
670	NORTH STREET	CHARLES STREET NORTH WILLIAM STREET NORTH	0.20	1,026	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
680	NORTH STREET	WILLIAM STREET NORTH INTERSECTION	0.20	1,026	ADEQ	ADEQ	ADEQ	ADEQ	NOW	1-5	RSS	453,673
690	NORTH STREET	JAMES STREET NORTH HERBERT STREET	0.20	203	ADEQ	ADEQ	ADEQ	ADEQ	NOW	1-5	RSS	453,673
380	OAK ALLEY	CHARLES STREET SOUTH WILLIAM STREET SOUTH	0.20	50	ADEQ	ADEQ	ADEQ	ADEQ	NOW	6-10	RSS	285,443
390	OAK ALLEY	STONE STREET SOUTH CHARLES STREET SOUTH	0.21	50	ADEQ	ADEQ	ADEQ	ADEQ	NOW	6-10	RSS	299,715
1740	OAK STREET	FOURTH STREET THIRD STREET	0.20	200	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	6-10	RNS	205,852
1750	OAK STREET	THIRD STREET 80M SOUTH OF THIRD STREET	0.08	50	ADEQ	NOW	ADEQ	ADEQ	NOW	1-5	RSS	181,469

Section No.	Road Name	From/ To	Length (km)	AADT	Critical Deficiency Geo- metrics	Surf. Type	Surf. Width	Capacity	Struct. Adeq.	Drainage	Improv. Type	Improv. Cost ($)
1870	OAK STREET	SECOND AVENUE FIRST STREET	0.20	289	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
2230	ONTARIO STREET	HILLSIDE DRIVE STEEL STREET	0.09	270	ADEQ	ADEQ	ADEQ	ADEQ	NOW	NOW	RSS	358,053
2180	OSBORNE STREET	KING STREET WEST WINDSOR STREET	0.29	350	ADEQ	ADEQ	ADEQ	ADEQ	NOW	NOW	RSS	792,076
360	PINE STREET	STONE STREET SOUTH CHARLES STREET SOUTH	0.20	405	ADEQ	ADEQ	ADEQ	ADEQ	NOW	ADEQ	RNS	283,265
370	PINE STREET	CHARLES STREET SOUTH WILLIAM STREET SOUTH	0.20	405	ADEQ	ADEQ	ADEQ	ADEQ	NOW	ADEQ	RNS	283,265
1310	PINE STREET	WEST END CULDESAC JAMES STREET SOUTH	0.11	106	ADEQ	ADEQ	ADEQ	ADEQ	NOW	1-5	RSS	249,520
1320	PINE STREET	JAMES STREET SOUTH ELIZABETH DRIVE	0.20	201	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	6-10	RSS	453,673
1330	PINE STREET	ELIZABETH DRIVE WILMER AVENUE	0.11	500	ADEQ	ADEQ	ADEQ	ADEQ	NOW	6-10	RSS	249,520
790	PINE STREET	STONE STREET SOUTH WEST END	0.15	152	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	256,500
2030	PRINCESS STREET	KING STREET WEST SOUTH END	0.20	201	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
930	QUEEN STREET	NORTH END ALBERTA STREET	0.26	500	ADEQ	ADEQ	ADEQ	ADEQ	6-10	6-10	RSS	589,775
940	QUEEN STREET	ALBERTA STREET BOOTH STREET	0.12	284	ADEQ	ADEQ	ADEQ	ADEQ	6-10	6-10	RSS	272,204
970	QUEEN STREET	BOOTH STREET ANN STREET	0.17	284	ADEQ	ADEQ	ADEQ	ADEQ	6-10	6-10	RSS	385,622
980	QUEEN STREET	ANN STREET SOUTH END	0.09	91	ADEQ	ADEQ	ADEQ	ADEQ	6-10	6-10	RSS	204,153

Section No.	Road Name	From/ To	Length (km)	AADT	Critical Deficiency: Geo-metrics	Surf. Type	Surf. Width	Capacity	Struct. Adeq.	Drainage	Improv. Type	Improv. Cost ($)
1660	RIVER STREET	NORTH END FOURTH STREET	0.05	49	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	6-10	NONE	0
1670	RIVER STREET	FOURTH STREET THIRD STREET	0.21	700	ADEQ	ADEQ	ADEQ	ADEQ	6-10	ADEQ	RNS	640,313
1830	SECOND AVENUE	MAPLE STREET NORTH BIRCH STREET	0.09	150	ADEQ	ADEQ	NOW	ADEQ	6-10	6-10	RSS	204,153
1840	SECOND AVENUE	BIRCH STREET ELM STREET	0.09	150	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	6-10	RSS	204,153
1850	SECOND AVENUE	ELM STREET VICTORIA AVENUE	0.10	150	ADEQ	ADEQ	ADEQ	ADEQ	NOW	1-5	RSS	226,836
1860	SECOND AVENUE	VICTORIA AVENUE OAK STREET	0.09	289	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	SD	0
140	SOUTH ALLEY	WILLIAM STREET SOUTH CHARLES STREET SOUTH	0.20	45	ADEQ	NOW	NOW	ADEQ	ADEQ	6-10	NONE	0
150	SOUTH ALLEY	CHARLES STREET SOUTH STONE STREET SOUTH	0.20	45	ADEQ	NOW	ADEQ	ADEQ	ADEQ	1-5	NONE	0
120	SOUTH STREET	STONE STREET SOUTH CHARLES STREET SOUTH	0.20	404	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
130	SOUTH STREET	CHARLES STREET SOUTH WILLIAM STREET SOUTH	0.20	404	ADEQ	ADEQ	ADEQ	ADEQ	1-5	ADEQ	R1	87,672
340	SPRUCE ALLEY	CHARLES STREET SOUTH WILLIAM STREET SOUTH	0.20	45	ADEQ	NOW	NOW	ADEQ	NOW	6-10	NONE	0
350	SPRUCE ALLEY	STONE STREET SOUTH CHARLES STREET SOUTH	0.20	45	ADEQ	NOW	NOW	ADEQ	NOW	6-10	NONE	0
2090	ST. LAWRENCE	MAIN STREET MARKET STREET	0.09	200	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
2110	ST. LAWRENCE	MARKET STREET KATE STREET	0.09	500	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0

Section No.	Road Name	From/ To	Length (km)	AADT	Critical Deficiency: Geo-metrics	Surf. Type	Surf. Width	Capacity	Struct. Adeq.	Drainage	Improv. Type	Improv. Cost ($)
2250	STEEL STREET	DEMPSTER LANE MAPLE STREET SOUTH	0.18	350	ADEQ	ADEQ	ADEQ	ADEQ	NOW	NOW	RSS	716,106
10	STONE STREET NORTH	401 EXIT RAMP ALBERTA STREET	0.41	7,984	ADEQ	ADEQ	ADEQ	ADEQ	1-5	ADEQ	R1	269,204
20	STONE STREET NORTH	ALBERTA STREET CULVERT	0.51	8,764	ADEQ	ADEQ	ADEQ	ADEQ	6-10	ADEQ	R1	263,810
30	STONE STREET NORTH	CULVERT NORTH STREET	0.44	5,400	ADEQ	ADEQ	ADEQ	ADEQ	6-10	ADEQ	R1	224,591
40	STONE STREET NORTH	NORTH STREET GARDEN STREET	0.20	6,325	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
50	STONE STREET NORTH	GARDEN STREET KING STREET EAST	0.10	6,325	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
60	STONE STREET SOUTH	KING STREET EAST PINE STREET	0.10	3,000	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
70	STONE STREET SOUTH	PINE STREET SYDENHAM STREET	0.10	2,700	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
80	STONE STREET SOUTH	SYDENHAM STREET WELLINGTON STREET	0.10	2,329	ADEQ	ADEQ	ADEQ	ADEQ	6-10	ADEQ	R1	50,116
90	STONE STREET SOUTH	WELLINGTON STREET JOHN STREET	0.23	2,000	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
100	STONE STREET SOUTH	JOHN STREET SOUTH STREET	0.10	500	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
110	STONE STREET SOUTH	SOUTH STREET STONE STREET SOUTH	0.02	50	ADEQ	ADEQ	ADEQ	ADEQ	6-10	ADEQ	R1	8,248
320	SYDENHAM STREET	STONE STREET SOUTH CHARLES STREET SOUTH	0.20	403	ADEQ	ADEQ	ADEQ	ADEQ	NOW	ADEQ	RNS	625,265
330	SYDENHAM STREET	CHARLES STREET SOUTH WILLIAM STREET SOUTH	0.20	403	ADEQ	ADEQ	ADEQ	ADEQ	1-5	6-10	RNS	520,163

Section No.	Road Name	From/ To	Length (km)	AADT	Critical Deficiency Geo-metrics	Surf. Type	Surf. Width	Capacity	Struct. Adeq.	Drainage	Improv. Type	Improv. Cost ($)
490	TALBOT PLACE	GARDEN STREET WILSON DRIVE	0.06	281	ADEQ	ADEQ	ADEQ	ADEQ	1-5	ADEQ	R1	26,302
1720	THIRD STREET	VICTORIA AVENUE RIVER STREET	0.20	200	ADEQ	ADEQ	ADEQ	ADEQ	6-10	6-10	RSS	453,673
1730	THIRD STREET	WEST END VICTORIA AVENUE	0.10	50	ADEQ	NOW	ADEQ	ADEQ	NOW	6-10	RSS	226,836
1360	THOMAS STREET	MACDONALD DRIVE 20M NORTH OF MACDONALD	0.02	10	ADEQ	ADEQ	ADEQ	ADEQ	1-5	6-10	NONE	0
1770	VICTORIA AVENUE	THIRD STREET SECOND AVENUE	0.20	1,210	ADEQ	ADEQ	ADEQ	ADEQ	6-10	6-10	RSS	453,673
1780	VICTORIA AVENUE	SECOND AVENUE FIRST STREET	0.20	1,286	ADEQ	ADEQ	ADEQ	ADEQ	NOW	ADEQ	RNS	625,265
1790	VICTORIA AVENUE	FIRST STREET KING STREET WEST	0.19	1,500	ADEQ	ADEQ	ADEQ	ADEQ	NOW	6-10	RNS	189,296
1760	VICTORIA AVENUE	FOURTH STREET THIRD STREET	0.21	1,200	ADEQ	ADEQ	ADEQ	ADEQ	6-10	6-10	RSS	476,357
2130	WATER STREET WEST	KATE STREET MARKET STREET	0.09	1,500	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
2140	WATER STREET WEST	MARKET STREET MAIN STREET	0.09	1,500	ADEQ	ADEQ	ADEQ	ADEQ	1-5	ADEQ	R2	80,393
2150	WATER STREET WEST	MAIN STREET MILL STREET	0.08	1,000	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
2160	WATER STREET WEST	MILL STREET BRIDGE	0.08	1,000	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
2170	WATER STREET WEST	BRIDGE STONE STREET SOUTH	0.10	1,000	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
280	WELLINGTON STREET	STONE STREET SOUTH CHARLES STREET SOUTH	0.20	404	ADEQ	ADEQ	ADEQ	ADEQ	6-10	ADEQ	RNS	625,265

Section No.	Road Name	From/ To	Length (km)	AADT	Critical Deficiency Geo-metrics	Surf. Type	Surf. Width	Capacity	Struct. Adeq.	Drainage	Improv. Type	Improv. Cost ($)
290	WELLINGTON STREET	CHARLES STREET SOUTH / WILLIAM STREET SOUTH	0.20	404	ADEQ	ADEQ	ADEQ	ADEQ	NOW	6-10	RSS	795,673
1200	WILLIAM STREET SOUTH	SOUTH STREET / ARTHUR STREET	0.22	850	ADEQ	ADEQ	ADEQ	ADEQ	1-5	ADEQ	R2	143,236
1210	WILLIAM STREET SOUTH	ARTHUR STREET / WELLINGTON STREET	0.10	850	ADEQ	ADEQ	ADEQ	ADEQ	NOW	ADEQ	RNS	141,632
1220	WILLIAM STREET SOUTH	WELLINGTON STREET / PINE STREET	0.20	1,479	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
1230	WILLIAM STREET SOUTH	PINE STREET / KING STREET EAST	0.10	1,916	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	NONE	0
1240	WILLIAM STREET SOUTH	KING STREET EAST / COOPERS ALLEY	0.06	1,681	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
1250	WILLIAM STREET SOUTH	COOPERS ALLEY / THOMAS STREET	0.04	1,883	ADEQ	ADEQ	ADEQ	ADEQ	NOW	ADEQ	RNS	56,653
1260	WILLIAM STREET SOUTH	GARDEN STREET / BROCK STREET	0.10	1,200	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
1270	WILLIAM STREET SOUTH	BROCK STREET / NORTH STREET	0.10	1,200	ADEQ	ADEQ	ADEQ	ADEQ	1-5	ADEQ	RNS	169,586
1280	WILLIAM STREET SOUTH	NORTH STREET / GEORGIANA STREET	0.19	600	ADEQ	ADEQ	ADEQ	ADEQ	6-10	6-10	RSS	430,989
1340	WILMER AVENUE	PINE STREET / 20M NORTH OF MACDONALD	0.42	1	ADEQ	ADEQ	NOW	ADEQ	NOW	NOW	NONE	0
1350	WILMER AVENUE	20M NORTH OF MACDONALD / MACDONALD DRIVE	0.02	20	ADEQ	NOW	ADEQ	ADEQ	NOW	6-10	NONE	0
460	WILSON DRIVE	KING STREET EAST / TALBOT PLACE	0.05	500	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	ADEQ	CRK	0
470	WILSON DRIVE	TALBOT PLACE / 60M NORTH OF TALBOT PLACE	0.06	500	ADEQ	ADEQ	ADEQ	ADEQ	NOW	6-10	REC	44,460

Section No.	Road Name	From/ To	Length (km)	AADT	Critical Deficiency: Geo-metrics	Surf. Type	Surf. Width	Capacity	Struct. Adeq.	Drainage	Improv. Type	Improv. Cost ($)
480	WILSON DRIVE	60M NORTH OF TALBOT PLACE / 230M NORTH OF TALBOT PLACE	0.18	500	ADEQ	NOW	ADEQ	ADEQ	NOW	1-5	REC	122,819
2190	WINDSOR STREET	OSBORNE STREET / EAST END	0.05	52	ADEQ	ADEQ	NOW	ADEQ	NOW	NOW	REC	34,116
2200	WINDSOR STREET	MAPLE STREET SOUTH / OSBORNE STREET	0.06	62	ADEQ	ADEQ	ADEQ	ADEQ	NOW	NOW	REC	40,940

Appendix 3

Geometric Deficiencies

Town of Gananoque
Geometric Deficiencies - Rural Sections Only

Data Last Refreshed March 02, 2011
4:31:33PM

Section No.	Road Name	From/ To	Length (km)	AADT	Roadside Env.	Speed Limit	Avg. Operating Speed	Number of Deficiencies on Section: Horz. Curves	Horz. Stop Sight Dist	Vert. Curves	Vert. Stop Sight Dist.
1580	BEAVER ROAD	WEST END / CROSBY ROAD	0.79	50	R	50	0	2	0	0	1
1610	CROSBY ROAD	NALON ROAD / FOURTH STREET	0.26	100	R	50	0	0	0	0	0
1630	FOURTH STREET	CROSBY ROAD / GANANOQUE TRAIL CROSSING	0.21	200	R	50	0	0	0	0	0
1490	KING STREET WEST	GANANOQUE WEST LIMIT / GANANOQUE GATE	0.32	5,026	R	50	0	0	0	0	0
1400	MACDONALD DRIVE	ELMWOOD DRIVE / 175M EAST OF ELMWOOD DRIVE	0.18	500	R	50	0	0	0	0	0
1820	MAPLE STREET NORTH	SECOND AVENUE / NORTH END	0.23	50	R	50	0	0	0	0	0
1600	NALON ROAD	CROSBY ROAD / QUARRY ENTRANCE	0.08	100	R	50	0	0	0	0	0
1340	WILMER AVENUE	PINE STREET / 20M NORTH OF MACDONALD	0.42	1	R	50	0	0	0	0	0

Appendix 4

Sample Road Inventory Appraisal

MUNICIPAL ROAD APPRAISAL

A. IDENTIFICATION

Road Name: STONE STREET NORTH
From: 401 EXIT RAMP
To: ALBERTA STREET
Owner:
Shared? [ ]
Shared With:
Owner Share: 100.00
Adjacent Road Section No.:

Road Value: 2,017,165
Special Designation:
Designation 2

Road Section No.: 10
Length: 0.41 km:
Old Section No.:
MunicA
Patrol:
MunicB
Year Assumed:

B. EXISTING CONDITIONS

Horizontal Alignment
Substandard Curves:
Substandard S.S.D.:

Vertical Alignment
Substandard Grades:
Substandard S.S.D.:

Right of Way Width
Existing: 0 m
Desirable: 26 m
Terrain: NR - Non R
Drainage: SS - Storm Sewer

Roadside Env.: U
Existing Class: 100
Number of Lanes: 4.00
Surface Type: HCB
Platform Width: m
Surface Width: 13.80 m
Median Width:
Shoulder Type: None
Shoulder Width:

Curb/Gutter
Left: BC
Right: BC
Sidewalk Width Left: Right:
Boulevard Width Left: Right:
Parking:
Existing Surface Depth:
Existing Gran "A" Depth:
Existing Gran "B" Depth:

C. TRAFFIC DATA

Legal Speed Limit: 50
Avg. Operating Speed: 0
Traffic Operation: 2W
Route Designations
[ ] Bus [ ] Truck Route
[ ] School [ ] Bicycle
Load Restrictions: NR

	Traffic Count		10 Year Traffic Forecast	
Year:	A-2004-C	Year:	2014	
AADT:	7,984	AADT:		
DHV Factor:	%	DHV Factor:		%
DHV:	vph	DHV:		vph
Trucks:	6.10 %	Trucks:	6.1	%
Peak Directional Split:	%	Capacity:	0	vph
10 Year Growth Factor:				

D. APPROVALS

Date: 2/16/2011 Inspected By: D. Anderson, CET Approved By:

MUNICIPAL ROAD APPRAISAL

E. ROAD NEEDS

Field	Max Points	Rating	Comments
Drainage	15.0	15	
Level Of Service	20.0	20	
Maint. Demand	10.0	4	
Shoulder Width	10.0	10	
Structural Adequacy	20.0	10	
Surface Condition	10.0	7	
Surface Width	25.0	25	

F. FUNCTIONAL NEEDS

Field	Existing	Min Tolerable	Time of Need	Comments
Capacity	A	E	ADEQ	
Drainage	15	8	ADEQ	
Geometrics	N/A	N/A	ADEQ	
Structural Adequacy	10	8	1-5	
Surface Type	HCB	Hardtop	ADEQ	
Surface Width	13.8	12.5	ADEQ	

Impr.Class	Improvement	Description	Override?	Percent	Time of Need	Year	Base/ Const Cost
Rehab	R1	Basic Resurfacing 1 - 50mm	☐ Override	100.00	1-5		269,204.24
					Rehab	Subtotal:	**269,204.24**

G. ENGINEERING RECOMMENDATIONS

Year (Re)Constructed:
Design Class: ART
Design Width: 0.00 m

Improvement Length: 0.41 km
☐ Set Values Manually?
Time of Need: 1-5
Improvement Type: R1 Basic Resurfacing 1 - 50mm

Ratings

Priority Rating: 16
Guide Number: 5
$/Vehicle km: 0.05

H. IMPROVEMENT COSTS

Total Base/Construction: **269,204.24**

TOTAL: 269,204.24
Owners Share: 269,204.24

Appendix 5

Inventory Manual References

TABLE F-1 ROAD DESIGN STANDARDS

RURAL ROAD STANDARDS

		50-199 AADT 200	200-399 AADT 300	400-999 AADT 400	1000-1999 AADT 500	2000-2999 AADT 600	3000-3999 AADT 700	4000+ AADT 800	4 lanes & Exp 4LN,EXP
	Surface Width (m)	6.0	6.0	6.5	6.5	7.0	7.0	7.5	15.0
Shw	Shoulder Width (m)	1.5	1.5	1.5	2.5	2.5	3.0	3.0	3.0
DDP	Hot Mix (mm)		*16	50	50	100	100	100	100
DA	Granular A (mm)	150	150	150	150	150	150	150	150
	Southern Ontario								
DB	*Granular B (mm)*								
	BS	150	150	150	150	150	150	150	150
	RW, REC,NC	300	300	450	450	450	450	450	450
	Northern Ontario								
DB	*Granular B (mm)*								
	BS	250	250	250	250	250	250	250	250
	RW, REC,NC	400	400	550	550	550	550	550	550
	Concrete Surface								
DC	Concrete (mm)	150	150	150	225	225	225	225	225
DB	Granular B (mm)	150	150	150	150	150	150	150	150

* Double Surface Treatment (DST) assumed to equal 16 mm of Hot Mix

Note: Class 100 rural roads are eligible for maintenance subsidy only.

SEMI-URBAN ROAD STANDARDS

		Local Roads		Collector Roads		Arterials
		Residential LR	Comm/Ind LCI	Residential CR	Comm/Ind CCI	All Lanes ART
	Lane Width (m)	3.0	3.25	3.25	3.75	3.75
Shw	Shoulder Width (m)	1.5	1.5	2.5	2.5	3.0
DDP	Hot Mix (mm)	50	50	50	100	100
DA	Granular A (mm)	150	150	150	150	150
	Southern Ontario					
DB	*Granular B (mm)*					
	BS	150	150	150	150	150
	RW, REC	250	300	300	450	450
	Northern Ontario					
DB	*Granular B (mm)*					
	BS	250	250	250	250	250
	RW, REC	350	400	400	550	550
	Concrete Surface					
DC	Concrete (mm)	150	150	225	225	225
DB	Granular B (mm)	150	150	150	150	150

URBAN ROAD STANDARDS

		Local Roads		Collector Roads		Arterials	Expressways
		Residential LR	Comm/Ind LCI	Residential CR	Comm/Ind CCI	All Lanes ART	All Lanes EXP
	Through Lane Width (m)	3.0	3.25	3.25	3.75	3.75	3.75
	Parking Lane Width (m)	2.5	2.5	2.5	2.5	3.0	3.0
	Curb Offset each side (m)	.5	.5	.5	.5	.5	.5
	Granular Base						
DDP	Hot Mix (mm)	100	100	100	150	150	150
DA	Granular A (mm)	150	150	150	150	150	150
DB	Granular B (mm)						
	Southern Ontario	300	300	300	300	450	450
	Northern Ontario	400	400	400	400	550	550
	Concrete Base						
DDP	Hot Mix (mm)	50	50	50	50	100	100
DC	Concrete (mm)	150	150	200	200	200	200
DB	Granular B (mm)	150	150	150	150	150	200
	Concrete Surface						
DC	Concrete (mm)	150	150	250	250	250	250
DB	Granular B (mm)	150	150	150	150	150	150

Note: Bench Mark Costs will not exceed the design standards specified in the above tables

TABLE 93R - MINIMUM TOLERABLE SURFACE WIDTH - RURAL (metres)

	EXISTING CLASS									
	100	200	300	400	500	600	700	800	4LN	EXP
ROADWAY WIDTH	5.0	5.5	5.5	6.0	6.0	6.0	6.5	6.5	13.0	3.5/lane

TABLE 93SU - MINIMUM TOLERABLE SURFACE WIDTH - SEMI-URBAN and URBAN (metres)

	SEMI-URBAN		URBAN	
FUNCTIONAL CLASSIFICATION	2-Way (2W,2M)	1 Way (1W,1M)	2 Way (2W,2M)	1 Way (1W,1M)
2-lane Local Residential	5.0	5.0	5.5	5.5
2-lane Local Comm. & Ind.	5.5	5.5	6.0	6.0
2-lane Collector Residential	5.5	5.5	6.0	6.0
2-lane Collector Comm. & Ind.	6.0	6.0	6.5	6.5
2-lane Arterial	6.0	6.0	6.5	6.5
3-lane Local Comm. & Ind.	9.0	8.7	9.0	8.7
3-lane Collector Residential	9.0	8.7	9.0	8.7
3-lane Collector Comm. & Ind.	9.0	8.7	9.0	8.7
3-lane Arterial	9.0	9.0	9.5	9.5
4-lane Collector Residential	11.0	11.0	11.5	11.5
4-lane Collector Comm. & Ind.	12.0	12.0	12.5	12.5
4-lane Arterial	12.0	12.0	12.5	12.5
5-lane Arterial	15.0	15.0	15.5	15.5
6-lane Arterial	18.0	18.0	18.5	18.5
7-lane Arterial	21.5	21.5	22.0	22.0
8-lane Arterial	24.5	24.5	25.0	25.0
9-lane Arterial	27.5	27.5	28.0	28.0
Expressway	—	—	3.5/ln	3.5/ln

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Appendix 6

Road Estimating Parameters

All calculations for costing, program sizing etc. are based upon the following parameters:

Table 1 Unit Costs

Item	Unit	Cost ($)
Excavation	m^3	25
Hot Mix Asphalt	t	135
Single Surface Treatment	m^2	2.75
Granular A	t	21
Granular B	t	19
Conc Base	m^3	420
Conc- Curb and Gutter-place	linear m	120
Conc- Curb and Gutter-removal	linear m	20
Subdrains	linear m	20
Storm Sewer-525mm	linear m	500
Manholes	ea	5000
manhole removed	ea	750
manholes-Adjust	ea	800
Catch Basins	ea	2500
Catch-Basins- removed	ea	420
Catch Basin Leads	Linear m	225
Catchbasins - adjust	ea	800
Asphalt Planing	m^2	3
Asphalt Pulverizing	m^2	1.5

All Calculations are based upon volumes, area or lengths and converted to other units as required based upon the following specific gravities derived from unit costs and weighted average widths of surfaces and platforms. Excavation calculations are based on the design road structure and existing weighted average platform and surface widths.

- specific gravity of 2.4 for Granular A
- Specific gravity of 2.1 for Granular 'B'
- specific gravity of 2.45 for HMA
- specific gravity of 2.6 for concrete

All calculations also include adjustment factors for general construction, engineering, terrain and contingency.

Road Cross-Section Assumptions

All rural sections assumed 500mm ditch depth which equals .55m3 /m road length/side with a 2:1 side slope

Earth Roads
300mm depth of excavation to remove unsuitable materials

Gravel Roads
300mm depth of Granular A
Rural LCB
150mm depth of Granular A
300mm depth of Granular B
Assumed a triple surface treatment was in place (double in year of construction, single year after)

Rural HCB
150mm depth of Granular A
350mm Granular
100mm of HMA in place

Rural Conc
150mm depth of Granular A
150mm of Granular B
150mm Conc

SU LCB
150mm depth of Granular A
300mm depth of Granular B
Assumed a triple surface treatment was in place (double in year of construction, single year after)

SU-HCB
150mm depth of Granular A
350mm Granular B
100mm of HMA in place

All urban cross-sections assume curb on both sides, sub-drain on both sides and 525mm pipe through 60% of the length; catchbasins and manholes every 90m

UR LCB
150mm depth of Granular A
350mm Granular
3 courses of SST in place (double in year of construction, single year after)

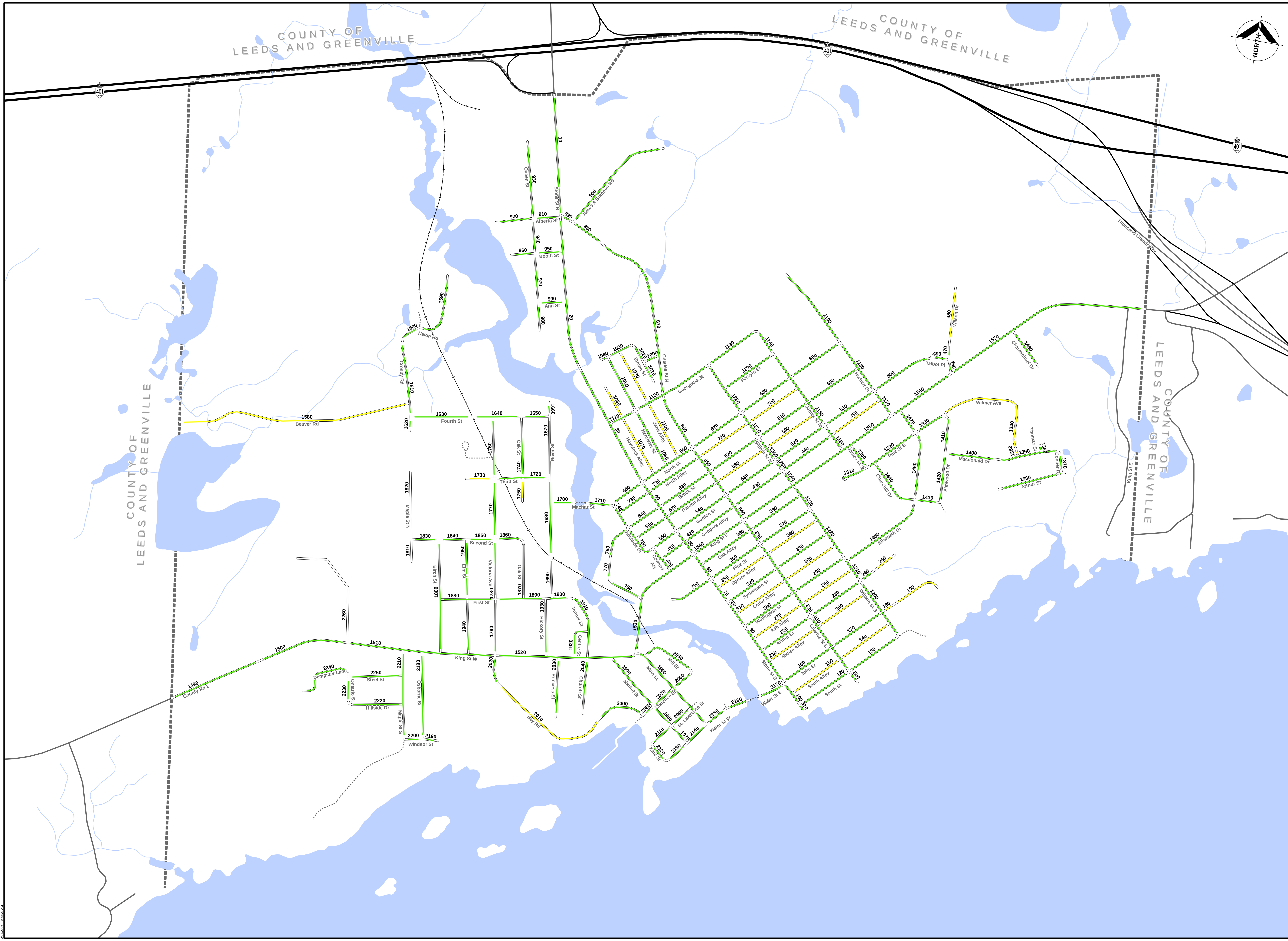
UR HCB

150mm depth of Granular A
350mm Granular B
100mm of HMA in place

UR CONC
150mm depth of Granular A
150mm of Granular B
150mm of Concrete in place

Map 1

Roads by Surface Type



LEGEND

SURFACE TYPE

- HIGH CLASS BITUMINOUS
- LOW CLASS BITMINOUS
- GRAVEL, STONE, OTHER LOOSE TOP

OTHER FEATURES

- HIGHWAY
- HIGHWAY RAMP
- ADJACENT TOWNSHIP OR COUNTY ROAD
- PRIVATE ROAD
- GANANOQUE TRAIL
- MUNICIPAL BOUNDARY
- WATER COURSE
- WATER BODY

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Canadian Gateway to the 1000 Islands

PROJECT

2009 ROAD NEEDS STUDY

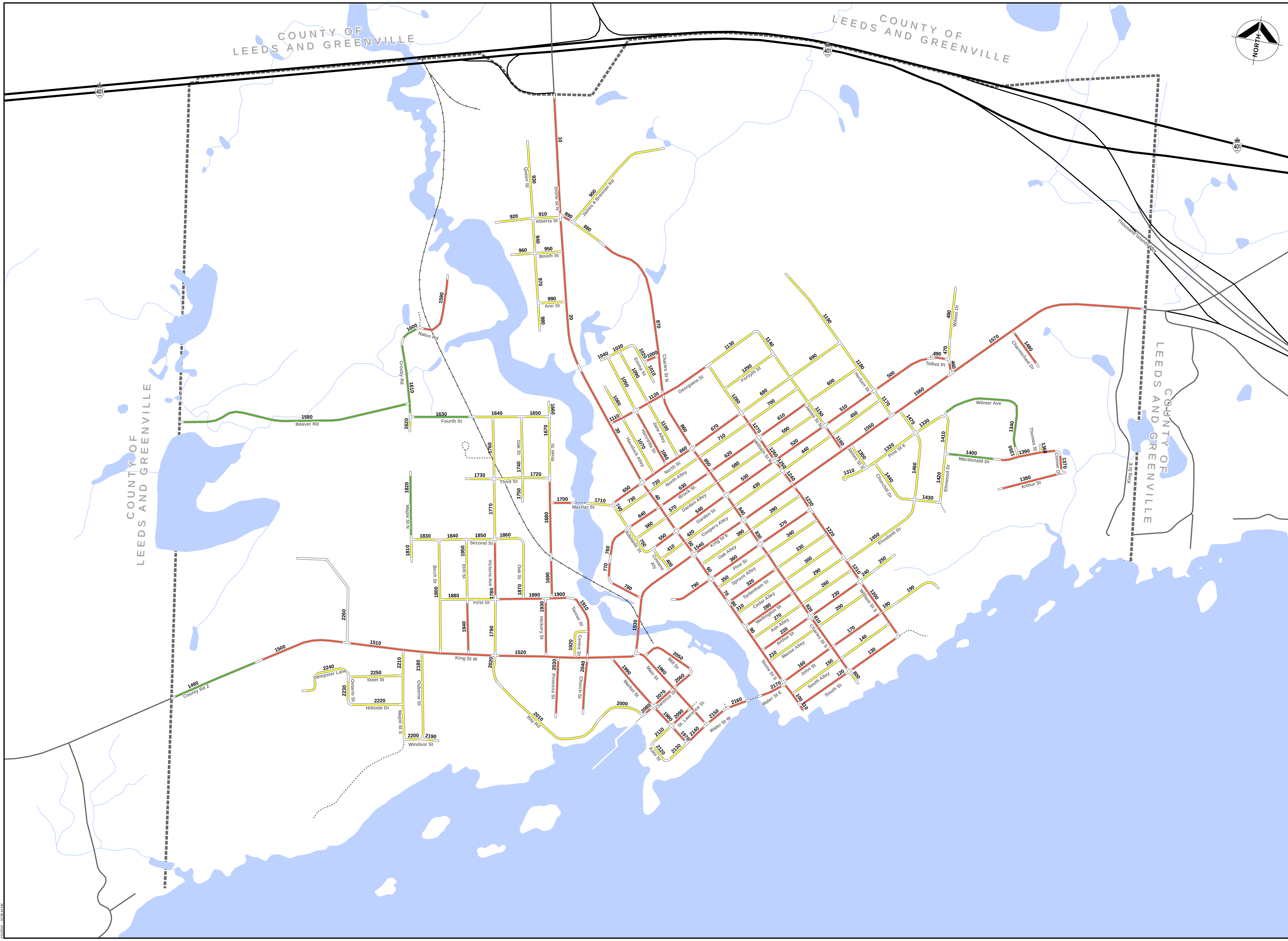
DRAWING

SURFACE TYPE

PREPARED BY: A MURRAY	CHECKED BY: ---	PROJECT No. **60118794**
DESIGNED BY: ---	APPROVED BY: ---	DRAWING No. 1
SCALE: 1:6,000	DATE: JAN- 2009	

Map 2

Roadside Environment



LEGEND

ROADSIDE ENVIRONMENT
- RURAL
- SEMI-URBAN
- URBAN

OTHER FEATURES
- HIGHWAY
- HIGHWAY RAMP
- ADJACENT TOWNSHIP OR COUNTY ROAD
- PRIVATE ROAD
- GANANOQUE TRAIL
- MUNICIPAL BOUNDARY
- WATER COURSE
- WATER BODY

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PROJECT

2009 ROAD NEEDS STUDY

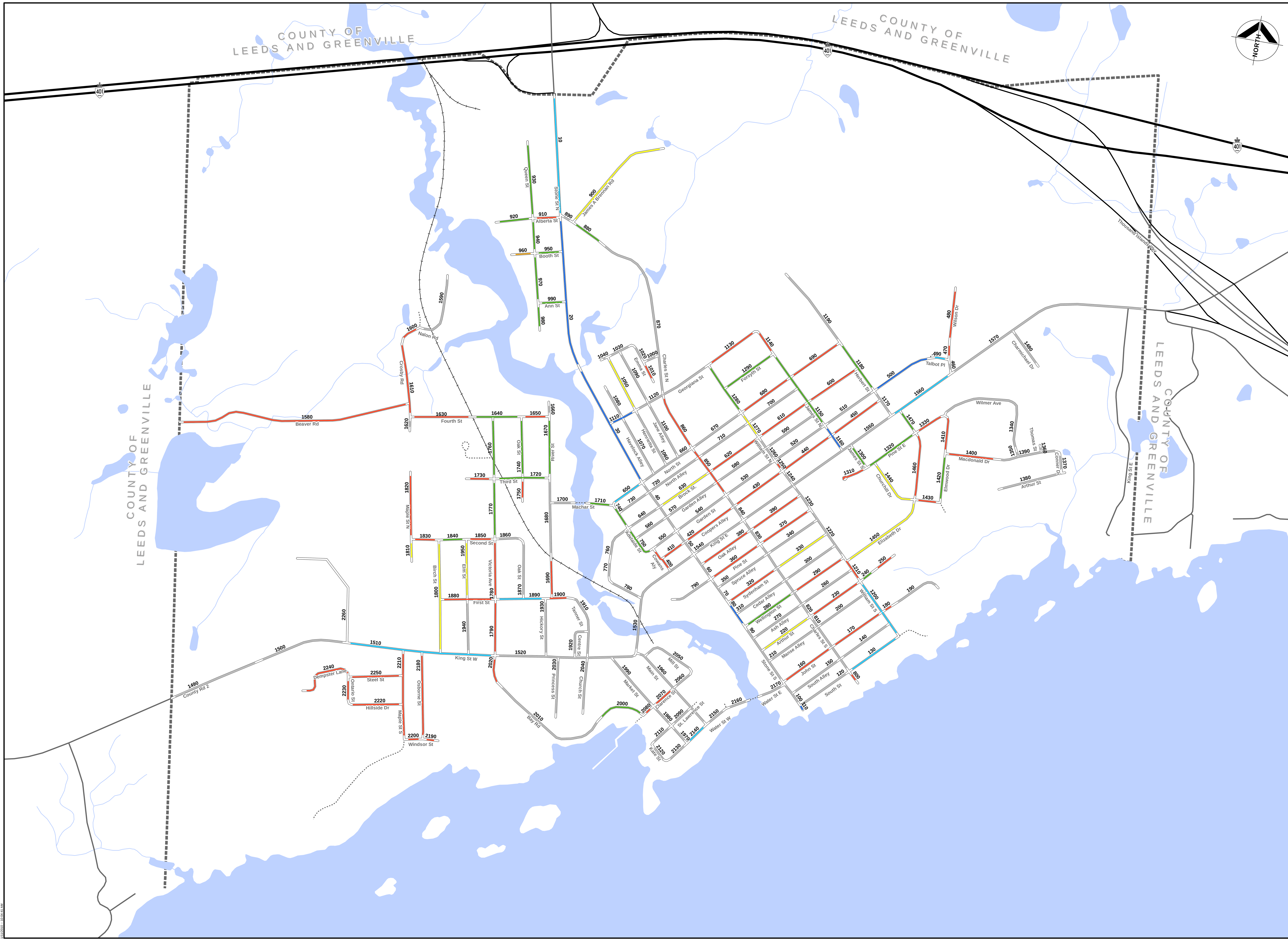
DRAWING

ROADSIDE ENVIRONMENT

PREPARED BY: A MURRAY	CHECKED BY: ---	PROJECT No. 60118794
DESIGNED BY: ---	APPROVED BY: ---	DRAWING No. 2
SCALE: 1:6,000	DATE: JAN- 2009	

Map 3

Roads by Time of Need



LEGEND

CONSTRUCTION AND RESURFACING NEEDS

- NOW CONSTRUCTION NEED
- 1-5 CONSTRUCTION NEED
- 6-10 CONSTRUCTION NEED
- 1-5 RESURFACING NEED
- 6-10 RESURFACING NEED
- 6-10 MAINTENANCE NEED
- ADEQUATE

OTHER FEATURES

- HIGHWAY
- HIGHWAY RAMP
- ADJACENT TOWNSHIP OR COUNTY ROAD
- PRIVATE ROAD
- GANANOQUE TRAIL
- MUNICIPAL BOUNDARY
- WATER COURSE
- WATER BODY

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PROJECT

2009 ROAD NEEDS STUDY

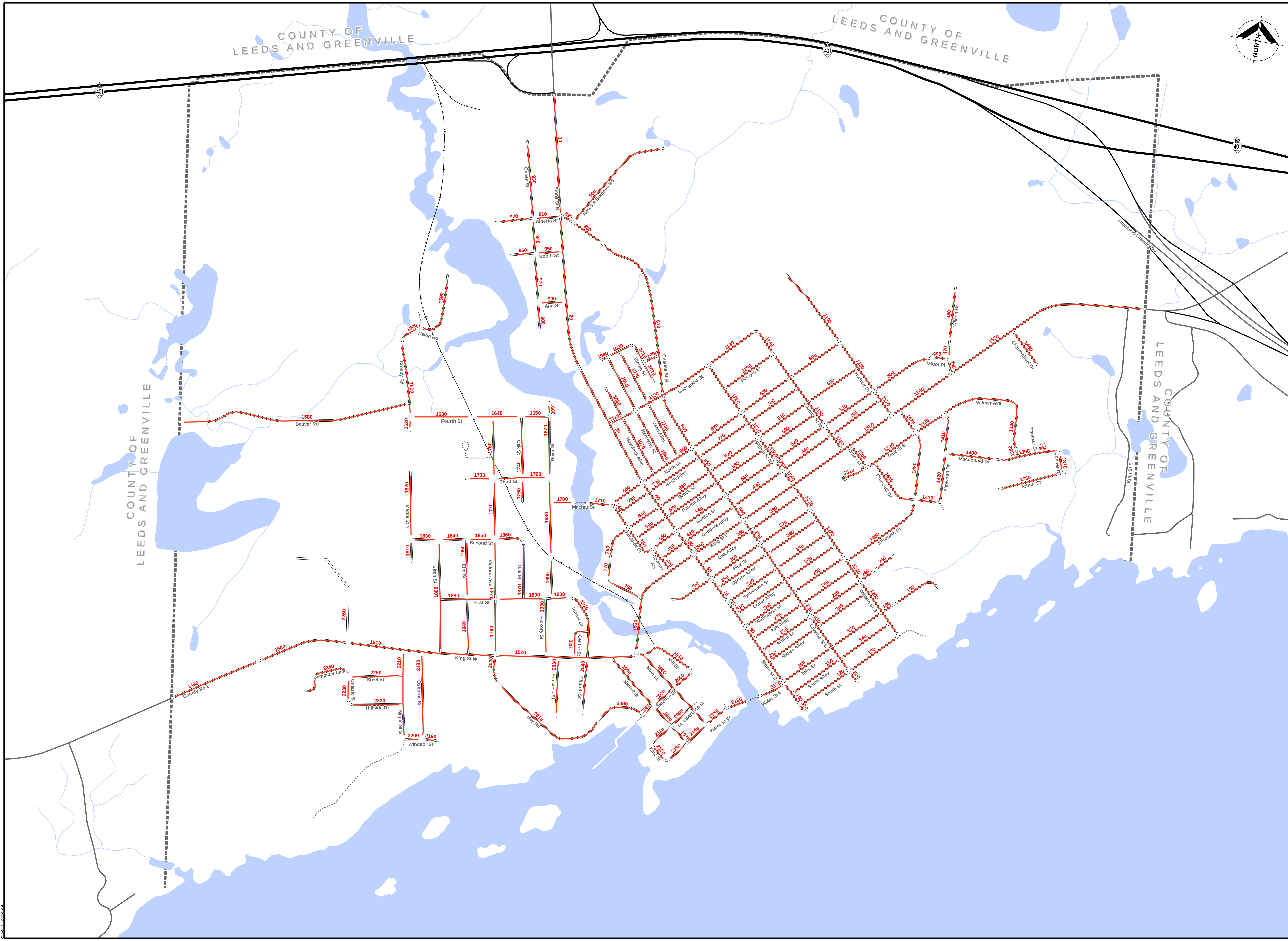
DRAWING

CONSTRUCTION AND RESURFACING NEEDS

PREPARED BY: A MURRAY	CHECKED BY: ---	PROJECT No. 60118794
DESIGNED BY: ---	APPROVED BY: ---	DRAWING No.
SCALE: 1:6,000	DATE: JAN- 2009	3

Map 4

Roads by Road Inventory Section



LEGEND

- ROAD SECTION
- HIGHWAY
- HIGHWAY RAMP
- ADJACENT TOWNSHIP OR COUNTY ROAD
- PRIVATE ROAD
- GANANOQUE TRAIL
- MUNICIPAL BOUNDARY
- WATER COURSE
- WATER BODY

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THE CORPORATION OF THE TOWN OF
GANANOQUE
Canadian Gateway to the 1000 Islands

PROJECT

2009 ROAD NEEDS STUDY

DRAWING

ROAD SECTIONS

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